

**CURRICULUM AND SYLLABUS (R2015)****CHOICE BASED CREDIT SYSTEM****B.TECH – AGRICULTURAL BIOTECHNOLOGY****I – VIII SEMESTERS**

| SEMESTER I                                                                                                                                                                       |                              |          |                                                             |                           |   |     |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------|-------------------------------------------------------------|---------------------------|---|-----|---|
| SL NO                                                                                                                                                                            | SUB.CO DE                    | CATEGORY | COURSE TITLE                                                | L                         | T | P   | C |
| THEORY                                                                                                                                                                           |                              |          |                                                             |                           |   |     |   |
| 1.                                                                                                                                                                               | BEN101                       | HS       | English – I                                                 | 3                         | 1 | 0   | 3 |
| 2.                                                                                                                                                                               | BMA101                       | BS       | Mathematics - I                                             | 3                         | 1 | 0   | 3 |
| 3.                                                                                                                                                                               | BPH101                       | BS       | Engineering Physics - I                                     | 3                         | 0 | 0   | 3 |
| 4.                                                                                                                                                                               | BCH101                       | BS       | Engineering Chemistry - I                                   | 3                         | 0 | 0   | 3 |
| 5.                                                                                                                                                                               | BBT101                       | ES       | Cell Biology                                                | 2                         | 1 | 0   | 3 |
| 6.                                                                                                                                                                               | BCS101                       | ES       | Fundamentals of Computing and Programming                   | 3                         | 0 | 0   | 3 |
| 7.                                                                                                                                                                               | BSS101                       | HS       | Personality Development                                     | 1                         | 1 | 0   | 2 |
| 8.                                                                                                                                                                               | BCE101                       | ES       | Basic Civil Engineering                                     | 2                         | 0 | 0   | 2 |
| 9.                                                                                                                                                                               | BME103                       | ES       | Basic Mechanical Engineering                                | 2                         | 0 | 0   | 2 |
| PRACTICAL                                                                                                                                                                        |                              |          |                                                             |                           |   |     |   |
| 10.                                                                                                                                                                              | BCM1L1                       | ES       | Basic Civil and Mechanical Engineering Practices Laboratory | 0                         | 0 | 3   | 1 |
| 11.                                                                                                                                                                              | BCS2L2                       | ES       | Computer Practices Lab                                      | 0                         | 0 | 3   | 1 |
| 12.                                                                                                                                                                              | BPC1L1                       | BS       | Physics and Chemistry Laboratory#                           | 0                         | 0 | 3/3 | 0 |
| 13                                                                                                                                                                               | BSS1L4/<br>BSS1L5/<br>BSS1L6 | HS       | NCC/ NSS/ NSO (to be conducted during weekends)             |                           |   |     | 1 |
| Total Instruction Periods per week=35                                                                                                                                            |                              |          |                                                             | Total No. of Credits = 27 |   |     |   |
| # Laboratory Classes on alternate weeks for Physics and Chemistry. The Lab examinations will be held only in the second semester (including the first semester experiments also) |                              |          |                                                             |                           |   |     |   |

| SEMESTER II                                                                                                                                                                      |           |          |                                                                   |                           |   |     |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------|-------------------------------------------------------------------|---------------------------|---|-----|---|
| SL. NO                                                                                                                                                                           | SUB. CODE | CATEGORY | COURSE TITLE                                                      | L                         | T | P   | C |
| THEORY                                                                                                                                                                           |           |          |                                                                   |                           |   |     |   |
| 1.                                                                                                                                                                               | BEN201    | HS       | English – II                                                      | 3                         | 1 | 0   | 3 |
| 2.                                                                                                                                                                               | BMA201    | BS       | Mathematics - II                                                  | 3                         | 1 | 0   | 3 |
| 3.                                                                                                                                                                               | BPH201    | BS       | Engineering Physics - II                                          | 3                         | 0 | 0   | 3 |
| 4.                                                                                                                                                                               | BCH201    | BS       | Engineering Chemistry – II                                        | 3                         | 0 | 0   | 3 |
| 5.                                                                                                                                                                               | BCS201    | ES       | Internet Programming                                              | 2                         | 0 | 0   | 2 |
| 6.                                                                                                                                                                               | BFR201*   | HS       | Foreign / Indian Language                                         | 3                         | 0 | 0   | 3 |
| 7.                                                                                                                                                                               | BBT201    | ES       | Principles of Genetics                                            | 2                         | 0 | 0   | 2 |
| 8.                                                                                                                                                                               | BEE201    | ES       | Basic Electrical and Electronics Engineering                      | 2                         | 0 | 0   | 2 |
| PRACTICAL                                                                                                                                                                        |           |          |                                                                   |                           |   |     |   |
| 9.                                                                                                                                                                               | BCS2L1    | ES       | Internet Practices Lab                                            | 0                         | 0 | 3   | 1 |
| 10.                                                                                                                                                                              | BEE2L1    | ES       | Basic Electrical and Electronics Engineering Practices Laboratory | 0                         | 0 | 3   | 1 |
| 11.                                                                                                                                                                              | BPC2L1    | BS       | Physics and Chemistry Laboratory#                                 | 0                         | 0 | 3/3 | 1 |
| 12.                                                                                                                                                                              | BSS1L7    | HS       | Yoga                                                              | 0                         | 0 | 2   | 1 |
| Total Instruction Periods per week=34                                                                                                                                            |           |          |                                                                   | Total No. of Credits = 25 |   |     |   |
| *Any one of the following courses: BFR201 – French, BGM201-German, BJP201 – Japanese, BKR201 – Korean, BCN201 – Chinese, BTM201 – Tamil.                                         |           |          |                                                                   |                           |   |     |   |
| # Laboratory Classes on alternate weeks for Physics and Chemistry. The Lab examinations will be held only in the second semester (including the first semester experiments also) |           |          |                                                                   |                           |   |     |   |

| SEMESTER III     |          |                                      |              |   |   |   |
|------------------|----------|--------------------------------------|--------------|---|---|---|
| SUB. CODE        | CATEGORY | COURSE TITLE                         | L            | T | P | C |
| THEORY           |          |                                      |              |   |   |   |
| BAC301           | PC       | Production of Agricultural crops     | 3            | 0 | 0 | 3 |
| BAC302           | PC       | Agricultural Botany                  | 3            | 1 | 0 | 4 |
| BAC303           | PC       | Plant Biochemistry                   | 3            | 0 | 0 | 3 |
| BAC304           | PC       | Agricultural Microbiology            | 3            | 0 | 0 | 3 |
| BBT305           | PC       | Instrumentation for Biotechnology    | 3            | 0 | 0 | 3 |
| BAC305           | PC       | Principles Plant Breeding            | 3            | 0 | 0 | 3 |
| PRACTICAL        |          |                                      |              |   |   |   |
| BAC3L1           | PC       | Plant Biochemistry Lab               | 0            | 0 | 3 | 2 |
| BBT3L2           | PC       | Instrumental Methods of Analysis Lab | 0            | 0 | 3 | 2 |
| BBT3L3           | PC       | Cell Biology Lab                     | 0            | 0 | 3 | 2 |
| TOTAL HOURS : 28 |          |                                      | CREDITS : 25 |   |   |   |

| SEMESTER IV      |          |                                      |             |   |   |   |
|------------------|----------|--------------------------------------|-------------|---|---|---|
| SUB. CODE        | CATEGORY | COURSE TITLE                         | L           | T | P | C |
| THEORY           |          |                                      |             |   |   |   |
| BAC401           | PC       | Plant Molecular Biology              | 3           | 0 | 0 | 3 |
| BAC402           | PC       | Crop Physiology                      | 3           | 0 | 0 | 3 |
| BAC403           | PC       | Enzymology                           | 3           | 1 | 0 | 4 |
| BAC404           | PC       | Process engineering in Biotechnology | 3           | 1 | 0 | 4 |
| BAC405           | PC       | Production of horticultural crops    | 3           | 0 | 0 | 3 |
| BCE406           | HS       | Environmental studies                | 3           | 0 | 0 | 3 |
| PRACTICAL        |          |                                      |             |   |   |   |
| BAC4L1           | PC       | Agricultural Microbiology Lab        | 0           | 0 | 3 | 2 |
| BAC4L2           | PC       | Process engineering Lab              | 0           | 0 | 3 | 2 |
| BAC4L3           | PC       | Plant Molecular Biology Lab          | 0           | 0 | 3 | 2 |
| BAC4S1           | PR       | Technical Seminar                    | 0           | 0 | 2 | 1 |
| TOTAL HOURS : 31 |          |                                      | CREDITS: 27 |   |   |   |

| SEMESTER V |
|------------|
|------------|

| SUB. CODE                           | CATEGORY | COURSE TITLE                           | L | T | P | C |
|-------------------------------------|----------|----------------------------------------|---|---|---|---|
| <b>THEORY</b>                       |          |                                        |   |   |   |   |
| BMA505                              | BS       | Probability and Statistics             | 3 | 1 | 0 | 4 |
| BAC501                              | PC       | Plant Genetic Engineering              | 3 | 0 | 0 | 3 |
| BAC502                              | PC       | Plant Pathology and disease management | 3 | 0 | 0 | 3 |
| BAC503                              | PC       | Introduction to Silviculture           | 4 | 0 | 0 | 4 |
| BAC505                              | PC       | Plant Cell and Tissue culture          | 3 | 0 | 0 | 3 |
|                                     | CE       | Core Elective -I                       | 3 | 0 | 0 | 3 |
| <b>PRACTICAL</b>                    |          |                                        |   |   |   |   |
| BAC5L1                              | PC       | Plant Genetic Engineering Lab          | 0 | 0 | 3 | 2 |
| BAC5L2                              | PC       | Plant Cell and Tissue culture Lab      | 0 | 0 | 3 | 2 |
| BAC5L3                              | PC       | Plant Pathology Lab                    | 0 | 0 | 3 | 2 |
| BAC5C1                              | PR       | Comprehension - I                      | 0 | 0 | 0 | 1 |
| <b>TOTAL HOURS : 29CREDITS : 27</b> |          |                                        |   |   |   |   |

| <b>SEMESTER VI</b>                |          |                                           |   |   |   |   |
|-----------------------------------|----------|-------------------------------------------|---|---|---|---|
| SUB. CODE                         | CATEGORY | COURSE TITLE                              | L | T | P | C |
| <b>THEORY</b>                     |          |                                           |   |   |   |   |
| BAC601                            | PC       | Fermentation Technology                   | 3 | 0 | 0 | 3 |
| BAC602                            | PC       | Biofertilizers and Biopesticides          | 3 | 0 | 0 | 3 |
| BAC603                            | PC       | Entomology and Pest Management            | 3 | 0 | 0 | 3 |
| BSS601                            | HS       | Value Education and Professional ethics   | 3 | 0 | 0 | 3 |
|                                   | CE       | Core Elective-II                          | 3 | 0 | 0 | 3 |
|                                   | NE       | Non Major Elective I                      | 3 | 0 | 0 | 3 |
| <b>PRACTICAL</b>                  |          |                                           |   |   |   |   |
| BAC6L1                            | PC       | Fermentation Technology Lab               | 0 | 0 | 3 | 2 |
| BAC6L2                            | PC       | Biofertilizers and Biopesticides Lab      | 0 | 0 | 3 | 2 |
| BAC6L3                            | PC       | Crop Production Lab I- Agricultural crops | 0 | 0 | 3 | 2 |
| BAC6P1                            | PR       | Mini Project                              | 0 | 0 | 4 | 2 |
| <b>TOTAL HOURS:31 CREDITS: 26</b> |          |                                           |   |   |   |   |

| SEMESTER VII          |          |                                                                                                                        |                    |   |   |   |
|-----------------------|----------|------------------------------------------------------------------------------------------------------------------------|--------------------|---|---|---|
| SUB. CODE             | CATEGORY | COURSE TITLE                                                                                                           | L                  | T | P | C |
| THEORY                |          |                                                                                                                        |                    |   |   |   |
| BBT701                | PC       | Research Methodology and Instrumentation                                                                               | 3                  | 0 | 0 | 3 |
| BAC701                | PC       | Biotechnology of biotic and abiotic stress tolerance                                                                   | 3                  | 0 | 0 | 3 |
| BAC702                | PC       | Food Biotechnology                                                                                                     | 3                  | 0 | 0 | 3 |
|                       | CE       | Core Elective III                                                                                                      | 3                  | 0 | 0 | 3 |
|                       | NE       | Non Major Elective II                                                                                                  | 3                  | 0 | 0 | 3 |
|                       | OE       | Open Elective I                                                                                                        | 3                  | 0 | 0 | 3 |
| PRACTICAL             |          |                                                                                                                        |                    |   |   |   |
| BAC7L1                | PC       | Food biotechnology Lab                                                                                                 | 0                  | 0 | 3 | 2 |
| BAC 7L2               | PC       | Crop Production Lab- Horticultural crops                                                                               | 0                  | 0 | 3 | 2 |
| BAC7P1                | PR       | Term Paper                                                                                                             | 0                  | 0 | 4 | 2 |
| BAC7V1                | PR       | In-plant Training<br>Note: Students to get trained in an industry for a period of two weeks at the end of VI semester) | 0                  | 0 | 0 | 1 |
| <b>TOTAL HOURS:28</b> |          |                                                                                                                        | <b>CREDITS: 25</b> |   |   |   |

| SEMESTER VIII         |          |                        |                    |   |    |   |
|-----------------------|----------|------------------------|--------------------|---|----|---|
| SUB. CODE             | CATEGORY | COURSE TITLE           | L                  | T | P  | C |
| THEORY                |          |                        |                    |   |    |   |
|                       | OE       | Open Elective –II      | 3                  | 0 | 0  | 3 |
|                       | NE       | Non Major Elective III | 3                  | 0 | 0  | 3 |
| PRACTICAL             |          |                        |                    |   |    |   |
| BAC8C1                | PR       | Comprehension – II     | 0                  | 0 | 0  | 1 |
| BAC8P1                | PR       | Project work           | 0                  | 0 | 18 | 9 |
| <b>TOTAL HOURS:24</b> |          |                        | <b>CREDITS: 16</b> |   |    |   |

**OVERALL CREDITS = 198**

**LIST OF ELECTIVES**

| CORE ELECTIVE(CE) I       |                                                   |   |   |   |   |
|---------------------------|---------------------------------------------------|---|---|---|---|
| BAC001                    | Immunotechnology                                  | 3 | 0 | 0 | 3 |
| BAC002                    | Industrial microbiology                           | 3 | 0 | 0 | 3 |
| BAC003                    | Biodiversity conservation                         | 3 | 0 | 0 | 3 |
| CORE ELECTIVE(CE) II      |                                                   |   |   |   |   |
| BAC004                    | Principles of Seed Technology                     | 3 | 0 | 0 | 3 |
| BAC005                    | Introduction to Agribusiness management           | 3 | 0 | 0 | 3 |
| BAC006                    | Bioremediation Technology                         | 3 | 0 | 0 | 3 |
| CORE ELECTIVE(CE) III     |                                                   |   |   |   |   |
| BAC007                    | Fundamentals of Soil Science                      | 3 | 0 | 0 | 3 |
| BAC008                    | Post-Harvest and Food Engineering                 | 3 | 0 | 0 | 3 |
| BAC009                    | Farming System & Sustainable Agriculture          | 3 | 0 | 0 | 3 |
| NON MAJOR ELECTIVE(NE) I  |                                                   |   |   |   |   |
| BBT010                    | Proteogenomics and Bioinformatics                 | 3 | 0 | 0 | 3 |
| BBT001                    | Food process technology                           | 3 | 0 | 0 | 3 |
| BAC010                    | Diary process Technology                          | 3 | 0 | 0 | 3 |
| NON MAJOR ELECTIVE(NE) II |                                                   |   |   |   |   |
| BBT007                    | Food safety and quality control                   | 3 | 0 | 0 | 3 |
| BAC011                    | Soil and Applied Microbiology                     | 3 | 0 | 0 | 3 |
| BAC012                    | Principles of organic Farming                     | 3 | 0 | 0 | 3 |
| NONMAJOR ELECTIVE(NE) III |                                                   |   |   |   |   |
| BAC013                    | Greenhouse Technology                             | 3 | 0 | 0 | 3 |
| BAC014                    | Livestock and Poultry Management                  | 3 | 0 | 0 | 3 |
| BBT016                    | Nanobiotechnology                                 | 3 | 0 | 0 | 3 |
| OPEN ELECTIVE(OE) I       |                                                   |   |   |   |   |
| BAC015                    | Introductory Nematology                           | 3 | 0 | 0 | 3 |
| BAC016                    | Manures, Fertilizers and Soil Fertility           | 3 | 0 | 0 | 3 |
| BBA008                    | Total Quality Management                          | 3 | 0 | 0 | 3 |
|                           | NSS Paper I                                       | 2 | 0 | 2 | 3 |
| OPEN ELECTIVE(OE) II      |                                                   |   |   |   |   |
| BBA009                    | Intellectual Property Rights                      | 3 | 0 | 0 | 3 |
| BAC017                    | Marketing and export of biotechnological products | 3 | 0 | 0 | 3 |
| BBT018                    | Industrial Safety Engineering                     | 3 | 0 | 0 | 3 |
| BBT019                    | Bio entrepreneurship Development                  | 3 | 0 | 0 | 3 |
|                           | NSS Paper II                                      | 2 | 0 | 2 | 3 |
|                           | Massive Open Online Course                        | 3 | 0 | 0 | 3 |

**ARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR  
DISTRIBUTION**

| S.No | Sub Area                                                 | Credit As per Semester |    |     |    |    |    |     |      | No. of<br>Credit | % of<br>credit |
|------|----------------------------------------------------------|------------------------|----|-----|----|----|----|-----|------|------------------|----------------|
|      |                                                          | I                      | II | III | IV | V  | VI | VII | VIII |                  |                |
| 1    | Humanities & Social Sciences (HS)                        | 6                      | 7  | -   | 3  | -  | 3  | -   | -    | 19               | 9.60           |
| 2    | Basic Sciences (BS)                                      | 9                      | 10 | -   | -  | 4  | -  | -   | -    | 23               | 11.62          |
| 3    | Engineering Sciences (ES)                                | 12                     | 8  | -   | -  | -  | -  | -   | -    | 20               | 10.10          |
| 4    | Professional Core (PC)                                   | -                      | -  | 25  | 23 | 19 | 15 | 13  | -    | 95               | 47.98          |
| 5    | Core Electives (CE)                                      | -                      | -  | -   | -  | 3  | 3  | 3   | -    | 9                | 4.55           |
| 6    | Non major Electives (NE)                                 | -                      | -  | -   | -  | -  | 3  | 3   | 3    | 9                | 4.55           |
| 7    | Open Electives (OE)                                      | -                      | -  | -   | -  | -  | -  | 3   | 3    | 6                | 3.03           |
| 8    | Project Work, Seminar, Internship, Term Paper, etc. (PR) | -                      | -  | -   | 1  | 1  | 2  | 3   | 10   | 17               | 8.59           |
|      | Total Credit                                             | 27                     | 25 | 25  | 27 | 27 | 26 | 25  | 16   | 198              | 100            |
|      | Total Contact Hour                                       | 35                     | 34 | 28  | 31 | 29 | 31 | 28  | 24   | 240              |                |

|                                                                                                                                      |                                                                              |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|----------------------------|--------------------|--------------------|-----------------------------|---|---|---|---|
| BEN101                                                                                                                               | ENGLISH - I                                                                  |                                                        |                     |                    |                        |                            |                    |                    |                             | L | T | P | C |
|                                                                                                                                      | Total Contact Hours – 60                                                     |                                                        |                     |                    |                        |                            |                    |                    |                             | 3 | 1 | 0 | 3 |
|                                                                                                                                      | Prerequisite – +2 Level English                                              |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
|                                                                                                                                      | Course Designed by – Dept of English                                         |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| OBJECTIVES                                                                                                                           |                                                                              |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| To make the students learn the basic modes of communication for fluency and attainment of confidence in speech, reading and writing. |                                                                              |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                |                                                                              |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| CO1                                                                                                                                  | Understand the importance of being responsible, logical, and thorough.       |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| CO2                                                                                                                                  | Respond to the situations where short reports and instructions are required. |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| CO3                                                                                                                                  | Explain “how things work”, and what to suggest when “things don’t work”      |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| CO4                                                                                                                                  | Develop our confidence and authority in the practical use of language.       |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| CO5                                                                                                                                  | Understand the importance of being responsible, logical, and thorough.       |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| CO6                                                                                                                                  | Able to Face interviews and competitive examinations                         |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low          |                                                                              |                                                        |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| 1                                                                                                                                    | COs/Pos                                                                      | a                                                      | b                   | c                  | d                      | e                          | f                  | g                  | h                           | i | j | k | L |
| 2                                                                                                                                    | CO1                                                                          | H                                                      | H                   | H                  | H                      | H                          | M                  | L                  | L                           | H | H | H | H |
|                                                                                                                                      | CO2                                                                          |                                                        |                     |                    |                        |                            |                    | L                  |                             |   |   |   |   |
|                                                                                                                                      | CO3                                                                          | H                                                      |                     |                    |                        |                            |                    | H                  |                             | H |   |   | H |
|                                                                                                                                      | CO4                                                                          | H                                                      | M                   |                    |                        |                            | M                  | L                  | H                           | H |   |   | H |
|                                                                                                                                      | CO5                                                                          |                                                        |                     |                    |                        |                            |                    | L                  |                             |   |   |   |   |
|                                                                                                                                      | CO6                                                                          | H                                                      |                     | H                  | H                      | H                          | H                  | L                  |                             | H | H | M | H |
| 3                                                                                                                                    | Category                                                                     | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Professional Elective (PE) | Non-Major Elective | Open Elective (OE) | Project/Term Paper/Seminar/ |   |   |   |   |
|                                                                                                                                      |                                                                              | √                                                      |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |
| 4                                                                                                                                    | Approval                                                                     | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                            |                    |                    |                             |   |   |   |   |

## UNIT STRUCTURES 12

Parts of speech - Active and passive voices - Subject verb agreement. - Writing about School life, Hobbies, Family and friends – Word formation with prefixes and suffixes - Tenses - Concord - Summarizing - Note-making

## UNIT II TRANSCODING

12

Cause and effect relations – Punctuations –Differences between verbal and nonverbal communication -E - mail communication – Homophones - Etiquettes of E mail communication. Interpreting graphic representation - Flow chart and Bar chart.

**UNIT III REPORTING****12**

Degrees of comparison – Positive, Comparative, Superlative - questions- SI units -Lab reports - Physics chemistry, workshop and survey report for introducing new product in the market.

**UNIT IV FORMAL DOCUMENTATION****12**

Writing project proposals - Presentation skills - Prefixes and suffixes - If conditions - Writing a review-Preparing minutes of the meeting, Agenda, official circulars.

**UNIT V METHODOLOGY****12**

Accident reports (due to flood and fire) - Hints development - Imperatives - Marking the stress Connectives, prepositional relatives.

**TEXT BOOK**

1. Department Of Humanities and Social Sciences Division, Anna University, Oxford University Press, 2013.

**REFERENCES:**

1. S.P.Danavel, English and Communication for Students of Science and Engineering, Orient Blackswan, Chennai, 2011.
2. Rizvi, M.Asharaf, Effective Technical Communication, New Delhi, Tata McGraw Hill Publishibg Company, 2007.
3. Murali Krishna and Sunitha Moishra, Communication Skills for Engineers. Pearson, New Delhi, 2011.

|                                                                                                                                        |                                          |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| BMA101                                                                                                                                 | MATHEMATICS I                            |                                                                             |   |   |   |   |   |   |   |   | L | T | P | C |
|                                                                                                                                        | Total Contact Hours - 60                 |                                                                             |   |   |   |   |   |   |   |   | 3 | 1 | 0 | 3 |
|                                                                                                                                        | Prerequisite – + 2 Level Mathematics     |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                                        | Course Designed by – Dept of Mathematics |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES                                                                                                                             |                                          |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| To make the students learn Mathematics in order to formulate and solve problems effectively in their respective fields of engineering. |                                          |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                  |                                          |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                                    |                                          | Study the fundamentals of mathematics                                       |   |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                                    |                                          | Students learn multiple integral techniques                                 |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                                    |                                          | Students gain knowledge in application of variables                         |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                                    |                                          | Find area and volume based on a function with one or more variables.        |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                                    |                                          | Apply matrix operations to solve relevant reallife problems in engineering. |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                                    |                                          | Formulate a mathematical model for three dimensional objects and solve      |   |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low            |                                          |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                                      | COs/Pos                                  | a                                                                           | b | c | D | e | f | g | h | i | j | k | l |   |

|   |          |                                                        |                             |                    |                        |                    |                         |                    |                                              |  |   |   |  |
|---|----------|--------------------------------------------------------|-----------------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|--|---|---|--|
| 2 | CO1      | H                                                      |                             |                    |                        |                    |                         |                    |                                              |  |   |   |  |
|   | CO2      |                                                        |                             | M                  |                        | H                  |                         |                    |                                              |  |   |   |  |
|   | CO3      |                                                        | H                           |                    |                        |                    | M                       |                    |                                              |  |   |   |  |
|   | CO4      |                                                        |                             |                    |                        |                    |                         | L                  |                                              |  |   |   |  |
|   | CO5      |                                                        |                             |                    |                        |                    |                         | H                  |                                              |  | L |   |  |
|   | CO6      |                                                        |                             |                    |                        |                    |                         |                    |                                              |  |   | L |  |
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences & Maths (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term Paper Seminar/ Internship (PR) |  |   |   |  |
|   |          |                                                        | √                           |                    |                        |                    |                         |                    |                                              |  |   |   |  |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                             |                    |                        |                    |                         |                    |                                              |  |   |   |  |

## UNIT 1 MATRICES

12

Characteristic equations- Eigen values and eigen vectors of the real matrix- Properties- Cayley-Hamilton theorem(Excluding proof)- Orthogonal transformation of a symmetric matrix to diagonal form- Quadratic form- Reduction of quadratic form to canonical form by orthogonal transformation.

## UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY

12

Equation of a Sphere- Plane section of a sphere- Tangent plane- Equation of cone- Right circular cone- Equation of a cylinder- Right circular cylinder.

## UNIT III DIFFERENTIAL CALCULUS

12

Curvature in Cartesian coordinates- Centre and radius of curvature- Circle of curvature- Evolutes- Envelopes- Applications of Evolutes and Envelopes.

## UNIT IV FUNCTIONS OF SEVERAL VARIABLES

12

Partial derivatives- Euler's theorem for homogeneous functions- Total derivatives- Differentiation of implicit functions- Jacobians- Taylor's expansion- Maxima and Minima- Method of Lagrangian multipliers.

## UNIT V MULTIPLE INTEGRALS

12

Double integration- Cartesian and Polar coordinates- Change of order of integration- Change of variables between Cartesian and Polar coordinates- Triple integration in Cartesian coordinates-Area as double integral- Volume as triple integral.

### TEXT BOOK:

1. Ravish R.Singh and Mukkul Bhatt, "Engineering Mathematics-I" First Reprint, Tata McGraw Hill Pub Co., New Delhi. 2011.
2. Grewal.B.S, "Higher Engineering Mathematics", 40<sup>th</sup> Edition, Khanna Publications, Delhi. 2007.

### REFERENCES:

1. Ramana.B.V. "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
2. Glyn James, "Advanced Engineering Mathematics", 7<sup>th</sup> Edition, Pearson Education, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons, New York, 2003.
4. Murray R.Spiegel, "Advanced Calculus", Schaum's Outline Series, First Edn, McGraw Hill Intl Book Co.,New Delhi, 1981.

|                                                                                                                                           |                                                                                     |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|---|--------------------|---|------------------------|---|----------------------------|---|-------------------------|---|--------------------|---|-----------------------------------------------|
| BPH101                                                                                                                                    | ENGINEERING PHYSICS I                                                               |                                                        |                     |   |                    |   |                        |   |                            |   |                         | L | T                  | P | C                                             |
|                                                                                                                                           | Total Contact Hours - 45                                                            |                                                        |                     |   |                    |   |                        |   |                            |   |                         | 3 | 0                  | 0 | 3                                             |
|                                                                                                                                           | Prerequisite – +2 level Physics                                                     |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
|                                                                                                                                           | Course Designed by – Department of Physics                                          |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| OBJECTIVES:<br>To enhance the fundamental knowledge in Physics and its applications relevant to various stream Engineering and Technology |                                                                                     |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| COURSE OUTCOMES (COs)                                                                                                                     |                                                                                     |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| CO                                                                                                                                        | Understand the Principles and Laws of Physics                                       |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| CO                                                                                                                                        | To understand the impact of Crystal Physics                                         |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| CO                                                                                                                                        | Learn the Properties of Elasticity and Heat transfer.                               |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| CO                                                                                                                                        | Acquire Knowledge on Quantum Physics.                                               |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| CO                                                                                                                                        | Understand the concepts on Laser & Ultrasonic's and its Applications                |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| CO                                                                                                                                        | Understand the Principle of Laser and its Applications in Engineering and Medicine. |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low               |                                                                                     |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| 1                                                                                                                                         | COs/Pos                                                                             | A                                                      | b                   | c | d                  | e | f                      | g | h                          | i | j                       | k | l                  |   |                                               |
| 2                                                                                                                                         | CO1                                                                                 | H                                                      |                     |   |                    |   |                        | M |                            |   | H                       |   |                    |   |                                               |
|                                                                                                                                           | CO2                                                                                 |                                                        | L                   | H |                    | M |                        |   |                            | M |                         | L | H                  |   |                                               |
|                                                                                                                                           | CO3                                                                                 |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
|                                                                                                                                           | CO4                                                                                 | H                                                      |                     | M | L                  |   |                        |   |                            |   | L                       |   | M                  |   |                                               |
|                                                                                                                                           | CO5                                                                                 |                                                        | L                   | L |                    |   |                        |   |                            |   |                         | L | L                  |   |                                               |
|                                                                                                                                           | CO6                                                                                 |                                                        |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| 3                                                                                                                                         | Category                                                                            | Humanities & Social Studies (HS)                       | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Professional Elective (PE) |   | Non-Major Elective (NE) |   | Open Elective (OE) |   | Project/ Term Paper/ Seminar/ Internship (PR) |
|                                                                                                                                           |                                                                                     |                                                        | √                   |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |
| 4                                                                                                                                         | Approval                                                                            | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |   |                    |   |                        |   |                            |   |                         |   |                    |   |                                               |

## UNIT I CRYSTAL PHYSICS

9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)-

Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

## **UNIT II      PROPERTIES OF MATTER AND THERMAL PHYSICS      9**

Elasticity-Hooke's law - Relationship between three moduli of elasticity (qualitative) – stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel).

## **UNIT III      QUANTUM PHYSICS      9**

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment-Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

## **UNIT IV      ACOUSTICS AND ULTRASONICS      9**

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies. Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Medical applications – Sonogram.

## **UNIT V      PHOTONICS AND FIBRE OPTICS      9**

Spontaneous and stimulated emission- Population inversion –Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO<sub>2</sub>, Semiconductor lasers (homo junction & hetero junction)- Industrial and Medical Applications. Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

### **TEXT BOOKS:**

1. Jayaraman D Engineering Physics I. Global Publishing House, 2014.
2. Arumugam M. Engineering Physics. Anuradha publishers, 2010.
3. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai Publishers, 2009.
4. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

### **REFERENCES:**

1. Searls and Zemansky. University Physics, 2009
2. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009.
3. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
4. <http://ocw.mit.edu/courses/find-by-topic>
5. <http://nptel.ac.in/course.php?disciplineId=122>
6. [https://en.wikipedia.org/wiki/Engineering\\_physics](https://en.wikipedia.org/wiki/Engineering_physics)

|                                                                                                                                                       |                                                                                                                          |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|----------------------------|-------------------------|--------------------|-----------------------------------------------|---|---|---|---|
| BCH101                                                                                                                                                | ENGINEERING CHEMISTRY - I                                                                                                |                                                        |                     |                    |                        |                            |                         | L                  | T                                             | P | C |   |   |
|                                                                                                                                                       | Total Contact Hours - 45                                                                                                 |                                                        |                     |                    |                        |                            |                         | 3                  | 0                                             | 0 | 3 |   |   |
|                                                                                                                                                       | Prerequisite – +2 Level Chemistry                                                                                        |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
|                                                                                                                                                       | Course Designed by – Department of Chemistry                                                                             |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| OBJECTIVES                                                                                                                                            |                                                                                                                          |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches. |                                                                                                                          |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                                 |                                                                                                                          |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| CO1                                                                                                                                                   | Understand the principles of water characterization and treatment for portable and industrial purposes.                  |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| CO2                                                                                                                                                   | To impart knowledge on the essential aspects of Principles of polymer chemistry and engineering applications of polymers |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| CO3                                                                                                                                                   | Having a sound knowledge in the Field of the Conventional and non-Conventional energy                                    |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| CO4                                                                                                                                                   | To impart knowledge on the essential aspects of electrochemical cells, emf and applications of EMF measurements          |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| CO5                                                                                                                                                   | To make the students understand the Principles of corrosion and corrosion control .                                      |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| CO6                                                                                                                                                   | To impart knowledge about the Conventional and non-conventional energy sources and energy storage devices                |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                           |                                                                                                                          |                                                        |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| 1                                                                                                                                                     | COs/Pos                                                                                                                  | a                                                      | b                   | c                  | d                      | e                          | f                       | g                  | h                                             | i | J | k | L |
| 2                                                                                                                                                     | CO1                                                                                                                      | H                                                      |                     |                    |                        |                            |                         | H                  |                                               |   |   |   |   |
|                                                                                                                                                       | CO2                                                                                                                      |                                                        | L                   | H                  |                        | M                          |                         |                    |                                               |   |   |   |   |
|                                                                                                                                                       | CO3                                                                                                                      |                                                        | M                   |                    | H                      |                            |                         |                    |                                               |   |   |   |   |
|                                                                                                                                                       | CO4                                                                                                                      | H                                                      |                     | M                  | L                      |                            |                         | H                  |                                               |   |   |   |   |
|                                                                                                                                                       | CO5                                                                                                                      |                                                        | L                   | L                  |                        |                            |                         |                    |                                               |   |   |   |   |
|                                                                                                                                                       | CO6                                                                                                                      | H                                                      |                     |                    |                        |                            |                         | H                  |                                               |   |   |   |   |
| 3                                                                                                                                                     | Category                                                                                                                 | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Professional Elective (PE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term Paper/ Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                                                       |                                                                                                                          |                                                        | √                   |                    |                        |                            |                         |                    |                                               |   |   |   |   |
| 4                                                                                                                                                     | Approval                                                                                                                 | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                            |                         |                    |                                               |   |   |   |   |

## UNIT I WATER TECHNOLOGY

9

Introduction-Characteristics : Hardness of water – types - temporary and permanent hardness - estimation by EDTA method Alkalinity – types of alkalinity - Phenolphthalein and Methyl orange alkalinity - determination –Domestic water treatment – disinfection methods (Chlorination, Ozonation , UV treatment) Boiler feed water – requirements – disadvantages of using hard water in boilers

Internal conditioning (Calgon Conditioning method) – External conditioning – Demineralization process – Desalination and Reverse osmosis.

## **UNIT II POLYMERS**

**9**

Introduction-Polymers- definition – polymerization – degree of polymerization - types of polymerization– Addition polymerization and Condensation polymerization – Mechanism of Polymerization - free radical polymerization mechanism only, Plastics: Classification – thermoplastics and thermosetting plastics – difference between thermoplastics and thermosetting plastics - preparation, properties and uses of PVC, Teflon, nylon-6,6, PET, Rubber :Types – drawbacks of natural rubber -vulcanization of rubber - properties and uses of vulcanized rubber Synthetic rubbers – butyl rubber and SBR

## **UNIT III ELECTRO CHEMISTRY**

**9**

Introduction CELLS: types of Electrochemical cells , Electrolytic cells – Reversible and irreversible cells EMF – measurement of EMF– Single electrode potential – Nernst equation Reference electrodes : Standard Hydrogen electrode -Calomel electrode Ion selective electrode :Glass electrode and measurement of pH using Glass electrode Electrochemical series – significance Titrations :Potentiometer titrations (redox -  $\text{Fe}^{2+}$  vs dichromate titrations) Conduct metric titrations (acid-base – HCl vs, NaOH titrations)

## **UNIT IV CORROSION AND CORROSION CONTROL**

**9**

Introduction: Chemical corrosion Definition - Chemical Corrosion - Electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – mechanism of Chemical and Electrochemical corrosion factors influencing corrosion control – sacrificial anode and impressed cathodic current methods – Protective coatings :Paints– constituents of the paint and their functions Metallic coatings – electroplating of Gold and electro less plating of Nickel.

## **UNIT V NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**

**9**

Introduction : Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain Reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation (block diagram only) – breeder reactor Solar energy conversion – solar cells – wind energy Fuel cells – hydrogen – oxygen fuel cell Batteries :Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries :Lead–acid storage battery –working –uses Nickel–cadmium battery - working – uses Solid – state battery : Lithium battery

### **TEXT BOOKS:**

1. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S. Dara “A text book of engineering chemistry” S.Chand& Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, “Engineering Chemistry, Volume 1”, Crystal Publications, Chennai, (2007).

### **REFERENCES :**

1. B.K.Sharma “Engineering chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
3. <http://ocw.mit.edu/courses/find-by-topic>
4. <http://nptel.ac.in/course.php?disciplineId=122>
5. <https://en.wikipedia.org/wiki/Electrochemistry>

|                                                                                                                             |                                                                                 |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|---|--------------------|---|------------------------|----------------------------|-------------------------|--------------------|---|-----------------------------------------------|---|
| BBT101                                                                                                                      | CELL BIOLOGY                                                                    |                                                        |                     |   |                    |   |                        |                            | L                       | T                  | P | C                                             |   |
|                                                                                                                             | Total Contact Hours - 45                                                        |                                                        |                     |   |                    |   |                        |                            | 2                       | 1                  | 0 | 3                                             |   |
|                                                                                                                             | Prerequisite – Higher Secondary level biology, basic concepts in cell signaling |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
|                                                                                                                             | Course Designed by – Dept of Industrial Biotechnology                           |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| OBJECTIVES                                                                                                                  |                                                                                 |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| To provide a basic understanding of cell, its structure, function, types and about its culture                              |                                                                                 |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                                                 |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| CO1                                                                                                                         | To understand the fundamentals of the structure of cells                        |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| CO2                                                                                                                         | To study the types and functions of cell organelles                             |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| CO3                                                                                                                         | To comprehend the methods involved in the cellular transport                    |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| CO4                                                                                                                         | To know the cause, and methods of cell signaling                                |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| CO5                                                                                                                         | To give a basic knowledge of cell culture and its applications                  |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| CO6                                                                                                                         | To understand about signal transduction                                         |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                 |                                                        |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| 1                                                                                                                           | COs/POs                                                                         | a                                                      | b                   | c | d                  | e | f                      | g                          | h                       | i                  | j | k                                             | l |
| 2                                                                                                                           | CO1                                                                             | H                                                      |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
|                                                                                                                             | CO2                                                                             |                                                        |                     |   | M                  |   |                        |                            |                         |                    |   |                                               |   |
|                                                                                                                             | CO3                                                                             | M                                                      |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
|                                                                                                                             | CO4                                                                             |                                                        |                     |   |                    |   |                        | H                          |                         |                    |   | M                                             |   |
|                                                                                                                             | CO5                                                                             | H                                                      |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
|                                                                                                                             | CO6                                                                             | H                                                      |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| 3                                                                                                                           | Category                                                                        | Humanities & Social Studies (HS)                       | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) | Professional Elective (PE) | Non-Major Elective (NE) | Open Elective (OE) |   | Project/ Term Paper/ Seminar/ Internship (PR) |   |
|                                                                                                                             |                                                                                 |                                                        | √                   |   |                    |   |                        |                            |                         |                    |   |                                               |   |
| 4                                                                                                                           | Approval                                                                        | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |   |                    |   |                        |                            |                         |                    |   |                                               |   |

### UNIT I: CELL STRUCTURE

9

Cells-definition, Eukaryotic cell and prokaryotic cell – differences and key organelles, Relationship and evolution of Eukaryotic cell and prokaryotic cell, plant cells and animal cells–differences and general structure- Cellular environment, tissues, various types of cell, Extra cellular matrix, cytoskeletal proteins, Cell cycle-Mitosis and meiosis

### UNIT II: CELL ORGANELLES

9

Cell Organelles and function – Nucleus, Cytoplasm, Endoplasmic reticulum, Golgi complex, lysosomes, cell membranes, chloroplast, mitochondria – structure, importance and function

### UNIT III: CELLULAR TRANSPORT

9

Transport across cell membranes – importance, classification – Active and passive, passive transport – movement of water, small lipid across membrane. Active – Na<sup>+</sup> K<sup>+</sup> ATPase Pump, Lysosomal and Vacuolar pumps. Cotransport – Symport, antiport – examples, Endocytosis and Exocytosis transport across prokaryotic membrane, entry of viruses and toxins

#### **UNIT IV: CELL SIGNALING AND SIGNAL TRANSDUCTION**

**9**

Cell signaling – process importance, various kinds of Receptors and ligands – Examples, Different modes of action of ligands, Qualification and characterization of receptors, different modes of signal transduction and amplification with examples, signaling through G-Proteins (Monomeric and trimeric), signaling for growth factors, second messengers, protein kinases, Ca ions and cAMP molecule in signaling.

#### **UNIT V: CELL CULTURE**

**9**

Definition, Media preparation, Propagation of eukaryotic and prokaryotic cell, cell lines, primary cultures, stock cell cultures, maintenance of cell lines in cell culture, explants cultures, differentiation and contamination

#### **TEXT BOOKS:**

1. P.K. Gupta, “Cell and Molecular Biology”, Rastogi Publication, 2003
2. Molecular Biology of the Cell, Bruce Albert et al., Taylor and Francis, 2002

#### **REFERENCE BOOKS:**

1. Molecular Biology of the Cell, Baltimore, Damell J., Lodish, H. Baltimore, D., Freeman Publications, 2003
2. The Cell, T. Cooper, John Wiley and Sons, 2005
3. Cytology, Verma and Aggarwal, S. Chand Publications, 2003

| BCS101                                                                                                               | FUNDAMENTALS OF COMPUTING AND PROGRAMMING                                 | L | T | P | C |
|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---|---|---|---|
|                                                                                                                      | Total Contact Hours - 45                                                  | 3 | 0 | 0 | 3 |
|                                                                                                                      | Prerequisite – +2 level Physics                                           |   |   |   |   |
|                                                                                                                      | Course Designed by – Department of Physics                                |   |   |   |   |
| OBJECTIVES                                                                                                           |                                                                           |   |   |   |   |
| Students will understand the basics of computers and solve computer oriented problems using various computing tools. |                                                                           |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                |                                                                           |   |   |   |   |
| CO1                                                                                                                  | Learn the fundamental principles in computing.                            |   |   |   |   |
| CO2                                                                                                                  | Learn to write simple programs using computer language                    |   |   |   |   |
| CO3                                                                                                                  | To enable the student to learn the major components of a computer system. |   |   |   |   |
| CO4                                                                                                                  | Computing problems                                                        |   |   |   |   |
| CO5                                                                                                                  | To learn to use office automation tools.                                  |   |   |   |   |
| CO6                                                                                                                  | To interpret and relate programs                                          |   |   |   |   |

| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                        |   |                        |   |                       |   |                           |   |                               |   |                            |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------|---|------------------------|---|-----------------------|---|---------------------------|---|-------------------------------|---|----------------------------|---|
| 1                                                                                                                           | COs/Pos  | a                                                      | b | c                      | d | e                     | f | g                         | h | i                             | J | k                          | L |
| 2                                                                                                                           | CO1      | H                                                      |   |                        |   |                       | H |                           |   |                               |   |                            |   |
|                                                                                                                             | CO2      |                                                        | L | H                      |   | M                     |   |                           |   |                               |   |                            |   |
|                                                                                                                             |          |                                                        |   |                        |   |                       |   |                           |   |                               |   |                            |   |
|                                                                                                                             | CO3      |                                                        | L |                        | S |                       |   |                           |   |                               |   |                            |   |
|                                                                                                                             |          |                                                        |   |                        |   |                       |   |                           |   |                               |   |                            |   |
|                                                                                                                             | CO4      | M                                                      |   | M                      | W |                       | M |                           |   |                               |   |                            |   |
|                                                                                                                             | CO5      |                                                        | L | L                      |   |                       |   |                           |   |                               |   |                            |   |
|                                                                                                                             | CO6      | H                                                      |   |                        |   |                       | H |                           |   |                               |   |                            |   |
| 3                                                                                                                           | Category | Humanities &<br>Social Studies<br>(HS)                 |   | Basic Sciences<br>(BS) |   | Engg Sciences<br>(ES) |   | Professional<br>Core (PC) |   | Professional<br>Elective (PE) |   | Non-Major<br>Elective (NE) |   |
|                                                                                                                             |          |                                                        |   |                        |   |                       |   |                           |   |                               |   |                            |   |
|                                                                                                                             |          |                                                        |   |                        |   | √                     |   |                           |   |                               |   |                            |   |
| 4                                                                                                                           | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                        |   |                       |   |                           |   |                               |   |                            |   |

## UNIT I INTRODUCTION TO COMPUTER

9

Introduction- Characteristics of computer-Evolution of Computers-Computer Generations - Classification of Computers- Basic Computer Organization-Number system. Computer Software: Types of Software—System software-Application software-Software Development Steps

## UNIT II PROBLEM SOLVING AND OFFICE AUTOMATION

9

Planning the Computer Program – Purpose – Algorithm – Flowcharts– Pseudo code Introduction to Office Packages: MS Word, Spread Sheet, Power Point, MS Access, Outlook.

## UNIT III INTRODUCTION TO C

9

Overview of C-Constants-Variables-Keywods-Data types-Operators and Expressions. Managing Input and Output statements-Decision making-Branching and Looping statements.

## UNIT IV ARRAYS AND STRUCTURES

9

Overview of C-Constants, Variables and Data types-Operators and Expressions -Managing Input and Output operators-Decision making-Branching and Looping.

## UNIT V INTRODUCTION TO C++

9

Overview of C++ - Applications of C++-Classes and objects-OOPS concepts -Constructor and Destructor- A simple C++ program –Friend classes and Friend Function.

## TEXT BOOKS:

1. Ashok, N.Kamthane,"Computer Programming", Pearson Education (2012).
2. Anita Goel and Ajay Mittal,"Computer Fundamentals and Programming in C", Dorling V Kindersley (India Pvt Ltd),Pearson Education in South Asia,(2011).
3. Yashavant P. Kanetkar, "Let us C",13th Edition,BPB Publications(2013).
4. Yashavant P. Kanetkar,"Let us C++"10th Edition, BPB Publications (2013).

#### REFERENCES:

1. Pradeep K.Sinha, Priti Sinha "Foundations of Computing", BPB Publications (2013).
2. Byron Gottfried, "Programming with C", 2nd edition, (Indian Adapted Edition), TMH Publication.
3. Pradip Dey, Manas Ghosh, Fundamentals of Computing and Programming in 'C' First Edition, Oxford University Press(2009).
4. The C++ Programming Language , 4<sup>th</sup> Edition, Bjarne Stroustrup, Addison-Wesley Publishing Company (2013).

|                                                                                                                             |         |                                                                                                                                                   |   |   |   |   |   |   |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|----------|----------|----------|----------|
| <b>BSS101</b>                                                                                                               |         | <b>PERSONALITY DEVELOPMENT</b>                                                                                                                    |   |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             |         | Total Contact Hours - 30                                                                                                                          |   |   |   |   |   |   |   | 1        | 1        | 0        | 2        |
|                                                                                                                             |         | Prerequisite – +2 Level Knowledge                                                                                                                 |   |   |   |   |   |   |   |          |          |          |          |
|                                                                                                                             |         | Course Designed by – Department of Management Studies                                                                                             |   |   |   |   |   |   |   |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                           |         |                                                                                                                                                   |   |   |   |   |   |   |   |          |          |          |          |
| To make students groom their personality and prove themselves as good Samaritans of the society.                            |         |                                                                                                                                                   |   |   |   |   |   |   |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |         |                                                                                                                                                   |   |   |   |   |   |   |   |          |          |          |          |
| CO1                                                                                                                         |         | Individual or in-group class presentations pertaining to the applications of concepts theories or issues in human development..                   |   |   |   |   |   |   |   |          |          |          |          |
| CO2                                                                                                                         |         | Scores obtained from essay and or objective tests.                                                                                                |   |   |   |   |   |   |   |          |          |          |          |
| CO3                                                                                                                         |         | Attendance, classroom participation, small group interactions.                                                                                    |   |   |   |   |   |   |   |          |          |          |          |
| CO4                                                                                                                         |         | Research and write about relevant topics.                                                                                                         |   |   |   |   |   |   |   |          |          |          |          |
| CO5                                                                                                                         |         | Design and complete a research project that can take the form of a developmental interview an observation or assessment through service learning. |   |   |   |   |   |   |   |          |          |          |          |
| CO6                                                                                                                         |         | Develop and maintain a Reflection                                                                                                                 |   |   |   |   |   |   |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |         |                                                                                                                                                   |   |   |   |   |   |   |   |          |          |          |          |
| 1                                                                                                                           | COs/Pos | a                                                                                                                                                 | b | c | d | e | f | g | h | i        | J        | k        | L        |
| 2                                                                                                                           | CO1     | L                                                                                                                                                 |   | H |   |   |   | M |   |          |          |          |          |
|                                                                                                                             | CO2     |                                                                                                                                                   | H | H |   |   |   | M |   |          |          |          |          |
|                                                                                                                             | CO3     |                                                                                                                                                   |   |   |   |   |   | M | H |          |          |          |          |
|                                                                                                                             | CO4     |                                                                                                                                                   |   |   |   |   |   |   |   | H        | H        |          |          |
|                                                                                                                             | CO5     |                                                                                                                                                   |   |   |   |   |   | M |   |          | H        | H        |          |
|                                                                                                                             | CO6     |                                                                                                                                                   |   |   |   |   |   | M |   |          |          |          | L        |

|   |          |                                                        |                     |                    |                        |                            |                         |                    |                                               |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|----------------------------|-------------------------|--------------------|-----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Professional Elective (PE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term Paper/ Seminar/ Internship (PR) |
|   |          | √                                                      |                     |                    |                        |                            |                         |                    |                                               |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                            |                         |                    |                                               |

### **UNIT I INTRODUCTION TO PERSONALITY DEVELOPMENT 6**

The concept personality- Dimensions of theories of Freud & Erickson- personality – significant of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles - Factors responsible for success – What is failure - Causes of failure. SWOT analyses.

### **UNIT II ATTITUDE & MOTIVATION 6**

Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude - Advantages – Negative attitude - Disadvantages - Ways to develop positive attitude - Difference between personalities having positive and negative attitude. Concept of motivation - Significance - Internal and external motives - Importance of self-motivation- Factors leading to de-motivation

### **UNIT III SELF-ESTEEM 6**

Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self-esteem - Symptoms - Personality having low selfesteem - Positive and negative self-esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviours - Lateral thinking.

### **UNIT IV OTHER ASPECTS OF PERSONALITY DEVELOPMENT 6**

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader - Character-building -Team-work - Time management -Work ethics –Good manners and etiquette.

### **UNIT V EMPLOYABILITY QUOTIENT 6**

Resume building- The art of participating in Group Discussion – Acing the Personal (HR & Technical) Interview -Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.

#### **TEXT BOOKS:**

1. Hurlock, E.B (2006). Personality Development, 28<sup>th</sup> Reprint. New Delhi: Tata McGraw Hill.
2. Stephen P. Robbins and Timothy A. Judge (2014), Organizational Behavior 16<sup>th</sup> Edition, Prentice Hall.

#### **REFERENCE BOOKS:**

1. Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw-Hill 1988.
2. Heller, Robert. Effective leadership. Essential Manager series. Dk Publishing, 2002

3. Hindle, Tim. Reducing Stress. Essential Manager series. Dk Publishing, 2003
4. Lucas, Stephen. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill. 2001
5. Mile, D.J Power of positive thinking. Delhi. Rohan Book Company, (2004).
6. Pravesh Kumar. All about Self- Motivation. New Delhi. Goodwill Publishing House. 2005.
7. Smith, B. Body Language. Delhi: Rohan Book Company. 2004

|                                                                                                                             |                                                                                |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|---|---------------------------|-------------------------------|---|----------------------------|--------------------|----------|-----------------------------------------------------|---|
| <b>BCE 101</b>                                                                                                              | <b>BASIC CIVIL ENGINEERING</b>                                                 |                                                        |                     |                    |   |                           |                               |   | <b>L</b>                   | <b>T</b>           | <b>P</b> | <b>C</b>                                            |   |
|                                                                                                                             | Total Contact Hours – 30                                                       |                                                        |                     |                    |   |                           |                               |   | 2                          | 0                  | 0        | 2                                                   |   |
|                                                                                                                             | Prerequisite – +2 Level Maths & Physical Science                               |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
|                                                                                                                             | Course Designed by – Department of Civil Engineering                           |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| <b>OBJECTIVES:</b> Understand the basic concepts of civil engineering.                                                      |                                                                                |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| CO1                                                                                                                         | Will gain knowledge in Design, concept preparation                             |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| CO2                                                                                                                         | Loading calculation                                                            |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| CO3                                                                                                                         | Structural component design                                                    |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| CO4                                                                                                                         | Drawing and chart preparation                                                  |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| CO5                                                                                                                         | Will understand the components of buildings.                                   |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| CO6                                                                                                                         | Will learn the engineering aspects to dams , water supply and sewage disposal. |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| 1                                                                                                                           | COs/POs                                                                        | a                                                      | b                   | c                  | d | e                         | f                             | g | h                          | i                  | j        | k                                                   | L |
| 2                                                                                                                           | CO1                                                                            | H                                                      | H                   |                    |   | H                         |                               | L |                            |                    |          |                                                     |   |
|                                                                                                                             | CO2                                                                            |                                                        |                     |                    |   | H                         | H                             |   |                            |                    |          |                                                     |   |
|                                                                                                                             | CO3                                                                            |                                                        |                     |                    |   |                           |                               | H | L                          |                    |          |                                                     |   |
|                                                                                                                             | CO4                                                                            |                                                        |                     |                    |   |                           |                               |   |                            | L                  |          |                                                     |   |
|                                                                                                                             | CO5                                                                            |                                                        |                     |                    |   |                           |                               |   |                            |                    | H        | L                                                   |   |
|                                                                                                                             | CO6                                                                            |                                                        |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |
| 3                                                                                                                           | Category                                                                       | Humanities & Social<br>Studies (HS)                    | Basic Sciences (BS) | Engg Sciences (ES) |   | Professional Core<br>(PC) | Professional Elective<br>(PE) |   | Non-Major Elective<br>(NE) | Open Elective (OE) |          | Project/ Term Paper/<br>Seminar/<br>Internship (PR) |   |
|                                                                                                                             |                                                                                |                                                        |                     | √                  |   |                           |                               |   |                            |                    |          |                                                     |   |
| 4                                                                                                                           | Approval                                                                       | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |   |                           |                               |   |                            |                    |          |                                                     |   |

|                                                                                                                                                                                                              |                                    |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------|
| <b>UNIT I</b>                                                                                                                                                                                                | <b>CIVIL ENGINEERING MATERIALS</b> | <b>8</b> |
| Introduction – Civil Engineering – Materials – Stones – Bricks – Sand – Cement – Plain Concrete – Reinforced Cement Concrete – Steel Sections – Timber – Plywood – Paints – Varnishes (simple examples only) |                                    |          |
| <b>UNIT II</b>                                                                                                                                                                                               | <b>SURVEYING</b>                   | <b>5</b> |
| Surveying – objectives – classification – principles of survey-Measurement of distances – Chain survey – Determination of areas – Use of compass – Use of leveling Instrument – (simple examples only)       |                                    |          |
| <b>UNIT III</b>                                                                                                                                                                                              | <b>FOUNDATION FOR BUILDING</b>     | <b>5</b> |
| Bearing Capacity of Soil – Foundation – Functions – Requirement of good foundations – Types of foundations – Merits & Demerits.                                                                              |                                    |          |
| <b>UNIT IV</b>                                                                                                                                                                                               | <b>SUPERSTRUCTURE</b>              | <b>7</b> |
| Stone Masonry – Brick Masonry – Columns – Lintels – Beams – Roofing – Flooring – Plastering– White Washing (Simple examples only)                                                                            |                                    |          |
| <b>UNIT V</b>                                                                                                                                                                                                | <b>MISCELLANEOUS TOPICS</b>        | <b>5</b> |
| Types of Bridges –Dam- purpose – selection of site - Types of Dams – Water Treatment & Supply sources – standards of drinking- distribution system. – Sewage Treatment (simple examples only)                |                                    |          |

**TEXT BOOKS:**

1. Raju.K.V.B, Ravichandran .P.T, “Basics of Civil Engineering”, Ayyappa Publications, Chennai, 2012.
2. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies, (1<sup>st</sup> ed. 2005).
3. Dr.M.S.Palanisamy, “Basic Civil Engineering” (3<sup>rd</sup>ed. 2000), TUG Publishers, New Delhi/Tata McGrawHill Publication Co., New Delhi

**REFERENCE BOOKS:**

1. Rangwala.S.C, ”Engineering Materials”, Charotar Publishing House, Anand, 41st Edition: 2014.
2. National Building Code of India, Part V, “Building Materials”, 2005
3. Ramesh Babu“A Textbook on Basic Civil Engineering” (1998). Anuradha Agencies, Kumbakonam.
4. RamamruthamS., “Basic Civil Engineering”, DhanpatRai Publishing Co. (P) Ltd. (1999).

|                                                                                                                                                                                                                          |                                                     |          |          |          |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|----------|----------|----------|----------|
| <b>BME101</b>                                                                                                                                                                                                            | <b>BASIC MECHANICAL ENGINEERING</b>                 | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                                                                                                                          | Total Contact Hours – 30                            | 2        | 0        | 0        | 2        |
|                                                                                                                                                                                                                          | Prerequisite – +2 Level Maths & Physical Science    |          |          |          |          |
|                                                                                                                                                                                                                          | Course Designed by – Dept of Mechanical Engineering |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                                                                                                                        |                                                     |          |          |          |          |
| <ul style="list-style-type: none"><li>• The program educational objectives (PEOs) for the mechanical-engineering program are to educate graduates who will be ethical, productive, and contributing members of</li></ul> |                                                     |          |          |          |          |

|                                                                                                                                                                                                                                                                                                                                                        |                                                                                      |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------|---|---------------------|---|--------------------|------------------------|---|----------------------------|-------------------------|--------------------|---|----------------------------------------------|
| society.                                                                                                                                                                                                                                                                                                                                               |                                                                                      |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| <ul style="list-style-type: none"><li>• The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context</li><li>• The ability to apply principles of engineering, basic science, and mathematics to design and realize physical systems, components, or processes</li></ul> |                                                                                      |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| COURSE OUTCOMES (COs)                                                                                                                                                                                                                                                                                                                                  |                                                                                      |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| CO1                                                                                                                                                                                                                                                                                                                                                    | an ability to apply knowledge of mathematics                                         |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| CO2                                                                                                                                                                                                                                                                                                                                                    | an ability to apply knowledge of science, and engineering                            |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| CO3                                                                                                                                                                                                                                                                                                                                                    | Ability to design and conduct experiments, as well as to analyze and interpret data. |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| CO4                                                                                                                                                                                                                                                                                                                                                    | an ability to function on multi-disciplinary teams                                   |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| CO5                                                                                                                                                                                                                                                                                                                                                    | To provide basic Knowledge of basic manufacturing process.                           |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| CO6                                                                                                                                                                                                                                                                                                                                                    | ability to identify, formulate, and solve engineering problems                       |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                                                                                            |                                                                                      |                                                        |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |
| 1                                                                                                                                                                                                                                                                                                                                                      | COs/POs                                                                              | a                                                      | b | c                   | d | e                  | f                      | g | h                          | i                       | j                  | k | l                                            |
| 2                                                                                                                                                                                                                                                                                                                                                      | CO1                                                                                  | M                                                      | M | M                   | H | M                  |                        | M |                            |                         | L                  | L | M                                            |
|                                                                                                                                                                                                                                                                                                                                                        | CO2                                                                                  | H                                                      | M | M                   | H | H                  |                        | M |                            |                         | L                  | L | M                                            |
|                                                                                                                                                                                                                                                                                                                                                        | CO3                                                                                  | H                                                      | M |                     | H | H                  |                        | M |                            |                         | L                  | L | M                                            |
|                                                                                                                                                                                                                                                                                                                                                        | CO4                                                                                  | H                                                      | M |                     | H | H                  |                        | M |                            |                         | L                  | L | M                                            |
|                                                                                                                                                                                                                                                                                                                                                        | CO5                                                                                  | H                                                      | M | M                   | H | H                  |                        | M |                            |                         | L                  | L | M                                            |
|                                                                                                                                                                                                                                                                                                                                                        | CO6                                                                                  | H                                                      |   |                     | H | H                  |                        | M |                            |                         | L                  | L | M                                            |
| 3                                                                                                                                                                                                                                                                                                                                                      | Category                                                                             | Humanities & Social Studies (HS)                       |   | Basic Sciences (BS) |   | Engg Sciences (ES) | Professional Core (PC) |   | Professional Elective (PE) | Non-Major Elective (NE) | Open Elective (OE) |   | Project/Term Paper/ Seminar/ Internship (PR) |
|                                                                                                                                                                                                                                                                                                                                                        |                                                                                      |                                                        |   |                     |   | √                  |                        |   |                            |                         |                    |   |                                              |
| 4                                                                                                                                                                                                                                                                                                                                                      | Approval                                                                             | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                     |   |                    |                        |   |                            |                         |                    |   |                                              |

## UNIT I ENERGY RESOURCES AND POWER GENERATION

6

Renewable and Non-renewable resources-solar, wind, geothermal, steam, nuclear and hydro power plants-Layout, major components and working. Importance of Energy storage, Environmental constraints of power generation using fossil fuels and nuclear energy.

## UNIT II IC ENGINES

6

Classification, working principles of petrol and diesel engines-two stroke and four stroke cycles, functions of main components of I.C. engine. Alternate fuels and emission control.

**UNIT III REFRIGERATION AND AIR-CONDITIONING SYSTEM****6**

Terminology of Refrigeration and Air-Conditioning, Principle of Vapor Compression & Absorption system- Layout of typical domestic refrigerator-window & Split type room air conditioner.

**UNIT IV MANUFACTURING PROCESSES****6**

Brief description of Mould making and casting process, Metal forming, Classification types of forging, forging operations, Brief description of extrusion, rolling, sheet forging, and drawing. Brief description of welding, brazing and soldering. Principal metal cutting processes and cutting tools, Brief description of Centre lathe and radial drilling machine.

**UNIT V MECHANICAL DESIGN****6**

Mechanical properties of material- Yield strength, ultimate strength, endurance limit etc., Stress-Strain curves of materials. Stresses induced in simple elements. Factor of safety- Design of Shafts and belts. Types of bearings and its applications. Introduction to CAD/CAM/CIM & Mechatronics.

**TEXTBOOKS:**

1. T.J. Prabhuetal, "Basic Mechanical Engineering", SciTech Publications (p) Ltd, 2000

**REFERENCES:**

1. NAGPAL, G.R, "Power plant Engineering", Khanna Publishers, 2004.
2. RAO. P.N, "Manufacturing Technology", Tata McGraw-Hill Education, 2000.
3. Kalpakjian, "Manufacturing Engineering and Technology", Addison Wesley publishers, 1995.
4. Ganesan. V, "Internal combustion engines", Tata McGraw-Hill Education, 2000.
5. C.P. Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill Education, 2001.
6. V.B. Bhandari, "Design of Machine elements", Tata McGraw-Hill Education, 2010.

|                                                                                                                         |                                                                                                                                                 |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|
| BCM1L1                                                                                                                  | BASIC CIVIL & MECHANICALENGINEERING<br>PRACTICES LABORATORY                                                                                     | L | T | P | C |
|                                                                                                                         | Total Contact Hours - 30                                                                                                                        | 0 | 0 | 2 | 1 |
|                                                                                                                         | Prerequisite – Basic Civil and Mechanical Engineering                                                                                           |   |   |   |   |
|                                                                                                                         | Course Designed by – Department of Mechanical Engineering& Civil Engineering                                                                    |   |   |   |   |
| OBJECTIVES                                                                                                              |                                                                                                                                                 |   |   |   |   |
| To provide exposure to the students with hands on experience on various basic Civil & Mechanical Engineering practices. |                                                                                                                                                 |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                   |                                                                                                                                                 |   |   |   |   |
| CO1                                                                                                                     | Learn Basic concepts                                                                                                                            |   |   |   |   |
| CO2                                                                                                                     | Students will get exposure regarding pipe connection for pumps & turbines and to study the joint used in roofs, doors, windows and furniture’s. |   |   |   |   |
| CO3                                                                                                                     | Students will get exposure regarding smithy, foundry operations and in latest welding operations such as TIG, MIG, CO2, spot welding etc.,      |   |   |   |   |
| CO4                                                                                                                     | Students will get hands on experience on basic welding techniques, machining and sheet metal works.                                             |   |   |   |   |
| CO5                                                                                                                     | Students will get hands on experience on basic machining techniques                                                                             |   |   |   |   |
| CO6                                                                                                                     | Students will get hands on experience on basic sheet metal techniques                                                                           |   |   |   |   |

| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                        |                           |   |                          |   |                            |                                   |                               |   |                          |                                                           |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------|---------------------------|---|--------------------------|---|----------------------------|-----------------------------------|-------------------------------|---|--------------------------|-----------------------------------------------------------|---|
| 1                                                                                                                           | COs/POs  | a                                                      | b                         | c | d                        | e | f                          | g                                 | h                             | i | J                        | k                                                         | l |
| 2                                                                                                                           | CO1      | H                                                      | L                         |   |                          |   |                            |                                   |                               |   |                          |                                                           |   |
|                                                                                                                             | CO2      |                                                        |                           |   | H                        |   |                            |                                   |                               |   |                          |                                                           |   |
|                                                                                                                             | CO3      |                                                        |                           |   |                          | H | L                          | L                                 |                               |   |                          |                                                           |   |
|                                                                                                                             | CO4      |                                                        | H                         |   |                          |   | M                          |                                   | L                             |   |                          | H                                                         |   |
|                                                                                                                             | CO5      |                                                        | H                         |   |                          |   | M                          |                                   | L                             |   |                          | H                                                         |   |
|                                                                                                                             | CO6      |                                                        | H                         |   |                          |   | M                          |                                   | L                             |   |                          | H                                                         |   |
| 3                                                                                                                           | Category | Humanities<br>& Social<br>Studies<br>(HS)              | Basic<br>Sciences<br>(BS) |   | Engg<br>Sciences<br>(ES) |   | Professiona<br>l Core (PC) | Professiona<br>l Elective<br>(PE) | Non-Major<br>Elective<br>(NE) |   | Open<br>Elective<br>(OE) | Project/Ter<br>m Paper/<br>Seminar/<br>Internship<br>(PR) |   |
|                                                                                                                             |          |                                                        |                           |   | ✓                        |   |                            |                                   |                               |   |                          |                                                           |   |
| 4                                                                                                                           | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                           |   |                          |   |                            |                                   |                               |   |                          |                                                           |   |

## LIST OF EXPERIMENTS

### I. CIVIL ENGINEERING PRACTICE

#### Buildings:

- Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

#### Plumbing Works:

- Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- Study of pipe connections requirements for pumps and turbines.
- Preparation of plumbing line sketches for water supply and sewerage works.
- Hands-on-exercise: Basic pipe connection of PVC pipes & G.I. Pipes – Mixed pipe material connection – Pipe connections with different joining components.
- Demonstration of plumbing requirements of high-rise buildings.

#### Carpentry using Hand tools and Power tools:

- Study of the joints in roofs, doors, windows and furniture.
- Hands-on-exercise: Woodwork, joints by sawing, planning and cutting.
- Preparation of half joints, Mortise and Tenon joints.

### II MECHANICAL ENGINEERING PRACTICE

#### Welding:

- Preparation of butt joints, lap joints and tee joints by arc welding

#### Basic Machining:

- Simple Turning and Taper turning
- Drilling Practice

#### Sheet Metal Work:

- Forming & Bending:
- Model making – Trays, funnels, etc.

- c) Different type of joints
- d) Preparation of air-conditioning ducts
- e) Preparation of butt joints, lap joints and tee joints by arc welding

**Machine assembly practice:**

- a) Assembling, dismantling and Study of centrifugal pump
- b) Assembling, dismantling and Study of air conditioner
- c) Assembling, dismantling and Study of lathe

**Moulding:**

- a) Moulding operations like mould preparation for gear and step cone pulley etc

**Fitting:**

- a) Fitting Exercises – Preparation of square fitting and vee-fitting models.

**Demonstration:**

- a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- b) Gas welding.

**REFERENCES:**

1. K. Jeyachandran, S. Nararajan & S. Balasubramanian, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).
2. T. Jeyapooan, M. Saravanapandian & S. Pranitha, “Engineering Practices Lab Manual”, Vikas Publishing House Pvt. Ltd. (2006)
3. H. S. Bawa, “Workshop Practice”, Tata McGraw–Hill Publishing Company Limited, (2007).
4. A. Rajendra Prasad & P. M. M. S Sarma, “Workshop Practice”, Sree Sai Publication, (2002).
5. P. Kannaiah & K.L. Narayana, “Manual on Workshop Practice”, Scitech Publication, (1999).

|                                                                                                                             |         |                                                                      |   |   |   |   |   |          |          |          |          |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------|----------------------------------------------------------------------|---|---|---|---|---|----------|----------|----------|----------|---|---|
| <b>BPC<br/>1L1/2L1</b>                                                                                                      |         | <b>PHYSICS AND CHEMISTRY LABORATORY</b>                              |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |   |
|                                                                                                                             |         | Total Contact Hours – 45                                             |   |   |   |   |   | 0        | 0        | 3        | 1        |   |   |
|                                                                                                                             |         | Prerequisite – Physics and Chemistry                                 |   |   |   |   |   |          |          |          |          |   |   |
|                                                                                                                             |         | Course Designed by – Department of Physics & Chemistry               |   |   |   |   |   |          |          |          |          |   |   |
| <b>OBJECTIVES:</b> To impart knowledge to the students in practical physics and chemistry                                   |         |                                                                      |   |   |   |   |   |          |          |          |          |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |         |                                                                      |   |   |   |   |   |          |          |          |          |   |   |
| CO1                                                                                                                         |         | Students will understand the concept of hall effect                  |   |   |   |   |   |          |          |          |          |   |   |
| CO2                                                                                                                         |         | Students will understand the concept of semiconductors. .            |   |   |   |   |   |          |          |          |          |   |   |
| CO3                                                                                                                         |         | Student will understand the working of spectrometer.                 |   |   |   |   |   |          |          |          |          |   |   |
| CO4                                                                                                                         |         | Student will able practically understand the chemical reactions.     |   |   |   |   |   |          |          |          |          |   |   |
| CO5                                                                                                                         |         | Students will Study the magnetic hysteresis and energy product       |   |   |   |   |   |          |          |          |          |   |   |
| CO6                                                                                                                         |         | Students understand the Determination of Band gap of a semiconductor |   |   |   |   |   |          |          |          |          |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |         |                                                                      |   |   |   |   |   |          |          |          |          |   |   |
| 1                                                                                                                           | COs/POs | a                                                                    | b | c | d | e | f | g        | h        | i        | j        | k | l |
| 2                                                                                                                           | CO1     | M                                                                    | H | M |   |   | L |          | L        | L        | M        | H | M |

|   |          |                                                        |                |               |                        |               |                         |               |                                             |   |   |   |   |
|---|----------|--------------------------------------------------------|----------------|---------------|------------------------|---------------|-------------------------|---------------|---------------------------------------------|---|---|---|---|
|   | CO2      |                                                        | H              | M             |                        |               | L                       |               | L                                           | L |   | H |   |
|   | CO3      |                                                        | H              | M             |                        |               | L                       |               | L                                           |   |   | H |   |
|   | CO4      | M                                                      | H              | M             |                        |               | L                       |               | L                                           | L | M | H | M |
|   | CO6      |                                                        | H              |               |                        |               | L                       |               | L                                           | H |   | H |   |
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences | Engg Sciences | Professional Core (PC) | Core Elective | Non-Major Elective (NE) | Open Elective | Project/Term Paper/Seminar/ Internship (PR) |   |   |   |   |
|   |          |                                                        | √              |               |                        |               |                         |               |                                             |   |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                |               |                        |               |                         |               |                                             |   |   |   |   |

### I -LIST OF EXPERIMENTS – PHYSICS

1. Determination of Wavelength, and particle size using Laser
2. Determination of acceptance angle in an optical fiber.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of Young's modulus by Non uniform bending method
7. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge
8. Determination of Young's modulus by uniform bending method
9. Determination of band gap of a semiconductor
10. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
11. Determination of Dispersive power of a prism - Spectrometer
12. Determination of thickness of a thin wire – Air wedge method
13. Determination of Rigidity modulus – Torsion pendulum

### II- LIST OF EXPERIMENTS – CHEMISTRY

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Determination of DO in water (Winkler's method)
4. Estimation of Chloride in Water sample (Argento metry)
5. Estimation of alkalinity of Water sample
6. Determination of molecular weight
7. Conduct metric titration (Simple acid base)
8. Conduct metric titration (Mixture of weak and strong acids)
9. Conduct metric titration using  $\text{BaCl}_2$  vs  $\text{Na}_2\text{SO}_4$
10. Potentiometric Titration ( $\text{Fe}^{2+}$  /  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ )
11. pH titration (acid & base)
12. Determination of water of crystallization of a crystalline salt (Copper Sulphate)
13. Estimation of Ferric iron by spectrophotometer.

|                  |                          |          |          |          |          |
|------------------|--------------------------|----------|----------|----------|----------|
| <b>BSS1L5/2L</b> | <b>NSS PRACTICAL</b>     | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| 5                | Total Contact Hours – 45 | 0        | 1        | 2        | 1        |

## OBJECTIVES

1. Understand the community in which they work and their relation
2. Identify the needs and problems of the community and involve them in problem-solving
3. Develop capacity to meet emergencies and natural disasters
4. Practice national integration and social harmony and
5. Utilize their knowledge in finding practical solutions to individual and community problems.

### 1. Regular Activities Programme

- 1) Traffic regulation
- 2) Working with Police Commissioner's Office
- 3) Working with Corporation of Chennai
- 4) Working with Health Department
- 5) Blind assistance
- 6) Garments collection
- 7) Non-formal education
- 8) Environmental Education, Awareness and Training (EEAT)
- 9) Blood donation

### 2. Special camp Programme

- A) Legal awareness
- B) Health awareness
- C) First-aid
- D) Career guidance
- E) Leadership training - cum - Cultural Programme
- F) Globalization and its Economic Social Political and Cultural impacts.

## REFERENCE BOOKS:

1. National Service Scheme Manual, Government of India.
2. Training Programme on National Programme scheme, TISS.
3. Orientation Courses for N.S.S. Programme officers, TISS.
4. Case material as Training Aid for field workers, Gurmeet Hans.
5. Social service opportunities in Hospitals, Kapil K. Krishan, TISS.
6. Social Problems in India, Ram Ahuja.

| BEN201                                                                                                                                               | ENGLISH II                                                                                                                                        | L | T | P | C |
|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|
|                                                                                                                                                      | Total Contact Hours – 60                                                                                                                          | 3 | 1 | 0 | 3 |
|                                                                                                                                                      | Prerequisite – English I                                                                                                                          |   |   |   |   |
|                                                                                                                                                      | Course Designed by – Department of English                                                                                                        |   |   |   |   |
| <b>OBJECTIVES</b>                                                                                                                                    |                                                                                                                                                   |   |   |   |   |
| Students will be able to actively participate in group discussions. Students will have Telephonic Skills, Giving Directions and Information Transfer |                                                                                                                                                   |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                         |                                                                                                                                                   |   |   |   |   |
| CO1                                                                                                                                                  | To make the students aware to different kinds of Learner-friendly modes of language to a variety of self- instructional learning (Computer based) |   |   |   |   |
| CO2                                                                                                                                                  | To make students comprehend the habit of intelligent Reading as well as Computer-based competitive exams glob                                     |   |   |   |   |

|     |                                                                                                                                                   |                                                        |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|----------------------------|-------------------------|--------------------|-----------------------------------------|---|---|---|---|
| CO3 | To achieve a reasonably good level of competency in Report Writing.                                                                               |                                                        |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
| CO4 | To make the students aware to different kinds of Learner-friendly modes of language to a variety of self- instructional learning (Computer based) |                                                        |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
| CO5 | To achieve a reasonably good level of competency in group discussions                                                                             |                                                        |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
| CO6 | To achieve a reasonably good level of competency in public speaking                                                                               |                                                        |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
|     | Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                       |                                                        |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
| 1   | COs/POs                                                                                                                                           | a                                                      | b                   | c                  | d                      | e                          | f                       | g                  | h                                       | i | J | k | l |
| 2   | CO1                                                                                                                                               | M                                                      | L                   | H                  | L                      | M                          |                         |                    | H                                       |   | M | L |   |
|     | CO2                                                                                                                                               |                                                        |                     | H                  | L                      |                            |                         |                    | H                                       |   | M | L |   |
|     | CO3                                                                                                                                               |                                                        |                     | H                  | L                      | M                          |                         |                    | H                                       |   | H | L |   |
|     | CO4                                                                                                                                               |                                                        |                     | H                  | L                      | M                          |                         |                    | H                                       |   | M | L |   |
|     | CO5                                                                                                                                               |                                                        |                     | H                  | L                      | M                          |                         |                    | H                                       |   | M | L |   |
|     | CO6                                                                                                                                               |                                                        |                     | H                  | L                      | M                          |                         |                    | H                                       |   | M | L |   |
| 3   | Category                                                                                                                                          | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Professional Elective (PE) | Non-Major Elective (NE) | Open Elective (OE) | Project/Term Paper/ Seminar/ Internship |   |   |   |   |
|     |                                                                                                                                                   | √                                                      |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |
| 4   | Approval                                                                                                                                          | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                            |                         |                    |                                         |   |   |   |   |

## UNIT I ORIENTATION

12

Numerical adjectives - Meanings in context - Same words used as different parts of speech -Paragraph writing - Non- verbal communication - Regular and Irregular verbs.

## UNIT II ORAL SKILL

12

Listening to audio cassettes - CDs, News bulletin - Special Lectures, Discourse - Note taking - Sentence patterns - SV, SVO, SVC, SVOC, SVOCA - and Giving Instructions - Reading Comprehension answering questions. Inferring meaning.

## UNIT III THINKING SKILL

12

Self- introduction describing –Group Discussion – Debate –Role play- Telephone- Things- etiquette- Recommendation and Sequencing jumbled sentences to make a suggestions-paragraph-advertisement and notice, Designing or drafting posters, writing formal and informal invitations and replies.

## UNIT IV WRITING SKILL

12

Definitions - Compound nouns - Abbreviations and acronyms – (a) business or official letters(for making enquiries, registering complaints, asking for and giving information, placing orders and sending replies): (b) Letters to the editor (giving suggestions on an issue)

## UNIT V FORMAL INFORMATION

12

Editing – Prepositions - Articles - Permission letter for undergoing practical training , Essay writing - Application for a job , letter to the principal authorities regarding admissions, other issues, requirement or suitability of course etc.

**TEXT BOOK:**

1. Meenakshi Raman, Sangeetha Sharma, Technical English for Communication: Principle and Practice, OUP, 2009.

**REFERENCE BOOKS:**

1. Sumanth , English for Engineers, Vijay Nicole , Imprints pvt ltd.2013.
2. Meenakshi Raman and Sangeetha Sharma, Technical Communication Principles and Practice, Oxford University Press, 2009.
3. Sangeetha Sharma, Binodmishra, Communication skills for engineers and scientists, PHI Learning Pvt Ltd, New Delhi, 2010.

|                                                                                                                             |                                                                                                                                                       |   |   |   |   |   |   |   |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|----------|----------|----------|----------|
| <b>BMA201</b>                                                                                                               | <b>MATHEMATICS – II</b>                                                                                                                               |   |   |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             | Total Contact Hours - 60                                                                                                                              |   |   |   |   |   |   |   |   | 3        | 1        | 0        | 3        |
|                                                                                                                             | Prerequisite – Mathematics I                                                                                                                          |   |   |   |   |   |   |   |   |          |          |          |          |
|                                                                                                                             | Course Designed by – Department of Mathematics                                                                                                        |   |   |   |   |   |   |   |   |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                           |                                                                                                                                                       |   |   |   |   |   |   |   |   |          |          |          |          |
| Ability to apply these principles of mathematics in projects and research works.                                            |                                                                                                                                                       |   |   |   |   |   |   |   |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                                                                                       |   |   |   |   |   |   |   |   |          |          |          |          |
| CO1                                                                                                                         | Student shall be able to Solve differential equations, simultaneous linear equations, and s special types of linear equations related to engineering. |   |   |   |   |   |   |   |   |          |          |          |          |
| CO2                                                                                                                         | Relate the use of mathematics in applications of various fields namely fluid flow, heat fl solid mechanics, electrostatics, etc.                      |   |   |   |   |   |   |   |   |          |          |          |          |
| CO3                                                                                                                         | Ability to test hypothesis                                                                                                                            |   |   |   |   |   |   |   |   |          |          |          |          |
| CO4                                                                                                                         | Find intensity of degree of relationship between two variables and also bring out regres equations.                                                   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO5                                                                                                                         | Understand to solve matrix problems related to real life problems.                                                                                    |   |   |   |   |   |   |   |   |          |          |          |          |
| CO6                                                                                                                         | Formulate mathematical models                                                                                                                         |   |   |   |   |   |   |   |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                                                                       |   |   |   |   |   |   |   |   |          |          |          |          |
| 1                                                                                                                           | COs/Pos                                                                                                                                               | a | b | c | d | e | f | g | h | i        | j        | k        | L        |
| 2                                                                                                                           | CO1                                                                                                                                                   | H |   | L |   |   |   |   |   |          |          |          |          |
|                                                                                                                             | CO2                                                                                                                                                   |   | H |   |   |   | H |   | L | L        |          | M        |          |
|                                                                                                                             | CO3                                                                                                                                                   |   | H |   |   |   | H |   | L | L        |          | M        |          |
|                                                                                                                             | CO4                                                                                                                                                   |   |   |   |   | M |   |   |   |          |          | M        |          |
|                                                                                                                             | CO5                                                                                                                                                   |   |   |   |   |   |   |   |   |          | M        | M        |          |
|                                                                                                                             | CO6                                                                                                                                                   |   |   |   |   |   |   |   |   |          | M        |          |          |

|   |          |                              |                                                        |                      |                   |                       |                    |               |              |
|---|----------|------------------------------|--------------------------------------------------------|----------------------|-------------------|-----------------------|--------------------|---------------|--------------|
| 3 | Category | Humanities & Social Sciences | Basic Sciences                                         | Engineering Sciences | Professional Core | Professional Elective | Non-Major Elective | Open Elective | Project/Term |
|   |          |                              | √                                                      |                      |                   |                       |                    |               |              |
| 4 | Approval |                              | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                      |                   |                       |                    |               |              |

### UNIT I ORDINARY DIFFERENTIAL EQUATION

12

Higher order linear differential equations with constant coefficients - Method of variation of parameters – **Cauchy's** and **Legendre's linear equations** - simultaneous first order linear equations with constant coefficients.

### UNIT II VECTOR CALCULUS

12

Gradient, divergence and curl –Directional derivatives –Irrotational and solenoidal vector fields – vector integration– **Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem** (without proofs) – simple applications involving cubes and rectangular parallelepipeds.

### UNIT III ANALYTIC FUNCTIONS

12

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy-Riemann equation and sufficient conditions (without proofs) – Harmonic and orthogonal properties of analytic functions – Harmonic conjugate – construction of analytic functions – conformal mapping:  $W = Z + C$ ,  $CZ$ ,  $1/Z$  and bilinear transformation.

### UNIT IV COMPLEX INTEGRATION

12

Complex integration – **Statement and application of Cauchy's integral theorem and Cauchy's integral formula** –Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of Residue theorem to evaluate real integrals – Unit circle and semi-circular contour (excluding poles on boundaries).

### UNIT V STATISTICS

12

Mean, Median, Mode – Moments –Skewness and Kurtosis – Correlation – Rank Correlation – Regression –Chi square test for contingency tables.

#### TEXT BOOK:

1. R.M.Kannan and B.Vijayakumar“ Engineering Mathematics–II “2<sup>nd</sup>Edition, SRB Publication, Chennai 2007.
2. Bali.N.P and Manish Goyal , “Engineering Mathematics“, 3<sup>rd</sup>Edition, Laxmi Publications (P) Llted, 2008 .
3. Grewal .B/S “Higher Engineering Mathematics”, 40<sup>th</sup>Editon, Khanna Publications, Delhi, 2007

#### REFERENCES :

1. Ramana.B.V, “Higher Engineering Mathematic“, Tata McGraw Hill Publishing Company, New Delhi, 2007.
2. Gupta SC, and VK.Kapoor, “Fundamentals Mathematical Statistics”, 11<sup>th</sup>edition, Sultan Chand Sons, New Delhi, 2014.

|  |                         |   |   |   |   |
|--|-------------------------|---|---|---|---|
|  | ENGINEERING PHYSICS -II | L | T | P | C |
|--|-------------------------|---|---|---|---|

|                                                                                                                                                                                                                                                                                                                                                            |                                                                       |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|--------------------|--------------------|-----------------------------------------|---|---|---|---|---|
| BPH201                                                                                                                                                                                                                                                                                                                                                     | Total Contact Hours - 45                                              |                                                        |                     |                    |                        |                    |                    |                    |                                         |   | 3 | 0 | 0 | 3 |
|                                                                                                                                                                                                                                                                                                                                                            | Prerequisite – ENGINEERING PHYSICS -I                                 |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            | Course Designed by – Department of Physics                            |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| OBJECTIVES                                                                                                                                                                                                                                                                                                                                                 |                                                                       |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| <ul style="list-style-type: none"><li>To expose the students to multiple areas of science of engineering materials which have direct relevance to different Engineering applications</li><li>To understand the concepts and applications of conducting, Semiconducting, magnetic &amp; dielectric materials as well as their optical properties.</li></ul> |                                                                       |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                                                                                                                                                                                                                                      |                                                                       |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| CO1                                                                                                                                                                                                                                                                                                                                                        | Understand about properties and advancements of conducting materials. |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| CO2                                                                                                                                                                                                                                                                                                                                                        | Understand the principle and properties semiconducting materials.     |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| CO3                                                                                                                                                                                                                                                                                                                                                        | Acquire Knowledge on Magnetic and dielectric Materials.               |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| CO4                                                                                                                                                                                                                                                                                                                                                        | To Know about the creation of new materials with novel properties     |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| CO5                                                                                                                                                                                                                                                                                                                                                        | To Understand the impact of modern materials in technical uses.       |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| CO6                                                                                                                                                                                                                                                                                                                                                        | Learn new engineering materials and its characteristics               |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                                                                                                |                                                                       |                                                        |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| 1                                                                                                                                                                                                                                                                                                                                                          | COs/Pos                                                               | a                                                      | b                   | c                  | d                      | e                  | f                  | g                  | h                                       | i | j | k | l |   |
| 2                                                                                                                                                                                                                                                                                                                                                          | CO1                                                                   | H                                                      |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            | CO2                                                                   |                                                        | L                   | H                  |                        | M                  |                    |                    |                                         |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            | CO3                                                                   |                                                        | M                   |                    | H                      |                    |                    |                    |                                         |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            | CO4                                                                   | H                                                      |                     | M                  | L                      |                    |                    |                    |                                         |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            | CO5                                                                   |                                                        | L                   | L                  |                        |                    |                    |                    |                                         |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            | CO6                                                                   | H                                                      |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| 3                                                                                                                                                                                                                                                                                                                                                          | Category                                                              | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective | Open Elective (OE) | Project/Term Paper/ Seminar/ Internship |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                            |                                                                       |                                                        | √                   |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |
| 4                                                                                                                                                                                                                                                                                                                                                          | Approval                                                              | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                    |                    |                                         |   |   |   |   |   |

## UNIT I CONDUCTING MATERIALS

9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

## UNIT II SEMICONDUCTING MATERIALS

9

Intrinsic semiconductor – carrier concentration derivation Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors -direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications.

### **UNIT III      MAGNETIC AND SUPERCONDUCTING MATERIALS      9**

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications Superconductivity : properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

### **UNIT IV      DIELECTRIC MATERIALS      9**

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

### **UNIT V      ADVANCED ENGINEERING MATERIALS      9**

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials –Birefringence- optical Kerr effect – Classification of Biomaterials and its applications.

#### **TEXT BOOKS:**

1. Jayaraman D Engineering Physics II. Global Publishing House, 2014.
2. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011.
3. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011.

#### **REFERENCES:**

1. Arumugam M., Materials Science. Anuradha publishers, 2010
2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
- 4 <http://ocw.mit.edu/courses/find-by-topic>
- 5 <http://nptel.ac.in/course.php?disciplineId=122>
- 6 [https://en.wikipedia.org/wiki/Engineering\\_physics](https://en.wikipedia.org/wiki/Engineering_physics)

| BCH 201                                                                                                                                 | ENGINEERING CHEMISTRY-II                     | L | T | P | C |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---|---|---|---|
|                                                                                                                                         | Total Contact Hours - 45                     | 3 | 0 | 0 | 3 |
|                                                                                                                                         | Prerequisite – ENGINEERING CHEMISTRY –I      |   |   |   |   |
|                                                                                                                                         | Course Designed by – Department of Chemistry |   |   |   |   |
| OBJECTIVES                                                                                                                              |                                              |   |   |   |   |
| To impart a sound knowledge on the principles of chemistry involving application oriented topics required for all engineering branches. |                                              |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                   |                                              |   |   |   |   |

|                                                                                                                             |                                                                                                    |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------|----------------|---|---------------|---|------------------------|---|--------------------|---|--------------------|---|--------------------|------------------------------|
| CO1                                                                                                                         | Students will understand the concepts and further industrial applications of surface chemistry     |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| CO2                                                                                                                         | To impart knowledge about the Industrial importance of Phase rule and alloys                       |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| CO3                                                                                                                         | To make the students to be conversant with Analytical techniques of chemistry and their importance |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| CO4                                                                                                                         | To have an idea and knowledge about the Chemistry of Fuels and                                     |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| CO5                                                                                                                         | Understanding of engineering materials                                                             |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| CO6                                                                                                                         | All about bonding and molecular structures                                                         |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                    |                                                        |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| 1                                                                                                                           | COs/Pos                                                                                            | a                                                      | b              | c | d             | e | f                      | g | h                  | i | j                  | k | l                  |                              |
| 2                                                                                                                           | CO1                                                                                                | H                                                      | H              | L |               | H |                        | H |                    |   |                    | M |                    |                              |
|                                                                                                                             | CO2                                                                                                |                                                        | H              |   |               | H |                        | H |                    |   |                    |   |                    |                              |
|                                                                                                                             | CO3                                                                                                | H                                                      |                | L |               | H |                        | H |                    |   |                    | M |                    |                              |
|                                                                                                                             | CO4                                                                                                |                                                        |                | L |               | H |                        | H |                    |   |                    |   |                    |                              |
|                                                                                                                             | CO5                                                                                                |                                                        |                | L |               | H |                        | H |                    |   |                    |   |                    |                              |
|                                                                                                                             | CO6                                                                                                |                                                        |                | L |               | H |                        | H |                    | H |                    | M |                    |                              |
| 3                                                                                                                           | Category                                                                                           | Humanities & Social                                    | Basic Sciences |   | Engg Sciences |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective |   | Open Elective (OE) | Project /Term Paper/ Seminar |
|                                                                                                                             |                                                                                                    |                                                        | √              |   |               |   |                        |   |                    |   |                    |   |                    |                              |
| 4                                                                                                                           | Approval                                                                                           | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                |   |               |   |                        |   |                    |   |                    |   |                    |                              |

## UNIT I SURFACE CHEMISTRY

9

Introduction : Adsorption , absorption , desorption , adsorbent , adsorbate and sorption – (definition only) Differences between adsorption and absorption Adsorption of gases on solids – factors affecting adsorption of gases on solids – Adsorption isotherms –Freundlich adsorption isotherm and Langmuir adsorption isotherm Role of adsorbents in catalysis, Ion-exchange adsorption and pollution abatement.

## UNIT II PHASE RULE AND ALLOYS

9

Introduction :Statement of Phase Rule and explanation of terms involved – one component system – water system – Construction of phase diagram by thermal analysis - Condensed phase rule [Definition only] Two Component System : Simple eutectic systems (lead-silver system only) – eutectic temperature – eutectic composition – Pattinsons Process of desilverisation of Lead Alloys: Importance, ferrous alloys –nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing – hardening – tempering normalizing – carburizing - nitriding . Non- ferrous alloys: Brass and Bronze

## UNIT III ANALYTICAL TECHNIQUES

9

Introduction: Type of Spectroscopy - Atomic spectroscopy – molecular spectroscopy - Explanation IR spectroscopy – principles – instrumentation (block diagram only) – applications - finger print region UV-visible spectroscopy — principle – instrumentation (block diagram only) – Beer-**Lambert's law**- – estimation of iron by colorimetry– Atomic absorption spectroscopy- principle - instrumentation (block diagram only) - estimation of Nickel by Atomic absorption spectroscopy

Flame photometry– principles – instrumentation (block diagram only) - estimation of sodium ion by Flame photometry

#### UNIT IV FUELS

9

Introduction : Calorific value – types of Calorific value - gross calorific value – net calorific value  
Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke – manufacture by Otto-Hoffmann method Petroleum processing and fractions – cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number (definition only) Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG (definition and composition only) Flue gas analysis – importance - Orsat apparatus

#### UNIT V ENGINEERING MATERIALS

9

**Introduction:** Refractory's – classification – acidic, basic and neutral refractory's – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) Manufacture of Refractory's: alumina bricks and Magnesite bricks, Abrasives – natural and synthetic abrasives Natural type : Siliceous - quartz ; Non –siliceous – diamond Synthetic Abrasives : silicon carbide and boron carbide. Lubricants: Liquid lubricants - Properties – viscosity index, flash and fire points, cloud and pour points, oiliness) Solid lubricants – graphite and molybdenum sulphide

#### TEXT BOOKS:

1. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara “A text book of Engineering Chemistry” S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, “Engineering Chemistry, Volume 1”, Crystal Publications, Chennai, (2007).

#### REFERENCES:

1. B.Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub. Co.Ltd, New Delhi,(2008)
2. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).
3. <http://ocw.mit.edu/courses/find-by-topic>
4. <http://nptel.ac.in/course.php?disciplineId=122>
5. <https://en.wikipedia.org/wiki/Spectroscopy>

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                           |   |   |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---|---|---|---|
| BCS 202                                                                                                                                                                                                                                                                                                                                                                                                                                                            | INTERNET PROGRAMMING                                                      | L | T | P | C |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Total Contact Hours - 30                                                  | 2 | 0 | 0 | 2 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Prerequisite – Fundamentals of Computer                                   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Course Designed by – Dept of Information Technology                       |   |   |   |   |
| <b>OBJECTIVES</b> <ul style="list-style-type: none"><li>• To impart a sound knowledge on the principles of computers involving the different application oriented topics required for all engineering branches.</li><li>• Graduates will demonstrate the ability to apply knowledge of mathematics to develop and analyze computing systems.</li><li>• Graduates will have a solid understanding of the theory and concepts underlying computer science.</li></ul> |                                                                           |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                           |   |   |   |   |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To enable the student to learn the major components of a computer system. |   |   |   |   |

|                                                                                                                             |                                               |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2                                                                                                                         | To know the correct way of solving problem.   |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                         | To identify efficient way of solving problem. |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                         | To learn to use office automation tools.      |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                         | To implement office automation tools          |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                         | To learn and write program in “C”.            |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                               |                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                           | COs/POs                                       | a                                                      | b | c | d | e | f | g | h | i | j | k | l |   |
| 2                                                                                                                           | CO1                                           | M                                                      | M | M | H | M |   | M |   |   | L | L | M |   |
|                                                                                                                             | CO2                                           | H                                                      | M | M | H | H |   | M |   |   | L | L | M |   |
|                                                                                                                             | CO3                                           | H                                                      | M |   | H | H |   | M |   |   | L | L | M |   |
|                                                                                                                             | CO4                                           | H                                                      | M |   | H | H |   | M |   |   | L | L | M |   |
|                                                                                                                             | CO5                                           | H                                                      | M | M | H | H |   | M |   |   | L | L | M |   |
|                                                                                                                             | CO6                                           | H                                                      |   |   | H | H |   | M |   |   | L | L | M |   |
| 3                                                                                                                           | Category                                      | H                                                      | u | m | a | n | a | B | a | s | i | c | S | c |
|                                                                                                                             |                                               |                                                        |   |   |   |   |   | √ |   |   |   |   |   |   |
| 4                                                                                                                           | Approval                                      | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |   |   |   |   |   |   |   |   |   |   |   |

## UNIT I BASIC INTERNET CONCEPTS

6

Internet principles-IP addressing-Internet Service Provider (ISP)-URL-Basic web concepts-World Wide Web (WWW)-Intranet and Extranet-Internet Protocols: HTTP, TCP, UDP, FTP, Telnet-Domain Name System(DNS)-E mail-Next generation internet.

## UNIT II WEB DESIGN BASICS

6

Introduction to HTML-Structure of HTML Document- Tags-Headings-Links-Images-Lists-Tables -Forms-Frames-Style sheets and its types.

## UNIT III DYNAMIC HTML

6

Introduction to Dynamic HTML-Object model and collections-Event model-Filters and transition-Data binding-Data control-ActiveX control.

## UNIT IV CLIENT AND SERVER SIDE PROGRAMMING

6

VBScript & JavaScript: Introduction-Operators-Data type-Control structures-Looping-Classes and Objects-Arrays-Functions-Events-Example programs.

## UNIT V INTERNET APPLICATIONS

6

Online database-functions of online database-Merits and Demerits-Internet Information Systems (IIS)-EDI applications in business and its types-Internet commerce-Types and Applications

### TEXT BOOKS:

- Deitel, Deitel and Nieto, “Internet and World Wide Web- How to program”, Pearson Education Publishers, 5<sup>th</sup> edition, 2008.

2. Elliott Rusty Harold, "Java Network Programming", O'Reilly Publishers, 2010
3. Java Script: A Beginners Guide John Pollock 4<sup>th</sup> Edition, TMH Edition (2013)
4. VB Script Beginners Guide, Jyoti B. Giramkar, Create Space Independent Publishing (2014)

#### REFERENCES:

- 1... Krishnamoorthy & S. Prabhu, "Internet and Java Programming", New Age International Publishers, 2010.
2. Thomno A. Powell, "The Complete Reference HTML and XHTML", fourth edition, Tata McGraw Hill, 2001
3. E Commerce Kamlesh K. Bajaj, Debjani Nag, Tata McGraw Hill, Second edition, 2010

|                                                                                                                                       |                                                                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| BFR 20                                                                                                                                | FRENCH                                                                                                                                                                                                                                                                  |   |   |   |   |   |   |   | L | T | P | C |   |
|                                                                                                                                       | Total Contact Hours – 45                                                                                                                                                                                                                                                |   |   |   |   |   |   |   | 3 | 0 | 0 | 3 |   |
|                                                                                                                                       | Prerequisite – +2 Level English                                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                                       | Course Designed by – Department of English                                                                                                                                                                                                                              |   |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES                                                                                                                            |                                                                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
| Language gives access and insights into another culture. It is a fundamental truth that cultures define themselves through languages. |                                                                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                 |                                                                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                                   | Introduce the basics of the language to beginners                                                                                                                                                                                                                       |   |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                                   | Understand a dialogue and dialogue presentation                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                                   | To develop their knowledge as well as their communicative skills so as to be able to respond in simple everyday contexts.                                                                                                                                               |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                                   | Synchronies I includes documents which initiate the learners to another world, another culture and which acclimatize them to the authentic use of the French language through the exploitation of written and iconographic documents. The Indian context has been used. |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                                   | Grammatical and lexical notions as well as activities required for communication are learnt by the students.                                                                                                                                                            |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                                   | Interpreting skills and confidence in the language.                                                                                                                                                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                                   | Interpreting skills and confidence in the language.                                                                                                                                                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low           |                                                                                                                                                                                                                                                                         |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                                     | COs/Pos                                                                                                                                                                                                                                                                 | a | b | c | d | e | f | g | h | i | j | k | l |
| 2                                                                                                                                     | CO1                                                                                                                                                                                                                                                                     | H | L |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                                       | CO2                                                                                                                                                                                                                                                                     |   |   | H | L |   |   |   | H | H | M | L | L |
|                                                                                                                                       | CO3                                                                                                                                                                                                                                                                     |   |   | H | L |   |   |   | H | H | M | L | L |
|                                                                                                                                       | CO4                                                                                                                                                                                                                                                                     |   |   | H |   |   |   |   | H | H | M | L | L |
|                                                                                                                                       | CO5                                                                                                                                                                                                                                                                     |   |   | H | L |   |   |   | H | H | M |   | L |
|                                                                                                                                       | CO6                                                                                                                                                                                                                                                                     |   |   | H |   |   |   |   | H | H | M |   | L |

|   |          |                                                        |               |             |             |             |         |       |                       |
|---|----------|--------------------------------------------------------|---------------|-------------|-------------|-------------|---------|-------|-----------------------|
| 3 | Category | H u m a n i t i                                        | B a s i c S c | E n g g S c | P r o f e s | C o r e E l | N o n - | O p e | P r o j e c t / T e r |
|   |          | √                                                      |               |             |             |             |         |       |                       |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |               |             |             |             |         |       |                       |

## UNIT I INTRODUCTION

8

At the airport: Savoir– faire: exchanging greetings, self introduction, introducing another, welcoming someone, identifying someone - Grammar: verbs ‘to be’, ‘to call oneself’, subject pronouns, interrogation

## UNIT II GRAMMAR

8

At the University: Savoir-faire: enquiring after one’s welfare, taking leave, expressing appreciation - Grammar: definite & indefinite articles, gender of nouns, adjectives, present tense of regular ‘er’ verbs, ‘to have’, ‘to learn’, negation, irregular verbs

## UNIT III CONVERSATION

8

At the café: Savoir –faire: speaking about one’s likes, giving information, expressing admiration, asking information about someone - Grammar: Interrogative adjectives, irregular verbs, possessive and interrogative adjectives

## UNIT IV PROPOSAL WRITING

7

At the beach: Savoir faire: proposing an outing, accepting/ refusing the proposal - Grammar: singular & plural, indefinite pronoun, demonstrative adjectives, negation, irregular verbs

## UNIT V FORMAL LETTERS

7

A concert: Savoir –faire: inviting, accepting, expressing one’s inability to accept an invitation

## UNIT VI REGULAR & IRREGULAR VERBS

7

Grammar: Present tense of more irregular verbs, contracted articles, future tense, interrogative adverbs, **At Nalli’s** Savoir- faire: asking the price of an article, protesting against the price, Grammar: possessive adjectives, Exclamative adjectives, imperative tense

## REFERENCES:

1. Course Material: Synchronie I –Méthode de Français
2. Madanagobalane -Samita Publications, Chennai, 2007

|                                                                                                                                                                         |                                            |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|---|---|---|---|
| BGM201                                                                                                                                                                  | GERMAN                                     | L | T | P | C |
|                                                                                                                                                                         | Total Contact Hours – 45                   | 3 | 0 | 0 | 3 |
|                                                                                                                                                                         | Prerequisite +2 Level English              |   |   |   |   |
|                                                                                                                                                                         | Course Designed by – Department of English |   |   |   |   |
| OBJECTIVES                                                                                                                                                              |                                            |   |   |   |   |
| At the end of this course, students shall be able to obtain good knowledge of the language, to read and write and speak German, whereby the emphasis is laid on speech. |                                            |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                                                   |                                            |   |   |   |   |

|                                                                                                                             |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|---|-------------------------|---|--------------------|--|------------------------------|--|
| CO1                                                                                                                         | Will have a basic knowledge of the language                           |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| CO2                                                                                                                         | Will acquire reading and writing skills.                              |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| CO3                                                                                                                         | Will develop basic conversational skills.                             |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| CO4                                                                                                                         | Will understand German lifestyle                                      |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| CO5                                                                                                                         | Will gain confidence to survive in a global environment               |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| CO6                                                                                                                         | Will have attained to survive and adopt change in a foreign culture . |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| 1                                                                                                                           | COs/Pos                                                               | a                                                      | b | c                   | d | e                  | f | g                      | h | i                  | j | k                       | l |                    |  |                              |  |
| 2                                                                                                                           | CO1                                                                   | H                                                      | L |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
|                                                                                                                             | CO2                                                                   |                                                        |   | H                   | L |                    |   |                        | H | H                  | M | L                       | L |                    |  |                              |  |
|                                                                                                                             | CO3                                                                   |                                                        |   | H                   | L |                    |   |                        | H | H                  | M | L                       | L |                    |  |                              |  |
|                                                                                                                             | CO4                                                                   |                                                        |   | H                   |   |                    |   |                        | H | H                  | M | L                       | L |                    |  |                              |  |
|                                                                                                                             | CO5                                                                   |                                                        |   | H                   | L |                    |   |                        | H | H                  | M |                         | L |                    |  |                              |  |
|                                                                                                                             | CO6                                                                   |                                                        |   | H                   |   |                    |   |                        | H | H                  | M |                         | L |                    |  |                              |  |
| 3                                                                                                                           | Category                                                              | Humanities & Social Studies (HS)                       |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/Term Paper/ Seminar/ |  |
|                                                                                                                             |                                                                       | √                                                      |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |
| 4                                                                                                                           | Approval                                                              | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                              |  |

#### Course structure:

- A. German Language (speaking, reading, writing, grammar and test)
- B. Life in Germany (shopping, restaurant, doctor, government, bank, post)
- C. The German Way (introduction, doing business, conversation, meetings, dining)
- D. Germany (Culture, Climate)

#### UNIT I PRONUNCIATION

9

Welcome: Introduction to the Language, Spelling and Pronunciation (The alphabets and numbers)  
Greetings, ordering, requesting, saying thank you - Grammar – **the article “the”, conjugation** of verbs

#### UNIT II SELF INTRODUCTION

9

Shopping - Grammar – adjectives, endings before nouns, practice. Self introduction

#### UNIT III TRAINING

9

Addresses, Occupations, Studies - Grammar - **‘to be’, the definite/indefinite** articles, individual Training

**UNIT IV ORAL****9**

Leisure Time, Sports, Hobbies - Grammar – position of a verb in a main clause , oral practice

**UNIT V NARRATION****9**

At a Restaurant, Food and Drink - Grammar – the personal pronoun in the Nominative and Accusative, Narrating an event

**RESOURCES:**

1. Sprachkurs Deutsch 1 ( Verlag Diesterweg), New Delhi Learning Centre

|                                                                               |                                                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BJP201                                                                        | JAPANESE                                                                                                                    |   |   |   |   |   |   |   |   |   | L | T | P | C |
|                                                                               | Total Contact Hours - 45                                                                                                    |   |   |   |   |   |   |   |   |   | 3 | 0 | 0 | 3 |
|                                                                               | Prerequisite – +2 Level English                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                               | Course Designed by – Department of English                                                                                  |   |   |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES                                                                    |                                                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| To have a basic knowledge of Japanese language, Japanese culture and heritage |                                                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| To impart knowledge Japanese lifestyle.                                       |                                                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| To give sufficient exposure to develop basic conversational skills.           |                                                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                         |                                                                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                           | Will have a basic knowledge of the language                                                                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                           | Will acquire reading and writing skills.                                                                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                           | Will develop basic conversational skills.                                                                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                           | Will understand Japanese lifestyle                                                                                          |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                           | Will gain confidence to survive in a global environment                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                           | Will have attained to survive and adopt change in a foreign culture.                                                        |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                               | Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                             | COs/Pos                                                                                                                     | a | b | c | d | e | f | g | h | i | j | k | l |   |
| 2                                                                             | CO1                                                                                                                         | H | L |   |   |   |   |   |   |   |   |   |   |   |
|                                                                               | CO2                                                                                                                         |   |   | H | L |   |   |   | H | H | M | L | L |   |
|                                                                               | CO3                                                                                                                         |   |   | H | L |   |   |   | H | H | M | L | L |   |
|                                                                               | CO4                                                                                                                         |   |   | H |   |   |   |   | H | H | M | L | L |   |
|                                                                               | CO5                                                                                                                         |   |   | H | L |   |   |   | H | H | M |   | L |   |
|                                                                               | CO6                                                                                                                         |   |   | H |   |   |   |   | H | H | M |   | L |   |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/Term Paper/ Seminar/ Internship (PR) |
|   |          | √                                                      |                     |                    |                        |                    |                         |                    |                                              |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |

### UNIT I CULTURAL HERITAGE

9

Introduction-history and origin of Japanese language-Japan and its cultural heritage-Self introduction-counting numbers (1-100)-time-conversation with the use of audio devices, grammar- usage of particles wa, no, mo and ka

### UNIT II USAGE

9

Greetings, seasons, days of the week and months of the year-numbers (up to 99,999)-grammar- usage of kore, sore, are, kono, sono, ano, koko and kochira, arimasu and imasu-i-ending and na-ending adjectives-use of audio and drills for practice

### UNIT III ORAL

9

Asking the price-associated vocabulary-usage of particles ni, ga and ne- use of audio and drills for practice-Introduction to basic Kanji characters- use of audio and drills for practice

### UNIT IV ART AND CULTURE

9

Family relationships- colours-Kanji (numbers) and festivals of Japan-religion-Japanese art and culture-ikebana, origami-introduction to hiragana- use of audio and drills for practice

### UNIT V DRILLS AND PRACTICE

9

Vocabulary associated with directions-asking way-particles – e, de, mo, koko, soko, asoko, doko, nani, mae, ushiro, ue, shita- use of audio and drills for practice-introduction to katakana

### TEXT BOOKS

1. Japanese Hiragana and Katakana for beginners, Timothy G. Stout, 2011
2. Genki I: An integrated course in elementary Japanese, Eri Banno and Yuko Ikeda, 2011

### REFERENCE BOOKS

1. Japanese Reader collection Volume I, Yumi Boutwell and Clay Boutwell, Kotoba books, 2013
2. Living Language Japanese Complete Edition beginners through advanced course, Living Language, 2012

| BKR201 | KOREAN                   | L | T | P | C |
|--------|--------------------------|---|---|---|---|
|        | Total Contact Hours - 45 | 3 | 1 | 0 | 3 |

|                                                                                                                             |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|---|-------------------------|---|--------------------|--|----------------------------------------------|--|
|                                                                                                                             |                                                                       | Prerequisite – +2 Level English                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             |                                                                       | Course Designed by – Department of English             |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| <b>OBJECTIVES</b>                                                                                                           |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| To have a basic knowledge of Korean language, Korean culture and heritage                                                   |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| To impart knowledge on Korean lifestyle and heritage.                                                                       |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO1                                                                                                                         | Will have a basic knowledge of the language                           |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO2                                                                                                                         | Will acquire reading and writing skills.                              |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO3                                                                                                                         | Will develop basic conversational skills.                             |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO4                                                                                                                         | Will understand Korean lifestyle                                      |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO5                                                                                                                         | Will gain confidence to survive in a global environment               |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO6                                                                                                                         | Will have attained to survive and adopt change in a foreign culture . |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                       |                                                        |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| 1                                                                                                                           | COs/Pos                                                               | a                                                      | b | c                   | d | e                  | f | g                      | h | i                  | j | k                       | l |                    |  |                                              |  |
| 2                                                                                                                           | CO1                                                                   | H                                                      | L |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO2                                                                   |                                                        |   | H                   | L |                    |   |                        | H | H                  | M | L                       | L |                    |  |                                              |  |
|                                                                                                                             | CO3                                                                   |                                                        |   | H                   | L |                    |   |                        | H | H                  | M | L                       | L |                    |  |                                              |  |
|                                                                                                                             | CO4                                                                   |                                                        |   | H                   |   |                    |   |                        | H | H                  | M | L                       | L |                    |  |                                              |  |
|                                                                                                                             | CO5                                                                   |                                                        |   | H                   | L |                    |   |                        | H | H                  | M |                         | L |                    |  |                                              |  |
|                                                                                                                             | CO6                                                                   |                                                        |   | H                   |   |                    |   |                        | H | H                  | M |                         | L |                    |  |                                              |  |
| 3                                                                                                                           | Category                                                              | Humanities & Social Studies (HS)                       |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/Term Paper/ Seminar/ Internship (PR) |  |
|                                                                                                                             |                                                                       | √                                                      |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| 4                                                                                                                           | Approval                                                              | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |

## UNIT I PLANNING

9

Asking/giving reasons for studying Korean, making plans for the holiday, writing letters, describing past travel experiences and future travel plans, shopping in a grocery store, shopping in electronics store, storytelling Grammar: would like to (do), want to (do), construct future tense.

## UNIT II MODIFIERS

9

Asking about feelings, asking about problems and giving advice, brief introductions - Grammar: Noun modifier, please try doing (something), irregular adjective/verb

## UNIT III PLACING ORDERS

9

Asking about hobbies, asking about abilities (sports), job requirements, Ordering things for delivery, ordering a meal at a restaurant - Grammar: Sentence ending for the honorific form, please do something for me, have tried (something),

**UNIT IV DESCRIPTIONS****9**

Asking about evening plans, making plans with others, making preparations - Asking about rooms, describing your room to your classmates, describing your house. Grammar: to know/not know how to do something, must (do), have to (do), should,

**UNIT V GRAMMAR****9**

Describing your plans and giving reasons, cancelling appointments. Grammar: Shall we~? / Should we~?, with, and, irregular verbs/adjective, so, because, cannot, intend to, plan to, or hope to, (more) than, the most, tag question/is n't it? ,will (do)

**COURSE MATERIAL:**

Korean for Non-Native Speakers (Student Book 1B) Korean Language Education Center, Sogang University

|                                                                                                                             |                                                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------|---------------------------|--------------------------|---------------------------|--------------------------|-------------------------------|--------------------------|-----------------------------------------------------------|---|---|---|---|---|
| BCN201                                                                                                                      | CHINESE                                                             |                                           |                           |                          |                           |                          |                               |                          |                                                           |   | L | T | P | C |
|                                                                                                                             | Total Contact Hours - 60                                            |                                           |                           |                          |                           |                          |                               |                          |                                                           |   | 3 | 0 | 0 | 3 |
|                                                                                                                             | Prerequisite – +2 Level English                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
|                                                                                                                             | Course Designed by – Department of English                          |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| OBJECTIVES                                                                                                                  |                                                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| To have a basic knowledge of Chinese language, Chinese culture and heritage                                                 |                                                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| To impart knowledge on Chinese lifestyle and heritage.                                                                      |                                                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| CO1                                                                                                                         | Will have a basic knowledge of the language                         |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| CO2                                                                                                                         | Will acquire reading and writing skills.                            |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| CO3                                                                                                                         | Will develop basic conversational skills.                           |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| CO4                                                                                                                         | Will understand Chinese lifestyle                                   |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| CO5                                                                                                                         | Will gain confidence to survive in a global environment             |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| CO6                                                                                                                         | Will have attained to survive and adopt change in a foreign culture |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                     |                                           |                           |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
| 1                                                                                                                           | COs/Pos                                                             | a                                         | b                         | c                        | d                         | e                        | f                             | g                        | h                                                         | i | j | k | l |   |
| 2                                                                                                                           | CO1                                                                 | H                                         | L                         |                          |                           |                          |                               |                          |                                                           |   |   |   |   |   |
|                                                                                                                             | CO2                                                                 |                                           |                           | H                        | L                         |                          |                               |                          | H                                                         | H | M | L | L |   |
|                                                                                                                             | CO3                                                                 |                                           |                           | H                        | L                         |                          |                               |                          | H                                                         | H | M | L | L |   |
|                                                                                                                             | CO4                                                                 |                                           |                           | H                        |                           |                          |                               |                          | H                                                         | H | M | L | L |   |
|                                                                                                                             | CO5                                                                 |                                           |                           | H                        | L                         |                          |                               |                          | H                                                         | H | M |   | L |   |
|                                                                                                                             | CO6                                                                 |                                           |                           | H                        |                           |                          |                               |                          | H                                                         | H | M |   | L |   |
| 3                                                                                                                           | Category                                                            | Humanities<br>& Social<br>Studies<br>(HS) | Basic<br>Sciences<br>(BS) | Engg<br>Sciences<br>(ES) | Professional<br>Core (PC) | Core<br>Elective<br>(CE) | Non-Major<br>Elective<br>(NE) | Open<br>Elective<br>(OE) | Project/Ter<br>m Paper/<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |   |

|   |          |                                                        |  |  |  |  |  |  |  |
|---|----------|--------------------------------------------------------|--|--|--|--|--|--|--|
|   |          | √                                                      |  |  |  |  |  |  |  |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |  |  |  |  |  |  |  |

**UNIT 1      RISE OF DIALECTS      9**

History, Origins, Old and middle Chinese, Rise of northern dialects

**UNIT II      VARIETIES      9**

Influences 3 Varieties of Chinese. 1.Classification 2.Standard Chinese and 3.Nomenclature

**UNIT III      CHARACTERS      9**

Chinese characters, Homophones, Phonology

**UNIT IV      TRANSCRIPTIONS      9**

Tones, Phonetic transcriptions, Romanization, Other phonetic transcriptions

**UNIT V      GRAMMAR      9**

Grammar and morphology, Vocabulary, Loanwords, Modern borrowings and loanwords

**REFERENCES:**

1. Hannas, William C. (1997), Asia's Orthographic Dilemma, University of Hawaii Press, ISBNHYPERLINK "<http://en.wikipedia.org/wiki/Special:BookSources/978-0-8248-1892-0>" 978-0-8248- 1892-0.
2. Qiu, Xigui (2000), Chinese Writing, trans. Gilbert Louis Mattos and Jerry Norman, Society for the Study of Early China and Institute of East Asian Studies, University of California, Berkeley, ISBN HYPERLINK [http://en.wikipedia.org/wiki/Special:BookSources/978-1-55729\\_071-7](http://en.wikipedia.org/wiki/Special:BookSources/978-1-55729_071-7), 978-1-55729-071-7.
3. Ramsey, S. Robert (1987), The Languages of China, Princeton University Press, ISBNHYPERLINK "<http://en.wikipedia.org/wiki/Special:BookSources/978-0-691-01468-5>" 978-0-691-01468-5.
4. Schuessler, Axel (2007), ABC Etymological Dictionary of Old Chinese, Honolulu: University of Hawaii Press, ISBNHYPERLINK "[http://en.wikipedia.org/wiki/Special:BookSources/978-0-8248\\_2975-9](http://en.wikipedia.org/wiki/Special:BookSources/978-0-8248_2975-9)" 978-0-8248-2975-9.
5. R. L. G. "Language borrowing Why so little Chinese in English?" The Economist. June 6, 2013.

|                                                                                                                                                                      |                                                                   |  |   |   |   |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--|---|---|---|---|
| BBT201                                                                                                                                                               | PRINCIPLES OF GENETICS                                            |  | L | T | P | C |
|                                                                                                                                                                      | Total Contact Hours – 30                                          |  | 2 | 0 | 0 | 2 |
|                                                                                                                                                                      | Prerequisite – Basic biology, concepts in genetics                |  |   |   |   |   |
|                                                                                                                                                                      | Course Designed by – Dept. of Industrial Biotechnology            |  |   |   |   |   |
| OBJECTIVES                                                                                                                                                           |                                                                   |  |   |   |   |   |
| To provide a fundamental knowledge on genetics, its laws, genes and chromosomes, inheritance, heredity, causes of genetic disorders and the methods of gene transfer |                                                                   |  |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                                                                |                                                                   |  |   |   |   |   |
| CO1                                                                                                                                                                  | To understand the fundamentals of genetics and the Mendelian laws |  |   |   |   |   |

|     |                                                                                                 |
|-----|-------------------------------------------------------------------------------------------------|
| CO2 | To understand about the structure and organization of chromosomes in prokaryotes and eukaryotes |
| CO3 | To understand about the structure and organization of chromosomes in eukaryotes                 |
| CO4 | To understand the concept of alleles in blood grouping and sex determination                    |
| CO5 | To know the concept of linkage and crossing over of genes                                       |
| CO6 | To get a basic knowledge of the methods of gene transfer                                        |

### **UNIT I BASICS OF GENETICS**

**6**

Classical genetics, Mendelian Laws- Mendel's experiment-monohybrid cross-phenotype, genotype, Dihybrid inheritance, Interaction of genes, Fine structure of Genes

### **UNIT II CHROMOSOMES**

**6**

Chromosome structure and organization in prokaryotes and eukaryotes, unusual chromosomes- chromosome banding, chromosome abnormalities- genetic disorders

### **UNIT III ALLELES**

**6**

Classical concepts of Pleomorphism, Multiple alleles, ABO blood groups, Rh factor, sex linkage in Drosophila, linkage in human beings, mechanism of sex determination, XX-XY mechanisms of sex determination, sex determination in Drosophila, environmental factors and sex determination, sex differentiation.

### **UNIT IV CROSSING OVER**

**6**

Coupling and Repulsion-Hypothesis, Test cross in maize and crossing over, theory of crossing over, molecular mechanism of crossing over, sex chromosomes and sex linked inherited disorders, colour blindness, hemophilia, Muscular dystrophy.

### **UNIT V GENE TRANSFER**

**6**

Transformation, Transduction, Conjugation, Plasmids and Episomes

### **TEXT BOOKS:**

1. Principles of Genetics, Gardner, Simmons and Snustad, John Wiley and Sons (Asia), 2002
2. Genes VIII, Lewin, International Edition, Prentice Hall, 2004

### **REFERENCE BOOKS:**

1. Instant Notes in Genetics, P.C. Winter, G.I. Hickey and H.L. Fletcher, Viva Books Private Limited, 2003
2. Weblink: nptel

|                                                               |                                                                         |   |   |   |   |
|---------------------------------------------------------------|-------------------------------------------------------------------------|---|---|---|---|
| BEE 201                                                       | BASIC ELECTRICAL ANDELECTRONICS<br>ENGINEERING                          | L | T | P | C |
|                                                               | Total Contact Hours - 30                                                | 2 | 0 | 0 | 2 |
|                                                               | Prerequisite – Engineering Mathematics, Engineering Physics-I & II      |   |   |   |   |
|                                                               | Course Designed by – Department of Electrical & Electronics Engineering |   |   |   |   |
| OBJECTIVES: To understand the laws of electrical engineering. |                                                                         |   |   |   |   |

| COURSE OUTCOMES (COs)                                                                                                       |                                                                                                               |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|---------------|-------------------------|--------------------|--------------------------------------------|---|---|---|---|
| CO1                                                                                                                         | Students will gain knowledge regarding the various laws and principles associated with electrical systems.    |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| CO2                                                                                                                         | Students will gain knowledge regarding electrical machines and apply them for practical problems.             |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| CO3                                                                                                                         | Students will gain knowledge regarding various types semiconductors.                                          |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| CO4                                                                                                                         | Student will gain knowledge digital electronics.                                                              |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| CO5                                                                                                                         | Student will gain knowledge on electronic systems.                                                            |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| CO6                                                                                                                         | Students will acquire knowledge in using the concepts in the field of electrical engg. projects and research. |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                               |                                                        |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |
| 1                                                                                                                           | COs/Pos                                                                                                       | a                                                      | b                   | c                  | d                      | e             | f                       | g                  | h                                          | i | j | k | l |
| 2                                                                                                                           | CO1                                                                                                           | M                                                      | H                   | M                  |                        |               | L                       |                    | L                                          | L |   |   |   |
|                                                                                                                             | CO2                                                                                                           |                                                        | H                   | M                  |                        |               | L                       |                    | L                                          | L |   |   |   |
|                                                                                                                             | CO3                                                                                                           |                                                        | H                   | M                  |                        |               | L                       |                    | L                                          |   |   |   |   |
|                                                                                                                             | CO4                                                                                                           | M                                                      | H                   | M                  |                        |               | L                       |                    | L                                          | L |   |   |   |
|                                                                                                                             | CO5                                                                                                           | M                                                      | H                   | M                  |                        |               | L                       |                    | L                                          |   |   |   |   |
|                                                                                                                             | CO6                                                                                                           |                                                        | H                   |                    |                        |               | L                       |                    | L                                          | H |   |   |   |
| 3                                                                                                                           | Category                                                                                                      | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective | Non-Major Elective (NE) | Open Elective (OE) | Project/Term Paper/Seminar/Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                                                               |                                                        |                     | √                  |                        |               |                         |                    |                                            |   |   |   |   |
| 4                                                                                                                           | Approval                                                                                                      | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |               |                         |                    |                                            |   |   |   |   |

### UNIT I ELECTRIC CIRCUITS

6

Ohm's law – Kirchoff's Laws, V – I Relationship of Resistor (R) Inductor (L) and capacitor (C). Series parallel combination of R, L&C – Current and voltage source transformation – mesh current & node voltage method –superposition theorem –Thevenin's and Norton's Theorem -Problems.

### UNIT II ELECTRICAL MACHINES

6

Construction, principle of operation, Basic Equations and applications - D.C.Generators and D.C.Motors. -Single phase Induction Motor - Single Phase Transformer.

### UNIT III BASIC MEASUREMENT SYSTEMS

6

Introduction to Measurement Systems, Construction and Operating principles of PMMC, Moving Iron, Dynamometer Wattmeter, power measurement by three-watt meter and two watt method – and Energy meter.

### UNIT IV SEMICONDUCTOR DEVICES

6

Basic Concepts of semiconductor devices – PN Junction Diode Characteristics and its

Applications – HWR, FWR – Zener Diode – BJT (CB, CE, CC) configuration & Characteristics.

## UNIT V DIGITAL ELECTRONICS

6

Number system – Logic Gates – Boolean Algebra– De-Morgan's Theorem – Half Adder & Full Adder – Flip Flops.

### TEXT BOOKS:

1. N.Mittal "Basic Electrical Engineering". Tata McGraw Hill Edition, New Delhi, 1990.
2. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
3. Jacob Millman and Christos C-Halkias, "Electronic Devices and Circuits", Tata McGraw Hill

### REFERENCE BOOKS:

1. Edminister J.A. "Theory and Problems of Electric Circuits" Schaum's Outline Series. McGrawHill Book Company, 2<sup>nd</sup> Edition, 1983.
2. Hyatt W.H and Kemmerly J.E. "Engineering Circuit Analysis", McGraw Hill International Editions, 1993.
3. D. P. Kothari and I. J. Nagrath "Electric Machines" Tata McGraw-Hill Education, 2004
4. Millman and Halkias, "Integrated Electronics", Tata McGraw Hill Edition, 2004.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| BCS2L1                                                                                                                                                                                                                                                                                                                                                                                                                                                             | INTERNET PRACTICES LABORATORY                                               |   |   |   |   |   |   | L | T | P | C |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Total Contact Hours - 45                                                    |   |   |   |   |   |   | 3 | 0 | 0 | 3 |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Prerequisite – Internet Programming                                         |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Course Designed by – Dept of Information Technology                         |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>OBJECTIVES</b> <ul style="list-style-type: none"><li>• To impart a sound knowledge on the principles of computers involving the different application oriented topics required for all engineering branches.</li><li>• Graduates will demonstrate the ability to apply knowledge of mathematics to develop and analyze computing systems.</li><li>• Graduates will have a solid understanding of the theory and concepts underlying computer science.</li></ul> |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To enable the student to learn the major components of a computer system.   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To know the correct and efficient way of solving problem.                   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To identify and implement the correct and efficient way of solving problem. |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To learn to use office automation tools.                                    |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To infer from use office automation tools.                                  |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                                                                                                                                                                                                                                                                                                                                                                | To learn and write program in “C”.                                          |   |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                                                                                                                                                                                                        |                                                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | COs/POs                                                                     | a | b | c | d | e | f | g | h | i | j | k | l |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CO1                                                                         | M | M | M | H | M |   | M |   |   | L | L | M |

|   |          |                                                        |                           |                          |                               |                  |                       |                  |                                                           |  |   |   |   |
|---|----------|--------------------------------------------------------|---------------------------|--------------------------|-------------------------------|------------------|-----------------------|------------------|-----------------------------------------------------------|--|---|---|---|
|   | CO2      | H                                                      | M                         | M                        | H                             | H                |                       | M                |                                                           |  | L | L | M |
|   | CO3      | H                                                      | M                         |                          | H                             | H                |                       | M                |                                                           |  | L | L | M |
|   | CO4      | H                                                      | M                         |                          | H                             | H                |                       | M                |                                                           |  | L | L | M |
|   | CO5      | H                                                      | M                         | M                        | H                             | H                |                       | M                |                                                           |  | L | L | M |
|   | CO6      | H                                                      |                           |                          | H                             | H                |                       | M                |                                                           |  | L | L | M |
| 3 | Category | Humanities<br>& Social<br>Studies<br>(HS)              | Basic<br>Sciences<br>(BS) | Engg<br>Sciences<br>(ES) | Professiona<br>l Core<br>(PC) | Core<br>Elective | Non-Major<br>Elective | Open<br>Elective | Project/Ter<br>m Paper/<br>Seminar/<br>Internship<br>(PR) |  |   |   |   |
|   |          |                                                        |                           | √                        |                               |                  |                       |                  |                                                           |  |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                           |                          |                               |                  |                       |                  |                                                           |  |   |   |   |

## LIST OF EXPERIMENTS

### 1. HTML (Hypertext Mark-up Language):

Basics of HTML.

How to create HTML Document

Steps for creating a simple HTML Program.

a) Favorite Personality

b) Resume Preparation

### 2. ADVANCED HTML: Advanced Topics of HTML

a) Time Table

b) Table Creation

### 3. JAVASCRIPT:

Script Basics.

Incorporating JavaScript into Web page.

a) Star Triangle

b) Temperature Converters

Script Basics.

Incorporating JavaScript into Web page.

a) Star Triangle

b) Temperature Converters

### 4. VBSCRIPT:

VBScript Basics.

Incorporating VBScript into HTML.

a) Changing Background Color

b) Simple Calculator

### 5. WEB DESIGN:

Inserting External Media in the Web Page.

a) Forms and Links

b) Frames with Links and Lists

To export a Dream weaver Document as XML File, checking entries, working in frames, windows control, the java script URL.

|  |                                     |          |          |          |          |
|--|-------------------------------------|----------|----------|----------|----------|
|  | <b>COMPUTER PRACTICE LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|--|-------------------------------------|----------|----------|----------|----------|

|                                                                                                                             |                                                                  |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------|---|---------------------|---|--------------------|------------------------|--------------------|-------------------------|---|--------------------|----------------------------------------------|---|
| BCS 2L2                                                                                                                     | Total Contact Hours - 45                                         |                                                        |   |                     |   |                    |                        |                    | 0                       | 0 | 3                  | 1                                            |   |
|                                                                                                                             | Prerequisite – Fundamentals of Computer                          |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
|                                                                                                                             | Course Designed by – Department of Computer Science &Engineering |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| OBJECTIVES: To impart basic computer knowledge                                                                              |                                                                  |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                                  |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| CO1                                                                                                                         | Demonstrate major algorithms and data                            |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| CO2                                                                                                                         | Implementation of array operations                               |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| CO3                                                                                                                         | Implementation of binary tree.                                   |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| CO4                                                                                                                         | Implementation of linked list                                    |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| CO5                                                                                                                         | Students will able to do analyse data using spread sheet         |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| CO6                                                                                                                         | Student will able to understand the basics of C programming.     |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                  |                                                        |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |
| 1                                                                                                                           | COs/POs                                                          | a                                                      | b | c                   | d | e                  | f                      | g                  | h                       | i | j                  | k                                            | L |
| 2                                                                                                                           | CO1                                                              | H                                                      | H | L                   | H |                    | H                      |                    | L                       |   | H                  | H                                            | H |
|                                                                                                                             | CO2                                                              |                                                        |   |                     |   |                    | H                      | H                  | L                       |   |                    |                                              |   |
|                                                                                                                             | CO3                                                              |                                                        |   |                     |   |                    | H                      | H                  | L                       |   | M                  |                                              |   |
|                                                                                                                             | CO4                                                              |                                                        |   |                     |   |                    | H                      | H                  | L                       |   | M                  |                                              |   |
|                                                                                                                             | CO5                                                              |                                                        |   |                     |   |                    | H                      | H                  | L                       |   | M                  |                                              |   |
|                                                                                                                             | CO6                                                              |                                                        |   |                     |   |                    | H                      | H                  | L                       |   | M                  |                                              |   |
| 3                                                                                                                           | Category                                                         | Humanities & Social Studies (HS)                       |   | Basic Sciences (BS) |   | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) |   | Open Elective (OE) | Project/Term Paper/ Seminar/ Internship (PR) |   |
|                                                                                                                             |                                                                  |                                                        |   |                     |   | √                  |                        |                    |                         |   |                    |                                              |   |
| 4                                                                                                                           | Approval                                                         | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                     |   |                    |                        |                    |                         |   |                    |                                              |   |

**A) WORD PROCESSING 6**

Document creation, Text manipulation with Scientific Notations. Table creation Table formatting and Conversion. Mail merge and Letter Preparation. Drawing-Flow Chart

**B) SPREAD SHEET 9**

Chart-Line Xy Bar and Pie – Formula-Formula Editor-Spread sheet-Inclusion of Object, Picture and Graphics Protecting the document and sheet-Sorting and Import/Export features.

**C) SIMPLE C PROGRAMMING\* 15**

Data types, Expression Evaluation, Condition Statement. Arrays structures and Unions – Functions

**D) SIMPLE C++PROGRAMMING 15**

-Classes and Objects

-Constructor and Destructor

**\*For Programming exercises Flow chart and Pseudo code are essential.**

|                                                                                                                             |                                                                                         |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------|----------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| BEE2L1                                                                                                                      | BASIC ELECTRICAL AND ELECTRONIC ENGINEERING PRACTICES LABORATORY                        |                                                        |                |                    |                        |                    |                         |                    | L                                            | T | P | C |   |
|                                                                                                                             | Total Contact Hours – 45                                                                |                                                        |                |                    |                        |                    |                         |                    | 0                                            | 0 | 3 | 1 |   |
|                                                                                                                             | Prerequisite – Basic Electrical and Electronics Engineering                             |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|                                                                                                                             | Course Designed by – Department of Electrical & Electronics Engineering                 |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| OBJECTIVES: To enhance the student with knowledge on electrical and electronic equipments.                                  |                                                                                         |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                                                         |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                         | Students will able to handle basic electrical equipments.                               |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         | Students will able to do staircase wiring.                                              |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | Students will able to understand domestic wiring procedures practically.                |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | Student will able to assemble electronic systems.                                       |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | Students will understand all the fundamental concepts involving electrical engineering  |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | Students will understand all the fundamental concepts involving electronics engineering |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                         |                                                        |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                                 | a                                                      | b              | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                                                     | M                                                      | H              | M                  |                        |                    | L                       |                    | L                                            | L | M | H |   |
|                                                                                                                             | CO2                                                                                     |                                                        | H              | M                  |                        |                    | L                       |                    | L                                            | L |   | H |   |
|                                                                                                                             | CO3                                                                                     |                                                        | H              | M                  |                        |                    | L                       |                    | L                                            |   |   | H |   |
|                                                                                                                             | CO4                                                                                     | M                                                      | H              | M                  |                        |                    | L                       |                    | L                                            | L | M | H |   |
|                                                                                                                             | CO5                                                                                     | M                                                      | H              | M                  |                        |                    | L                       |                    | L                                            |   | M | H |   |
|                                                                                                                             | CO6                                                                                     |                                                        | H              |                    |                        |                    | L                       |                    | L                                            | H |   | H |   |
| 3                                                                                                                           | Category                                                                                | Humanities & Social Studies (HS)                       | Basic Sciences | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/Term Paper/ Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                                         |                                                        |                | √                  |                        |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                                                                | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## I LIST OF EXPERIMENTS FOR ELECTRICAL ENGINEERING LAB

1. Fluorescent lamp wiring
2. Stair case wiring
3. Measurement of electrical quantities-voltage current, power & power factor in RLC circuit

4. Residential house wiring using fuse, switch, indicator, lamp and energy meter
5. Measurement of energy using single phase energy meter
6. Measurement of resistance to earth of electrical equipment

## II LIST OF EXPERIMENTS FOR ELECTRONICS ENGINEERING LAB

1. Study of electronic components and equipments.
  - a. Resistor colour coding using digital multi-meter.
  - b. Assembling electronic components on bread board.
2. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
3. Soldering and desoldering practice.
4. Verification of logic gates (OR, AND, OR, NOT, NAND, EX-OR).
5. Implementation of half adder circuit using logic gates.

|                                                                                                                             |                                                                      |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------|---|----------------|---|---------------|---|------------------------|----------|---------------|----------|-------------------------|---|---------------|--|----------------------------------------------|--|
| <b>BPC<br/>1L1/2L1</b>                                                                                                      |                                                                      | <b>PHYSICS AND CHEMISTRY LABORATORY</b>                |   |                |   |               |   |                        | <b>L</b> | <b>T</b>      | <b>P</b> | <b>C</b>                |   |               |  |                                              |  |
|                                                                                                                             |                                                                      | Total Contact Hours – 45                               |   |                |   |               |   |                        | 0        | 0             | 3        | 1                       |   |               |  |                                              |  |
|                                                                                                                             |                                                                      | Prerequisite – Physics and Chemistry                   |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
|                                                                                                                             |                                                                      | Course Designed by – Department of Physics & Chemistry |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| <b>OBJECTIVES:</b> To impart knowledge to the students in practical physics and chemistry                                   |                                                                      |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                      |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| CO1                                                                                                                         | Students will understand the concept of hall effect                  |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| CO2                                                                                                                         | Students will understand the concept of semiconductors. .            |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| CO3                                                                                                                         | Student will understand the working of spectrometer.                 |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| CO4                                                                                                                         | Student will able practically understand the chemical reactions.     |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| CO5                                                                                                                         | Students will Study the magnetic hysteresis and energy product       |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| CO6                                                                                                                         | Students understand the Determination of Band gap of a semiconductor |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                      |                                                        |   |                |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |
| 1                                                                                                                           | COs/POs                                                              | a                                                      | b | c              | d | e             | f | g                      | h        | i             | j        | k                       | l |               |  |                                              |  |
| 2                                                                                                                           | CO1                                                                  | M                                                      | H | M              |   |               | L |                        | L        | L             | M        | H                       | M |               |  |                                              |  |
|                                                                                                                             | CO2                                                                  |                                                        | H | M              |   |               | L |                        | L        | L             |          | H                       |   |               |  |                                              |  |
|                                                                                                                             | CO3                                                                  |                                                        | H | M              |   |               | L |                        | L        |               |          | H                       |   |               |  |                                              |  |
|                                                                                                                             | CO4                                                                  | M                                                      | H | M              |   |               | L |                        | L        | L             | M        | H                       | M |               |  |                                              |  |
|                                                                                                                             | CO6                                                                  |                                                        | H |                |   |               | L |                        | L        | H             |          | H                       |   |               |  |                                              |  |
| 3                                                                                                                           | Category                                                             | Humanities & Social Studies (HS)                       |   | Basic Sciences |   | Engg Sciences |   | Professional Core (PC) |          | Core Elective |          | Non-Major Elective (NE) |   | Open Elective |  | Project/Term Paper/ Seminar/ Internship (PR) |  |
|                                                                                                                             |                                                                      |                                                        |   | √              |   |               |   |                        |          |               |          |                         |   |               |  |                                              |  |

|   |          |                                                        |
|---|----------|--------------------------------------------------------|
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |
|---|----------|--------------------------------------------------------|

### **I -LIST OF EXPERIMENTS – PHYSICS**

14. Determination of Wavelength, and particle size using Laser
15. Determination of acceptance angle in an optical fiber.
16. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
17. Determination of wavelength of mercury spectrum – spectrometer grating
18. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
19. Determination of Young's modulus by Non uniform bending method
20. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge
21. Determination of Young's modulus by uniform bending method
22. Determination of band gap of a semiconductor
23. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
24. Determination of Dispersive power of a prism - Spectrometer
25. Determination of thickness of a thin wire – Air wedge method
26. Determination of Rigidity modulus – Torsion pendulum

### **II- LIST OF EXPERIMENTS – CHEMISTRY**

1. Estimation of hardness of Water by EDTA
2. Estimation of Copper in brass by EDTA
3. Determination of DO in water (Winkler's method)
4. Estimation of Chloride in Water sample (Argento metry)
5. Estimation of alkalinity of Water sample
6. Determination of molecular weight
7. Conduct metric titration (Simple acid base)
8. Conduct metric titration (Mixture of weak and strong acids)
9. Conduct metric titration using  $\text{BaCl}_2$  vs  $\text{Na}_2\text{SO}_4$
10. Potentiometric Titration ( $\text{Fe}^{2+}$  /  $\text{KMnO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ )
11. pH titration (acid & base)
12. Determination of water of crystallization of a crystalline salt (Copper Sulphate)
13. Estimation of Ferric iron by spectrophotometer.

### **BSS1L7/BSS2L7 YOGA FOR EMPOWERMENT**

**L T P C**  
**0 1 2 1**

#### **OBJECTIVE:**

Providing Value Education to improve the Students' character - understanding yogic life and physical health - maintaining youthfulness - Measure and method in five aspects of life

#### **UNIT I PHYSICAL HEALTH**

**6**

**Manavalakalai (SKY) Yoga:** Introduction - Education as a means for youth empowerment - Greatness of Education - Yoga for youth Empowerment.

**Simplified Physical Exercises:** Hand, Leg, Breathing, Eye exercises - Kapalabathi, Makarasana Part I, Makarasana Part II, Body Massage, Acu pressure, Relaxation exercises - Benefits.

**Yogasanas 1:** Pranamasana - Hastha Uttanasana - Pada Hasthasana - Aswa Sanjalana Asana - Thuvipatha asva Sanjalana asana - Astanga Namaskara - Bhujangasana - Atha Muktha Savasana - Aswa Sanjalana Asana - Pada Hasthasana - Hastha Uttanasana - Pranamasana.

**Pranayama:** Naddi suddi - Clearance Practice - Benefits.

Simplified Physical Exercise - Kayakalpa Practices - Meditation Practices.

## **UNIT II LIFE FORCE**

**6**

**Reasons for Diseases:** Natural reasons (Genetic / imprints, Planetary Position, Natural calamities and climatic changes) - Unnatural reasons (Food habits, Thoughts, Deeds)

**Philosophy of Kaya kalpa:** Physical body - Sexual vital fluid - Life force - Bio-Magnetism - Mind.

**Maintaining youthfulness:** Postponing old age - Transformation of food into seven components - Importance of sexual vital fluid - Measure and method in five aspects of life - Controlling undue Passion.

**Kayakalpa practice:** Aswini Mudra - Ojas breath - Benefits of Kaya Kalpa.

## **UNIT III MENTAL HEALTH**

**6**

**Mental Frequencies:** Beta, Apha, Theta and Delta wave-Agna Meditation explanation-benefits.

**Shanti meditation:** Shanthi Meditation explanation-benefits

**Thuriya Meditation:** Thuriya Meditation explanation-benefits

**Benefits of Blessing:** Self blessing(Auto suggestion) - Familyblessing-Blessing the others-World blessing-Divineprotection

## **UNIT IV VALUES**

**6**

**Human Values:** Self control-Self confidence - Honesty Contentment - Humility-Modesty Tolerance – Adjustment - Sacrifice-Forgiveness  
Purity(Body,Dress,Environment)-Physicalpurity-Mentalpurity - Spiritual purity

**Social Values :**

Non violence-Service Patriotism-Equality

Respectforparentsandelders-careandprotection-Respectforteacher  
TimeManagement

Punctuality-

## **UNIT V MORALITY (virtues)**

**6**

Importance of Introspection: I-Mine (Ego, Possessiveness)

SixEvilTemperaments-Greed-Anger-Miserliness-Immoralsexualpassion-InferiorityandsuperiorityComplex-Vengeance

Five essential Qualities acquired through Meditation: Perspicacity – Magnanimity –  
Receptivity-Adaptability-Creativity(Improved Memory Power)

### REFERENCE BOOKS:

1. Yoga for modern age - ThathuvagnaniVethathiri Maharishi
2. Simplified Physical Exercises - ThathuvagnaniVethathiri Maharishi
3. Kayakalpam - Thathuvagnani VethathiriMaharishi
4. Thirukkural -Rev.Dr.G.U.pope
5. Mind-ThathuvagnaniVethathiriMaharishi
6. SoundHealththroughyoga-Dr.Chandrasekaran
7. Light on yoga -BKS.lyenger
8. ஐய்யாத்தியாயம் – ஐய்யாத்தியாயமென்பதுஐய்யாத்தியாயமென்பது

|                                                                                                                             |                                                                           |   |   |   |   |   |   |   |          |          |          |          |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---|---|---|---|---|---|---|----------|----------|----------|----------|---|
| <b>BAC301</b>                                                                                                               | <b>PRODUCTION OF AGRICULTURAL CROPS</b>                                   |   |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |
|                                                                                                                             | Total Contact Hours - 45                                                  |   |   |   |   |   |   |   | 3        | 0        | 0        | 3        |   |
|                                                                                                                             | Prerequisite – plus 2 biology                                             |   |   |   |   |   |   |   |          |          |          |          |   |
|                                                                                                                             | Course Designed by – Dept. of Industrial Biotechnology                    |   |   |   |   |   |   |   |          |          |          |          |   |
| <b>OBJECTIVES</b>                                                                                                           |                                                                           |   |   |   |   |   |   |   |          |          |          |          |   |
| To give a basic knowledge of agricultural crops and its production                                                          |                                                                           |   |   |   |   |   |   |   |          |          |          |          |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                           |   |   |   |   |   |   |   |          |          |          |          |   |
| CO1                                                                                                                         | to understand the fundamentals in the production of cereals               |   |   |   |   |   |   |   |          |          |          |          |   |
| CO2                                                                                                                         | to know the various technologies to grow cereals                          |   |   |   |   |   |   |   |          |          |          |          |   |
| CO3                                                                                                                         | To know the fundamentals in the production of millets                     |   |   |   |   |   |   |   |          |          |          |          |   |
| CO4                                                                                                                         | To get idea about technologies to grow pulses                             |   |   |   |   |   |   |   |          |          |          |          |   |
| CO5                                                                                                                         | To know about technologies to grow oilseeds (Kharif)                      |   |   |   |   |   |   |   |          |          |          |          |   |
| CO6                                                                                                                         | To understand about the fundamentals in the production of oilseeds (Rabi) |   |   |   |   |   |   |   |          |          |          |          |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                           |   |   |   |   |   |   |   |          |          |          |          |   |
| 1                                                                                                                           | COs/POs                                                                   | a | b | c | d | e | f | g | h        | i        | j        | k        | l |
| 2                                                                                                                           | CO1                                                                       | H | M | M | H | M |   | M |          |          | L        | L        | M |
|                                                                                                                             | CO2                                                                       | H | M | M | H | H |   | M |          |          | L        | L        | M |
|                                                                                                                             | CO3                                                                       | H | M |   | H | H |   | M |          |          | L        | L        | M |
|                                                                                                                             | CO4                                                                       | H | M |   | H | H |   | M |          |          | L        | L        | M |
|                                                                                                                             | CO5                                                                       | H | M | M | H | H |   | M |          |          | L        | L        | M |
|                                                                                                                             | CO6                                                                       | H |   |   | H | H |   | M |          |          | L        | L        | M |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                                        |                     |                    | √                      |                    |                         |                    |                                              |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |

#### UNIT I CEREALS

9

Rice, Maize, Wheat, Oat, Barley, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural and practices (from land preparation to harvest) and yield. **Recent Techniques**

#### UNIT II MILLETS

9

Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet - Origin, **Distribution of crops**, economic importance, soil and climatic requirement, varieties, cultural practices and yield

#### UNIT III PULSES

9

Redgram, Blackgram, Greengram, Bengalgram, Horsegram, Cowpea, Soybean and Lentil - Origin, **Distribution of crops**, economic importance, soil and climatic requirement, varieties, cultural practices and yield

#### UNIT IV OILSEEDS (KHARIF)

9

Groundnut, sesame, sunflower, castor, Origin, and, **Distribution of crops**, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

#### UNIT V OILSEEDS (RABI)

9

Rape seed and mustard, safflower, Linseed, Niger - Origin, , **Distribution of crops**, economic importance, soil and climatic requirement, varieties, cultural practices, yield

#### TEXT BOOK:

1. Ahlawat, I.P.S., Om Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama publishing House, Meerut.

#### REFERENCE BOOKS

- Chidida Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co Pvt. Ltd, New Delhi.
- Singh. S.S. 1997, Crop management under irrigated and rainfed conditions, Kalyani Publishers, New Delhi

| BAC302 | AGRICULTURAL BOTANY                                   | L | T | P | C |
|--------|-------------------------------------------------------|---|---|---|---|
|        | Total Contact Hours - 60                              | 3 | 1 | 0 | 4 |
|        | Prerequisite – Biology                                |   |   |   |   |
|        | Course Designed by – Dept of Industrial Biotechnology |   |   |   |   |

|                                                                                                                             |                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| <b>OBJECTIVES</b>                                                                                                           |                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| To provide a basic knowledge of basic botany of agricultural crops                                                          |                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                         | to understand the classification of plants                        |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         | to know the uses of poaceae                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | to know the economic uses of papilionaceae                        |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | to get an idea about th uses of plants belonging to papilionaceae |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to know about the uses of other ornamental and vegetable crops    |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | to know about the uses of fibre crops                             |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                           | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                               | H                                                      | M                   | M                  | H                      | M                  |                         | M                  |                                              |   | L | L | M |
|                                                                                                                             | CO2                                                               | H                                                      | M                   | M                  | H                      |                    |                         |                    |                                              |   |   |   |   |
|                                                                                                                             | CO3                                                               | H                                                      |                     |                    |                        | H                  |                         | M                  |                                              |   |   |   | M |
|                                                                                                                             | CO4                                                               | H                                                      | M                   |                    | H                      | H                  |                         |                    |                                              |   |   |   |   |
|                                                                                                                             | CO5                                                               | H                                                      | M                   | M                  |                        | H                  |                         | M                  |                                              |   |   |   |   |
|                                                                                                                             | CO6                                                               | H                                                      |                     |                    | H                      |                    |                         | M                  |                                              |   | L | L | M |
| 3                                                                                                                           | Category                                                          | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              | √ |   |   |   |
| 4                                                                                                                           | Approval                                                          | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I INTRODUCTION

12

Bentham and Hooker's classification of plant kingdom — International code of nomenclature and its major guidelines – author citation – Agricultural classification of crops; General morphology: Life span, habit, root, stem, leaf - petiole, leaf margin, leaf apex, leaf shape, venation and phyllotaxy; Root and Leaf Modifications; Floral morphology: **Types of bracts**, inflorescence; Structure of flower, androecium, gynoecium, placentation, types of fruits.

## UNIT II ECONOMIC USES OF POEACEAE

12

List of cultivated crops, economic parts, chromosome number and family description of Poaceae: Key botanical features of Rice, Wheat, Sorghum, Maize, Pearl millet, Finger millet, list of small millets, Guinea grass, Napier grass, and Sugarcane. **Production and economic importance**

## UNIT III ECONOMIC USES OF PAPILIONACEAE

12

List of cultivated crops, economic parts, chromosome number and family description of Papilionaceae: Key botanical features of Red gram, Soybean, Black gram, Green gram, Cowpea, Lablab, and Groundnut **Production and economic importance.**

#### UNIT IV ECONOMIC USES OF OTHER PLANTS

12

List of cultivated crops, economic parts, chromosome number and family description of the following families and Key botanical features of the crops given against them: Pedaliaceae - Gingelly; Asteraceae- Sunflower, Safflower, Euphorbiaceae: Castor; Jatropha and Tapioca; Arecaceae: Coconut; Solanaceae: Tobacco, Potato, Chilli **Production and economic importance**

#### UNIT V ECONOMIC USES OF FIBRE CROPS

12

List of cultivated crops, economic parts, chromosome number and family description of the following families and key botanical features of the crops given against them , Malvaceae: Cotton, Mesta and Bhendi. **Production and economic importance**

#### TEXT BOOK

1. Daniel Sundararaj, D. and G. Thulasidas, 1993. Botany of field crops. MacMillan India Ltd., New Delhi.
2. Sambamurthy, V.S. and N.S. Subramanian, 1989. Text Book of Economic Botany, Wiley Eastern, New Delhi

#### REFERENCE BOOKS

1. Purse glow, 1988. Tropical Crops – Monocotyledons, The English Language book Society and Longman Co., Singapore
2. Purse glow. 1988. Tropical Crops - Dicotyledons. The English language book Society and Longman Co., Singapore.
3. Albert F. Hill and O.P. Sharma, 1996. Economic Botany. Tata McGraw - Hill Publishing Co. Ltd., New Delhi.
4. John Joel, A., C. Vanniarajan, T.S. Raveendran, and A. Gopalan 2006. Fundamentals of Crop Botany, Directorate of ODL, Tamil Nadu Agricultural University, Coimbatore-641 003

|                              |                                                                                                         |          |          |          |          |
|------------------------------|---------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC303</b>                | <b>PLANT BIOCHEMISTRY</b>                                                                               | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | Total Contact Hours - 45                                                                                | 3        | 0        | 0        | 3        |
|                              | Prerequisite – Basic Chemistry and Biology                                                              |          |          |          |          |
|                              | Course Designed by – Dept. of Industrial Biotechnology                                                  |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b> |                                                                                                         |          |          |          |          |
| CO1                          | to understand the fundamentals of biomolecules, their classification, structure                         |          |          |          |          |
| CO2                          | to apply the basic concept of carbohydrates, proteins ,lipids, nucleic acids and enzymes in metabolism. |          |          |          |          |
| CO3                          | to know the application of biomolecules in functioning of biological system                             |          |          |          |          |
| CO4                          | to get a basic knowledge of macromolecules in living organism and its energetic                         |          |          |          |          |
| CO5                          | To know basic concepts of enzymes                                                                       |          |          |          |          |

|                                                                                                                             |          |                                                         |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------|-------------------|--------------------------|---------------------------|-----------------------|-------------------------------|------------------|----------------------------------------------------------|---|---|---|---|
| CO6                                                                                                                         |          | to understand the fundamentals function of biomolecules |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                         |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| 1                                                                                                                           | COs/POs  | a                                                       | b                 | c                        | d                         | e                     | f                             | g                | h                                                        | i | j | k | l |
| 2                                                                                                                           | CO1      | H                                                       | M                 |                          |                           |                       | H                             |                  |                                                          |   |   |   | L |
|                                                                                                                             | CO2      |                                                         |                   |                          |                           |                       |                               |                  | H                                                        |   |   | H |   |
|                                                                                                                             | CO3      | H                                                       |                   | H                        |                           | H                     |                               |                  |                                                          | H | H |   | H |
|                                                                                                                             | CO4      | H                                                       | M                 |                          |                           |                       | H                             | H                |                                                          |   |   |   |   |
|                                                                                                                             | CO5      | H                                                       |                   |                          |                           |                       |                               |                  |                                                          |   |   | H |   |
|                                                                                                                             | CO6      | H                                                       |                   | H                        |                           |                       |                               |                  | H                                                        |   | H |   | M |
| 3                                                                                                                           | Category | Humanities<br>& Social<br>Studies (HS)                  | Basic<br>Sciences | Engg<br>Sciences<br>(ES) | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective<br>(NE) | Open<br>Elective | Project/<br>Term paper<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |
|                                                                                                                             |          |                                                         |                   |                          |                           |                       |                               |                  |                                                          | √ |   |   |   |
| 4                                                                                                                           | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015  |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |

## UNIT I CARBOHYDRATES AND LIPIDS

9

Introduction- scope and importance in Agri. Biotechnology Concept of life and living processes: nature of biological material- classification, structure and function, occurrence of simple and ,derived carbohydrates-Lipids: classification, structure and function, occurrence of simple and derived lipids. **Phospholipids- structure m properties and functions**

## UNIT II AMINO ACIDS AND PROTEINS

9

Amino acids: structure, classification and properties. Peptides: chemistry and function- structure Proteins: classification based on composition and biological functions-four levels of protein structure, **Various orders of Protein structure**

## UNIT III VITAMINS AND ENZYMES

9

Water soluble vitamins, their coenzyme forms, sources and biochemical functions-Fat soluble vitamins: sources and functions. Enzymes: historical perspective, naming and classification, factors affecting enzyme activity, mechanism of enzyme action, enzyme units.

## UNIT IV NUCLEIC ACIDS AND CHROMOSOMES

9

Nucleic acid structure-**Nucleosides and Nucleotides** and function, physical and chemical properties, spectroscopic and thermal properties, *in vitro* denaturation and renaturation of DNA, DNA as genetic material.

## UNIT V BIOENERGETICS

9

Principles of thermodynamics and their applications in biochemistry -introduction and thermodynamic state functions, first and second law of thermodynamics, **Changes in free energy-**mconcept of free energy, standard free energy change, biological oxidation-reduction reactions,

redox potential. Highenergy phosphate compounds, free energy of hydrolysis of ATP and sugar phosphates.

#### Text Book

1. 'Gaw A, 2008, "Clinical biochemistry" Elsevier Health Sciences, 4<sup>th</sup>.Ed.
2. J.L. Jain, 2008, "Fundamentals of biochemistry" S. Chand.8<sup>th</sup> Ed

#### Reference Books

1. J.L. Jain , , 2007 , "Text Book Of Biochemistry" ,14<sup>th</sup> Ed
2. Zubey 2004 "Biochemistry" III Ed,
3. Voet&Voet 2006, "Biochemistry" V ed,.
4. Lehninger Nelson &Cox , 2005 "Principles of Biochemistry",4<sup>th</sup> Ed
5. Weblink: nptel

|                                                                                                                             |                                                                                    |   |   |   |   |   |   |          |          |          |          |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---|---|---|---|---|---|----------|----------|----------|----------|---|---|
| <b>BAC304</b>                                                                                                               | <b>AGRICULTURAL MICROBIOLOGY</b>                                                   |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |   |
|                                                                                                                             | Total Contact Hours - 45                                                           |   |   |   |   |   |   | 3        | 0        | 0        | 3        |   |   |
|                                                                                                                             | Prerequisite – Basic concepts in biology                                           |   |   |   |   |   |   |          |          |          |          |   |   |
|                                                                                                                             | Course Designed by – Dept. of Industrial Biotechnology                             |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>OBJECTIVES</b><br>To provide a basic understanding of microbes and their applications from the perspective of engineers  |                                                                                    |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                    |   |   |   |   |   |   |          |          |          |          |   |   |
| CO1                                                                                                                         | to understand the source of microbes and their role in biotechnology               |   |   |   |   |   |   |          |          |          |          |   |   |
| CO2                                                                                                                         | to get the knowledge of microbial diversity classification and morphology          |   |   |   |   |   |   |          |          |          |          |   |   |
| CO3                                                                                                                         | to know the visualization of microbes by different microscopes                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO4                                                                                                                         | to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens |   |   |   |   |   |   |          |          |          |          |   |   |
| CO5                                                                                                                         | to get a basic knowledge of the microbial nutrition and growth                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO6                                                                                                                         | To get knowledge about classification of microbes                                  |   |   |   |   |   |   |          |          |          |          |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                    |   |   |   |   |   |   |          |          |          |          |   |   |
| 1                                                                                                                           | COs/POs                                                                            | a | b | c | d | e | f | g        | h        | i        | j        | k | l |
| 2                                                                                                                           | CO1                                                                                | H |   |   | M |   |   | H        | H        | H        | H        |   | H |
|                                                                                                                             | CO2                                                                                | H |   | M |   |   |   |          |          |          |          |   |   |
|                                                                                                                             | CO3                                                                                | H |   |   |   |   |   | H        |          | H        |          |   | H |
|                                                                                                                             | CO4                                                                                | H |   | M | M |   |   | H        |          |          |          |   |   |
|                                                                                                                             | CO5                                                                                | H |   |   |   | H | H |          |          |          |          |   |   |
|                                                                                                                             | CO6                                                                                | H |   | M | M |   |   |          |          | H        |          |   | H |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                                        |                     |                    | ✓                      |                    |                         |                    |                                              |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |

### **UNIT I INTRODUCTION TO MICROBIOLOGY 9**

Development and scope of microbiology - Spontaneous generation theory – Germ theory – Germ theory of disease – Contributions by Antonie van Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Joseph Lister, Winogradsky, Beijerinck, Alexander Fleming, Waksman and others in the development of microbiology and their discoveries.

### **UNIT II MICROSCOPY 9**

Microscopy – Principles of optics – **Resolution** -Resolving Power – Numerical aperture, magnification, aberrations – Different types of microscopes – Light microscope, Dark field, phase contrast, U.V Microscopes, Electron microscope (Scanning – Transmission types, **Fluorescent Microscopy**)– Micrometry.

### **UNIT III GENERAL FEATURES OF MICROORGANISMS 9**

Structure and organization of microbial cell – Prokaryotes – Eukaryotes – Morphology and fine structure of different microorganisms-**Identification of microbes**-Distribution of microorganisms – Groups of microorganisms and their importance – Bacteria, Fungi, actinomycetes, algae, protozoa and viruses

### **UNIT IV MICROBIAL NUTRITION AND GROWTH 9**

Methods of isolation and purification – pure culture methods – preparation of media – Different types of nutritional media – Staining techniques – Simple staining, differential staining, structural staining – **maintenance and preservation of the microbial culture**. Nutritional types: autotrophy, heterotroph, phototroph, chemolithotroph - Growth curve – Continuous culture, synchronous culture- chemostat – Energy production by aerobes, anaerobes, photosynthetic organisms – Biosynthesis of proteins and other macro molecules.

### **UNIT V CLASSIFICATION OF MICROORGANISMS 9**

Classification of microorganisms – General principle and outline of classification in bacteria, fungi, algae, etc- Viruses and bacteriophages – chemical nature – Life cycle – lytic and lysogenic types – importance

### **TEXT BOOKS**

1. Michael J. Pelzar, J.R.E.C.S Chan, Noel R. Erieg, 2005, “Microbiology “ TATA McGraw Hill, 5<sup>th</sup>ed

- Anantha Narayan, C.K. Jayaram Paniker, 2009, “Text Book of Microbiology” Orient Blackswan, 7<sup>th</sup>ed

## REFERENCE BOOKS

- Presscott and Dunn, 2006, “Industrial Microbiology” CBS Publishers& Distributors.
- Daniel V.Lim, “Microbiology”, Kendall Hunt, 2002 ed
- Michael T Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock, 2017, Brock Biology of Microorganisms, 15<sup>th</sup> Edition, Pearson Publishers
- Weblink: nptel

|                                                                                                                               |                                                                                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BBT305                                                                                                                        | INSTRUMENTATION FOR BIOTECHNOLOGY                                                                  |   |   |   |   |   |   |   |   |   | L | T | P | C |
|                                                                                                                               | Total Contact Hours - 45                                                                           |   |   |   |   |   |   |   |   |   | 3 | 0 | 0 | 3 |
|                                                                                                                               | Prerequisite – basic principles in instrumentation                                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                               | Course Designed by – Dept of Industrial Biotechnology                                              |   |   |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES                                                                                                                    |                                                                                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |
| To provide a basic knowledge of the working principle of instruments and their applications from the perspective of engineers |                                                                                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                         |                                                                                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                           | to understand the fundamentals of instruments and their different mode of applications             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                           | to know the principle, working concept and its applications                                        |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                           | to find the various laboratory work based on instruments                                           |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                           | to know the different types of instruments based on various parameters                             |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                           | to get a basic knowledge of equipments and their role in biological systems in relevant industries |   |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                           | To understand about working principles about instruments                                           |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low   |                                                                                                    |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                             | COs/POs                                                                                            | a | b | c | d | e | f | g | h | i | j | k | l |   |
| 2                                                                                                                             | CO1                                                                                                | H |   | H |   |   |   | H |   |   |   |   |   |   |
|                                                                                                                               | CO2                                                                                                | H | H | H | H |   |   |   |   | H |   | H |   |   |
|                                                                                                                               | CO3                                                                                                | H |   |   |   |   |   | H |   |   |   |   |   |   |
|                                                                                                                               | CO4                                                                                                | H |   |   |   |   |   | H |   |   | M |   |   |   |
|                                                                                                                               | CO5                                                                                                | H |   |   |   |   |   | H |   |   |   |   |   |   |
|                                                                                                                               | CO6                                                                                                | H |   |   |   | H |   |   | H |   |   |   |   | H |

|   |          |                                                        |                     |                    |                        |                    |                    |                    |                                              |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|--------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                                        |                     |                    | √                      |                    |                    |                    |                                              |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                    |                    |                                              |

### UNIT I RADIATION TECHNIQUES

9

Sources of radiation- absorptivity-Lambert Beers law, deviations, detectors, photometric accuracy, Rayleigh scattering, Fourier transform, calibration and standardization, atomisation, flame atomisation, turbidimetric and nephelometric titrations -scattering in gases.

### UNIT II ELECTROCHEMICAL TECHNIQUES

9

Principles: redox potential-pH electrode-ion selective and gas sensing electrodes-Clarke oxygen electrode and its application-biosensors.

### UNIT III SPECTROSCOPIC TECHNIQUES

9

Colorimetry-UV-visible spectrophotometry-ORD-CD-X-ray spectroscopy-IR spectroscopy-ESR spectroscopy-NMR spectroscopy-Mass spectroscopy

### UNIT IV SEDIMENTATION TECHNIQUES

9

Centrifugation principles-centrifuges and its types-differential and density gradient centrifugation-analysis of subcellular fractions-assessment of purity and determination of relative molecular mass

### UNIT V RADIOISOTOPE TECHNIQUES

9

Nature of radioactivity-Detection and measurement of radioactivity-GM counter-Scintillation counting-photographic emulsions-radiotracer techniques-autoradiography.

### TEXT BOOK

1. Willard and Merrit, "Instrumental Methods of Analysis", VI Edition, CBS Publishers and Distributors.
2. Asokan, Practical Biochemistry, IV edition

### REFERENCES

1. Ewing GW, "Instrumental Methods of Chemical Analysis", McGraw Hill Book Company, 1989.
2. Braun H., "Introduction to Chemical Analysis", McGraw Hill, 1987.
3. Keith Wilson and Walker, Practical Biochemistry, V edition, Cambridge editions.

|               |                                                        |          |          |          |          |
|---------------|--------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC305</b> | <b>PRINCIPLES OF PLANT BREEDING</b>                    | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 45                               | 3        | 0        | 0        | 3        |
|               | Prerequisite – Biology                                 |          |          |          |          |
|               | Course Designed by – Dept. of Industrial Biotechnology |          |          |          |          |

|                                                                                                                             |                                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| <b>OBJECTIVES</b>                                                                                                           |                                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| To provide basic knowledge about general techniques involved in plant breeding                                              |                                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                         | to understand the basics of genetics                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         | to know about population genetics and its significance              |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | to know about types and structure of genes                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | to know about techniques in isolation and characterization of genes |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to get idea about polymorphism at DNA level                         |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | to know about modern concepts in genetics                           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                             | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                                 | H                                                      | M                   | M                  | H                      | M                  | H                       | H                  |                                              | L | L | L | M |
|                                                                                                                             | CO2                                                                 | H                                                      | M                   | M                  | H                      | H                  | H                       | M                  | H                                            |   |   |   | M |
|                                                                                                                             | CO3                                                                 | H                                                      | M                   |                    | H                      |                    | H                       | H                  |                                              |   | L | L |   |
|                                                                                                                             | CO4                                                                 | H                                                      | M                   |                    | H                      | H                  | H                       | M                  |                                              |   | L |   | M |
|                                                                                                                             | CO5                                                                 | H                                                      | M                   | M                  | H                      | H                  | H                       | M                  | M                                            | M | L | L |   |
|                                                                                                                             | CO6                                                                 | H                                                      |                     |                    | H                      | H                  | H                       | M                  |                                              |   |   | L | M |
| 3                                                                                                                           | Category                                                            | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                     |                                                        |                     |                    | √                      |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                                            | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I: INTRODUCTION

9

Beginning of genetics; Cell structure and cell division; Early concepts of inheritance, Mendel's laws; Discussion on Mendel's paper, Chromosomal theory of inheritance.-Multiple alleles, Gene interactions.

## UNIT II: SEX DETERMINATION AND LINKAGE

Sex determination, Sex differentiation and sex-linkage, Sex-influenced and sex-limited traits; Linkage- Coupling and repulsion detection, estimation; Recombination and genetic mapping in eukaryotes.

9

## UNIT III: POPULATION GENETICS

Population - Mendelian population – Random mating population - Frequencies of genes and genotypes-Causes of change: Hardy-Weinberg equilibrium-Structural and numerical changes in chromosomes; Nature, structure and replication of the genetic material; Genetic code

#### UNIT IV: GENE STRUCTURE

9

Genetic fine structure analysis, Overlapping genes, Split genes, Transposable genetic elements, Pseudogenes, Oncogenes, Gene families and clusters- Regulation of gene activity in prokaryotes; Bacterial plasmids, insertion (IS) and transposable (Tn) elements

#### UNIT V: MODERN CONCEPT OF GENETICS AND MUTATION

9

Methods of studying polymorphism at biochemical and DNA level; Transgenic bacteria and bioethics; Gene silencing; - Concepts of Eugenics, Epigenetics, Genetic disorders and Behavioural genetics, types of mutation

#### TEXT BOOK

1. Gardner EJ & Snustad DP. 1991. Principles of Genetics. John Wiley & Sons
2. Klug WS & Cummings MR. 2003. Concepts of Genetics. Peterson Edu
3. Lewin B. 2008. Genes IX. Jones & Bartlett Publ
4. Russell PJ. 1998. Genetics. The Benjamin/Cummings Publ. Co

#### REFERENCE BOOKS

1. Snustad DP & Simmons MJ. 2006. Genetics. 4th Ed. John Wiley & Sons
2. Strickberger MW. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India
3. Tamarin RH. 1999. Principles of Genetics. Wm. C. Brown Pub

|                                                                                                                                   |                                                                                                      |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC3L1</b>                                                                                                                     | <b>PLANT BIOCHEMISTRY LAB</b>                                                                        | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                                   | Total Contact Hours - 45                                                                             | 0        | 0        | 3        | 2        |
|                                                                                                                                   | Prerequisite – Basic concepts in chemistry and biology                                               |          |          |          |          |
|                                                                                                                                   | Course Designed by – Dept. of Agricultural Biotechnology                                             |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                                 |                                                                                                      |          |          |          |          |
| To provide a basic knowledge of biochemical components and its functions and their Applications from the perspective of engineers |                                                                                                      |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                      |                                                                                                      |          |          |          |          |
| CO1                                                                                                                               | to understand the fundamentals of biomolecules, their classification,structure and functions         |          |          |          |          |
| CO2                                                                                                                               | to apply the basic concept of carbohydrates, proteins,lipids, nucleicacids and enzymes in metabolism |          |          |          |          |
| CO3                                                                                                                               | to know the application of biomolecules in functioning of biological system                          |          |          |          |          |
| CO4                                                                                                                               | to get a basic knowledge of macromolecules in living organism and its energetics                     |          |          |          |          |
| CO5                                                                                                                               | To know basic concepts of enzymes                                                                    |          |          |          |          |
| CO6                                                                                                                               | To understand about compound identification                                                          |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low       |                                                                                                      |          |          |          |          |

|   |          |                                                        |                           |                          |                           |                          |                               |                          |                                                          |   |   |   |   |
|---|----------|--------------------------------------------------------|---------------------------|--------------------------|---------------------------|--------------------------|-------------------------------|--------------------------|----------------------------------------------------------|---|---|---|---|
| 1 | COs/POs  | a                                                      | b                         | c                        | d                         | e                        | f                             | g                        | h                                                        | i | j | k | l |
| 2 | CO1      | H                                                      | H                         | H                        | H                         |                          |                               | H                        |                                                          |   | H | H |   |
|   | CO2      | H                                                      | H                         | H                        | H                         |                          |                               | H                        |                                                          |   | H | H |   |
|   | CO3      | H                                                      | H                         | H                        | H                         |                          |                               | H                        |                                                          |   | H | H |   |
|   | CO4      | H                                                      | H                         | H                        | H                         |                          |                               | H                        |                                                          |   | H | H |   |
|   | CO5      | H                                                      |                           | H                        |                           |                          |                               | H                        |                                                          |   | H | H |   |
|   | CO6      | H                                                      | H                         |                          |                           |                          | M                             | M                        | M                                                        |   |   |   |   |
| 3 | Category | Humanities<br>& Social<br>Studies (HS)                 | Basic<br>Sciences<br>(BS) | Engg<br>Sciences<br>(ES) | Professional<br>Core (PC) | Core<br>Elective<br>(CE) | Non-Major<br>Elective<br>(NE) | Open<br>Elective<br>(OE) | Project/<br>Term paper<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |
|   |          |                                                        |                           |                          |                           |                          |                               |                          |                                                          |   |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                           |                          |                           |                          |                               |                          |                                                          |   |   |   |   |

### **LIST OF EXPERIMENTS**

- |                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>Preparation of normal, molar and percent solutions.</li> <li><b>Preparation of different buffer solution and measure its ion concentration</b></li> <li>Qualitative analysis of Unknown sugar- Monosaccharides, disaccharides and polysaccharides.</li> <li>Estimation of sugar- Benedicts method.</li> <li>Qualitative of unknown protein- Albumin, casein and gelatin.</li> </ol> | <ol style="list-style-type: none"> <li>Quantitative test for aminoacids- Ninhydrin method.</li> <li>Quantitative test for protein – Biuret method.</li> <li>Quantitative test for protein – Lowry method.</li> <li>Quantitative test for protein – Bradford method</li> <li>Spectrophotometric analysis of DNA.</li> </ol> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                               |                                                                                        |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|---|---|---|---|
| BBT3L2                                                                                                                        | INSTRUMENTAL METHODS OF ANALYSIS LAB                                                   | L | T | P | C |
|                                                                                                                               | Total Contact Hours - 45                                                               | 0 | 0 | 3 | 2 |
|                                                                                                                               | Prerequisite – Basic chemistry and physics                                             |   |   |   |   |
|                                                                                                                               | Course Designed by – Dept. of Industrial Biotechnology                                 |   |   |   |   |
| OBJECTIVES                                                                                                                    |                                                                                        |   |   |   |   |
| To provide a basic knowledge of the working principle of instruments and their applications from the perspective of engineers |                                                                                        |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                         |                                                                                        |   |   |   |   |
| CO1                                                                                                                           | To understand the fundamentals of instruments and their different mode of applications |   |   |   |   |
| CO2                                                                                                                           | to know the principle, working concept and its applications                            |   |   |   |   |

|                                                                                                                             |                                                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| CO3                                                                                                                         | to find the various laboratory work based on instruments                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | to know the different types of instruments based on various parameters                            |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to get a basic knowledge of equipment and their role in biological systems in relevant industries |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | To understand about basic working principles of equipment                                         |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                                           | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                                                               | H                                                      | H                   |                    |                        |                    |                         | H                  |                                              |   |   | M |   |
|                                                                                                                             | CO2                                                                                               | H                                                      |                     | H                  | L                      |                    |                         | H                  | L                                            |   | L |   | H |
|                                                                                                                             | CO3                                                                                               | H                                                      | H                   |                    |                        | L                  |                         | H                  |                                              | L |   | M |   |
|                                                                                                                             | CO4                                                                                               | H                                                      | H                   |                    |                        |                    | L                       | H                  |                                              |   |   | M | L |
|                                                                                                                             | CO5                                                                                               | H                                                      | H                   |                    |                        |                    |                         | M                  |                                              |   |   | H |   |
|                                                                                                                             | CO6                                                                                               | H                                                      | M                   |                    |                        | M                  |                         |                    |                                              | M |   |   |   |
| 3                                                                                                                           | Category                                                                                          | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                                                                          | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

### **LIST OF EXPERIMENTS**

- Working principle of colorimeter and spectrophotometer
- Difference between the spectrophotometer and colorimeter.
- Validating beer lamberts law using colorimeter-potassium permanganate
- Validating beer lamberts law using colorimeter-copper sulphate
- Validating beer lamberts law using colorimeter-potassium dichromate
- Determination of  $\lambda$  max.
- Estimation of  $\text{SO}_4^{2-}$  by nephelometry
- Measurement of turbidity in water by nephelometry
- Measurement of hydrogen ion in water samples
- Preparation of buffer using pH paper
- Determination of moisture content
- Precipitation of protein using ammonium sulphate.

|               |                                                        |          |          |          |          |
|---------------|--------------------------------------------------------|----------|----------|----------|----------|
| <b>BBT3L3</b> | <b>CELL BIOLOGY LAB</b>                                | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 45                               | 0        | 0        | 3        | 2        |
|               | Prerequisite – basic cell biology                      |          |          |          |          |
|               | Course Designed by – Dept. of Industrial Biotechnology |          |          |          |          |

|                                                                    |                                                                                        |
|--------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <b>OBJECTIVES:</b> To provide a basic knowledge about cell biology |                                                                                        |
| <b>COURSE OUTCOMES (COs)</b>                                       |                                                                                        |
| CO1                                                                | to understand the fundamentals of instruments and their different mode of applications |
| CO2                                                                | to get idea about slide preparation                                                    |
| CO3                                                                | to know about blood grouping                                                           |
| CO4                                                                | to get knowledge about mitosis                                                         |
| CO5                                                                | to get a basic knowledge of extraction of plant pigments                               |
| CO6                                                                | To understand about preservation technique                                             |

|   |          | Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                        |                       |                           |                       |                            |                       |                                                          |   |   |   |   |
|---|----------|-----------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------------|---------------------------|-----------------------|----------------------------|-----------------------|----------------------------------------------------------|---|---|---|---|
| 1 | COs/POs  | a                                                                                                                           | b                      | c                     | d                         | e                     | f                          | g                     | h                                                        | i | j | k | l |
| 2 | CO1      | H                                                                                                                           |                        | H                     | H                         |                       |                            | H                     |                                                          |   |   |   |   |
|   | CO2      | H                                                                                                                           | H                      |                       |                           |                       |                            | H                     | M                                                        |   |   |   |   |
|   | CO3      | H                                                                                                                           |                        |                       | H                         | H                     | H                          | H                     |                                                          |   |   |   |   |
|   | CO4      | H                                                                                                                           |                        |                       |                           |                       |                            | H                     |                                                          |   |   |   |   |
|   | CO5      | H                                                                                                                           |                        |                       |                           |                       |                            | H                     |                                                          |   |   |   |   |
|   | CO6      | H                                                                                                                           |                        |                       | H                         |                       |                            | H                     |                                                          |   |   |   |   |
| 3 | Category | Humanities &<br>Social Studies<br>(HS)                                                                                      | Basic<br>Sciences (BS) | Engg<br>Sciences (ES) | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective (NE) | Open Elective<br>(OE) | Project/ Term<br>paper<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |
|   |          |                                                                                                                             |                        |                       |                           |                       |                            |                       |                                                          |   |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015                                                                      |                        |                       |                           |                       |                            |                       |                                                          |   |   |   |   |

### **LIST OF EXPERIMENTS**

1. Study of Microscope
2. Spotters
3. Permanent Slide preparation
4. Killing and Fixing
5. Mitosis on onion root tip
6. Cryopreservation
7. Preparation of Blood smear
8. Separation of plasma and serum from blood sample
9. Total RBC and WBC Count
10. Osmosis and Diffusion
11. Extraction of pigments

|               |                                |          |          |          |          |
|---------------|--------------------------------|----------|----------|----------|----------|
| <b>BAC401</b> | <b>PLANT MOLECULAR BIOLOGY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|--------------------------------|----------|----------|----------|----------|

|                                                                                                                             |                                                                                                |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|---|-------------------------|---|--------------------|--|----------------------------------------------|--|
|                                                                                                                             |                                                                                                | Total Contact Hours - 45                                 |   |                     |   |                    |   |                        | 3 | 0                  | 0 | 3                       |   |                    |  |                                              |  |
|                                                                                                                             |                                                                                                | Prerequisite – Basics of Cell biology and biochemistry   |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             |                                                                                                | Course Designed by – Dept. of Agricultural Biotechnology |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| <b>OBJECTIVES</b>                                                                                                           |                                                                                                |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| To provide a basic understanding of molecular level of DNA and their applications from the perspective of engineers         |                                                                                                |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                                |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO1                                                                                                                         | to understand the fundamentals of central dogma of biological systems                          |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO2                                                                                                                         | to know the concept of cell replication,transcription and translation                          |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO3                                                                                                                         | to comprehend DNA and its role in functioning of a cell                                        |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO4                                                                                                                         | to know the functioning of regulatory factors and its application in maintaining cell activity |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO5                                                                                                                         | to get a basic knowledge of the DNA and RNA                                                    |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO6                                                                                                                         | to get a basic knowledge of the proteins                                                       |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                |                                                          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| 1                                                                                                                           | COs/POs                                                                                        | a                                                        | b | c                   | d | e                  | f | g                      | h | i                  | j | k                       | l |                    |  |                                              |  |
| 2                                                                                                                           | CO1                                                                                            | H                                                        | H |                     |   | H                  |   | H                      |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO2                                                                                            | H                                                        |   |                     |   |                    |   |                        | H |                    | H | H                       | H |                    |  |                                              |  |
|                                                                                                                             | CO3                                                                                            | H                                                        |   | H                   | H | H                  | H | H                      |   |                    |   | M                       |   |                    |  |                                              |  |
|                                                                                                                             | CO4                                                                                            | H                                                        |   |                     |   |                    |   | M                      |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO5                                                                                            | H                                                        |   |                     |   |                    |   | H                      |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO6                                                                                            | H                                                        |   | H                   |   |                    |   |                        |   | H                  |   | H                       |   |                    |  |                                              |  |
| 3                                                                                                                           | Category                                                                                       | Humanities & Social Studies (HS)                         |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |
|                                                                                                                             |                                                                                                |                                                          |   |                     |   |                    |   | √                      |   |                    |   |                         |   |                    |  |                                              |  |
| 4                                                                                                                           | Approval                                                                                       | 37 <sup>th</sup> Meeting of Academic Council, May 2015   |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |

## UNIT I DNA STRUCTURE

9

DNA as the vehicle of inheritance-structure of DNA-forms of DNA-nucleic acid biosynthesis-experimental evidence: Griffith, McLeod, McCarty and Avery, Hershey–Chase experiments-Definition of gene-**organization of genes in prokaryotes and eukaryotes** -non coding DNA in prokaryotes- Eukaryotes– unique, moderately repetitive and highly repetitive DNA sequence-satellite DNA- Cot value- DNA binding proteins

## UNIT II DNA REPLICATION

9

DNA replication in prokaryotes and eukaryotes- modes of replication-semi continuous and semi discontinuous replication- Okazaki fragments- RNA primers – enzymes of replication – DNA polymerases I, II, III, -DNA modifying enzymes: topoisomerases-helicases- binding proteins and ligases- replication in E.coli–replisomes-events at OriC (initiation), events on the replication fork (elongation) and termination-Semi conservative model of DNA- Fidelity of replication-Sigma or rolling circle mode of replication in  $\Phi$  x 174-Inhibitors of replication.

### UNIT III DNA REPAIR

9

Repair of DNA–types of damages- repair by direct reversal of damage- excision repair-recombination repair- SOS repair-Mutation: definition-type of mutations (spontaneous and induced) point mutation-Gene mutation and chromosomal aberrations- Cause of mutations-chemical and physical agent and **Biological agents**

### UNIT IV TRANSCRIPTION

9

Transcription in prokaryotes and eukaryotes: RNA polymerases–enzyme structure- role of sigma factor- promoter-closed and open promoter complexes-Initiation-elongation and termination of RNA synthesis-Post transcriptional modification in prokaryotes and eukaryotes-transcription factors. **Inhibitors of Transcription**

### UNIT V GENETIC CODE

9

Genetic code–Basic features of genetic code-Deciphering of genetic code-Wobble hypothesis-Protein biosynthesis-activation of amino acids- initiation-elongation and termination of translation in prokaryotes and eukaryotes-Post translational modifications-Inhibitors of translation.-Regulation of gene expression in prokaryotes and eukaryotes- operon concept-**Lac Operon**

### TEXT BOOKS

1. Biochemistry by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, 2006
2. Lehninger, Principles of Biochemistry, David L. Nelson and Michael M. Cox, 2008
3. James D. Watson, Tania A. Baker, Stephen P. Bell, and Alexander Gann, Molecular Biology of the Gene (6th ed), 2007

### REFERENCE BOOKS

1. R.L. Adams, J.T. Knowler, and D.P. Leader, The Biochemistry of the Nucleic Acids, 1992
2. Stephen Neidle, Principles of Nucleic Acid Structure, 2007
3. Robert Weaver, Molecular Biology, 2007
4. Weblink: npTEL

|                              |                                                                                                        |          |          |          |          |
|------------------------------|--------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC402</b>                | <b>CROP PHYSIOLOGY</b>                                                                                 | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                              | Total Contact Hours - 45                                                                               | 3        | 0        | 0        | 3        |
|                              | Prerequisite – Basic Chemistry and Biology                                                             |          |          |          |          |
|                              | Course Designed by – Dept. of Agricultural Biotechnology                                               |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b> |                                                                                                        |          |          |          |          |
| CO1                          | to understand the fundamentals of crop physiology                                                      |          |          |          |          |
| CO2                          | to apply the basic concept of carbohydrates, proteins ,lipids, nucleicacids and enzymes in metabolism. |          |          |          |          |

|                                                                                                                             |                                                                                 |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|--------------------------------------------------------|-------------------|--------------------------|---------------------------|-----------------------|-------------------------------|------------------|----------------------------------------------------------|---|---|---|---|
| CO3                                                                                                                         | to know the application of biomolecules in functioning of biological system     |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| CO4                                                                                                                         | to get a basic knowledge of macromolecules in living organism and its energetic |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| CO5                                                                                                                         | To know basic concepts of enzymes                                               |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| CO6                                                                                                                         | to understand the fundamentals function of biomolecules                         |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                 |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                         | a                                                      | b                 | c                        | d                         | e                     | f                             | g                | h                                                        | i | j | k | l |
| 2                                                                                                                           | CO1                                                                             | H                                                      | M                 |                          |                           |                       | H                             |                  |                                                          |   |   |   | L |
|                                                                                                                             | CO2                                                                             |                                                        |                   |                          |                           |                       |                               |                  | H                                                        |   |   | H |   |
|                                                                                                                             | CO3                                                                             | H                                                      |                   | H                        |                           | H                     |                               |                  |                                                          | H | H |   | H |
|                                                                                                                             | CO4                                                                             | H                                                      | M                 |                          |                           |                       | H                             | H                |                                                          |   |   |   |   |
|                                                                                                                             | CO5                                                                             | H                                                      |                   |                          |                           |                       |                               |                  |                                                          |   |   | H |   |
|                                                                                                                             | CO6                                                                             | H                                                      |                   | H                        |                           |                       |                               |                  | H                                                        |   | H |   | M |
| 3                                                                                                                           | Category                                                                        | Humanities<br>& Social<br>Studies (HS)                 | Basic<br>Sciences | Engg<br>Sciences<br>(ES) | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective<br>(NE) | Open<br>Elective | Project/<br>Term paper<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |
|                                                                                                                             |                                                                                 |                                                        |                   |                          |                           |                       |                               |                  |                                                          | √ |   |   |   |
| 4                                                                                                                           | Approval                                                                        | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |

## UNIT I PLANT WATER RELATIONS

9

Importance of Crop Physiology in Agriculture – cell organelle- plasma membrane, chloroplast, mitochondria, peroxisome and vacuole - Structure and role of water –water potential and its components – diffusion – osmosis – imbibition - plasmolysis – Field Capacity and Permanent Wilting Point- Mechanisms of water absorption – Pathways of water movement – Apoplast and symplast - Translocation of water – ascent of sap – mechanisms - Transpiration – significance – structure of stomatal pore- mechanisms of stomatal opening and closing – guttation – antitranspirants

## UNIT II PLANT MINERAL NUTRITION

9

Criteria of essentiality - classification of nutrients – macro, micro, mobile, beneficial elements and immobile – mechanism of nutrient uptake- Physiological functions, deficiencies and disorders of macro and micro nutrients – Hidden hunger- Foliar nutrition- root feeding and fertigation – sand culture, hydroponics and aeroponics

## UNIT III PHOTOSYNTHESIS AND RESPIRATION

9

Light reaction – Photosystems- red drop and Emerson enhancement effect- Photolysis of water and photophosphorylation - Z scheme - Photosynthetic pathways – C<sub>3</sub> and C<sub>4</sub>, CAM – difference between three pathways - Factors affecting photosynthesis- Photorespiration – pathway and its

significance - Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations - Glycolysis – TCA cycle - Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting - respiratory quotient

#### UNIT IV GROWTH AND DEVELOPMENT

9

Growth – phases of growth - Factors affecting growth – Hormones- classifications - Biosynthetic pathway and role of auxins - Biosynthetic pathway and role of gibberellins and cytokinins- Biosynthetic pathway and role of ethylene and ABA- Novel and new generation PGR's – Brassinosteroids and salicylic acid - Growth retardants – Commercial uses of PGR's- Photoperiodism - short, long and day neutral plants – Chailakhyan's theory of flowering-Forms of phytochrome - Pr and Pfr - regulation of flowering - Vernalisation - Theories of vernalisation – Lysenko and Chailakhyan's theories- Seed germination - physiological and biochemical changes - seed dormancy and breaking methods - Senescence and abscission – physiological and biochemical changes -Physiology of fruit ripening- climacteric and non-climacteric fruits - factors affecting ripening- Manipulations

#### UNIT V STRESS PHYSIOLOGY

9

Classification of stresses - Physiological changes and adaptations to drought, flooding, high and low temperature, salinity and UV radiation – compatible osmolytes – membrane properties — compartmentalization – stress alleviation - Global warming – green house gases – physiological effects on crops - Carbon Sequestration

#### Text Books

1. P. Boominathan, R. Sivakumar, A. Senthil, and D. Vijayalakshmi. 2014. Introduction to Plant Physiology, A.E. Publications. Coimbatore
2. Jain, V.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi.
3. Taiz. L. and Zeiger. E., 2010 (Fifth edition). Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

#### e- books and e-references

·<http://www.plantphys.org>

[http://www. Biologie. Uni-hamburg. de/b-online](http://www.Biologie.Uni-hamburg.de/b-online)

|               |                                                          |          |          |          |          |
|---------------|----------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC403</b> | <b>ENZYMOLOGY</b>                                        | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 60                                 | 3        | 1        | 0        | 4        |
|               | Prerequisite – Basic Chemistry and Biology               |          |          |          |          |
|               | Course Designed by – Dept. of Agricultural Biotechnology |          |          |          |          |

| COURSE OUTCOMES (COs)                                                                                                       |          |                                                                                                        |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
|-----------------------------------------------------------------------------------------------------------------------------|----------|--------------------------------------------------------------------------------------------------------|----------------|---|--------------------|---|------------------------|---|--------------------|---|-------------------------|---|---------------|----------------------------------------------|
| CO1                                                                                                                         |          | to understand the fundamentals of biomolecules, their classification, structure                        |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| CO2                                                                                                                         |          | to apply the basic concept of carbohydrates, proteins ,lipids, nucleicacids and enzymes in metabolism. |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| CO3                                                                                                                         |          | to know the application of biomolecules in functioning of biological system                            |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| CO4                                                                                                                         |          | to get a basic knowledge of macromolecules in living organism and its energetic                        |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| CO5                                                                                                                         |          | To know basic concepts of enzymes                                                                      |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| CO6                                                                                                                         |          | to understand the fundamentals function of biomolecules                                                |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                                                                        |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |
| 1                                                                                                                           | COs/POs  | a                                                                                                      | b              | c | d                  | e | f                      | g | h                  | i | j                       | k | l             |                                              |
| 2                                                                                                                           | CO1      | H                                                                                                      | M              |   |                    |   | H                      |   |                    |   |                         |   | L             |                                              |
|                                                                                                                             | CO2      |                                                                                                        |                |   |                    |   |                        |   | H                  |   |                         | H |               |                                              |
|                                                                                                                             | CO3      | H                                                                                                      |                | H |                    | H |                        |   |                    | H | H                       |   | H             |                                              |
|                                                                                                                             | CO4      | H                                                                                                      | M              |   |                    |   | H                      | H |                    |   |                         |   |               |                                              |
|                                                                                                                             | CO5      | H                                                                                                      |                |   |                    |   |                        |   |                    |   |                         | H |               |                                              |
|                                                                                                                             | CO6      | H                                                                                                      |                | H |                    |   |                        |   | H                  |   | H                       |   | M             |                                              |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                                                                       | Basic Sciences |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective (NE) |   | Open Elective | Project/ Term paper Seminar/ Internship (PR) |
|                                                                                                                             |          |                                                                                                        |                |   |                    |   | √                      |   |                    |   |                         |   |               |                                              |
| 4                                                                                                                           | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015                                                 |                |   |                    |   |                        |   |                    |   |                         |   |               |                                              |

## UNITI: ENZYMES

12

Classification - IUB system, rationale, overview and specific examples. Characteristics of enzymes, **Classification of enzymes**-enzyme substrate complex. Concept of active centre, binding sites, stereo specificity and ES complex formation. Effect of temperature, pH and substrate concentration on reaction rate. Activation energy. Transition state theory. Enzyme activity, international units, specific activity, turnover number.

## UNIT II ENZYME CATALYSIS

12

Enzyme catalysis-Factors affecting catalytic efficiency - proximity and orientation effects, distortion or strain, acid - base and nucleophilic catalysis. Isoenzymes and multiple forms of enzymes. Mechanism of action chymotrypsin, ribonuclease and **Carboxy peptidase**

### UNIT III ENZYME KINETICS

12

Michaelis - Menten Equation - form and derivation, steady state enzyme kinetics. Significance of  $V_{max}$  and  $K_m$ . Bisubstrate reactions-**Ping pong Reaction**. Graphical procedures in enzymology - advantages and disadvantages of alternate plotting. Enzyme inhibition - types of inhibitors - competitive, noncompetitive and uncompetitive, their mode of action and experimental determination.

### UNIT IV ALLOSTERIC INTERACTIONS

12

Protein ligand binding including measurements, analysis of binding isotherms, cooperativity and kinetics of allosteric enzymes. Enzyme regulation: Product inhibition, feedback control, enzyme induction and repression and covalent modification. Allosteric regulation-**Phosphofructokinase**.

### UNIT V IMMOBILIZED ENZYMES

12

Relative practical and economic advantage for industrial use, effect of partition on kinetics and performance with particular emphasis on charge and hydrophobicity (pH, temperature and  $K_m$ ). Various methods of immobilization - ionic bonding, adsorption, covalent bonding (based on R groups of amino acids), microencapsulation and gel entrapment. **Applications of immobilized enzymes**

#### TEXT BOOK:

1. Enzyme Kinetics (1995) – Palmer, London: Portland Press

#### REFERENCE BOOKS

1. Enzyme Kinetics - Dixon , 1972, wiley publishers
2. Fundamental of Enzymology – Price & Steven , 1999-Bowker company
3. The Enzymes Vol. 1 & 2 – Boyer, 1983
4. Enzyme Structure & Mechanism – Alan Fersht, 1985, W.H. Freeman
5. Enzyme Biotechnology – Tripathi, G, 2009- ABD Publishers.
6. Industrial Enzyme & their Application (1998) –Uhlig, H.
7. Enzyme 3rd Ed. (1979) – Dixon M. & Webb, E.C.

|               |                                                                                              |          |          |          |          |
|---------------|----------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC404</b> | <b>PROCESS ENGINEERING IN BIOTECHNOLOGY</b>                                                  | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 60                                                                     | 3        | 1        | 0        | 4        |
|               | Prerequisite – Engg Mathematics-I, Engg Mathematics –II, Principles of chemical Engineering. |          |          |          |          |
|               | Course Designed by – Dept. of Agricultural Biotechnology                                     |          |          |          |          |

|                                                                                                                             |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| OBJECTIVES                                                                                                                  |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| To study the development of bioprocesses                                                                                    |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                         | Students will know about the design of a fermenter.                                            |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         | Students will know about the stoichiometry and energetics of cell growth and product formation |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | To acquire the knowledge of bioprocesses                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | To analyze various parameters to be monitored and controlled during fermentation processes     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | To facilitate the design and optimization of media for various fermentation processes          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | Tto know about product optimization                                                            |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                                        | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                                                            | H                                                      | M                   | M                  |                        | M                  |                         |                    |                                              | M |   | L | M |
|                                                                                                                             | CO2                                                                                            | H                                                      | M                   | M                  | H                      | H                  |                         | M                  |                                              |   | L | L |   |
|                                                                                                                             | CO3                                                                                            | H                                                      | M                   |                    | H                      |                    |                         | M                  | M                                            | L |   | L | M |
|                                                                                                                             | CO4                                                                                            | H                                                      | M                   |                    |                        | H                  | M                       |                    |                                              |   | L |   | M |
|                                                                                                                             | CO5                                                                                            | H                                                      | M                   | M                  | H                      | H                  |                         | M                  |                                              | L | L | L |   |
|                                                                                                                             | CO6                                                                                            | H                                                      |                     |                    | H                      | H                  | M                       | M                  | L                                            |   | L |   | M |
| 3                                                                                                                           | Category                                                                                       | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                                                |                                                        |                     |                    | √                      |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                                                                       | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## **UNIT I      BASIC STOICHIOMETRY      12**

Basic stoichiometric calculations: mole, -molar mass, normality, molarity, molality, mole fraction, mass fraction, Ideal gas law, Raoult's law, Dalton's law, Amagat's law, Average molecular weight and density

## **UNIT II      STOICHIOMETRY OF BIOPROCESS      12**

Unit operation & Process - Stoichiometry of Cell growth and product formation- elemental balances- degrees of reduction of substrate and biomass-available electron balances-yield coefficients of biomass and product formation- **Fermentor** - types of bioreactor: Air lift bioreactor, fluidized bed bioreactor, **photobioreactor**.

## **UNIT III HEAT & MASS TRANSFER      12**

Modes of heat transfer- Heat transfer through compound wall- Heat flow through cylinder-Heat exchanger- Theory of Shell and Tube heat exchanger and double pipe heat exchanger- Mass transfer: Derivation of Diffusion of A through non diffusing B in gases and Liquids and Equimolar counter diffusion.

## **UNIT IV      FLUID MECHANICS      12**

Fluids –Types of fluid - Nature of flow – Reynold's experiment- Bernoulli's equation - Flow meters: Manometers - **types of manometers and function** —Venturi meter and orifice meter- Weirs and notches-Pumps: single acting and double acting pump -Centrifugal Pump -Work of consumption of single and double acting pumps.

## **UNIT V      12**

**Post-Harvest techniques** - Grading, cleaning, washing, sorting, shelling, dehulling, decortication, milling, polishing, pearling, fermentation, drying -size reduction: cryogenic grinding, crystallization, filtration, membrane processing, microfiltration, **ultra-filtration**, reverse osmosis, evaporation, distillation, mixing, clarification, coagulation- separation: sedimentation, pressing, expelling, leaching, extraction, extrusion.

### **Text book**

1. K.A.Gavhane, 2009, "Introduction to process calculations Stoichiometry" NiraliPrakasham Publications 22<sup>nd</sup>.

### **Reference Books**

1. K.A. Gavhane, 2009, "Fundamentals of chemical engineering" NiraliPrakasham Publications 22<sup>nd</sup>.
2. McCabe and Smith, 2002, "Unit operations in Chemical Engineering", Tata McHraw Hill Publications, 6<sup>th</sup> Ed.
3. K.A. Gavhane, 2009, "Unit operations I Fluid flow & Mechanical operations" NiraliPrakasham Publications, 17<sup>th</sup>.
4. Bhat & Vora, 2001, 'Stoichiometry', Tata McGraw Hill Ltd, III Ed.
5. Weblink: nptel

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|---|--------------------|------------------------|--------------------|----------|-------------------------|--------------------|-----------------------------------------|---|---|
| <b>BAC405</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>PRODUCTION OF HORTICULTURAL CROPS</b>                                                                                                |                                                        |                     |   |                    |                        | <b>L</b>           | <b>T</b> | <b>P</b>                | <b>C</b>           |                                         |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Total Contact Hours - 45                                                                                                                |                                                        |                     |   |                    |                        | <b>3</b>           | <b>0</b> | <b>0</b>                | <b>3</b>           |                                         |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Prerequisite – Physical Sciences                                                                                                        |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Course Designed by – Dept of Civil Engineering                                                                                          |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| <b>OBJECTIVES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| 1. To study the nature and facts about environment.<br>2. To find and implement scientific, technological, economic and political solutions to environmental problems.<br>3. To study the interrelationship between living organism and environment.<br>4. To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.<br>5. To study the dynamic processes and understand the features of the earth’s interior and surface.<br>6. To study the integrated themes and biodiversity, natural resources, pollution control and waste management. |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Play an important role in transferring a healthy environment for future generations                                                     |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Analyze the impact of engineering solutions in a global and societal context                                                            |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Ability to consider issues of environment and sustainable development in his personal and professional undertakings                     |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Highlight the importance of ecosystem and biodiversity                                                                                  |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | COs/POs                                                                                                                                 | a                                                      | b                   | c | d                  | e                      | f                  | g        | h                       | i                  | j                                       | k | l |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CO1                                                                                                                                     | M                                                      | M                   | M | H                  | M                      |                    | M        |                         |                    | L                                       | L | M |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CO2                                                                                                                                     | H                                                      | M                   | M | H                  | H                      |                    | M        |                         |                    | L                                       | L | M |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CO3                                                                                                                                     | H                                                      | M                   |   | H                  | H                      |                    | M        |                         |                    | L                                       | L | M |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CO4                                                                                                                                     | H                                                      | M                   |   | H                  | H                      |                    | M        |                         |                    | L                                       | L | M |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CO5                                                                                                                                     | H                                                      | M                   | M | H                  | H                      |                    | M        |                         |                    | L                                       | L | M |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | CO6                                                                                                                                     | H                                                      |                     |   | H                  | H                      |                    | M        |                         |                    | L                                       | L | M |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Category                                                                                                                                | Humanities & Social Studies (HS)                       | Basic Sciences (BS) |   | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) |          | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Approval                                                                                                                                | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |   |                    |                        |                    |          |                         |                    |                                         |   |   |

## UNIT I: INTRODUCTION

9

Horticulture –**Introduction**- Origin, definitions – role of fruit crops in national economy - pollination mechanism – fruitfulness and causes of unfruitfulness. Propagation – definition – methods - merits and demerits –**Seed dispersal**- dormancy and methods of overcoming dormancy – vegetative propagation – merits and demerits – cutting, layering, grafting and budding – rootstock influence – stock / scion relationship– micro propagation.

## UNIT II: CROP PRODUCTION TECHNIQUES IN TROPICAL FRUIT CROPS 9

Scope and importance of fruit crops- classification of fruit crops – area, production, productivity and export potential. Climate and soil requirements – varieties – propagation-**Hybrid varieties** - planting density and systems of planting -cropping systems - after care - training and pruning - water, nutrient and weed management –fertilization - special horticultural techniques - plant growth regulation - important disorders – maturity and **productivity**- post harvest management. **Crops:** Mango, Banana, Grapes, Citrus (sweet orange, mandarin, acid lime), Papaya, Indian goose berry (Aonla)

## UNIT III: CROP PRODUCTION TECHNIQUES IN SUBTROPICAL

9

Climate and soil requirements – varieties – propagation - planting density and systems of planting -cropping systems - after care - training and pruning - water, nutrient and weed management **Techniques and latest technology** - plant growth regulation - important disorders – maturity indices and harvest- post harvest management. **Crops:** Sapota, pomegranate,Guava, Pineapple, Jack, Apple, Pear, Plum.

## UNIT IV: STATUS OF PRODUCTION, PRINCIPLES OF CROP PRODUCTION 9

Scope and Importance of plantation crops - area and production- export potential- classification of plantation crops- planting and cropping systems - principles of canopy management and growth regulation. Climate and soil requirements- varieties- propagation- **nursery management**- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-intercropping -mulching-cover cropping -harvest- post harvest management and processing-**Crops:** Tea, coffee, rubber

## UNIT V: CROP PRODUCTION TECHNOLOGIES IN PLANTATION CROPS 9

Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-**intercropping and economic importance** – multi-tier cropping system-mulching-top working and other special horticultural practices- maturity indices and harvest- post harvest management and processing-**Crops:** cocoa, cashew, coconut, arecanut, oil palm and palmyrah

## Reference text books

1. Kumar, N. 2014. Introduction to Horticulture. Oxford & IBH Publishing co. Pvt. Ltd.
2. Chadha, K.L and Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vols. IIIIV., Malhotra Publ. House
3. Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India, Publishing Agency, New Delhi.
5. Veeraragavathatham, D and et al.,2004. Scientific fruit culture, Sun Associates, Coimbatore.

|                                                                                                                                                                |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|---|--------------------|------------------------|--------------------|---|-------------------------|--------------------|---|----------------------------------------------|---|
| BCE406                                                                                                                                                         | ENVIRONMENTAL STUDIES                                                                                                                   |                                                        |                     |   |                    |                        | L                  | T | P                       | C                  |   |                                              |   |
|                                                                                                                                                                | Total Contact Hours - 45                                                                                                                |                                                        |                     |   |                    |                        | 3                  | 0 | 0                       | 3                  |   |                                              |   |
|                                                                                                                                                                | Prerequisite – Physical Sciences                                                                                                        |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
|                                                                                                                                                                | Course Designed by – Dept of Civil Engineering                                                                                          |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| OBJECTIVES                                                                                                                                                     |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 7. To study the nature and facts about environment.                                                                                                            |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 8. To find and implement scientific, technological, economic and political solutions to environmental problems.                                                |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 9. To study the interrelationship between living organism and environment.                                                                                     |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 10. To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value. |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 11. To study the dynamic processes and understand the features of the earth’s interior and surface.                                                            |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 12. To study the integrated themes and biodiversity, natural resources, pollution control and waste management.                                                |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| COURSE OUTCOMES (COs)                                                                                                                                          |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| CO1                                                                                                                                                            | Play an important role in transferring a healthy environment for future generations                                                     |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| CO2                                                                                                                                                            | Analyze the impact of engineering solutions in a global and societal context                                                            |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| CO3                                                                                                                                                            | Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| CO4                                                                                                                                                            | Ability to consider issues of environment and sustainable development in his personal and professional undertakings                     |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| CO5                                                                                                                                                            | Highlight the importance of ecosystem and biodiversity                                                                                  |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                    |                                                                                                                                         |                                                        |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |
| 1                                                                                                                                                              | COs/POs                                                                                                                                 | a                                                      | b                   | c | d                  | e                      | f                  | g | h                       | i                  | j | k                                            | l |
| 2                                                                                                                                                              | CO1                                                                                                                                     | M                                                      | M                   | M | H                  | M                      |                    | M |                         |                    | L | L                                            | M |
|                                                                                                                                                                | CO2                                                                                                                                     | H                                                      | M                   | M | H                  | H                      |                    | M |                         |                    | L | L                                            | M |
|                                                                                                                                                                | CO3                                                                                                                                     | H                                                      | M                   |   | H                  | H                      |                    | M |                         |                    | L | L                                            | M |
|                                                                                                                                                                | CO4                                                                                                                                     | H                                                      | M                   |   | H                  | H                      |                    | M |                         |                    | L | L                                            | M |
|                                                                                                                                                                | CO5                                                                                                                                     | H                                                      | M                   | M | H                  | H                      |                    | M |                         |                    | L | L                                            | M |
|                                                                                                                                                                | CO6                                                                                                                                     | H                                                      |                     |   | H                  | H                      |                    | M |                         |                    | L | L                                            | M |
| 3                                                                                                                                                              | Category                                                                                                                                | Humanities & Social Studies (HS)                       | Basic Sciences (BS) |   | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) |   | Non-Major Elective (NE) | Open Elective (OE) |   | Project/ Term paper Seminar/ Internship (PR) |   |
|                                                                                                                                                                |                                                                                                                                         |                                                        |                     | √ |                    |                        |                    |   |                         |                    |   |                                              |   |
| 4                                                                                                                                                              | Approval                                                                                                                                | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |   |                    |                        |                    |   |                         |                    |   |                                              |   |

## UNIT I THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 9

Definition, scope and importance, Need for public awareness.

## **Natural Resources: Renewable And Non – Renewable Resources**

Natural resources and associated problems

- a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effect on forests and tribal people.
- b) Water resources: Use and over-utilization of surface and ground water, flood, drought conflicts over water, dams-benefits and problems.
- c) Mineral resources: Uses and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) Food resources: World food problems, changes caused by agriculture and overgrazing , effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
- e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies.
- f) Land resources: Land as a resource, Land degradation, man induced landslides, soil erosion and desertification

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

## **UNIT II ECOSYSTEMS**

**8**

Concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)-

Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics: Issues and possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

## **UNIT III BIODIVERSITY AND ITS CONSERVATION**

**7**

Introduction and Definition- genetic, species and ecosystems diversity, Biogeographical classification of India - Value biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels. India as a mega-diversity nation, Hot-spots of biodiversity -Threats to biodiversity, habitat, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation biodiversity - In-situ and Ex-situ conservation of biodiversity.

## **Environmental Pollution**

**7**

Definition, Causes, effects and control measures of :- Air Pollution, Water pollution, Soil Pollution, Marine Pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster Management : floods earthquake, cyclone and landslides.

## **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**8**

From Unsustainable to Sustainable development, Urban problems related to energy, nuclear accident and holocaust, case studies, wasteland reclamation, Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife protection Act, Forest Conservation Act, Issues involved in enforcement of environmental Legislation, public awareness –

Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel –oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes – Noise produced by fire crackers – Noise pollution – Noise level standards for fire crackers – Intensity of sound – Impact on hearing – Safety measures.

## UNIT V HUMAN POPULATION AND THE ENVIRONMENT

6

Population growth, variation among nations, population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

### TEXTBOOKS:

1. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297 0277-0, 2004.
2. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
3. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.,Ahmedabad – 380 013, India, 1989.
4. Benny Joseph, “Environmental Studies”., TATA McGraw Hill, 2010

### REFERENCES

1. Trivedi R.K., “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Vol.I and II, EnviroMedia 2009
2. Cunningham, W.P.Cooper, T.H.Gorhani, “Environmental Encyclopedia”, Jaico Publ., House, Mumbai, 2001.
3. Wager K.D. “Environmental Management”, W.B. Saunders Co., Philadelphia, USA, 1998.
4. Trivedi R.K. and P.K. Goel, “Introduction to Air Pollution”, Techno Science Publications 2013
5. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB),2001.
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
7. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
8. Jadhav, H &Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
9. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions, Web enhanced edition. 639p.
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
11. Rao M N. &Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publish Co. Pvt. Ltd. 345p.
12. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut.
13. <http://eng.mft.info/uploadedfiles/gfiles/c8e31c9e52d84c3.pdf>

| <b>BAC4L1</b> | <b>AGRICULTURAL MICROBIOLOGY LAB</b>          | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|-----------------------------------------------|----------|----------|----------|----------|
|               | Total Contact Hours - 45                      | 0        | 0        | 3        | 2        |
|               | Prerequisite- Microbiology, Molecular biology |          |          |          |          |

|                                                                                                                             |          |                                                                                    |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|---|-------------------------|---|--------------------|--|----------------------------------------------|--|
|                                                                                                                             |          | Course Designed by – Dept. of Agricultural Biotechnology                           |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| <b>OBJECTIVES-</b><br>To provide a basic understanding of microbes and their applications from the perspective of engineers |          |                                                                                    |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |          |                                                                                    |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO1                                                                                                                         |          | to understand the source of microbes and their role in biotechnology               |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO2                                                                                                                         |          | to get the knowledge of microbial diversity classification and morphology          |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO3                                                                                                                         |          | to know the visualization of microbes by different microscopes                     |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO4                                                                                                                         |          | to know the cause, symptoms, diagnosis and treatment of diseases causing pathogens |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO5                                                                                                                         |          | to get a basic knowledge of the microbial nutrition and growth                     |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO6                                                                                                                         |          | To understand about various identification methods of microorganisms               |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                                                    |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| 1                                                                                                                           | COs/POs  | a                                                                                  | b | c                   | d | e                  | f | g                      | h | i                  | j | k                       | l |                    |  |                                              |  |
| 2                                                                                                                           | CO1      |                                                                                    |   |                     |   |                    |   |                        |   |                    |   | H                       |   |                    |  |                                              |  |
|                                                                                                                             | CO2      | H                                                                                  |   |                     |   |                    |   | H                      |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO3      | H                                                                                  | H |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO4      |                                                                                    |   |                     |   |                    |   |                        |   | L                  |   |                         |   |                    |  |                                              |  |
|                                                                                                                             | CO5      |                                                                                    |   |                     |   |                    | L |                        |   |                    |   |                         | L |                    |  |                                              |  |
|                                                                                                                             | CO6      | H                                                                                  |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                                                   |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |
|                                                                                                                             |          |                                                                                    |   |                     |   |                    |   | √                      |   |                    |   |                         |   |                    |  |                                              |  |
| 4                                                                                                                           | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015                             |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |

### **LIST OF EXPERIMENTS**

1. Microscopes – handling light microscope.
2. Micrometry- measurement of microorganisms.
3. Sterilization – equipment and apparatus used for sterilization.
4. Media preparation for bacteria, fungi and actinomycetes.
5. Isolation of microorganisms-serial dilution plate technique.
6. Purification and preservation of bacteria
7. Purification and preservation of fungi.
8. Staining techniques- simple and negative staining.
9. Differential staining - Gram-staining
10. Structural staining - spore staining.
11. Morphology of bacteria-shape and cell arrangement
12. Growth of bacteria - turbidometric method.
13. Physiological characters of bacteria.
14. Biochemical characters of bacteria.
15. Identification of bacteria.

16. Identification of fungi

|                                                                                                                             |                                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|---|
| BAC4L2                                                                                                                      | PROCESS ENGINEERING LAB                                  |                                                        |                     |                    |                        |                    |                         |                    |                                              |   | L | T | P | C |
|                                                                                                                             | Total Contact Hours - 60                                 |                                                        |                     |                    |                        |                    |                         |                    |                                              |   | 0 | 0 | 3 | 2 |
|                                                                                                                             | Prerequisite – Bioprocess engg., Unit Operation          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
|                                                                                                                             | Course Designed by – Dept. of Agricultural Biotechnology |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| OBJECTIVES                                                                                                                  |                                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| To provide basic knowledge about bioprocessing                                                                              |                                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| CO1                                                                                                                         | to get knowledge on biomass                              |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| CO2                                                                                                                         | to know about enzyme kinetics                            |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| CO3                                                                                                                         | to understand about immobilization of enzyme             |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| CO4                                                                                                                         | to get idea about mass transfer                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| CO5                                                                                                                         | to know about death kinetics                             |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| CO6                                                                                                                         | to know about product optimization                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                  | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |   |
| 2                                                                                                                           | CO1                                                      |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   | H |   |   |
|                                                                                                                             | CO2                                                      | H                                                      |                     |                    |                        |                    |                         | H                  |                                              |   |   |   |   |   |
|                                                                                                                             | CO3                                                      | H                                                      | H                   |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
|                                                                                                                             | CO4                                                      |                                                        |                     |                    |                        |                    |                         |                    |                                              | L |   |   |   |   |
|                                                                                                                             | CO5                                                      |                                                        |                     |                    |                        |                    | L                       |                    |                                              |   |   |   | L |   |
|                                                                                                                             | CO6                                                      | H                                                      |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |
| 3                                                                                                                           | Category                                                 | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |   |
|                                                                                                                             |                                                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   | √ |   |
| 4                                                                                                                           | Approval                                                 | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |   |

## LIST OF EXPERIMENTS

1. Estimation of biomass production
2. Plate assay for amylase enzyme.
3. Enzyme kinetics
4. Immobilization of enzyme.
5. Solid state fermentation.
6. Production of wine
7. Estimation of alcohol concentration in wine.
8. Estimation of acid concentration in wine.
9. Production of soap and analyse its properties.
10. Production of biofuel and analyse its properties.
11. Activity of Various Natural Substances on the Growth of *Malassezia furfur*
12. Production of biofertilizer and analyse plant growth.
13. Leaching.
14. Determination of Coefficient of discharge ( $C_d$ ) of notch.
15. Study of shell and tube heat exchanger.

|                                                                                                                                          |                                                                                                |   |   |   |   |   |   |          |          |          |          |   |   |
|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---|---|---|---|---|---|----------|----------|----------|----------|---|---|
| <b>BAC4L3</b>                                                                                                                            | <b>PLANT MOLECULAR BIOLOGY LAB</b>                                                             |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |   |
|                                                                                                                                          | Total Contact Hours - 60                                                                       |   |   |   |   |   |   | 0        | 0        | 3        | 2        |   |   |
|                                                                                                                                          | Prerequisite – Biochemistry, Bioorganic chemistry                                              |   |   |   |   |   |   |          |          |          |          |   |   |
|                                                                                                                                          | Course Designed by – Dept. of Agricultural Biotechnology                                       |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>OBJECTIVES</b><br>To provide a basic understanding of molecular level of DNA and their applications from the perspective of engineers |                                                                                                |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                             |                                                                                                |   |   |   |   |   |   |          |          |          |          |   |   |
| CO1                                                                                                                                      | to understand the fundamentals of central dogma of biological systems                          |   |   |   |   |   |   |          |          |          |          |   |   |
| CO2                                                                                                                                      | to know the concept of cell replication,transcription and translation                          |   |   |   |   |   |   |          |          |          |          |   |   |
| CO3                                                                                                                                      | to comprehend DNA and its role in functioning of a cell                                        |   |   |   |   |   |   |          |          |          |          |   |   |
| CO4                                                                                                                                      | to know the functioning of regulatory factors and its application in maintaining cell activity |   |   |   |   |   |   |          |          |          |          |   |   |
| CO5                                                                                                                                      | to get a basic knowledge of the DNA and RNA                                                    |   |   |   |   |   |   |          |          |          |          |   |   |
| CO6                                                                                                                                      | to get a basic knowledge of the proteins                                                       |   |   |   |   |   |   |          |          |          |          |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low              |                                                                                                |   |   |   |   |   |   |          |          |          |          |   |   |
| 1                                                                                                                                        | COs/POs                                                                                        | a | b | c | d | e | f | g        | h        | i        | j        | k | l |
| 2                                                                                                                                        | CO1                                                                                            | H | M | H | H | H |   | H        | H        |          |          |   | H |
|                                                                                                                                          | CO2                                                                                            |   | H | H |   |   | M |          |          |          |          | M |   |
|                                                                                                                                          | CO3                                                                                            | H |   | M | M | H |   |          |          |          | M        |   |   |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
|   | CO4      |                                                        | L                   | L                  |                        |                    |                         | L                  | L                                            | L |   |   | L |
|   | CO5      |                                                        |                     | H                  | H                      |                    | M                       |                    |                                              | H |   | M | M |
|   | CO6      | M                                                      | M                   | M                  |                        |                    |                         |                    | M                                            |   | M | M |   |
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|   |          |                                                        |                     |                    | √                      |                    |                         |                    |                                              |   |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

### **LIST OF EXPERIMENTS**

1. Extraction of plant genomic DNA.
2. Extraction of Bacterial genomic DNA
3. Extraction of Animal DNA
4. Agarose gel electrophoresis.
5. Restriction Digestion of DNA.
6. Ligation of E-CoR1 digest of  $\lambda$ DNA
7. Isolation of plasmid DNA by alkaline lysis and characterization
8. Effect of UV radiation on bacterial survival (induced mutagenesis).
9. Transformation.
10. SDS-PAGE slab gel electrophoresis of proteins

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                         |          |          |          |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC4S1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>TECHNICAL SEMINAR I</b>                                              | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Total Contact Hours - 30                                                | 0        | 0        | 2        | 1        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Prerequisite – General Biochemistry, General Microbiology, Cell Biology |          |          |          |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Course Designed by– Dept. of Agricultural Biotechnology                 |          |          |          |          |
| <b>OBJECTIVES</b><br>To enable students to create the habit of exploring new avenues of biotechnology and to improve their presentation skills                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                         |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b> <ul style="list-style-type: none"><li>• It is a one credit course offered in the IV Semester</li><li>• Each student will be allocated topics for presentation</li><li>• There are 2 hours allocated per week for the students give their presentation. This will be considered for the award of internal marks.</li><li>• The final topic will be presented on the day of the external examination in the presence of the internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic.</li></ul> |                                                                         |          |          |          |          |

|                                                                                                                             |                                                                                           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|----------|----------|----------|----------|
| <b>BMA505</b>                                                                                                               | <b>PROBABILITY AND STATISTICS</b>                                                         |                                                        |                     |                    |                        |                    |                         |                    |                                              |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             | Total Contact Hours - 60                                                                  |                                                        |                     |                    |                        |                    |                         |                    |                                              |   | 3        | 1        | 0        | 4        |
|                                                                                                                             | Prerequisite – Engg Mathematics-I &II                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
|                                                                                                                             | Course Designed by – Dept. of Mathematics                                                 |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                           |                                                                                           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| To provide a basic knowledge of probability and statistics                                                                  |                                                                                           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO1                                                                                                                         | to understand the importance and the application of Probability in Engineering            |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO2                                                                                                                         | to know Discrete and Continuous Random variables, Random Processes and their applications |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO3                                                                                                                         | to know about testing the parameters based on samples                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO4                                                                                                                         | to know about techniques of sampling, and estimating and testing the parameters           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO5                                                                                                                         | to know about various testing methods                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO6                                                                                                                         | To know about how design of experiments are to be analysed                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                           |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| 1                                                                                                                           | COs/POs                                                                                   | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j        | k        | l        |          |
| 2                                                                                                                           | CO1                                                                                       | H                                                      | M                   | M                  | H                      | M                  |                         |                    | H                                            | H | L        | L        | H        |          |
|                                                                                                                             | CO2                                                                                       | H                                                      | M                   | M                  |                        |                    |                         | H                  |                                              |   |          |          |          |          |
|                                                                                                                             | CO3                                                                                       | H                                                      |                     |                    | H                      | H                  | H                       | H                  |                                              |   | L        | L        | M        |          |
|                                                                                                                             | CO4                                                                                       | H                                                      | M                   |                    |                        | H                  |                         |                    | H                                            |   | L        | H        | M        |          |
|                                                                                                                             | CO5                                                                                       | H                                                      | M                   | M                  | H                      | H                  |                         | M                  |                                              |   |          |          |          |          |
|                                                                                                                             | CO6                                                                                       | H                                                      |                     |                    | H                      |                    | M                       | M                  |                                              | H | M        | L        | M        |          |
| 3                                                                                                                           | Category                                                                                  | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |          |          |          |          |
|                                                                                                                             |                                                                                           | √                                                      |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| 4                                                                                                                           | Approval                                                                                  | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |

## UNIT I PROBABILITY AND RANDOM VARIABLES

12

Probability concepts, Random Variables, discrete and continuous functions of random variables. Moment generating function of Binomial, Poisson, Geometric, Uniform, Exponential and Normal distribution (Problems)

## UNIT II TWO DIMENSIONAL RANDOM VARIABLES

12

Joint distributions - Marginal and Conditional distributions – Expectation and conditional expectations. Transformation of Random Variable, Central limit theorem (for independent and identically distributed random variables)

### **UNIT III BASIC STATISTICS 12**

Measures of central tendency – Measures of dispersion – Moments, Skewness & Kurtosis – Correlation, and Regression and Rank Correlation.

### **UNIT IV TESTING OF HYPOTHESIS 12**

Introduction – Large sample tests based on normal distribution - Test for single mean, difference between means, proportion, difference between proportions, standard deviation, difference between standard deviation. Chi-square test for goodness of fit, independence of attributes.

### **UNIT V ANALYSIS OF VARIANCE 12**

Small sample tests based on T and F distribution - Test for, single mean, difference between means, Paired t-test, test for equality of variances, ANOVA – one – way classification, Two-way classification.

#### **Text Books**

1. S.C.Gupta & V.K.Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand and Sons, New Delhi, 2003. [Units I to III].
2. S.C. Gupta and V.K. Kapoor, “Applied Statistics”. Sultan Chand and Sons, New Delhi 2004 [Units IV & V].
3. Douglas C. Montgomery. “Design and Analysis of Experiments, Student Solutions Manual”, 8<sup>th</sup> Edn: Wiley India Pvt Ltd., New Delhi-2. 2012.

#### **Reference Books**

1. Veerarajan T. “Probability Statistics and Random Processes” Tata McGraw Hill, New Delhi 2003.
2. W.W. Daniel, “Biostatistics-A foundation for Analysis of Health Sciences”, John Wiley and Sons, New Delhi 2000.
3. Douglas C. Montgomery and George C. Runger. “Applied Statistics and Probability For Engineers”, 6<sup>th</sup> Edn. Wiley India Pvt Ltd., New Delhi-2. 2010.
4. Tirupathi R.Chandrauptta. “Quality and Reliability in Engineering”. Book Vistas, New Delhi.

|               |                                  |          |          |          |          |
|---------------|----------------------------------|----------|----------|----------|----------|
| <b>BAC501</b> | <b>PLANT GENETIC ENGINEERING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 45         | 3        | 0        | 0        | 3        |

|                                                                                                                             |                                                                                                                   |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
|                                                                                                                             |                                                                                                                   | Prerequisite – Molecular biology, Cell biology, Microbiology |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|                                                                                                                             |                                                                                                                   | Course Designed by – Dept. of Industrial Biotechnology       |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| <b>OBJECTIVES</b>                                                                                                           |                                                                                                                   |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers         |                                                                                                                   |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                                                   |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                         | to understand the fundamentals of genetic engineering                                                             |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         | to apply the concept of recombinant DNA in plant, animal and microbial systems and growth in real life situations |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | to get the knowledge of molecular scissors and its role in creating transgenic products                           |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | To know the techniques related to screening of recombinant products                                               |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to get a basic knowledge of the applications of transgenes in agriculture                                         |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | to know about gene transfer methods                                                                               |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                                   |                                                              |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                                                           | a                                                            | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                                                                               | H                                                            | M                   | M                  | H                      | M                  |                         | M                  | H                                            | H | H | L | H |
|                                                                                                                             | CO2                                                                                                               | H                                                            | M                   | M                  | H                      | H                  | M                       | M                  | H                                            |   | L |   |   |
|                                                                                                                             | CO3                                                                                                               | H                                                            | M                   |                    | H                      |                    |                         |                    |                                              | H | M | L | H |
|                                                                                                                             | CO4                                                                                                               | H                                                            | M                   |                    |                        | H                  | H                       | M                  | M                                            |   | M | M | M |
|                                                                                                                             | CO5                                                                                                               | H                                                            | M                   | M                  |                        | H                  |                         | M                  |                                              | M |   | L | H |
|                                                                                                                             | CO6                                                                                                               | H                                                            |                     |                    | H                      | H                  |                         |                    | L                                            |   |   |   | M |
| 3                                                                                                                           | Category                                                                                                          | Humanities & Social Studies (HS)                             | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                                                                   |                                                              |                     |                    |                        |                    |                         |                    |                                              | √ |   |   |   |
| 4                                                                                                                           | Approval                                                                                                          | 37 <sup>th</sup> Meeting of Academic Council, May 2015       |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I CLONING

9

Introduction to Genetic engineering.- Restriction enzymes, Restriction sites, Linkers and adapters, **Homopolymer tailing**. Markers for screening- Vectors- Characteristics- plasmid: EcoIi - .pBR 322, Cosmid- Shuttle vectors, pblue script vectors, Expression vectors, BAC, YAC, MAC. Characterization of recombinant clones by Southern, Northern, Western Blotting

## UNIT II CONSTRUCTION OF LIBRARIES

9

Overlapping and Non overlapping DNA fragments, Genomic library- Purification and Separation of RNA. cDNA library construction, Genome mapping, Polymerase Chain Reaction – methods, types and Applications. Semi quantitative and Real time PCR, **RT-PCR and applications**

### UNIT III NUCLEIC ACID SEQUENCING AND LABELLING

9

Nucleic acid sequencing methods-Maxam Gilbert chemical sequencing, Sanger dideoxy enzymatic method- DNA Labelling: Nick translation, RNA labeling and Fluorescent labeling and non isotopic labeling methods.-**Fluorescent labelling Techniques**

### UNIT IV GENE TRANSFER IN PLANTS

9

Method of gene transfer to plants- agrobacterium mediated / chemical mediated, Biolistics. Transgenic plants- Ri and Ti plasmids, Screening of recombinants -Direct and indirect methods, Single cell proteins using fungi and **economic importance**

### UNIT V APPLICATIONS

9

Transgenic plants for insect, disease, stress & herbicide resistance – edible vaccines and plantibodies – methods of crop improvement through genetic engineering – Fruit ripening- Antisense RNA technology

### TEXT BOOK

1. Adrian Slater, 2006, “Plant biotechnology”, 3<sup>rd</sup> Ed,
1. Brown TA, 2000, “Gene cloning-and introduction” VNR (U.K) Co Ltd.

### REFERENCE BOOKS

2. C. B. Nirmala, G. Rajalakshmi, Chandra Karthick. 2009,” Plant Biotechnology
3. Setlow JK,2004, “Genetic engineering: principles and methods” Springer.
4. Fridal R,2006, “Genetic engineering” Lerner publications.
5. LeVine H,2006, “Genetic engineering-A reference handbook” ABC-CLIO.
6. Levine AD,2009, “Cloning” The Rosen publishing group, 1<sup>st</sup>.
7. Weblink: npTEL

|                                                                                                     |                                                              |          |          |          |          |
|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC502</b>                                                                                       | <b>PLANT PATHOLOGY AND DISEASE MANAGEMENT</b>                | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                     | Total Contact Hours - 45                                     | 3        | 0        | 0        | 3        |
|                                                                                                     | Prerequisite – Microbiology                                  |          |          |          |          |
|                                                                                                     | Course Designed by – Dept of Industrial Biotechnology        |          |          |          |          |
| <b>OBJECTIVES:</b> To provide a basic knowledge on plant diseases, symptoms and causative organisms |                                                              |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                        |                                                              |          |          |          |          |
| CO1                                                                                                 | to understand the concept of pathogenesis                    |          |          |          |          |
| CO2                                                                                                 | to know about the types of fungal diseases in plants         |          |          |          |          |
| CO3                                                                                                 | to understand about the various bacterial diseases in plants |          |          |          |          |
| CO4                                                                                                 | to study the various aspects of viral diseases               |          |          |          |          |

|                                                                                                                             |                                                          |                                                        |                        |                       |                           |                       |                            |                       |                                                       |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|------------------------|-----------------------|---------------------------|-----------------------|----------------------------|-----------------------|-------------------------------------------------------|---|---|---|---|
| CO5                                                                                                                         | to understand the concept of disease management          |                                                        |                        |                       |                           |                       |                            |                       |                                                       |   |   |   |   |
| CO6                                                                                                                         | to know the measures taken to control diseases in plants |                                                        |                        |                       |                           |                       |                            |                       |                                                       |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                          |                                                        |                        |                       |                           |                       |                            |                       |                                                       |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                  | a                                                      | b                      | c                     | d                         | e                     | f                          | g                     | h                                                     | i | j | k | l |
| 2                                                                                                                           | CO1                                                      | H                                                      | M                      | M                     | H                         |                       | H                          | H                     | H                                                     | H | M | L | M |
|                                                                                                                             | CO2                                                      | H                                                      | M                      | M                     | H                         |                       |                            |                       |                                                       |   |   | L | M |
|                                                                                                                             | CO3                                                      | H                                                      |                        |                       |                           | H                     |                            |                       | H                                                     | L |   |   |   |
|                                                                                                                             | CO4                                                      | H                                                      | M                      |                       |                           |                       | M                          | M                     |                                                       |   |   | L |   |
|                                                                                                                             | CO5                                                      | H                                                      | M                      | M                     |                           | H                     |                            |                       |                                                       | M | L |   |   |
|                                                                                                                             | CO6                                                      | H                                                      |                        |                       |                           | H                     |                            | L                     | M                                                     |   | L | L | M |
| 3                                                                                                                           | Category                                                 | Humanities &<br>Social Studies<br>(HS)                 | Basic Sciences<br>(BS) | Engg Sciences<br>(ES) | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective (NE) | Open Elective<br>(OE) | Project/ Term<br>paper<br>Seminar/<br>Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                          |                                                        |                        |                       | √                         |                       |                            |                       |                                                       |   |   |   |   |
| 4                                                                                                                           | Approval                                                 | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                        |                       |                           |                       |                            |                       |                                                       |   |   |   |   |

## UNIT I: INTRODUCTION AND PATHOGENESIS

9

Plant Pathology-Definition-History of plant Pathology-causes of plant diseases-Biotic and abiotic; Pathogenesis-Mode of infection-pre penetration, penetration and post penetration; Effect of pathogen on physiological functions of the plants; Role of enzymes and toxins on disease development-Plant defense mechanisms.

## UNIT II: FUNGAL DISEASES IN PLANTS

9

General characters of fungi-structure, Reproduction – outline of asexual and sexual reproduction ; Molecular phylogeny of fungi; Fungal diseases- Damping off, Downy mildews, White Rusts, Powdery Mildew, Rots, smuts, Bunt, Rust, Wilt, Head blight, Root rots, Leaf spots, Leaf blights, Anthracnoses, Galls-Symptoms-causative organisms –Pathogenesis.

## UNIT III: BACTERIAL DISEASES IN PLANTS

9

**General Features of Phytopathogenic bacteria** ;Bacterial diseases-Blight, Leaf streak, Citrus canker, Black rot, Wilt, Brown rot, Yellow ear rot, Black leg, Fire blight of Apples and pears, Crown gall, Stalk rot, scab, Ratoon stunting of sugarcane-Angular leaf spot-Symptoms-causative organisms –Pathogenesis.

**UNIT IV: VIRAL DISEASES IN PLANTS AND OTHER CAUSATIVE AGENTS****9**

Viral diseases –Mosaic disease, Leaf roll, Leaf curl, Bunchy disease-Tristeza of citrus -symptoms-causative organisms-pathogenesis; General characters and symptoms of candidatus phytoplasma – spiroplasma-algae-viroids-Phanerogamic parasites, Vectors -types and **Mode of spread. of diseases**

**UNIT V: PLANT DISEASE MANAGEMENT****9**

Principles and Methods of plant disease management –Avoidance-Exclusion-Eradication of pathogens-Protection –Resistance; Management of plant diseases –Regulatory-cultural-biological-physical-chemical strategies; **Seed health maintenance system** –Resistance Breeding - Integrated disease management.

**References**

1. Agrios, G.N. 2005. Plant Pathology – (5<sup>th</sup> Edition). Academic Press, New York.
2. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. 2010 Introductory Mycology. John Wiley and Sons Ltd., N.York.
3. Alice D, and Jeyalakshmi C 2014. Plant Pathology. A.E Publications, Coimbatore
4. Dube, H.C. 2009. A textbook of Fungi, Bacteria and Viruses, Vikas Publishing House P. Ltd, New Delhi.
5. Mehrotra, R.S. and Aneja, K.R. 1990. An Introduction to Mycology, Wiley E.Ltd. New Delhi.
6. Singh, R.S. 1982. Plant Pathogens – The Fungi. Oxford and IBH Publishing Co., New Delhi.
7. Vidyasekaran, P. 1993. Principles of Plant Pathology –. CBS Publishers & Distributors, New Delhi.

|                                                                                                                             |         |                                                           |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| BAC503                                                                                                                      |         | INTRODUCTION TO SILVICULTURE                              |   |   |   |   |   | L | T | P | C |   |   |
|                                                                                                                             |         | Total Contact Hours - 60                                  |   |   |   |   |   | 3 | 1 | 0 | 4 |   |   |
|                                                                                                                             |         | Prerequisite – Environmental studies, Agricultural Botany |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                             |         | Course Designed by – Dept. of Industrial Biotechnology    |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES: To provide basic understanding on Silvicultural practices                                                       |         |                                                           |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |         |                                                           |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                         |         | to understand basic concepts in forestry                  |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                         |         | to know about the interaction between forest and people   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                         |         | to know about the concept of agroforestry                 |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                         |         | to know about agroforestry species and forest mensuration |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                         |         | to know about the agroforestry practices                  |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                         |         | to know about the applications of agroforestry            |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |         |                                                           |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                           | COs/POs | a                                                         | b | c | d | e | f | g | h | i | j | k | l |
| 2                                                                                                                           | CO1     | H                                                         | M | M | H | M |   | M | H | H |   | M | M |

|   |          |                                                        |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |
|---|----------|--------------------------------------------------------|-------------------|--------------------------|---------------------------|-----------------------|-------------------------------|------------------|----------------------------------------------------------|---|---|---|---|
|   | CO2      | H                                                      |                   | M                        | M                         | H                     | M                             |                  |                                                          |   |   | M |   |
|   | CO3      | H                                                      | M                 |                          |                           | H                     |                               |                  | M                                                        | M | M |   | H |
|   | CO4      | H                                                      |                   |                          | M                         | M                     | M                             |                  | M                                                        |   |   | L | M |
|   | CO5      | H                                                      | M                 | M                        | M                         | L                     |                               | L                | L                                                        | L | M | M | L |
|   | CO6      | H                                                      | L                 | M                        |                           |                       |                               | L                |                                                          |   |   |   | L |
| 3 | Category | Humanities<br>& Social<br>Studies (HS)                 | Basic<br>Sciences | Engg<br>Sciences<br>(ES) | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective<br>(NE) | Open<br>Elective | Project/<br>Term paper<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |
|   |          |                                                        |                   |                          | √                         |                       |                               |                  |                                                          |   |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                   |                          |                           |                       |                               |                  |                                                          |   |   |   |   |

## UNIT I INTRODUCTION TO FORESTRY

12

Forest – Forestry – Definition, objectives, classification and historical perspectives in India- Role of forest – tangible and intangible benefits- Geographical distribution of world and Indian forests – Forest types – definition and major forest types of India - Forest cover of India as per Forest Survey of India - Definition of Silvics and Silviculture – objectives – its relation with other branches of forestry - International forestry organizations.

## UNIT II FORESTS AND PEOPLE

12

Social forestry – Definition, history, objectives – Components – Farm forestry, Extension forestry, Community forestry, Recreation forestry, Urban forestry – Benefits of social forestry - Important social forestry schemes implemented in India - Definition, origin and evolution of JFM in India – Salient features of JFM – Organisational structure in JFM- Benefit sharing mechanism

## UNIT III AGROFORESTRY CONCEPT AND SYSTEMS

12

Land use and land capability classification - Agroforestry – definition and scope – History of agroforestry – Components of agroforestry, benefits and limitations - Overview of **world** agroforestry - traditional agroforestry practices in Asia and India - Agroforestry system classification – structural, functional, ecological and socio-economic basis

## UNIT IV AGROFORESTRY TREE SPECIES AND MENSURATION

12

Important farm grown trees - Silvicultural characters – Regeneration techniques – Tending – Rotation – Yield and Uses of *Tectona grandis*, *Santalum album*, *Casuarina* species, *Eucalyptus* species, *Azadirachta indica*, *Melia dubia*, *Leucaena leucocephala*, *Aibizia lebbeck*, *Acacia nilotica*, *Acacia leucophloea*, *Acacia auriculiformis*, *Ailanthus excelsa*, *Dalbergia sissoo*,

*Gmelina aroborea* and *Pterocarpus marsupium* - Forest Mensuration – definition, objectives – Diameter, girth and height measurement methods–standard rules governing breast height measurement – Volume estimation in standing and felled trees

## UNIT V AGROFORESTRY PRACTICES

12

Agroforestry practices for arid and semi arid regions – Agroforestry for problem soils - salt affected soils, waterlogged areas – Multifunctional agroforestry – green manure, fuel wood and fodder production – agroforestry for soil and water conservation, wasteland development – Carbon sequestration through agroforestry approaches – Timber transit rules for farm grown trees - National Agroforestry policy, 2014

### Text Books

1. Divya, M.P., K.T.Parthiban, K.Srinivasan, K.Vanangamudi and M.Govinda Rao. 2008. A text book on Social Forestry and Agroforestry. Satish Publishers, Delhi
2. Dwivedi, A.P. 1992. Agroforestry Principles and Practices. oxford & IBH publishing Co., New Delhi
3. Khanna, L. S. 1991. Principles and Practice of Silviculture. Khanna Bandhu, Dehradun.
4. Chaturvedi, A. N and Khanna, L. S. 2000. Forest Mensuration. International Book Distributors, Dehradun.

|                                                                                                                             |                                                           |   |   |   |   |   |   |   |   |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|---|---|---|---|---|---|---|---|---|----------|----------|----------|----------|
| <b>BAC505</b>                                                                                                               | <b>PLANT CELL AND TISSUE CULTURE</b>                      |   |   |   |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             | Total Contact Hours - 45                                  |   |   |   |   |   |   |   |   |   | 3        | 0        | 0        | 3        |
|                                                                                                                             | Prerequisite – Basic sciences, microbiology               |   |   |   |   |   |   |   |   |   |          |          |          |          |
|                                                                                                                             | Course Designed by – Dept. of Industrial Biotechnology    |   |   |   |   |   |   |   |   |   |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                           |                                                           |   |   |   |   |   |   |   |   |   |          |          |          |          |
| To provide a knowledge about tissue culture and its applications                                                            |                                                           |   |   |   |   |   |   |   |   |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                           |   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO1                                                                                                                         | to understand the uses of tissue culture                  |   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO2                                                                                                                         | to know about the concept of variation                    |   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO3                                                                                                                         | to know about the types of culture                        |   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO4                                                                                                                         | to study about protoplast culture                         |   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO5                                                                                                                         | to get knowledge about the applications of tissue culture |   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO6                                                                                                                         | to get ideas about various importance of tissue culture   |   |   |   |   |   |   |   |   |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                           |   |   |   |   |   |   |   |   |   |          |          |          |          |
| 1                                                                                                                           | COs/POs                                                   | a | b | c | d | e | f | g | h | i | j        | k        | l        |          |
| 2                                                                                                                           | CO1                                                       | H | M | M | H | M |   | M | L | M | L        | L        | M        |          |

|   |          |                                                        |                           |                          |                           |                          |                               |                          |                                                          |   |   |   |   |
|---|----------|--------------------------------------------------------|---------------------------|--------------------------|---------------------------|--------------------------|-------------------------------|--------------------------|----------------------------------------------------------|---|---|---|---|
|   | CO2      | H                                                      | M                         | M                        | H                         | H                        |                               |                          |                                                          |   |   | L | M |
|   | CO3      | H                                                      | M                         |                          | H                         | H                        |                               | M                        | H                                                        | H | L |   |   |
|   | CO4      | H                                                      | L                         |                          | H                         |                          |                               | M                        |                                                          |   | L | L | M |
|   | CO5      | H                                                      | M                         | M                        | H                         | H                        |                               |                          |                                                          |   | L |   | M |
|   | CO6      | H                                                      |                           |                          | H                         | H                        | L                             | M                        | M                                                        | L |   | L |   |
| 3 | Category | Humanities<br>& Social<br>Studies (HS)                 | Basic<br>Sciences<br>(BS) | Engg<br>Sciences<br>(ES) | Professional<br>Core (PC) | Core<br>Elective<br>(CE) | Non-Major<br>Elective<br>(NE) | Open<br>Elective<br>(OE) | Project/<br>Term paper<br>Seminar/<br>Internship<br>(PR) |   |   |   |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                           |                          |                           |                          |                               |                          |                                                          |   |   |   |   |

## UNIT I INTRODUCTION

9

History-organization of tissue culture lab-sterilization methods-lab requirements: equipments, culture vessels-culture media: constitution, types of media, preparation: MS medium, White's, Gamborg, Nitsch medium-**Plant growth enhancers**- Auxins - Cytokinins – Gibbrellins - Abscissic acid - Ethylene – Polyamines

## UNIT II TISSUE CULTURE AND VARIATION

9

Tissue culture as a source of genetic variability: somoclonal and gametoclonal variation, sources and causes of variation, **selection and screening of variants**-micropropagation as a tool of in vitro multiplication

## UNIT III TYPES OF CULTURE

9

General terms in Tissue culture-embryogenesis and organogenesis-cytodifferentiation-callus culture-anther culture-haploid culture-embryo culture-meristem culture-single cell culture.**pollen culture**

## UNIT IV PROTOPLAST CULTURE

9

Protoplast isolation, culture and fusion-selection of hybrid cells –regeneration of hybrid plants-somatic hybridization and cybridization –somatic embryogenesis and artificial seeds

## UNIT V APPLICATIONS OF TISSUE CULTURE

9

Production of plants for crop improvement- secondary metabolite production through plant cell cultures-presentation of plant genetic resources-Gene conservation bank-application in plant pathology and **crop improvement**

## TEXT BOOKS

1. Plant Biotechnology – S Ignacimuthu, S J Oxford and IBH, New Delhi, 1996.
2. Applied Biotechnology and Plant Genetics – M Sudhir, Domain publishers & distributors, 2000

## REFERENCE BOOKS

1. S.S. Purohit, Textbook of Plant Biotechnology, 2015, Bio Green Books
3. Plant Biotechnology: Recent Advances – P C Trivedi, Panima publishing corporation, 2000

|                                                                                                                     |                                                                                                                                       |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
|---------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|----------|--------------------|----------|-------------------------|---|--------------------|--|----------------------------------------------|--|
| <b>BAC5L1</b>                                                                                                       | <b>PLANT GENETIC ENGINEERING LAB</b>                                                                                                  |                                                                                                                             |   |                     |   |                    |   | <b>L</b>               | <b>T</b> | <b>P</b>           | <b>C</b> |                         |   |                    |  |                                              |  |
|                                                                                                                     | Total Contact Hours - 45                                                                                                              |                                                                                                                             |   |                     |   |                    |   | 0                      | 0        | 3                  | 2        |                         |   |                    |  |                                              |  |
|                                                                                                                     | Prerequisite – Molecular biology,rDNATechnology,Microbiology.                                                                         |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
|                                                                                                                     | Course Designed by – Dept. of Agricultural Biotechnology                                                                              |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| <b>OBJECTIVES</b>                                                                                                   |                                                                                                                                       |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| To provide a basic understanding of recombinant mechanisms and their applications from the perspective of engineers |                                                                                                                                       |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                        |                                                                                                                                       |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO1                                                                                                                 | to understand the fundamentals of genetic engineering                                                                                 |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO2                                                                                                                 | to apply the concept of recombinant DNA IN plant, animal and microbial systems and growth in real life situations                     |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO3                                                                                                                 | to get the knowledge of molecular scissors and its role in creating transgenic products                                               |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO4                                                                                                                 | to know the techniques related to screen the recombinant products.                                                                    |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO5                                                                                                                 | to get a basic knowledge of the applications of transgenes in agriculture, health care and biological products in relevant industries |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO6                                                                                                                 | To get knowledge about PCR                                                                                                            |                                                                                                                             |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
|                                                                                                                     |                                                                                                                                       | Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| 1                                                                                                                   | COs/POs                                                                                                                               | a                                                                                                                           | b | c                   | d | e                  | f | g                      | h        | i                  | j        | k                       | l |                    |  |                                              |  |
| 2                                                                                                                   | CO1                                                                                                                                   | H                                                                                                                           | M | M                   | H |                    | H | M                      | H        | H                  | L        | L                       | M |                    |  |                                              |  |
|                                                                                                                     | CO2                                                                                                                                   | H                                                                                                                           | M |                     |   |                    | L |                        | H        | M                  | L        |                         |   |                    |  |                                              |  |
|                                                                                                                     | CO3                                                                                                                                   | H                                                                                                                           | M | H                   | H | H                  | H | M                      | H        | H                  | L        |                         |   |                    |  |                                              |  |
|                                                                                                                     | CO4                                                                                                                                   | H                                                                                                                           |   |                     | H | H                  | H | M                      | M        | M                  |          | L                       | M |                    |  |                                              |  |
|                                                                                                                     | CO5                                                                                                                                   | H                                                                                                                           | M | M                   | H |                    |   |                        |          | L                  | L        | L                       |   |                    |  |                                              |  |
|                                                                                                                     | CO6                                                                                                                                   | H                                                                                                                           |   |                     | H | H                  | H | M                      |          |                    | L        |                         | M |                    |  |                                              |  |
| 3                                                                                                                   | Category                                                                                                                              | Humanities & Social Studies (HS)                                                                                            |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |          | Core Elective (CE) |          | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |
|                                                                                                                     |                                                                                                                                       |                                                                                                                             |   |                     |   |                    |   | √                      |          |                    |          |                         |   |                    |  |                                              |  |

|   |          |                                                        |
|---|----------|--------------------------------------------------------|
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |
|---|----------|--------------------------------------------------------|

### **LIST OF EXPERIMENTS**

1. Extraction of DNA
2. Agarose gel electrophoresis of DNA
3. Restriction digestion of DNA
4. Ligation of digested DNA
5. Preparation of competent cell
6. Transformation using Bacteria
7. Southern hybridization
8. AFLP, GFP cloning
9. Polymerase Chain reaction

|                                                                                                                             |                                                                        |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|----------|--------------------|----------|-------------------------|---|--------------------|--|----------------------------------------------|--|
| <b>BAC5L2</b>                                                                                                               | <b>PLANT CELL AND TISSUE CULTURE LAB</b>                               |                                                        |   |                     |   |                    |   |                        | <b>L</b> | <b>T</b>           | <b>P</b> | <b>C</b>                |   |                    |  |                                              |  |
|                                                                                                                             | Total Contact Hours - 45                                               |                                                        |   |                     |   |                    |   |                        | 0        | 0                  | 3        | 2                       |   |                    |  |                                              |  |
|                                                                                                                             | Prerequisite – Biochemistry, Microbiology, Environmental Biotechnology |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
|                                                                                                                             | Course Designed by – Dept. of Agricultural Biotechnology               |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| <b>OBJECTIVES:</b> To provide knowledge about environmental science and technology                                          |                                                                        |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                        |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO1                                                                                                                         | to know about analysis of water                                        |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO2                                                                                                                         | to understand about microbial examination of effluent                  |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO3                                                                                                                         | to get basic idea about adsorption of dye                              |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO4                                                                                                                         | to know about microbial remediation                                    |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO5                                                                                                                         | to get basic idea about bioremediation                                 |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| CO6                                                                                                                         | to know about analysis of soil                                         |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                        |                                                        |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |
| 1                                                                                                                           | COs/POs                                                                | a                                                      | b | c                   | d | e                  | f | g                      | h        | i                  | j        | k                       | l |                    |  |                                              |  |
| 2                                                                                                                           | CO1                                                                    | H                                                      | M | M                   | H | M                  | M |                        | M        | H                  |          | L                       |   |                    |  |                                              |  |
|                                                                                                                             | CO2                                                                    | H                                                      | M | M                   | H | H                  |   | M                      |          |                    | L        | L                       |   |                    |  |                                              |  |
|                                                                                                                             | CO3                                                                    | H                                                      | M |                     | H |                    | M | M                      |          |                    |          |                         | M |                    |  |                                              |  |
|                                                                                                                             | CO4                                                                    | H                                                      | M |                     | H | H                  |   |                        | L        | M                  |          | L                       | M |                    |  |                                              |  |
|                                                                                                                             | CO5                                                                    | H                                                      | M | M                   | H | H                  | M | M                      |          |                    | L        |                         | M |                    |  |                                              |  |
|                                                                                                                             | CO6                                                                    | H                                                      |   |                     | H | H                  |   |                        |          | L                  | L        | L                       |   |                    |  |                                              |  |
| 3                                                                                                                           | Category                                                               | Humanities & Social Studies (HS)                       |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |          | Core Elective (CE) |          | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |
|                                                                                                                             |                                                                        |                                                        |   |                     |   |                    |   | √                      |          |                    |          |                         |   |                    |  |                                              |  |
| 4                                                                                                                           | Approval                                                               | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                     |   |                    |   |                        |          |                    |          |                         |   |                    |  |                                              |  |

### **LIST OF EXPERIMENTS**

1. Tissue culture lab practices
2. Sterilisation techniques for tissue culture
3. Preparation of culture medium and preservation
4. Callus culture using *Daucus carota*.
5. Nodal bud culture of *Hibiscus*.
6. Micropropagation of Rose
7. Rooting and hardening
8. Preparation of Synthetic seeds.
9. Embryo culture.
10. Anther culture

|                                                                                                                             |                                                                         |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <b>BAC5L3</b>                                                                                                               |                                                                         | <b>PLANT PATHOLOGY LAB</b>                                                    |   |                     |   |                    |   |                        |   |                    | <b>L</b> | <b>T</b>                | <b>P</b> | <b>C</b>           |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             |                                                                         | Total Contact Hours - 45                                                      |   |                     |   |                    |   |                        |   |                    | 0        | 0                       | 3        | 2                  |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             |                                                                         | Prerequisite – Plant biotechnology, Animal biotechnology, Genetic engineering |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             |                                                                         | Course Designed by – Dept. of Industrial Biotechnology                        |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>OBJECTIVES:</b> To provide a basic understanding of plant and animal cell culture techniques                             |                                                                         |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                         |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO1                                                                                                                         | to understand the fundamentals of plant biotechnology                   |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO2                                                                                                                         | to know about sterilization techniques                                  |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO3                                                                                                                         | to know about plant tissue culture                                      |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO4                                                                                                                         | to know about animal cell culture                                       |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO5                                                                                                                         | to get a basic knowledge of the applications using plant biotechnology  |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO6                                                                                                                         | to get a basic knowledge of the applications using animal biotechnology |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                         |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 1                                                                                                                           | COs/POs                                                                 | a                                                                             | b | c                   | d | e                  | f | g                      | h | i                  | j        | k                       | l        |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2                                                                                                                           | CO1                                                                     | H                                                                             | M | M                   | H | M                  | H | H                      | L | M                  |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             | CO2                                                                     | H                                                                             | M | M                   | H | H                  |   | M                      |   |                    | L        | L                       | M        |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             | CO3                                                                     | H                                                                             | M |                     | H | H                  | M | H                      | L | M                  | L        |                         | M        |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             | CO4                                                                     | H                                                                             | M |                     | H | H                  |   | M                      |   |                    | L        | L                       |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             | CO5                                                                     | H                                                                             | M | M                   | H | H                  | H | H                      |   | M                  | L        | L                       | M        |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             | CO6                                                                     | H                                                                             |   |                     | H | H                  |   | M                      | M |                    |          | L                       |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3                                                                                                                           | Category                                                                | Humanities & Social Studies (HS)                                              |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |          | Non-Major Elective (NE) |          | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|                                                                                                                             |                                                                         |                                                                               |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

|   |          |                                                        |
|---|----------|--------------------------------------------------------|
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |
|---|----------|--------------------------------------------------------|

### **LIST OF EXPERIMENTS**

1. General characters of fungi – Types of mycelia -Types of vegetative, asexual and sexual spores- asexual and sexual fruiting bodies.
2. Study of important taxonomic characters and symptoms produced by *Plasmodiophora*, *Pythium* and *Phytophthora*.
3. Study of important taxonomic characters and symptoms produced by *Sclerospora*, *Peronospora*, *Peronosclerospora*, *Pseudoperonospora* and *Plasmopara*
4. Study of important taxonomic characters and symptoms produced by *Albugo* and *Rhizopus*.
5. Study of important taxonomic characters and symptoms produced by *Taphrina*, *Capnodium*, *Cercospora*, (*Mycosphaerella*), *Botryodiplodia* (*Botryosphaeria*), *Drechslera* (*Helminthosporium*) and *Alternaria*
6. Study of important taxonomic characters and symptoms produced by *Eurotium*, *Talaromyces*, *Erysiphe*, *Leveillula*, *Phyllactinia*, *Uncinula*, *Podosphaera* and *Sphaerotheca*
7. Study of important taxonomic characters and symptoms produced by *Claviceps*, *Fusarium* (*Gibberella*, *Nectria*) and *Verticillium*
8. Study of important taxonomic characters and symptoms produced by *Colletotrichum* (*Glomerella*), *Pestalotia* (*Pestalosphaeria*), *Pyricularia* (*Magnaporthe*), *Sarocladium* and *Macrophomina*
9. Study of important taxonomic characters and symptoms produced by *Puccinia*, *Uromyces*, and *Hemileia*
10. Study of important taxonomic characters and symptoms produced by *Ustilago*, *Sphacelotheca* (*Sporisorium*), *Tolyposporium* (*Moesziomyces*), and *Exobasidium*
11. Study of important taxonomic characters of *Agaricus*, *Pleurotus*, *Calocybe*, *Volvariella* and symptoms produced by *Athelium*, *Thanetophorus* and *Ganoderma*
12. Symptoms of bacterial diseases – leaf blight, leaf streak, canker, scab, crown gall, wilt and soft rot.

|               |                                                        |          |          |          |          |
|---------------|--------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC601</b> | <b>FERMENTATION TECHNOLOGY</b>                         | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 45                               | 3        | 0        | 0        | 3        |
|               | Prerequisite –Microbiology                             |          |          |          |          |
|               | Course Designed by – Dept. of Industrial Biotechnology |          |          |          |          |

**OBJECTIVES:** To provide a basic knowledge of Biological processes.

#### **COURSE OUTCOMES (COs)**

|     |                                                                         |
|-----|-------------------------------------------------------------------------|
| CO1 | To understand the development of bioprocess techniques.                 |
| CO2 | To know about the instrumentation and control for bioprocess operations |
| CO3 | To get idea about fermentation techniques                               |
| CO4 | To know about fermentation products                                     |
| CO5 | To know about various bioreactors                                       |

| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                  |   |                     |   |                    |   |                        |                    |                         |   |                    |                                              |
|-----------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------|---|---------------------|---|--------------------|---|------------------------|--------------------|-------------------------|---|--------------------|----------------------------------------------|
| 1                                                                                                                           | COs/POs  | a                                | b | c                   | d | e                  | f | g                      | h                  | i                       | j | k                  | l                                            |
| 2                                                                                                                           | CO1      | H                                | M | M                   | H | M                  |   | H                      |                    |                         | L | L                  |                                              |
|                                                                                                                             | CO2      | H                                | M | M                   | H | H                  |   | M                      |                    | M                       | L |                    | M                                            |
|                                                                                                                             | CO3      | H                                |   |                     | H | H                  | M | H                      | H                  |                         |   | L                  | M                                            |
|                                                                                                                             | CO4      | H                                | M |                     | H |                    |   | M                      |                    |                         | L |                    |                                              |
|                                                                                                                             | CO5      | H                                | M | M                   | H | H                  |   | M                      | M                  | M                       | L |                    | M                                            |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS) |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) |   | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|                                                                                                                             |          |                                  |   |                     |   |                    |   | √                      |                    |                         |   |                    |                                              |
| 4                                                                                                                           | Approval | Academic Council, July 2018      |   |                     |   |                    |   |                        |                    |                         |   |                    |                                              |

## UNIT –I INTRODUCTION TO FERMENTATION

History of fermentation – **Different types of Media**, Media sterilization, Batch Process (thermal death kinetics), continuous sterilization process; sterilization of fermenter and other ancillaries, filter sterilization of air and media- Upstream process.

## UNIT II INSTRUMENTATION AND CONTROL OF PROCESS PARAMETERS 9

Main parameters to be monitored and controlled in fermentation processes: **Parameters** Temperature, pressure, pH, flow, dissolved oxygen, dissolved CO<sub>2</sub>- cell mass, cell number, solid-substrate fermentation and its applications.

## UNIT III FERMENTATION TECHNIQUES

9

Fermentation- Definition & types - Submerged and Solid state. Fermentors & its types (Tower, cylindroconical & airlift) – Batch fermentation – Continuous fermentation. **Applications of fermentation**

## UNIT –IV FERMENTATION PRODUCT

9

Production of beverages – beer and wine- vitamin B12–Antibiotics- penicillin - Bakers yeast, Details of mushroom development- Oyster (Pleurotus) and Button (Agaricus) mushroom. **Fermented milk products**

## UNIT –V DOWNSTREAM PROCESSING

9

Downstream process- Intercellular and extracellular- Centrifugation, filtration, Flootation- solvent extraction, precipitation- cell disruption- physical and Chemical methods.

**TEXT BOOK:**

1. Stanbury P T and Whitaker 1984, Principles of Fermentation Technology, Pergamon Press. NY

**REFERENCES**

1. Casida, L E JR 1968 Industrial Microbiology. New Age International Publishers.
2. Prescott and Rehm 1979. Industrial Microbiology. Wiley and Sons.

|                                                                                                                             |          |                                                           |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------|------------------------|-----------------------|---------------------------|-----------------------|----------------------------|-----------------------|-------------------------------------------------------|----------|----------|----------|---|
| <b>BAC602</b>                                                                                                               |          | <b>BIOFERTILIZERS AND BIOPESTICIDES</b>                   |                        |                       |                           |                       |                            |                       | <b>L</b>                                              | <b>T</b> | <b>P</b> | <b>C</b> |   |
|                                                                                                                             |          | Total Contact Hours - 45                                  |                        |                       |                           |                       |                            |                       | 3                                                     | 0        | 0        | 3        |   |
|                                                                                                                             |          | Prerequisite – Agricultural microbiology                  |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
|                                                                                                                             |          | Course Designed by – Dept of Agricultural Biotechnology   |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| <b>OBJECTIVES:</b> To provide a basic knowledge of biofertilizers and biopesticides                                         |          |                                                           |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |          |                                                           |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| CO1                                                                                                                         |          | to understand the production of symbiotic nitrogen fixers |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| CO2                                                                                                                         |          | to know about non symbiotic nitrogen fixers               |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| CO3                                                                                                                         |          | to get idea about mycorrhizal biofertilizers              |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| CO4                                                                                                                         |          | to know about PSMs and their uses                         |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| CO5                                                                                                                         |          | to know about biopesticides                               |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                           |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| 1                                                                                                                           | COs/POs  | a                                                         | b                      | c                     | d                         | e                     | f                          | g                     | h                                                     | i        | j        | k        | l |
| 2                                                                                                                           | CO1      | H                                                         | M                      | M                     | H                         |                       | H                          | H                     | H                                                     | H        | M        | L        | M |
|                                                                                                                             | CO2      | H                                                         | M                      | M                     | H                         |                       |                            |                       |                                                       |          |          | L        | M |
|                                                                                                                             | CO3      | H                                                         |                        |                       |                           | H                     |                            |                       | H                                                     | L        |          |          |   |
|                                                                                                                             | CO4      | H                                                         | M                      |                       |                           |                       | M                          | M                     |                                                       |          |          | L        |   |
|                                                                                                                             | CO5      | H                                                         | M                      | M                     |                           | H                     |                            |                       |                                                       | M        | L        |          |   |
| 3                                                                                                                           | Category | Humanities &<br>Social Studies<br>(HS)                    | Basic Sciences<br>(BS) | Engg Sciences<br>(ES) | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective (NE) | Open Elective<br>(OE) | Project/ Term<br>paper<br>Seminar/<br>Internship (PR) |          |          |          |   |
|                                                                                                                             |          |                                                           |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |
| 4                                                                                                                           | Approval | Academic Council, July 2018                               |                        |                       |                           |                       |                            |                       |                                                       |          |          |          |   |

**UNIT I SYMBIOTIC NITROGEN FIXERS****9**

Introduction- **Nitrogen cycle**, history-symbiotic and non symbiotic nitrogen fixation-Symbiotic N<sub>2</sub> fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application-Frankia biofertilizer

**UNIT II NON SYMBIOTIC NITROGEN FIXERS****9**

Free living Azotobacter- free isolation, characteristics, mass inoculums, production and field application; Azospirillum isolation, characteristics, mass production, Acetobacter isolation and characterization, mass production-**Cyanobacteria** - biofertilizers-Azolla-green manuring

**UNIT III MYCORRHIZAL BIOFERTILIZERS****9**

Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and **VAM and its manuring capability**.

**UNIT IV PHOSPHATE SOLUBILIZERS****9**

Phosphate solubilization in plants-Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field Application, Plant growth promoting Rhizoflora (PGPR)

**UNIT V BIOPESTICIDES****9**

Biocontrol-agents of biocontrol-antagonism-biopesticides vs chemical pesticides-field application of biocontrol-bacterial pesticides; *Bacillus thuringiensis*, production, Field applications-mycopesticides-viral pesticides-biological control of weeds

**TEXT BOOK**

1. Singh B.D, (2003), Biotechnology, Kalyani Publishers
2. R.C. Dubey, (2009), A Textbook of Biotechnology, S Chand and Company, Ltd

**REFERENCE BOOK**

1. Kannaiyan, S. (2003). Bioethnology of Biofertilizers, CHIPS, Texas.
2. Mahendra K. Rai (2005). Hand book of Microbial biofertilizers, The Haworth Press, Inc. New York.
3. Reddy, S.M. et. al. 2002), Bioinoculants for sustainable agriculture and forestry, Scientific Publishers

|                                                                    |                                                          |          |          |          |          |
|--------------------------------------------------------------------|----------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC603</b>                                                      | <b>ENTOMOLOGY AND PEST MANAGEMENT</b>                    | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                    | Total Contact Hours - 45                                 | 3        | 0        | 0        | 3        |
|                                                                    | Prerequisite – basics of entomology                      |          |          |          |          |
|                                                                    | Course Designed by – Dept. of Agricultural Biotechnology |          |          |          |          |
| <b>OBJECTIVES</b>                                                  |                                                          |          |          |          |          |
| To provide a basic understanding on entomology and pest management |                                                          |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                       |                                                          |          |          |          |          |
| CO1                                                                | to understand the fundamentals of insect morphology      |          |          |          |          |

|                                                                                                                             |                                                      |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| CO2                                                                                                                         | to know about insect taxonomy                        |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | to give an idea on pest management                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | to learn about pest of field crops                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to get a basic knowledge pest of horticultural crops |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | To know about storage pests                          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                      |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                              | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                  | H                                                      |                     |                    |                        |                    |                         | H                  |                                              | H |   |   |   |
|                                                                                                                             | CO2                                                  | H                                                      |                     | H                  |                        |                    |                         | H                  |                                              | H |   |   |   |
|                                                                                                                             | CO3                                                  | H                                                      |                     | H                  |                        |                    |                         | H                  |                                              | H |   |   |   |
|                                                                                                                             | CO4                                                  | H                                                      |                     | H                  | M                      |                    |                         | H                  |                                              | H |   |   |   |
|                                                                                                                             | CO5                                                  |                                                        |                     | H                  |                        | H                  | H                       | H                  | H                                            |   |   |   | H |
|                                                                                                                             | CO6                                                  | H                                                      |                     |                    |                        | H                  |                         | H                  |                                              |   |   |   |   |
| 3                                                                                                                           | Category                                             | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                      |                                                        |                     |                    | √                      |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                             | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I INSECT MORPHOLOGY ANATOMY AND PHYSIOLOGY

9

Position of insects in the animal kingdom and their relationship with other classes of Arthropoda; Reasons for insect dominance. **Structural organisation of insect body wall** - structure and function, cuticular appendages, moulting; Body regions - insect head, thorax and abdomen, their structure and appendages. Digestive, excretory, respiratory, circulatory and reproductive systems in insect

## UNIT II TAXONOMY OF APTERYGOTA, EXOPTERYGOTA AND ENDOPTERYGOTA 9

Insect systematics; Distinguishing characters of agriculturally important orders and families of Hexapoda. Apterygota (Thysanura, Diplura, Protura and Collembola); Exopterygota (Ephemeroptera, Odonata, Orthoptera, Phasmida, Dictyoptera, Embioptera, Dermaptera, Hemiptera, Isoptera, Psocoptera, Mallophaga, Thysanoptera and Siphunculata). **Features of agriculturally important families** of Lepidoptera, Coleoptera, Diptera, Hymenoptera, Siphonaptera, Neuroptera and Strepsiptera

## UNIT III ECOLOGY AND PEST MANAGEMENT

9

Pests – definition and **classification** – pest outbreak – factors governing pest outbreak– pest monitoring, surveillance and forecasting. Economic Threshold Level – Economic Injury Level- Integrated Pest Management – history, principles and strategies – requirements for successful pest management programme; Cultural, physical, mechanical, ecological engineering methods and host plant resistance in pest management

#### UNIT IV

#### PESTS OF FIELD CROPS

9

Distribution, bionomics, symptoms of damage and management strategies for insects and non-insect pests of rice, wheat, maize, sorghum, cumbu, ragi, tenai, redgram, green gram, black gram, bengal gram, cowpea, groundnut, castor, gingelly, sunflower, safflower, jatropha, soybean and mustard. Distribution, bionomics, symptoms of damage and management strategies of insects and non-insect pests of cotton and sugarcane, green manures (Sunhemp, Sesbania, Daincha, Glyricidia), forage crops (Lucerne and Subabul)

#### UNIT V

#### PESTS OF HORTICULTURAL CROPS AND STORAGE PEST 9

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Brinjal, Bhendi, Tomato, Chillies, Onion, Garlic, Moringa, Amaranthus, Crucifers, Cucurbits, Mango, Citrus, Banana, Guava, Grapevine and Sapota. Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Pomegranate, Papaya, Aonla, Apple, Pine apple, Custard apple and Jack, Potato, Sweet potato, Tapioca, Yam, Colocasia, Coconut, Arecanut, Tea, Coffee, Cashew, Cocoa, Betelvine, Ginger, Turmeric, Coriander, Cardamom, Pepper, Curry leaf and Tamarind, Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose, Cut flowers, Glory lily, Coleus, Stonebreaker, Aswagantha, Senna, Periwinkle and Lawn. Distribution, bionomics, symptoms of damage and management strategies of pests of and stored products. Rodents and birds of agricultural importance and their management- Locusts and their management

#### TEXT BOOKS:

1. Richards O.W. and R.G. Davies. 1977. *Imm's General Text Book of Entomology*. Vol.I and II. Chapman and Hall Publication, London. 1354p. {ISBN 0412 15220 7}

#### REFERENCES:

1. Chapman, R.F. 1998. *The Insects: Structure and Function*. Fourth Edition. Cambridge University Press. 770p. {ISBN 0 521 78732 7}
2. Snodgrass, R.E. 1994. *Principles of Insect Morphology*. CBS publishers and distributors, New Delhi. 667p.
3. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}
4. Srivastava, P. D. and R. P. Singh. 1997. *An Introduction to Entomology*. Concept Publishing Company, New Delhi.

| BSS601 | VALUE EDUCATION AND PROFESSIONAL ETHICS          | L | T | P | C |
|--------|--------------------------------------------------|---|---|---|---|
|        | Total Contact Hours - 45                         | 3 | 0 | 0 | 3 |
|        | Prerequisite – English & Professional Courses    |   |   |   |   |
|        | Course Designed by – Dept. of Management Studies |   |   |   |   |

|                                                                                                                                                                                                                                                                                       |                                                                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| <b>OBJECTIVES</b>                                                                                                                                                                                                                                                                     |                                                                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| <ul style="list-style-type: none"><li>- To teach the philosophy of Life, personal value, social value, mind cultural value and personal health</li><li>- To teach professional ethical values, codes of ethics, responsibilities, safety, rights and related global issues.</li></ul> |                                                                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                          |                                                                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                                                                                                                                                                                   | To learn about philosophy of Life and Individual qualities                                            |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                                                                                                                                                                                   | To learn and practice social values and responsibilities                                              |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                                                                                                                                                                                   | To learn and practice mind culture, forces acting on the body and causes of diseases and their curing |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                                                                                                                                                                                   | To learn more of Engineer as Responsible Experimenter.                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                                                                                                                                                                                   | To learn more of Risk and Safety assessment with case studies.                                        |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                                                                                                                                                                                   | To learn more of Responsibilities and Rights as Professional and facing Global Challenges             |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                           |                                                                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                                                                                                                                                                                     | COs/POs                                                                                               | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                                                                                                                                                                                     | CO1                                                                                                   |                                                        |                     | M                  |                        | H                  |                         | M                  | H                                            | M | L | L | M |
|                                                                                                                                                                                                                                                                                       | CO2                                                                                                   |                                                        |                     | M                  |                        | H                  |                         | M                  | H                                            | M | L | L | M |
|                                                                                                                                                                                                                                                                                       | CO3                                                                                                   |                                                        |                     | M                  |                        | H                  |                         | M                  | H                                            | M | L | L | M |
|                                                                                                                                                                                                                                                                                       | CO4                                                                                                   |                                                        |                     | H                  |                        | H                  |                         | M                  | H                                            | M | L | L | M |
|                                                                                                                                                                                                                                                                                       | CO5                                                                                                   |                                                        |                     | H                  |                        | H                  |                         | M                  | H                                            | M | L | L | M |
|                                                                                                                                                                                                                                                                                       | CO6                                                                                                   |                                                        |                     | H                  |                        | H                  |                         | M                  | H                                            | M | L | L | M |
| 3                                                                                                                                                                                                                                                                                     | Category                                                                                              | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                                                                                                                                                                                       | ✓                                                                                                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                                                                                                                                                                                     | Approval                                                                                              | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I **PHILOSOPHY OF LIFE AND INDIVIDUAL QUALITIES** **9**

Human Life on Earth - Purpose of Life, Meaning and Philosophy of Life. The Law of Nature – Protecting Nature /Universe- Basic Culture - Thought Analysis - Regulating desire - Guarding against anger - To get rid of Anxiety – The Rewards of Blessing - Benevolence of Friendship - Love and Charity - Self – tranquility/Peace

**UNIT II SOCIAL VALUES (INDIVIDUAL AND SOCIAL WELFARE) 9**

Family - Peace in Family, Society, The Law of Life Brotherhood - The Pride of Womanhood – Five responsibilities/duties of Man : - a) to himself, b) to his family, c) to his environment, d) to his society, e) to the Universe in his lives, Thriftiness (Thrift)/Economics. Health - Education - Governance - People's Responsibility / duties of the community, World peace.

**UNIT III MIND CULTURE & TENDING PERSONAL HEALTH 9**

Mind Culture - Life and Mind - Bio - magnetism, Universal Magnetism (God –Realization and Self Realization) - Genetic Centre – Thought Action – Short term Memory – Expansiveness – Thought – Waves, Channelizing the Mind, Stages - Meditation, Spiritual Value. Structure of the body - the three forces of the body- life body relation, natural causes and unnatural causes for diseases, Methods in Curing diseases

**UNIT IV: ENGINEERING AS SOCIAL EXPERIMENTATION AND ENGINEERS'SRESPONSIBILITIES FOR SAFETY 9**

Engineering as Experimentation – Engineer as Responsible Experimenters – Codes of Ethics – The Challenger, case study-Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – The Three Mile Island and Chernobyl case studies

**UNIT V: ENGINEERS'S RESPONSIBILITIES FOR RIGHTS AND GLOBAL ISSUES 9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Whistle Blowing – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development –Engineers as Managers – Consulting Engineers – Engineers as Expert Eye Witnesses and Advisors – Moral Leadership

**TEXT BOOKS**

1. Value Education for Health, Happiness and Harmony, the World Community Service, Centre Vethathiri Publications (Unit 1 – III).
2. Mike W Martin and Roland Schinzinger, Ethics In Engineering, Tata Mcgraw Hill, Newyork 2005 (Units IV & V)

**REFERENCE**

1. Philosophy of Universal Magnetism (Bio - magnetism, Universal Magnetism) The World Community Service Centre Vethathiri Publications (for Unit III)
2. Thirukkural with English Translation of Rev. Dr. G.U. Pope, Uma Publication, 156, Serfoji Nagar, Medical College Road, Thanjavur 613 004 (for Units I - III)
3. R S Nagaarazan, Textbook On Professional Ethics And Human Values, New Age International Publishers, 2006 (for Units IV-V)
4. Charles D Fledderman, Engineering Ethics, Prentice Hall, New Mexico, 2004 (Units IV-V)

|               |                                    |          |          |          |          |
|---------------|------------------------------------|----------|----------|----------|----------|
| <b>BAC6L1</b> | <b>FERMENTATION TECHNOLOGY LAB</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | Total Contact Hours - 45           | 0        | 0        | 2        | 1        |

|                                                                                                                             |                                              |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------------|------------------------|---|-----------------------|---|---------------------------|-----------------------|----------------------------|---|-----------------------|-------------------------------------------------------|---|
|                                                                                                                             |                                              | Prerequisite – Bioprocess Engg., Unit Operation          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
|                                                                                                                             |                                              | Course Designed by – Dept. of Agricultural Biotechnology |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| <b>OBJECTIVES:</b> To provide basic knowledge about bioprocessing                                                           |                                              |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                              |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| CO1                                                                                                                         | to get knowledge on biomass                  |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| CO2                                                                                                                         | to know about enzyme kinetics                |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| CO3                                                                                                                         | to understand about immobilization of enzyme |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| CO4                                                                                                                         | to get idea about mass transfer              |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| CO5                                                                                                                         | to know about death kinetics                 |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| CO6                                                                                                                         | to know about product optimization           |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                              |                                                          |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |
| 1                                                                                                                           | COs/POs                                      | a                                                        | b                      | c | d                     | e | f                         | g                     | h                          | i | j                     | k                                                     | l |
| 2                                                                                                                           | CO1                                          | H                                                        | M                      | H | H                     | M |                           | M                     |                            | H | L                     |                                                       | M |
|                                                                                                                             | CO2                                          | H                                                        | M                      | M | H                     | H |                           |                       | M                          |   |                       | L                                                     |   |
|                                                                                                                             | CO3                                          | H                                                        | M                      | M | H                     |   |                           | M                     |                            |   | L                     | L                                                     | M |
|                                                                                                                             | CO4                                          | H                                                        | M                      | H | H                     | H |                           |                       | H                          | M |                       | L                                                     | M |
|                                                                                                                             | CO5                                          | H                                                        | M                      | M |                       | H | L                         | M                     |                            |   | L                     | L                                                     |   |
|                                                                                                                             | CO6                                          | H                                                        |                        | H | H                     | H |                           | M                     |                            |   | L                     |                                                       | M |
| 3                                                                                                                           | Category                                     | Humanities &<br>Social Studies<br>(HS)                   | Basic Sciences<br>(BS) |   | Engg Sciences<br>(ES) |   | Professional<br>Core (PC) | Core Elective<br>(CE) | Non-Major<br>Elective (NE) |   | Open Elective<br>(OE) | Project/ Term<br>paper<br>Seminar/<br>Internship (PR) |   |
|                                                                                                                             |                                              |                                                          |                        |   |                       | √ |                           |                       |                            |   |                       |                                                       |   |
| 4                                                                                                                           | Approval                                     | Academic Council, July 2018                              |                        |   |                       |   |                           |                       |                            |   |                       |                                                       |   |

### **LIST OF EXPERIMENTS**

1. Fermentative production of amylase by *Aspergillus niger*.
2. Production of wine and analyse its properties.
3. **Brewing of beer and wine Production** of Antibiotic Bacitracin by bacillus sp.
4. Production of Vitamin B<sub>12</sub>.
5. Cultivation of mushroom *in vitro* studies.
6. Fermentation of citrus juices.
7. Bio-ethanol production
8. Production of probiotics from lactic acid bacteria.
9. **Operational procedures of bioreactors and Fermentors.**
10. Bio-ethanol production by using *Zymomonas mobilis*.
11. Bio-surfactant production

|                                                                                                                             |          |                                                                            |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|----------|-------------------------|----------|--------------------|--|----------------------------------------------|--|
| <b>BAC6L2</b>                                                                                                               |          | <b>BIOFERTILIZERS AND BIOPESTICIDES LAB</b>                                |   |                     |   |                    |   |                        |   | <b>L</b>           | <b>T</b> | <b>P</b>                | <b>C</b> |                    |  |                                              |  |
|                                                                                                                             |          | Total Contact Hours - 45                                                   |   |                     |   |                    |   |                        |   | 0                  | 0        | 2                       | 1        |                    |  |                                              |  |
|                                                                                                                             |          | Prerequisite – Microbiology, pathology                                     |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
|                                                                                                                             |          | Course Designed by – Dept of Industrial Biotechnology                      |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| <b>OBJECTIVES:</b> To provide basic knowledge about preparation of biofertilizers and biopesticides                         |          |                                                                            |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |          |                                                                            |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO1                                                                                                                         |          | to understand the fundamentals of preparation of biofertilizers            |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO2                                                                                                                         |          | to know about Rhizobial, Azotobacter and Azospirillum biofertilizers       |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO3                                                                                                                         |          | to know the protocol for preparation of PSM and mycorrhizal biofertilizers |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO4                                                                                                                         |          | to know about bacterial pesticides                                         |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO5                                                                                                                         |          | to study the preparation of mycopesticides                                 |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                                            |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| 1                                                                                                                           | COs/Pos  | a                                                                          | b | c                   | d | e                  | f | G                      | h | I                  | j        | k                       | l        |                    |  |                                              |  |
| 2                                                                                                                           | CO1      | H                                                                          |   | M                   | H | M                  | M | M                      |   |                    |          | L                       |          |                    |  |                                              |  |
|                                                                                                                             | CO2      | H                                                                          | M | M                   | H | H                  |   | M                      |   | M                  | L        | L                       | M        |                    |  |                                              |  |
|                                                                                                                             | CO3      | H                                                                          | M | M                   | H | H                  | L |                        | H |                    | L        |                         | M        |                    |  |                                              |  |
|                                                                                                                             | CO4      | H                                                                          | M |                     |   | H                  |   | M                      |   |                    | L        | L                       | M        |                    |  |                                              |  |
|                                                                                                                             | CO5      | H                                                                          | M | M                   | H | H                  |   | M                      |   | M                  | L        | L                       | M        |                    |  |                                              |  |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                                           |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |          | Non-Major Elective (NE) |          | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |
|                                                                                                                             |          |                                                                            |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
|                                                                                                                             |          |                                                                            |   |                     |   |                    |   |                        |   |                    | √        |                         |          |                    |  |                                              |  |
| 4                                                                                                                           | Approval | Academic Council, July 2018                                                |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |

### LIST OF EXPERIMENTS

- General protocol for production of biofertilizers and biopesticides
- Preparation of Rhizobial biofertilizer and applications
- Preparation of Azotobacter biofertilizer
- Preparation of Azospirillum biofertilizer
- Preparation of Frankia Biofertilizer
- Preparation of Blue green algae biofertilizer
- Preparation of Azolla

8. Preparation of PSMs
9. Preparation of mycorrhizal biofertilizer
10. Biocontrol agents-  
microbes and insects

11. Preparation of Bacillus thuringiensis biopesticides
12. Preparation of Mycopesticides

|                                                                                                                             |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|----------|----------|----------|----------|
| <b>BAC6L3</b>                                                                                                               |          | <b>CROP PRODUCTIONLAB-AGRICULTURAL CROPS</b>             |                     |                    |                        |                    |                         |                    |                                              |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             |          | Total Contact Hours - 45                                 |                     |                    |                        |                    |                         |                    |                                              |   | 0        | 0        | 2        | 1        |
|                                                                                                                             |          | Prerequisite – crop production of Agricultural crops     |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
|                                                                                                                             |          | Course Designed by – Dept. of Industrial Biotechnology   |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| <b>OBJECTIVES:</b> To provide knowledge about production of crops                                                           |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO1                                                                                                                         |          | to know about land preparation                           |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO2                                                                                                                         |          | to know about nursery preparation                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO3                                                                                                                         |          | to understand about fertilizer and pesticide application |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO4                                                                                                                         |          | to get basic idea about harvesting and post harvesting   |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO5                                                                                                                         |          | to get basic idea about yield calculation                |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| 1                                                                                                                           | COs/POs  | a                                                        | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j        | k        | l        |          |
| 2                                                                                                                           | CO1      | H                                                        | M                   | M                  |                        | M                  |                         |                    |                                              | M |          | L        | M        |          |
|                                                                                                                             | CO2      | H                                                        | M                   | M                  | H                      | H                  |                         | M                  |                                              |   | L        | L        |          |          |
|                                                                                                                             | CO3      | H                                                        | M                   |                    | H                      |                    |                         | M                  | M                                            | L |          | L        | M        |          |
|                                                                                                                             | CO4      | H                                                        | M                   |                    |                        | H                  | M                       |                    |                                              |   | L        |          | M        |          |
|                                                                                                                             | CO5      | H                                                        | M                   | M                  | H                      | H                  |                         | M                  |                                              | L | L        | L        |          |          |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                         | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |          |          |          |          |
|                                                                                                                             |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          | √        |          |          |
| 4                                                                                                                           | Approval | Academic Council, July 2018                              |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |

#### LIST OF EXPERIMENTS

1. Tillage and land configuration
2. Seed treatment and sowing
3. Nursery preparation
4. Fertilizer schedule calendar
5. Weeding protocol
6. Pesticide application
7. Harvesting

8. Post harvesting
9. Storage

10. Yield calculation

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |          |          |          |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC6P1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>MINI PROJECT</b>                                                                   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Total Contact Hours -60                                                               | 0        | 0        | 4        | 2        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology |          |          |          |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Course Designed by– Dept. of Industrial Biotechnology                                 |          |          |          |          |
| <b>OBJECTIVES:</b> To enable students to do independent research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                       |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |          |          |          |          |
| <ul style="list-style-type: none"><li>• It is a two credit course offered in the VI Semester</li><li>• Each student will be allocated a guide and a research topic at the end of the V semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students</li><li>• There are 4 hours allocated per week for the students to do research. This will be considered for the award of internal marks.</li><li>• There will be three reviews to assess the progress of their research</li><li>• The final review will be on the day of the external examination in the presence of the an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic.</li></ul> |                                                                                       |          |          |          |          |

|                                                                                                                             |                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
| BBT701                                                                                                                      | RESEARCH METHODOLOGY AND INSTRUMENTATION                                            |   |   |   |   |   |   | L | T | P | C |   |   |
|                                                                                                                             | Total Contact Hours - 45                                                            |   |   |   |   |   |   | 3 | 0 | 0 | 3 |   |   |
|                                                                                                                             | Prerequisite – Biochemistry, Instrumental method of analysis, Downstream processing |   |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                             | Course Designed by – Dept. of Industrial Biotechnology                              |   |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES                                                                                                                  |                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
| To provide basic knowledge about various instrumentation techniques and data documentation                                  |                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                         | to understand the biochemical analysis                                              |   |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                         | to know about spectroscopic and microscopic techniques                              |   |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                         | to know about the separation techniques                                             |   |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                         | to get ideas about ethical issues related to research                               |   |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                         | to know about data documentation                                                    |   |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                         | To prepare research articles                                                        |   |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                     |   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                             | a | b | c | d | e | f | g | h | i | j | k | l |

|   |          |                                                        |   |                   |   |                  |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
|---|----------|--------------------------------------------------------|---|-------------------|---|------------------|---|---------------------------|---|-----------------------|---|----------------------------|---|-----------------------|--|----------------------------------------------------------|--|
| 2 | CO1      | H                                                      | M | M                 | H | M                |   | H                         | H | H                     | M | M                          | M |                       |  |                                                          |  |
|   | CO2      | H                                                      | M | M                 | H | H                |   | H                         |   |                       | L | L                          |   |                       |  |                                                          |  |
|   | CO3      | H                                                      | M | H                 | H | H                |   | M                         | H |                       | M |                            | M |                       |  |                                                          |  |
|   | CO4      | H                                                      | M | H                 | H | H                | H | H                         |   | M                     |   | M                          | H |                       |  |                                                          |  |
|   | CO5      | H                                                      | M | M                 | H | H                |   | M                         | H |                       | L | L                          | M |                       |  |                                                          |  |
|   | CO6      | H                                                      | H | H                 | H | H                |   | H                         |   | M                     | L |                            |   |                       |  |                                                          |  |
| 3 | Category | Humanities<br>& Social<br>Studies (HS)                 |   | Basic<br>Sciences |   | Engg<br>Sciences |   | Professional<br>Core (PC) |   | Core Elective<br>(CE) |   | Non-Major<br>Elective (NE) |   | Open<br>Elective (OE) |  | Project/ Term<br>paper<br>Seminar/<br>Internship<br>(PR) |  |
|   |          |                                                        |   |                   |   |                  |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                   |   |                  |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |

## **UNIT I BASIC PRINCIPLES FOR BIOCHEMICAL ANALYSIS 9**

Introduction – preparation of organ and tissue samples for analysis – cell disruption methods – physiological solutions: buffers and growth media for plants, animals and microbes – Medium standardization - cell sorting, isolation and enumeration techniques – cryopreservation – elucidating metabolic pathways by tracer studies.

## **UNIT II SPECTROSCOPIC AND MICROSCOPY TECHNIQUES 9**

Introduction – UV – visible spectroscopy – NMR spectroscopy – IR and Raman spectroscopy – atomic spectroscopy - Introduction to microscopy – Election microscopy –ultramicrotome- phase contrast microscopy – Fluorescent and confocal microscopy.

## **UNIT III SEPARATION TECHNIQUES 9**

Introduction to chromatography and electrophoresis – gel filtration – ion exchange – affinity – GC – HPLC - partition chromatography – electrophoresis of proteins and nucleic acids – immune precipitation techniques – ELISA.

## **UNIT IV ETHICAL ISSUES IN BIOTECHNOLOGY 9**

Legal and socio economic impacts of biotech research – bio safety regulation – r-DNA guidelines- issues involved in experimenting with animals – Experimental protocol approvals – contaminant levels and environmental effects- impact of GM organisms and GM foods – IPR and patents.

## **UNIT V DATA ANALYSIS AND DOCUMENTATION 9**

Sampling concepts for statistical analysis – Mean, median, standard deviation, standard error – ANNOVA – Guidelines for thesis writing: literature collection methods – writing of abstract, introduction and review of literature – results, discussion and summary – guidelines to publish articles in journals.

## **TEXT BOOKS**

1. Keith Wilson and John Walker, 2004, Practical biochemistry, Principles and techniques – Cambridge publication
2. N. Gurumani, 2006, Research methodology for biological sciences, MJP publishers.

## REFERENCE BOOKS

1. P. Ramadass, 2009, Research and writing: Across the disciplines, MJP publishers.

|                                                                                                                             |                                                                        |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------|----------------|---------------|------------------------|--------------------|-------------------------|--------------------|---------------------------------------------|---|----------|----------|----------|----------|
| <b>BAC701</b>                                                                                                               | <b>BIOTECHNOLOGY OF BIOTIC AND ABIOTIC STRESS TOLERANCE</b>            |                                                        |                |               |                        |                    |                         |                    |                                             |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             | Total Contact Hours - 45                                               |                                                        |                |               |                        |                    |                         |                    |                                             |   | 3        | 0        | 0        | 3        |
|                                                                                                                             | Prerequisite – Biochemistry, Crop Physiology                           |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
|                                                                                                                             | Course Designed by – Dept. of Industrial Biotechnology                 |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                           |                                                                        |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| To provide basic knowledge on plant stress and its prevention and consequences                                              |                                                                        |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                        |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| CO1                                                                                                                         | to understand the types of abiotic and biotic stress factors           |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| CO2                                                                                                                         | to analyze the factors responsible for disease and pest resistance     |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| CO3                                                                                                                         | to remember the various enzymatic pathway involved in stress tolerance |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| CO4                                                                                                                         | to understand the concept of host response to disease resistance       |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| CO5                                                                                                                         | to analyze the efficiency of transgenic plants in stress tolerance     |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| CO6                                                                                                                         | To understand the mechanisms involved in abiotic stress tolerance      |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                        |                                                        |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |
| 1                                                                                                                           | COs/POs                                                                | a                                                      | b              | c             | d                      | e                  | f                       | g                  | h                                           | i | j        | k        | l        |          |
| 2                                                                                                                           | CO1                                                                    | H                                                      | M              | M             | H                      | M                  |                         | H                  | H                                           | H | M        | M        | M        |          |
|                                                                                                                             | CO2                                                                    | H                                                      | M              | M             | H                      | H                  |                         | H                  |                                             |   | L        | L        |          |          |
|                                                                                                                             | CO3                                                                    | H                                                      | M              | H             | H                      | H                  |                         | M                  | H                                           |   | M        |          | M        |          |
|                                                                                                                             | CO4                                                                    | H                                                      | M              | H             | H                      | H                  | H                       | H                  |                                             | M |          | M        | H        |          |
|                                                                                                                             | CO5                                                                    | H                                                      | M              | M             | H                      | H                  |                         | M                  | H                                           |   | L        | L        | M        |          |
|                                                                                                                             | CO6                                                                    | H                                                      | H              | H             | H                      | H                  |                         | H                  |                                             | M | L        |          |          |          |
| 3                                                                                                                           | Category                                                               | Humanities & Social Studies (HS)                       | Basic Sciences | Engg Sciences | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/Term paper Seminar/ Internship (PR) |   |          |          |          |          |
|                                                                                                                             |                                                                        |                                                        |                |               |                        |                    |                         |                    |                                             |   | √        |          |          |          |
| 4                                                                                                                           | Approval                                                               | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                |               |                        |                    |                         |                    |                                             |   |          |          |          |          |

## UNIT I INTRODUCTION

9

Prospects & Perspective of Biotic & abiotic stress resistant plants, Genetics of host-pathogen interactions, Mechanism of plant resistance- Role of jasmonates and salicylic acid in systematic resistance induction on wounding.

## **UNIT II INSECT PEST RESISTANCE**

**9**

Insect pest resistance – Structural/ morphological changes; Protease and amylase inhibitors; polyphenol oxidases; peroxidases; lectins; chitinase; seed proteins; their limitations and resistance-significance in multi-gene pyramiding. **Vertical and Horizontal mode of resistance to pathogens.**

## **UNIT III HYPERSENSITIVE HOST RESPONSE**

**9**

Hypersensitive host response (HRGP) and apoptosis in relation to plant defence. Virulence-Avirulence in host–pathogens interaction. Race specific Resistance Gene Analogues (RGAs). Pathogenesis related proteins – groups with examples (Glucanases; chitinases; osmotin, chitin binding proteins; thaumatin like proteins; micropeptidal defensins; phytoalexins) and their role.

## **UNIT IV FIELD TESTING FOR TRANSGENIC PLANTS**

**9**

Role of Phenylalanine ammonia lyase, callose synthases, detoxification for pathogen resistance. Ribosome inactivating protein (RIP). Field testing of transgenic plants for fungal, bacterial, viral and pest resistance. Prospects and perspectives. **Biopesticides**-Developing antagonistic strains suitable for varying stress conditions

## **UNIT V ABIOTIC STRESS TOLERANCE**

**9**

Biochemical basis of abiotic stresses namely osmotic (drought, salinity), temperature, heavy metals, air and water pollutants, synthesis and functions of proline and glycine betaine in stress tolerance-interaction between biotic and abiotic stresses; stress adaptation. Reactive oxygen species and biotic and abiotic stress, antioxidants, enzymes defence system. **Role of calcium, nitric oxide** and salicylic acid in plant development. Molecular strategies for imparting tolerance against abiotic stress.

### **Text book:**

- Li PH & Sakai A. 1987. Plant Cold Hardiness. Liss, New York
- Luginpill P. 1969. Developing Resistant Plants - The Ideal Method of Controlling Insects. USDA, ARS, Washington DC.
- Maxwell FG & Jennings PR. (Eds.). 1980. Breeding Plants Resistant to Insects. John Wiley & Sons.
- Painter RH. 1951. Insect Resistance in Crop Plants. MacMillan, New York.
- Russel GE. 1978. Plant Breeding for Pest and Disease Resistance. Butterworths.

### **Reference:**

1. Verma DPS & Kohn TH. 1984. Genes Involved in Microbe-Plant Interactions. Springer Verlag.
2. Molecular Plant-Microbe Interactions. Journal Published by APS.
3. Basra AS. 1997. Stress Induced Gene Expression in Plants. Harwood Academic Publ.
4. Chessin M, DeBorde D & Zipf A. 1995. Antiviral Proteins in Higher Plants. CRC Press.
5. Crute IR, Burdon JJ & Holub EB. (Eds.). 1997. Gene-for-Gene Relationship in Host-Parasite Interactions. CABI.

6. Hopkins WG & Huner NPA. 2004. Introduction to Plant Physiology. John Wiley & Sons.
7. Salisbury FB & Ross C. 1992. Plant Physiology. 4th Ed. Wadsworth Publ. Taiz L & Zeiger E. 2006. Plant Physiology. 4th Ed. Sinauer Associates.
8. Kosuge T & Nester EW. 1989. Plant-Microbe Interactions: Molecular and Genetic Perspectives. Vols I-IV. McGraw Hill.

|                                                                                                                                              |                                                                        |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|----------|-------------------------|----------|--------------------|--|----------------------------------------------|--|
| <b>BAC702</b>                                                                                                                                | <b>FOOD BIOTECHNOLOGY</b>                                              |                                  |   |                     |   |                    |   |                        |   | <b>L</b>           | <b>T</b> | <b>P</b>                | <b>C</b> |                    |  |                                              |  |
|                                                                                                                                              | Total Contact Hours – 45                                               |                                  |   |                     |   |                    |   |                        |   | 3                  | 0        | 0                       | 3        |                    |  |                                              |  |
|                                                                                                                                              | Prerequisite – microbiology, pathology                                 |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
|                                                                                                                                              | Course Designed by – Dept. of Industrial Biotechnology                 |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| <b>OBJECTIVES:</b> The students understand concepts involved in microbial contamination of food and methods to control the food preservation |                                                                        |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                 |                                                                        |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO1                                                                                                                                          | To understand the factors responsible for food spoilage                |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO2                                                                                                                                          | To investigate the microbes involved in the food spoilage              |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO3                                                                                                                                          | To analyze the techniques by which the food is preserved               |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO4                                                                                                                                          | To study the different toxins produced by the bacteria and fungi       |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO5                                                                                                                                          | To study the different food products by using the microbes as a source |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| CO6                                                                                                                                          | To understand the quality control standards in food                    |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                  |                                                                        |                                  |   |                     |   |                    |   |                        |   |                    |          |                         |          |                    |  |                                              |  |
| 1                                                                                                                                            | COs/Pos                                                                | a                                | b | c                   | d | e                  | f | G                      | h | I                  | j        | k                       | l        |                    |  |                                              |  |
| 2                                                                                                                                            | CO1                                                                    | H                                |   | M                   | H | M                  | M | M                      |   |                    |          | L                       |          |                    |  |                                              |  |
|                                                                                                                                              | CO2                                                                    | H                                | M | M                   | H | H                  |   | M                      |   | M                  | L        | L                       | M        |                    |  |                                              |  |
|                                                                                                                                              | CO3                                                                    | H                                | M | M                   | H | H                  | L |                        | H |                    | L        |                         | M        |                    |  |                                              |  |
|                                                                                                                                              | CO4                                                                    | H                                | M |                     |   | H                  |   | M                      |   |                    | L        | L                       | M        |                    |  |                                              |  |
|                                                                                                                                              | CO5                                                                    | H                                | M | M                   | H | H                  |   | M                      |   | M                  | L        | L                       | M        |                    |  |                                              |  |
|                                                                                                                                              | CO6                                                                    |                                  | H |                     | H |                    | M | H                      |   |                    |          | H                       | H        |                    |  |                                              |  |
| 3                                                                                                                                            | Category                                                               | Humanities & Social Studies (HS) |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |          | Non-Major Elective (NE) |          | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |
|                                                                                                                                              |                                                                        |                                  |   |                     |   |                    |   |                        |   |                    |          | √                       |          |                    |  |                                              |  |

|   |          |                             |
|---|----------|-----------------------------|
| 4 | Approval | Academic Council, July 2015 |
|---|----------|-----------------------------|

## UNIT I INTRODUCTION

9

Food and Microorganisms – Important microorganisms in food (Bacteria, Mold and yeasts); Factors affecting the growth of microorganisms in food – pH, moisture, oxidation – Reduction potential, Nutrient content and Inhibitory substances and biological structure.

## UNIT II FOOD PRESERVATION

9

Principles of food preservation **Methods of food preservation** – General principles and application methods – Asepsis – Techniques of removal – use of temperature (low & high) - Drying, radiation and chemical preservatives

## UNIT III FOOD SPOILAGE AND ITS CAUSES

9

Spoilage of food – cereals, vegetables, fruits, egg and milk – canned foods and sea foods .**Causes and prevention.**

## UNIT IV FERMENTED FOODS

9

Fermented food – pickled cucumber, Sauerkraut- soysauce, Bread, Idli – Fermented dairy products – Yoghurt and cheese. **Jams**

## UNIT V FOOD BORNE DISEASES

9

Food borne diseases & Food Quality control Measures – Food poisoning and Food borne infections – Bacterial and Mycotoxins- Investigation of food poisoning outbreaks- food standards, quality control- HACCP, FDA, WHO

## References

1. Frazier. W.C and D.C Westhoff. 1978. Food Microbiology. 3<sup>rd</sup> ed. Tata Macgraw Hill publishing Co., New Delhi.
  2. Jay,J.M .1991 . Modern Food Microbiology 4<sup>th</sup> edition, Van Nostra and Rainhokdd Co.
  3. Adams. M. R and M. D Moss. 1995. Food Microbiology. New Age International limited.
- Roday. S. Food Hygeine and Sanitation. Tata Mcgraw Hill Publications.1998.

|                                                                              | <b>FOOD BIOTECHNOLOGY LAB</b>                          | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|------------------------------------------------------------------------------|--------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC7L1</b>                                                                | Total Contact Hours - 45                               | 0        | 0        | 2        | 1        |
|                                                                              | Prerequisite – microbiology                            |          |          |          |          |
|                                                                              | Course Designed by – Dept. of Industrial Biotechnology |          |          |          |          |
| <b>OBJECTIVES:</b> To provide basic technologies involved in food processing |                                                        |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                 |                                                        |          |          |          |          |

|                                                                                                                             |                                                                 |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|----------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| CO1                                                                                                                         | To know about preservation techniques                           |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         | to understand basic concepts in sterilization of food products  |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | to know about various dryers                                    |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | to know about the mixing equipment for various products         |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to know about various preservation techniques for food products |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                 |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                         | a                                | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                             | H                                | M                   | M                  | H                      | M                  |                         | H                  | H                                            |   | L | L |   |
|                                                                                                                             | CO2                                                             | H                                | M                   | M                  | H                      | H                  |                         | M                  |                                              | M | L | L |   |
|                                                                                                                             | CO3                                                             | H                                | M                   |                    | H                      | H                  |                         | M                  |                                              |   |   | L | M |
|                                                                                                                             | CO4                                                             | H                                | M                   |                    | H                      |                    | L                       |                    |                                              |   | M | L | M |
|                                                                                                                             | CO5                                                             | H                                | M                   | M                  | H                      | H                  |                         | M                  | M                                            |   | L |   |   |
| 3                                                                                                                           | Category                                                        | Humanities & Social Studies (HS) | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                 |                                  |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                                        | Academic Council, July 2015      |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

### LIST OF EXPERIMENTS

1. Isolation, identification of storage microflora from food stuffs/vegetable/fruit
2. Food colorants from microbes and their separation by HPTLC
3. Estimation of carotenes and xanthophylls from fruits/vegetables
4. Extraction and estimation of antioxidant in vegetables/fruits/food
4. Extraction and Characterization of Gluten
5. Extraction and Characterization of chitin
6. Estimation of caffeine from tea/coffee
7. Estimation of phytic acid from chillies
8. Estimation of trypsin inhibitor
9. Estimation of capsaicin
10. Extraction of alginate from red algae

|                                                                                                                             |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|----------|----------|----------|----------|
| BAC7L2                                                                                                                      |          | <b>CROP PRODUCTION LAB- HORTICULTURAL CROPS</b>          |                     |                    |                        |                    |                         |                    |                                              |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             |          | Total Contact Hours - 45                                 |                     |                    |                        |                    |                         |                    |                                              |   | 0        | 0        | 2        | 1        |
|                                                                                                                             |          | Prerequisite – crop production of Horticultural crops    |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
|                                                                                                                             |          | Course Designed by – Dept. of Industrial Biotechnology   |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| <b>OBJECTIVES:</b> To provide knowledge about production of crops                                                           |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO1                                                                                                                         |          | to know about land preparation                           |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO2                                                                                                                         |          | to know about nursery preparation                        |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO3                                                                                                                         |          | to understand about fertilizer and pesticide application |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO4                                                                                                                         |          | to get basic idea about harvesting and post harvesting   |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| CO5                                                                                                                         |          | to get basic idea about yield calculation                |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| 1                                                                                                                           | COs/POs  | a                                                        | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j        | k        | l        |          |
| 2                                                                                                                           | CO1      | H                                                        | M                   | M                  |                        | M                  |                         |                    |                                              | M |          | L        | M        |          |
|                                                                                                                             | CO2      | H                                                        | M                   | M                  | H                      | H                  |                         | M                  |                                              |   | L        | L        |          |          |
|                                                                                                                             | CO3      | H                                                        | M                   |                    | H                      |                    |                         | M                  | M                                            | L |          | L        | M        |          |
|                                                                                                                             | CO4      | H                                                        | M                   |                    |                        | H                  | M                       |                    |                                              |   | L        |          | M        |          |
|                                                                                                                             | CO5      | H                                                        | M                   | M                  | H                      | H                  |                         | M                  |                                              | L | L        | L        |          |          |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                         | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |          |          |          |          |
|                                                                                                                             |          |                                                          |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |
| 4                                                                                                                           | Approval | Academic Council, July 2018                              |                     |                    |                        |                    |                         |                    |                                              |   |          |          |          |          |

### LIST OF EXPERIMENTS

1. Studying and practicing different propagation techniques of horticultural crops
2. Nursery practices for production of seedlings in containers and raised bed nursery preparation for horticultural crops
3. Practicing seed treatment, sowing of seeds, layout of main field preparation and practicing main field preparation, ploughing and formation of irrigation channels
4. Practicing basal application of fertilizers, FYM
5. Preparation of ridges and furrows /paired row systems
6. Practicing direct sowing and transplanting techniques
7. Practicing irrigation methods and formulating and practicing fertigation schedule to fruits, vegetable and flower crops
8. Practicing earthing up and hand weeding

9. Practicing special horticultural practices (training/ staking/ pruning)
10. Recording observations of growth parameters and Yield parameters
11. Practicing foliar application of nutrients/ growth regulators, herbicides, fungicides and pesticides
12. Identification of different physiological disorders, nutrient deficiency symptoms and their management
13. Practicing harvesting techniques fruits/vegetables /flowers
14. Practicing post harvest operations (cleaning/grading/packing/storage)
15. Working out the economics of cultivation (Cost of Cultivation)

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                       |          |          |          |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BAC7P1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>TERM PAPER</b>                                                                     | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Total Contact Hours -60</b>                                                        | <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology |          |          |          |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Course Designed by– Dept. of Agricultural Biotechnology                               |          |          |          |          |
| <b>OBJECTIVES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                       |          |          |          |          |
| To enable students to do independent research                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                       |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                       |          |          |          |          |
| <ul style="list-style-type: none"><li>• It is a two credit course offered in the VII Semester</li><li>• Each student should register for the course</li><li>• Each student will be allocated a guide and a research topic at the end of the VI semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students</li><li>• There are 4 hours allocated per week for the students to do research. This will be considered for the award of internal marks.</li><li>• There will be three reviews to assess the progress of their research</li><li>• The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic. The student also should publish a paper in a journal or in a conference proceeding</li></ul> |                                                                                       |          |          |          |          |

|                                                           |                                                                                                           |   |   |    |   |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---|---|----|---|
| BAC8P1                                                    | PROJECT WORK                                                                                              | L | T | P  | C |
|                                                           | Total Contact Hours -18 per week                                                                          | 0 | 0 | 18 | 9 |
|                                                           | Prerequisite – Biochemistry, Microbiology, Bioprocess, Plant and Animal Biotechnology, Downstream process |   |   |    |   |
|                                                           | Course Designed by– Dept. of Industrial Biotechnology                                                     |   |   |    |   |
| OBJECTIVES: To enable students to do independent research |                                                                                                           |   |   |    |   |
| COURSE OUTCOMES (COs)                                     |                                                                                                           |   |   |    |   |

- It is a nine credit course offered in the VIII Semester
- Each student will be allocated a guide and a research topic at the end of the VII semester. This will help them to collect sufficient literature during their vacation. A guide will have a maximum of four students
- There are 18 hours allocated per week for the students to do research. This will be considered for the award of internal marks.
- There will be three reviews to assess the progress of their research
- The final review will be on the day of the external examination in the presence of an external and internal examiner. The student will be judged based on the presentation and how he or she defends the selected topic.

## ELECTIVES

|                                                                                                                                                 |                                                                               |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|----------|----------|----------|----------|
| <b>BACE01</b>                                                                                                                                   | <b>IMMUNOTECHNOLOGY</b>                                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                                                 | Total Contact Hours - 45                                                      |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   | 3        | 0        | 0        | 3        |
|                                                                                                                                                 | Prerequisite – basics of immune system                                        |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
|                                                                                                                                                 | Course Designed by – Dept. of Agricultural Biotechnology                      |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| <b>OBJECTIVES</b><br>To provide a basic understanding of biological defense mechanisms and their applications from the perspective of engineers |                                                                               |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                    |                                                                               |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| CO1                                                                                                                                             | to understand the fundamentals of immune system                               |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| CO2                                                                                                                                             | to apply the techniques for antigen and antibody reaction                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| CO3                                                                                                                                             | to give the mechanism of immune response against antigens                     |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| CO4                                                                                                                                             | to know the natural barrier against pathogens                                 |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| CO5                                                                                                                                             | to get a basic knowledge of the applications of immunology in transplantation |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| CO6                                                                                                                                             | To understand about techniques in immunology                                  |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                     |                                                                               |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |
| 1                                                                                                                                               | COs/POs                                                                       | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k        |          | l        |          |
| 2                                                                                                                                               | CO1                                                                           | H                                                      |                     |                    |                        |                    |                         | H                  |                                              | H |   |          |          |          |          |
|                                                                                                                                                 | CO2                                                                           | H                                                      |                     | H                  |                        |                    |                         | H                  |                                              | H |   |          |          |          |          |
|                                                                                                                                                 | CO3                                                                           | H                                                      |                     | H                  |                        |                    |                         | H                  |                                              | H |   |          |          |          |          |
|                                                                                                                                                 | CO4                                                                           | H                                                      |                     | H                  | M                      |                    |                         | H                  |                                              | H |   |          |          |          |          |
|                                                                                                                                                 | CO5                                                                           |                                                        |                     | H                  |                        | H                  | H                       | H                  | H                                            |   |   |          |          | H        |          |
|                                                                                                                                                 | CO6                                                                           | H                                                      |                     |                    |                        | H                  |                         | H                  |                                              |   |   |          |          |          |          |
| 3                                                                                                                                               | Category                                                                      | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |          |          |          |          |
|                                                                                                                                                 |                                                                               |                                                        |                     |                    | √                      |                    |                         |                    |                                              |   |   |          |          |          |          |
| 4                                                                                                                                               | Approval                                                                      | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |          |          |          |          |

Introduction, Immunity, antigens & their classification, complement and their biological functions, types of immune responses, anatomy of immune response. **Primary and Secondary lymphoid organs**

## **UNIT II HUMORAL IMMUNITY 9**

B-lymphocytes and their maturation, activation & differentiation, structure and function of immunoglobulin, immunoglobulin classes, antibody production, mono-clonal antibodies and diagnosis major histocompatibility complex-**classes and functions**

## **UNIT III CELLULAR IMMUNOLOGY 9**

T-Lymphocytes their classification, maturation, activation & differentiation, antigen presenting, cells (APC), macrophages, langerhans cells, their origin and function, mechanisms of phagocytosis, Cytokines and their role in immune response, immunosuppression, immune tolerance

## **UNIT IV ANTIGEN - ANTIBODY INTERACTION AND HYPERSENSITIVITY 9**

Principle and application: Precipitation- immuno diffusion & widal test, Agglutination reactions, radio immuno assay, ELISA, Complement fixation test, Immuno fluorescence technique, Immuno electrophoresis-Hypersensitivity reactions

## **UNIT V TRANSPLANTATION AND AUTO IMMUNITY 9**

Graft rejection, evidence and mechanisms of graft rejection, prevention of graft rejection-**GVH disease** immunosuppressive drugs, mechanisms of immunity to tumour antigens. Auto antibodies in humans, pathogenic mechanisms -autoimmune diseases- treatment of auto immune disorders

### **TEXT BOOKS:**

1. Janis Kuby, 2007, "Immunology" W.H. Freeman & Co. 6<sup>th</sup> ed.
2. Roitt I, 2001, "Essential Immunology". Blackwell Scientific Publications, Oxford,

### **REFERENCES:**

1. Tizard, 1992, "Introduction to Immunology" Saunders collage publication, 3<sup>rd</sup> ed.
2. Abbas, 2009, "Basic Immunology" W.B. Saunders Company, 2<sup>nd</sup> ed.

|                                                 |                                                             |  |   |   |   |   |
|-------------------------------------------------|-------------------------------------------------------------|--|---|---|---|---|
| BACE03                                          | BIODIVERSITY CONSERVATION                                   |  | L | T | P | C |
|                                                 | Total Contact Hours - 45                                    |  | 3 | 0 | 0 | 3 |
|                                                 | Prerequisite- Botany, Environmental studies                 |  |   |   |   |   |
|                                                 | Course Designed by – Department of Industrial biotechnology |  |   |   |   |   |
| OBJECTIVES                                      |                                                             |  |   |   |   |   |
| To learn about the conservation of biodiversity |                                                             |  |   |   |   |   |
| COURSE OUTCOMES (COs)                           |                                                             |  |   |   |   |   |
| CO1                                             | to understand what is diversity                             |  |   |   |   |   |
| CO2                                             | to learn about the threats to diversity                     |  |   |   |   |   |
| CO3                                             | to know the methods of conservation of diversity            |  |   |   |   |   |

|                                                                                                                             |                                                                  |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------|---------------------|--------------------|------------------------|----------------------------|-------------------------|--------------------|------------------------------------------|---|---|---|---|
| CO4                                                                                                                         | to learn the sustainable methods of diversity                    |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |
| CO5                                                                                                                         | to have a knowledge about various policies                       |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |
| CO6                                                                                                                         | to understand the different acts enacted to protect biodiversity |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                  |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |
| 1                                                                                                                           | COs/Pos                                                          | a                                | b                   | c                  | d                      | e                          | f                       | g                  | h                                        | i | J | k | L |
| 2                                                                                                                           | CO1                                                              | M                                |                     |                    |                        |                            |                         |                    | H                                        |   |   | H |   |
|                                                                                                                             | CO2                                                              |                                  |                     |                    | M                      |                            | H                       |                    |                                          |   |   |   |   |
|                                                                                                                             | CO3                                                              |                                  |                     |                    |                        |                            |                         |                    |                                          |   | M |   |   |
|                                                                                                                             | CO4                                                              |                                  | M                   |                    |                        |                            |                         |                    | H                                        |   |   |   |   |
|                                                                                                                             | CO5                                                              |                                  |                     |                    |                        | M                          |                         |                    |                                          |   |   |   |   |
|                                                                                                                             | CO6                                                              |                                  |                     |                    |                        |                            |                         | M                  |                                          |   | H | H |   |
| 3                                                                                                                           | Category                                                         | Humanities & Social Studies (HS) | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Professional Elective (PE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Paper/ Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                  |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |
| 4                                                                                                                           | Approval                                                         |                                  |                     |                    |                        |                            |                         |                    |                                          |   |   |   |   |

## UNIT I TYPES, FUNCTIONS AND BENEFITS OF BIODIVERSITY

9

Types of Biodiversity: Species, Genetic and Ecosystem diversity – Alpha, beta, and gamma diversity – Biodiversity and ecosystem function – Megadiversity zones and Biodiversity Hot Spots in India – Ecologically Sensitive Areas (ESA) in India - Use of Biodiversity: Source of food, medicine, raw material, aesthetic and cultural uses – Biodiversity Prospecting: Significance of Indigenous Knowledge Systems

## UNIT II THREATS TO BIODIVERSITY

9

Natural and anthropogenic threats to biodiversity – Human-Animal conflict with special reference to elephants and tigers - IUCN Threat Categories – Red Data Book – Wildlife exploitation - Species extinctions – Endangered and endemic species of flora and fauna in India - Over-harvesting and Climate change on biodiversity - Causes and Impacts of Invasive species to biodiversity

## UNIT III CONSERVATION STRATEGIES

9

Current practices in conservation: Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches: Chipko Movement – In-situ conservation: Afforestation, Social Forestry, Agro-forestry, Botanical gardens, Zoos, Biosphere Reserves, National Parks,

Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas – Ex-situ conservation: Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies

#### **UNIT IV SUSTAINABLE MANAGEMENT OF BIORESOURCES**

**9**

National Biodiversity Authority (NBA) – Functions of State Biodiversity Board (SBB) and Biodiversity Management Committee's (BMC) – The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation – An elementary account on WTO, GAAT and TRIPS – Biopiracy rights of farmers, breeders and indigenous people –Biodiversity informatics with special reference to plant genetic resources

#### **UNIT V POLICIES, PROGRAMMES AND ACTS FOR CONSERVATION**

**9**

Status and protection of species in National and International levels – Role of CITES and IUCN – Convention on Biological Diversity (CBD) – Nagoya Protocol – Man and Biosphere Programme (MAB) – Policies implemented by MoEF for biodiversity conservation – Salient features of Biological Diversity Act 2002 – Ecosystem restoration

##### **Text/Reference book**

1. Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.
2. Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
3. Kumar HD (1997) General Ecology. Vikas Publishing House (P) Ltd., New Delhi.
4. Muthuchelian K (2013) Uyir Virimam (Tamil), Pranisha Pathippagam, Madurai.
5. Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India.
6. Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.

##### **Web References**

1. [www.iucn.org](http://www.iucn.org)
2. [www.cites.org](http://www.cites.org)
3. [www.cbd.int](http://www.cbd.int)
4. [www.fao.org/Ag/agp/agpc/doc/Publicat/TAPAFON/TAP\\_7.pdf](http://www.fao.org/Ag/agp/agpc/doc/Publicat/TAPAFON/TAP_7.pdf)
5. [www.wri.org/biodiv/bp-home.html](http://www.wri.org/biodiv/bp-home.html)

|                                                                                                                             |          |                                                            |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| BACE04                                                                                                                      |          | PRINCIPLES OF SEED TECHNOLOGY                              |                     |                    |                        |                    |                         |                    |                                              | L | T | P | C |
|                                                                                                                             |          | Total Contact Hours - 45                                   |                     |                    |                        |                    |                         |                    |                                              | 3 | 0 | 0 | 3 |
|                                                                                                                             |          | Prerequisite – General biology, Cell biology, Agrl. Botany |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|                                                                                                                             |          | Course Designed by – Dept of Biotechnology                 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| OBJECTIVES: To provide a basic knowledge about seeds its quality, handling and production methods                           |          |                                                            |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |          |                                                            |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO1                                                                                                                         |          | to understand basic concepts of seed and its quality       |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO2                                                                                                                         |          | to know about the seed production principles               |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         |          | to know about production of seeds of agricultural crops    |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         |          | to know about production of seeds of vegetable crops       |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         |          | to understand the post harvest handling of seeds           |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                            |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs  | a                                                          | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1      | H                                                          | M                   | M                  | H                      | M                  |                         | M                  | H                                            | M | L | L | H |
|                                                                                                                             | CO2      | H                                                          | M                   | M                  | H                      | H                  | H                       |                    | H                                            | H | M | H |   |
|                                                                                                                             | CO3      | H                                                          |                     |                    | H                      |                    |                         |                    | M                                            | M | L | L |   |
|                                                                                                                             | CO4      |                                                            | M                   | H                  | H                      | H                  | M                       | M                  | L                                            | M |   | M | H |
|                                                                                                                             | CO5      |                                                            | M                   | M                  | H                      | H                  | M                       | M                  | M                                            | M |   | L | M |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                           | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |          |                                                            |                     |                    |                        |                    |                         |                    |                                              |   |   | √ |   |
| 4                                                                                                                           | Approval | Academic Council, July 2018                                |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I - INTRODUCTION TO SEED AND SEED QUALITY

9

Seed - definition - Seed structure - Seed development and maturation - Germination -phases of seed germination - Dormancy - types of seed dormancy - Seed senescence - causes of seed senescence - Seed quality characteristics - significance - Classes of seed - Generation system of seed multiplication in seed supply chain .

## UNIT II - PRINCIPLES OF SEED PRODUCTION

9

Seed replacement rate and varietal replacement - Seed Multiplication Ratio - Seed renewal period - Causes of varietal deterioration and maintenance - Genetic and agronomic principles of

seed production - Factors affecting quality seed production - Methods of seed production of varieties and hybrids.

### UNIT III - SEED PRODUCTION TECHNIQUES OF AGRICULTURAL CROPS 9

Floral biology and pollination behavior - seed production techniques of rice, maize, sorghum and bajra varieties and hybrids - redgram varieties and hybrids - blackgram and greengram varieties - groundnut and sesame varieties - sunflower, castor and cotton varieties and hybrids – Bt cotton.

### UNIT IV - SEED PRODUCTION TECHNIQUES OF VEGETABLE CROPS 9

Floral biology and pollination behavior - seed production techniques of tomato, chillies, brinjal, bhendi, onion, snakegourd, bittergourd, pumpkin, ashgourd, ribbedgourd and bottlegourd varieties and hybrids.

### UNIT V - POST HARVEST SEED HANDLING TECHNIQUES 9

Threshing - methods - Drying - methods of seed drying - advantages and disadvantages -Seed processing – definition - importance - Seed cleaning and grading - upgrading - equipments - working principles - Seed treatment - importance - types - Seed invigoration techniques - seed hardening - seed fortification - seed priming - Seed enhancement techniques - seed coating - seed pelleting.

#### Text books

1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.

Bhaskaran, M. *et al.*, 2004. Principles of seed production. Scientific Publishers, Ludhiana.

|                                                                                   |                                                        |          |          |          |          |
|-----------------------------------------------------------------------------------|--------------------------------------------------------|----------|----------|----------|----------|
| <b>BACE06</b>                                                                     | <b>BIOREMEDIATION TECHNOLOGY</b>                       | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                   | Total Contact Hours - 45                               | 3        | 0        | 0        | 3        |
|                                                                                   | Prerequisite – Bioprocess technology, Microbiology     |          |          |          |          |
|                                                                                   | Course Designed by – Dept. of Industrial Biotechnology |          |          |          |          |
| <b>OBJECTIVES:</b> To provide basic knowledge about the bioremediation techniques |                                                        |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                      |                                                        |          |          |          |          |
| CO1                                                                               | To know about the types of bioremediation              |          |          |          |          |
| CO2                                                                               | to understand basic techniques in bioremediation       |          |          |          |          |
| CO3                                                                               | to know about bioremediation of chlorinated compounds  |          |          |          |          |
| CO4                                                                               | to know about the nuclear waste bioremediation         |          |          |          |          |
| CO5                                                                               | to know about remediation of oil spills                |          |          |          |          |

| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                        |                           |   |                          |   |                           |   |                       |   |                               |   |                          |  |                                                          |  |
|-----------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------|---------------------------|---|--------------------------|---|---------------------------|---|-----------------------|---|-------------------------------|---|--------------------------|--|----------------------------------------------------------|--|
| 1                                                                                                                           | COs/POs  | a                                      | b                         | c | d                        | e | f                         | g | h                     | i | j                             | k | l                        |  |                                                          |  |
| 2                                                                                                                           | CO1      | M                                      | M                         | M | H                        | M |                           | M |                       | L | L                             | L | M                        |  |                                                          |  |
|                                                                                                                             | CO2      | H                                      | M                         | M | H                        | H |                           | M |                       |   | L                             | L | M                        |  |                                                          |  |
|                                                                                                                             | CO3      | H                                      | M                         |   | H                        | H |                           | M | L                     | M | L                             | L | M                        |  |                                                          |  |
|                                                                                                                             | CO4      | H                                      | M                         |   | H                        | H |                           | M |                       |   | L                             | L | M                        |  |                                                          |  |
|                                                                                                                             | CO5      | H                                      | M                         | M | H                        | H |                           | M | M                     | H | L                             | L | M                        |  |                                                          |  |
| 3                                                                                                                           | Category | Humanities<br>& Social<br>Studies (HS) | Basic<br>Sciences<br>(BS) |   | Engg<br>Sciences<br>(ES) |   | Professional<br>Core (PC) |   | Core Elective<br>(CE) |   | Non-Major<br>Elective<br>(NE) |   | Open<br>Elective<br>(OE) |  | Project/<br>Term paper<br>Seminar/<br>Internship<br>(PR) |  |
|                                                                                                                             |          |                                        |                           |   |                          |   |                           | √ |                       |   |                               |   |                          |  |                                                          |  |
| 4                                                                                                                           | Approval | Academic Council, July 2018            |                           |   |                          |   |                           |   |                       |   |                               |   |                          |  |                                                          |  |

## UNIT I BIOREMEDIATION

9

**Introduction**-Types of Bioremediation, Factors affecting Bioremediation. Bioremediation Mechanisms. Limitations of Bioremediations. Microbes for Bioremediation: Essential Characteristics of Microbes for Bioremediation, **Microbial Adaptation for Adverse conditions**. Microbes involved in Bioremediation. Metabolic process involved in bioremediation. Bioremediation Techniques: In situ & Ex situ bioremediation techniques. Phytoremediation

## UNIT II SPECIFIC BIOREMEDIATION TECHNOLOGIES

9

Application, specific advantages and disadvantages of specific bioremediation technologies - land farming, prepared beds, biopiles, composting, bioventing, **biosparging**, pump and treat method, constructed wet lands, use of bioreactors for bioremediation.

## UNIT III BIOREMEDIATION OF CHLORINATED COMPOUNDS

9

Bioremediation of phenols, chlorinated phenols, chlorinated aliphatic compounds, heterocyclic compounds, cyanides, dyes; Rhizoremediation: a beneficial plant-microbe interaction; **Molecular techniques in bioremediation**- Enhanced biodegradation through pathway engineering; Biodegradation of polyhalogenated compounds by genetically engineered bacteria.

## UNIT IV NUCLEAR WASTE BIOREMEDIATION

9

Spent fuel characterisation, storage and disposal; Partitioning, transmutation and conditioning; Measurement of Radioactivity in the environment; Basic actinide research.

## UNIT V HEAVY METAL AND OIL SPILL BIOREMEDIATION

9

Heavy metal pollution & sources; Microbial interactions with heavy metals - resistance & tolerance; Microbial transformation; Accumulation and concentration of metals. Biosorption of heavy metals by microbial biomass and secondary metabolites – Biosurfactants.

Advantages of biosurfactants over chemical surfactants- Biotechnology and oil spills;  
Improved oil recovery.

## REFERENCES

1. Bruce E. Rittmann, Perry L. McCarty, “*Environmental Biotechnology: Principles and Applications*” McGraw-Hill, 2001.
  2. Phillip L. Buckingham , Jeffrey C. Evans,” *Hazardous Waste Management*” Waveland Pr Inc; Reissue edition 1, 2010.
  3. S. K. Agarwal, “*Environmental Biotechnology*”, APH Publishing, 2000
  4. Martin Alexander, “*Biodegradation & Bioremediation*”, Academic press, 1999.
  5. Karrely D., Chakrabarty K., Omen G.S, “*Biotechnology and Biodegradation*”, Portfolio Pub. Co., 1990.
- P. Rajendran, P. Guansekar, “*Microbial Bioremediation*”, Mjp Publishers, 2011.

|                                                                                                                             |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---|---|---|---|---|---|----------|----------|----------|----------|---|---|
| <b>BACE07</b>                                                                                                               | <b>FUNDAMENTALS OF SOIL SCIENCE</b> |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |   |
|                                                                                                                             | Total Contact Hours - 45            |   |   |   |   |   |   | 3        | 0        | 0        | 3        |   |   |
|                                                                                                                             | Prerequisite –                      |   |   |   |   |   |   |          |          |          |          |   |   |
|                                                                                                                             | Course Designed by –                |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>OBJECTIVES:</b>                                                                                                          |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO1                                                                                                                         |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO2                                                                                                                         |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO3                                                                                                                         |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO4                                                                                                                         |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO5                                                                                                                         |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| CO6                                                                                                                         |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                     |   |   |   |   |   |   |          |          |          |          |   |   |
| 1                                                                                                                           | COs/POs                             | a | b | c | d | e | f | g        | h        | i        | j        | k | l |
| 2                                                                                                                           | CO1                                 | H | M | M | H |   | H | H        | H        | H        | M        | L | M |
|                                                                                                                             | CO2                                 | H | M | M | H |   |   |          |          |          |          | L | M |
|                                                                                                                             | CO3                                 | H |   |   |   | H |   |          | H        | L        |          |   |   |
|                                                                                                                             | CO4                                 | H | M |   |   |   | M | M        |          |          |          | L |   |
|                                                                                                                             | CO5                                 | H | M | M |   | H |   |          |          | M        | L        |   |   |
|                                                                                                                             | CO6                                 |   |   |   |   |   |   |          |          |          |          |   |   |

|   |          |                                  |                     |                    |                        |                    |                         |                    |                                              |
|---|----------|----------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS) | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                  |                     |                    | √                      |                    |                         |                    |                                              |
| 4 | Approval | Academic Council, July 2015      |                     |                    |                        |                    |                         |                    |                                              |

### Unit I

Soil as a natural body, Pedological and edaphological concepts of soil. Components of soil. Soil genesis: Composition of Earth's crust- soil forming rocks and minerals – Primary and secondary minerals. Weathering of rocks and minerals. **Factors affecting soil formation**. Soil forming processes. Soil Profile.

### Unit II

Soil physical properties: Soil texture, structure, density and porosity, soil colour, consistence and plasticity. Soil water retention, movement and availability. Soil air, composition, gaseous exchange-problem and its effect on crop growth. **Source, amount and flow of heat in soil**, Soil temperature and crop growth.

### Unit III

Soil physico chemical and chemical properties: Soil reaction-pH, soil acidity and alkalinity, buffering, **effect of pH and temperature on nutrient availability**. Electrical conductivity. Soil colloids - inorganic and organic. Silicate clays: constitution and properties, sources of charge, ion exchange, cation and anion exchange capacity and base saturation.

### Unit IV

Soil organic matter: composition, properties and its influence on soil properties. Humic substances - nature and properties. Soil Biology: Soil organisms : macro and micro organisms, their beneficial and harmful effects. Soil enzymes.

## UNIT V

Soil pollution – Types and behaviour of pesticides. Inorganic contaminants. Prevention and mitigation of soil pollution.

|                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                      |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|---------------------------------------------|---|---|---|---|
| BACE09                                                                                                                                                                                                                                                                                                                                  | FARMING SYSTEM AND SUSTAINABLE AGRICULTURE                                                                                           |                                  |                     |                    |                        |                    |                         | L                  | T                                           | P | C |   |   |
|                                                                                                                                                                                                                                                                                                                                         | Total Contact Hours - 45                                                                                                             |                                  |                     |                    |                        |                    |                         | 3                  | 0                                           | 0 | 3 |   |   |
|                                                                                                                                                                                                                                                                                                                                         | Prerequisite-                                                                                                                        |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                         | Course Designed by                                                                                                                   |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| OBJECTIVES:                                                                                                                                                                                                                                                                                                                             |                                                                                                                                      |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| COURSE OUTCOMES (COs):<br>1. Students get knowledge about basic principles and concepts in cropping and farming systems<br>2. Provides hands on experience in establishing different IFS models for different ecosystems<br>3. It gives idea and knowledge about low cost technologies in crop production and cost reduction strategies |                                                                                                                                      |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO1                                                                                                                                                                                                                                                                                                                                     | Students get knowledge about basic definitions and concepts of cropping system                                                       |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO2                                                                                                                                                                                                                                                                                                                                     | It deals with different indices for evaluation of cropping systems and their economic viability                                      |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO3                                                                                                                                                                                                                                                                                                                                     | students get information about the basic principles in farming systems                                                               |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO4                                                                                                                                                                                                                                                                                                                                     | It gives knowledge about resources recycling and deals with the principles and concepts of LEISA, HEIA and conservation agriculture. |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO5                                                                                                                                                                                                                                                                                                                                     | It gives idea and knowledge about low cost technologies in crop production and cost reduction strategies                             |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                                                                             |                                                                                                                                      |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| 1                                                                                                                                                                                                                                                                                                                                       | COs/POs                                                                                                                              | a                                | b                   | c                  | d                      | e                  | f                       | g                  | h                                           | i | j | k | l |
| 2                                                                                                                                                                                                                                                                                                                                       | CO1                                                                                                                                  | H                                | M                   | M                  |                        | M                  |                         |                    |                                             | M |   | L | M |
|                                                                                                                                                                                                                                                                                                                                         | CO2                                                                                                                                  | H                                | M                   | M                  | H                      | H                  |                         | M                  |                                             |   | L | L |   |
|                                                                                                                                                                                                                                                                                                                                         | CO3                                                                                                                                  | H                                | M                   |                    | H                      |                    |                         | M                  | M                                           | L |   | L | M |
|                                                                                                                                                                                                                                                                                                                                         | CO4                                                                                                                                  | H                                | M                   |                    |                        | H                  | M                       |                    |                                             |   | L |   | M |
|                                                                                                                                                                                                                                                                                                                                         | CO5                                                                                                                                  | H                                | M                   | M                  | H                      | H                  |                         | M                  |                                             | L | L | L |   |
|                                                                                                                                                                                                                                                                                                                                         | CO6                                                                                                                                  |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| 3                                                                                                                                                                                                                                                                                                                                       | Category                                                                                                                             | Humanities & Social Studies (HS) | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/Term paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                      |                                  |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| 4                                                                                                                                                                                                                                                                                                                                       | Approval                                                                                                                             | Academic Council, July 2015      |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |

## 9

## UNIT II EVALUATION OF CROPPING SYSTEM

9

## UNIT III FARMING SYSTEM

9

## UNIT IV EVALUATION OF FARMING SYSTEM

9

UNIT V RESOURCE AND LABOUR MANAGEMENT IN FARMING SYSTEM 9

## References

1. Palaniappan, SP and K. Sivaraman.1996. Cropping systems in the tropics Principles and management.New Age International (P) Ltd., New Delhi.
2. Jayanthi, C. Devasenapathy, P and C. Vennila. 2007. Farming Systems. Principles and practices. Satish Serial Publishing House.Delhi.
3. S.C. Panda. 2003. Cropping and Farming Systems. AgrobioPublishers. Jodhpur.

4. Jana, B.L. 2014. Farming Systems. Agrotech Publishing Academy, Udaipur Shagufta. 2015. Cropping and Farming Systems. APH publishing Corporation

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1. [www.agriinfo.in](http://www.agriinfo.in)
2. [www.fao.org](http://www.fao.org)
3. [www.agritech.tnau.ac.in](http://www.agritech.tnau.ac.in)

|                                                                                                                                     |                                                                                                |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|----------------------------------------------------------|---|---------------------|---|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|
| BBTE10                                                                                                                              |                                                                                                | PROTEOGENOMICS AND BIOINFORMATICS                        |   |                     |   |                    |                        |                    | L                       | T                  | P                                            | C |   |
|                                                                                                                                     |                                                                                                | Total Contact Hours - 45                                 |   |                     |   |                    |                        |                    | 3                       | 0                  | 0                                            | 3 |   |
|                                                                                                                                     |                                                                                                | Prerequisite – Bioorganic chemistry, Basic Biotechnology |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
|                                                                                                                                     |                                                                                                | Course Designed by – Dept. of Industrial Biotechnology   |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| OBJECTIVES                                                                                                                          |                                                                                                |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers |                                                                                                |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| COURSE OUTCOMES (COs)                                                                                                               |                                                                                                |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| CO1                                                                                                                                 | to understand the classification of biological databases and its role in research              |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| CO2                                                                                                                                 | to apply the concept of genomics of different organism, gene expression and mapping situations |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| CO3                                                                                                                                 | to know the tools for gene identification and prediction                                       |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| CO4                                                                                                                                 | to know the structural elucidation and prediction of proteins                                  |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| CO5                                                                                                                                 | to get a basic knowledge of techniques related to proteomics                                   |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| CO6                                                                                                                                 | To know about bioinformatics tools                                                             |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low         |                                                                                                |                                                          |   |                     |   |                    |                        |                    |                         |                    |                                              |   |   |
| 1                                                                                                                                   | COs/POs                                                                                        | a                                                        | b | c                   | d | e                  | f                      | g                  | h                       | i                  | j                                            | k | l |
| 2                                                                                                                                   | CO1                                                                                            | H                                                        | M | M                   | H | M                  |                        | M                  |                         | L                  | L                                            | L | M |
|                                                                                                                                     | CO2                                                                                            | H                                                        | M | M                   | H | H                  |                        | M                  |                         |                    | L                                            | L | M |
|                                                                                                                                     | CO3                                                                                            | H                                                        | M |                     | H | H                  |                        | M                  | M                       |                    | L                                            | L | M |
|                                                                                                                                     | CO4                                                                                            | H                                                        | M |                     | H | H                  |                        | M                  |                         | M                  | L                                            | L | M |
|                                                                                                                                     | CO5                                                                                            | H                                                        | M | M                   | H | H                  |                        | M                  | L                       |                    | L                                            | L | M |
|                                                                                                                                     | CO6                                                                                            | H                                                        |   |                     | H | H                  |                        | M                  |                         |                    | L                                            | L | M |
| 3                                                                                                                                   | Category                                                                                       | Humanities & Social Studies (HS)                         |   | Basic Sciences (BS) |   | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |



|                                                                                                                             |                                                                 |                                                        |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------------------|------------------------|---|-----------------------|---|---------------------------|---|-----------------------|---|----------------------------|---|-----------------------|--|----------------------------------------------------------|--|
| CO4                                                                                                                         | to know about the mixing equipment for various products         |                                                        |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
| CO5                                                                                                                         | to know about various preservation techniques for food products |                                                        |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
| CO6                                                                                                                         | to understand the microbiological aspects in food process       |                                                        |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                 |                                                        |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |
| 1                                                                                                                           | COs/POs                                                         | a                                                      | b                      | c | d                     | e | f                         | g | h                     | i | j                          | k | l                     |  |                                                          |  |
| 2                                                                                                                           | CO1                                                             | H                                                      | M                      | M | H                     | M |                           | M |                       |   |                            | L | M                     |  |                                                          |  |
|                                                                                                                             | CO2                                                             | H                                                      | M                      | M | H                     | H |                           |   | H                     | M | L                          | L |                       |  |                                                          |  |
|                                                                                                                             | CO3                                                             | H                                                      | M                      |   | H                     | H |                           | H |                       |   |                            | L | M                     |  |                                                          |  |
|                                                                                                                             | CO4                                                             | H                                                      | M                      |   | H                     |   |                           | M | L                     |   | L                          | L | M                     |  |                                                          |  |
|                                                                                                                             | CO5                                                             | H                                                      | M                      | M | H                     | H |                           | H |                       | M | L                          | L |                       |  |                                                          |  |
|                                                                                                                             | CO6                                                             | H                                                      |                        |   | H                     | H | L                         | M |                       |   | L                          |   | M                     |  |                                                          |  |
| 3                                                                                                                           | Category                                                        | Humanities &<br>Social Studies<br>(HS)                 | Basic Sciences<br>(BS) |   | Engg Sciences<br>(ES) |   | Professional<br>Core (PC) |   | Core Elective<br>(CE) |   | Non-Major<br>Elective (NE) |   | Open Elective<br>(OE) |  | Project/ Term<br>paper<br>Seminar/<br>Internship<br>(PR) |  |
|                                                                                                                             |                                                                 |                                                        |                        |   |                       |   | √                         |   |                       |   |                            |   |                       |  |                                                          |  |
| 4                                                                                                                           | Approval                                                        | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                          |  |

## UNIT I PHYSICAL TREATMETN OF FOOD

9

Thermal, electrical and rheological properties- Heat processing- Methods of applying heat to food - sterilization - Thermo bacteriology- dehydration and drying - free moisture - equilibrium moisture content- water activity- classification of dryers- tray, and freeze dryers, osmotic dehydration - foam mat drying- extrusion coking.

## UNIT II BLENDING METHODS

9

Mixing of solids, Pastes and liquids - Characteristics of mixtures-Blending -emulsification-equipments - liquid, pastes, and plastic masses - dry powders - criteria of mixer effectiveness-mixing index

## UNIT III PRESERVATION OF FOOD

9

Concentration - freeze concentration - freezing and storage of frozen products - low temperature preservation - irradiation of food products - microwave heating - dielectric heating of foods.

## UNIT IV DAIRY FOODS

9

Physics and chemical properties of milk and their effect on design - heaters - coolers -heat exchange equipments - storage tanks - can washers - pasteurization - principles and methods - equipments - LTLT - HTST - UHT pasteurization - CIP unit -Homogenization - Theory and working of homogenizers - bottle fillers and cappers -cream separation - principles - types of separator - classifiers - butter churns - cheese plant equipments - ice cream freezers - drying equipments - drum drier and spray drier -membrane concentration equipments.

## UNIT V FOOD MICROBIOLOGY

9

Food microbiology: food spoilage, food borne diseases, infections, intoxications, utilization of microorganisms in food industries, Nutraceuticals. Quality control, Case studies on biotechnology in the evaluation of food quality.

**Total No. of Periods: 45**

### Text Books

1. Lehninger and Beverlov, 2002, "Food Process Engineering". Reidal Publishing Co. Holland
2. Yin H.Hui, 2006, "Handbook of food science, technology and engineering" Wiley, Newyork, 2<sup>nd</sup> ed

### Reference Books

1. Tucker & Woods, 1995, "Enzymes in food processing" Springer, 5<sup>th</sup>ed.
2. Hamm & Hammilton, 2000, "Edible oil processing" Academic Press 5<sup>th</sup> ed
3. Fellows, 2009, "Food processing technology" 21<sup>th</sup> ed
4. Heldman, 2007, "Hand book of food engineering" CRC Press 2<sup>nd</sup> ed
5. P.G. Smith, 2003, "Food Process Engineering" Academic Plenum Pub, New York 1<sup>st</sup> ed
6. Srilakshmi, 2005, "Food Science" MJP Publiashers, 3<sup>rd</sup> ed

Weblink: nptel

|                                                                                                                             |                                                                          |   |   |   |   |   |   |          |          |          |          |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---|---|---|---|---|---|----------|----------|----------|----------|---|---|
| <b>BACE10</b>                                                                                                               | <b>DAIRY PROCESS TECHNOLOGY</b>                                          |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |   |
|                                                                                                                             | Total Contact Hours - 45                                                 |   |   |   |   |   |   | 3        | 0        | 0        | 3        |   |   |
|                                                                                                                             | Prerequisite – Microbiology                                              |   |   |   |   |   |   |          |          |          |          |   |   |
|                                                                                                                             | Course Designed by – Agricultural Biotechnology                          |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>OBJECTIVES</b>                                                                                                           |                                                                          |   |   |   |   |   |   |          |          |          |          |   |   |
| To learn the techniques involved in the processing of dairy products                                                        |                                                                          |   |   |   |   |   |   |          |          |          |          |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                          |   |   |   |   |   |   |          |          |          |          |   |   |
| CO1                                                                                                                         | To remember the ways to preserve milk                                    |   |   |   |   |   |   |          |          |          |          |   |   |
| CO2                                                                                                                         | To understand the different types of processing of milk and its products |   |   |   |   |   |   |          |          |          |          |   |   |
| CO3                                                                                                                         | To analyze the presence of different contaminants in milk products       |   |   |   |   |   |   |          |          |          |          |   |   |
| CO4                                                                                                                         | To understand the methods to produce powdered milk products              |   |   |   |   |   |   |          |          |          |          |   |   |
| CO5                                                                                                                         | To analyze ways to increase the shelf life of milk and its products      |   |   |   |   |   |   |          |          |          |          |   |   |
| CO6                                                                                                                         | To remember the ways to sanitize the dairy equipments                    |   |   |   |   |   |   |          |          |          |          |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                          |   |   |   |   |   |   |          |          |          |          |   |   |
| 1                                                                                                                           | COs/POs                                                                  | a | b | c | d | e | f | g        | h        | i        | j        | k | l |
| 2                                                                                                                           | CO1                                                                      | H | M | M | H | M |   | M        | H        | H        | H        | L | H |
|                                                                                                                             | CO2                                                                      | H | M | M | H | H | M | M        | H        |          | L        |   |   |

|   |          |                             |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|---|----------|-----------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
|   | CO3      | H                           | M                   |                    | H                      |                    |                         |                    |                                              | H | M | L | H |
|   | CO4      | H                           | M                   |                    |                        | H                  | H                       | M                  | M                                            |   | M | M | M |
|   | CO5      |                             |                     | M                  |                        | H                  |                         | M                  |                                              | M |   | L | H |
|   | CO6      | H                           |                     |                    |                        | H                  |                         |                    | M                                            |   |   |   | M |
| 3 | Category | Humanities & Social Studies | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|   |          |                             |                     |                    | √                      |                    |                         |                    |                                              |   |   |   |   |
| 4 | Approval | Academic Council, July 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I PRESERVATION OF MILK

9

Preservation of raw milk: effects on physicochemical, microbial and nutritional properties of milk and milk products, preservation of raw milk by chemical preservatives; **thermal and chilling processing for preservation.**

## UNIT II PROCESSING OF MILK

9

Methods of determining lethality of thermal processing, UHT processed milk products, their properties and prospects, types of UHT plants, aseptic fillers, heat stability and deposit formation aspects, effect on milk quality; techno- economic considerations; retort processing.

## UNIT III BACTOFUGATION AND BACTOTHERM

9

Principles and equipment for bactofugation and Bactotherm processes, Microfluidization of milk: Principle, equipment, effects and applications, **Homogenization ,Pasteurization and their applications in dairy industry.**

## UNIT IV DRYING OF MILK

9

Dehydration: advances in drying of milk and milk products; freeze concentration, freeze dehydration: physicochemical changes during freeze drying and industrial developments.

## UNIT V SHELF LIFE OF MILK PRODUCTS

9

Sorption behaviour of milk foods, control of water activity of different milk products in relation to their chemical; microbiological and textural properties; hurdle technology and its application in development of shelf-stable and intermediate-moisture foods, Use of carbonation in extending the shelf life of dairy products-Cleaning and sanitization of dairy equipment: biological; detergents; Automation; **Ultrasonic techniques in cleaning**; bio-detergents, development of sanitizers- heat; chemical; radiation, mechanism of fouling and soil removal; Bio-films, assessing the effectiveness of cleaning and sanitization of dairy products.

### Text Books

1. Burton H. 1998. Ultra-high Temperature Processing of Milk and Milk Products. Elsevier.
2. Fellow P. 1988. Food Processing Technology. Elliss Horwood Ltd.
3. Gould GW. 1995. New Methods of Food Preservation. Blackie.

#### Reference Books

1. IDF Bulletin 1981. New Monograph on UHT Milk. Document No. 133, Intern. Dairy Fed., Brussels.
2. Smit G. 2003. Dairy Processing – Improving Quality. CRC-Woodhead Publ.
3. Troller JA & Christian HB. 1978. Water Activity and Food, Food Science and Technology. A Series of Monograph Academic Press, London.
4. Walstra P, Geurts TJ, Noomen A, Jellema A & Van Boekel MAJS. 1999. Dairy Technology – Principles of Milk Properties and Processes. Marcel Dekker

| BBTE07                                                                                      | FOOD SAFETY AND QUALITY CONTROL                   |   |   |   |  |
|---------------------------------------------------------------------------------------------|---------------------------------------------------|---|---|---|--|
|                                                                                             | Total Contact Hours - 45                          |   |   |   |  |
|                                                                                             | L                                                 | T | P | C |  |
|                                                                                             | 3                                                 | 0 | 0 | 3 |  |
| Prerequisite – Food process engineering, Microbiology, Bioprocess Engineering, Biochemistry |                                                   |   |   |   |  |
| Course Designed by – Dept. of Industrial Biotechnology                                      |                                                   |   |   |   |  |
| <b>OBJECTIVES:</b> To know about the safety regulations of food industries                  |                                                   |   |   |   |  |
| <b>COURSE OUTCOMES (COs)</b>                                                                |                                                   |   |   |   |  |
| CO1                                                                                         | To study the history of food safety regulations   |   |   |   |  |
| CO2                                                                                         | to know about food adulteration                   |   |   |   |  |
| CO3                                                                                         | to understand about food management practices     |   |   |   |  |
| CO4                                                                                         | to get basic idea about food hygiene              |   |   |   |  |
| CO5                                                                                         | to get basic idea about microbial quality control |   |   |   |  |
| CO6                                                                                         | to get basic idea about food safety standards     |   |   |   |  |

#### UNIT I FOOD SAFETY REGULATIONS

9

History of food regulations in India- Legislations- Prevention of Food Adulteration act 1954, Food product order (1955), Solvent Extracted Oil, De-oiled Meal and Edible Flour (Control) Order, 1967, Meat Food Products Order (1973), Edible Oils Packaging, 1998, Edible Oils Packaging, 1998, Vegetable Oil Products Order, 1998, Milk & Milk Product Amendment Regulations – 2009.

#### UNIT II FOOD SAFETY MANAGEMENT

9

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

#### UNIT III FOOD QUALITY MANAGEMENT

9

Principles of food quality assurance, total quality management (TQM)–good manufacturing/management practices, good hygienic practices, good lab practices, general

awareness and role of management practices in quality control Food safety management, applications of HACCP in food safety, concept of food traceability for food safety,

#### **UNIT IV MICROBIAL CONTAMINATION**

**9**

Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods. Statistical quality control in food industry Food safety and Standards Act 2006: salient provision and prospects

#### **UNIT V FOOD SAFETY STANDARDS**

**9**

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarius commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

#### **TEXT BOOKS:**

1. V. K. Kaushik (1999), Nutrition And Food Safety, Neha Publishers
2. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.

#### **REFERENCE BOOKS:**

1. Andre, Gordan (2015), Food Safety and Quality Systems in Developing Countries, Elsevier
2. Yasmine Motarjemi (2013), Food Safety Management, 1st Edition, Elsevier

|                                                                                                                             |                                                                                                                                                         |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|
| <b>BACE11</b>                                                                                                               | <b>SOIL AND APPLIED MICROBIOLOGY</b>                                                                                                                    | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             | Total Contact Hours - 45                                                                                                                                | 0        | 3        | 0        | 3        |
|                                                                                                                             | Prerequisite – Agricultural microbiology                                                                                                                |          |          |          |          |
|                                                                                                                             | Course Designed by – Dept of Agricultural Biotechnology                                                                                                 |          |          |          |          |
| <b>OBJECTIVES:</b> To provide a basic knowledge of soil and industrial related microorganisms and its application           |                                                                                                                                                         |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                                                                                                                         |          |          |          |          |
| CO1                                                                                                                         | To illuminate the students about historical developments in soil microbiology and industrial microbiology.                                              |          |          |          |          |
| CO2                                                                                                                         | To enlighten the students with the knowledge of microbial diversity in soils                                                                            |          |          |          |          |
| CO3                                                                                                                         | The students must know about involvements of microorganism’s Biogeochemical cycles.                                                                     |          |          |          |          |
| CO4                                                                                                                         | To highlighted the role of soil microorganisms in soil fertility and plant growth promotion                                                             |          |          |          |          |
| CO5                                                                                                                         | To develop experimental skills in soil microbiology which includes isolation of beneficial microorganisms from soil and plant and their mass production |          |          |          |          |
| CO6                                                                                                                         | To make students gain expertise in practical aspects of production of industrial products                                                               |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                                                                         |          |          |          |          |

|   |          |                                  |   |                     |   |                    |   |                        |                    |                         |   |                    |                                              |
|---|----------|----------------------------------|---|---------------------|---|--------------------|---|------------------------|--------------------|-------------------------|---|--------------------|----------------------------------------------|
| 1 | COs/POs  | a                                | b | c                   | d | e                  | f | g                      | h                  | i                       | j | k                  | l                                            |
| 2 | CO1      | H                                | M | M                   | H |                    | H | H                      | H                  | H                       | M | L                  | M                                            |
|   | CO2      | H                                | M | M                   | H |                    |   |                        |                    |                         |   | L                  | M                                            |
|   | CO3      | H                                |   |                     |   | H                  |   |                        | H                  | L                       |   |                    |                                              |
|   | CO4      | H                                | M |                     |   |                    | M | M                      |                    |                         |   | L                  |                                              |
|   | CO5      | H                                | M | M                   |   | H                  |   |                        |                    | M                       | L |                    |                                              |
|   | CO6      | H                                |   |                     |   | H                  |   |                        | H                  | L                       |   |                    |                                              |
| 3 | Category | Humanities & Social Studies (HS) |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) |   | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                  |   |                     |   |                    | √ |                        |                    |                         |   |                    |                                              |
| 4 | Approval | Academic Council, July 2015      |   |                     |   |                    |   |                        |                    |                         |   |                    |                                              |

### Unit I Introduction to Soil Microbiology

Soil Microbiology- definition and scope. Historical developments in soil microbiology. **Diversity of soil microorganisms** - culturable (bacteria, actinobacteria, yeasts, moulds and algae) and unculturable microorganisms - metagenomic approach - factors influencing the microbial diversity

### Unit II Microbial Processes in soil

Organic matter decomposition and humus formation- C:N ratio.. Carbon cycle. Nitrogen cycle - biological nitrogen fixation (BNF) – nodulation and biochemistry of BNF. **Nitrogen cycle**-Phosphorus cycle and sulphur cycle. Microbial transformation of potassium, zinc and silica in soil – role of soil enzymes

### Unit III Soil Microorganisms and plants

Rhizosphere, spermosphere, phyllosphere, epiphytic and endophytic microorganisms and their significance. and **Plant growth promoting rhizobacteria(PGPR)**. Soil microorganisms and their interactions – positive and negative interactions

### Unit IV Microbial inoculants

Bioinoculants – types of bioinoculants – nitrogen fixers, P, K, Zn and Si solubilizers and phosphate mobilizers, sulphur oxidizers and PPFM. BGA and Azolla. Mass production and quality control of bacterial and fungal bioinoculants. **Methods of application of bioinoculants in crop production**

### Unit V Industrial Microbiology

Industrial utilization of microorganisms - Alcohol fermentation – wine and beer.

Antibiotics and vitamin production. Microbes in food industry – single cell protein, baker's and brewer's yeast and dairy products – cheese and yoghurt. Biofuels- ethanol and biodiesel.

#### Text Books

1. Alexander, M. 1977. Soil Microbiology. John Wiley and Sons. New York
2. Waiter.M.J.,N.L.Morgan,J.S.Rocky and G.Higton.1999. Industrial Microbiology – An Introduction. Blackwell Scientific
3. e book: Paul , E .A. 2007. Soil Microbiology, Ecology and Biochemistry. 3rd Ed., Academic Press, USA
4. e book: Waksman, S. A 1952. Soil Microbiology John Wiley & Sons, Inc.

#### Reference Books

1. Rangaswamy,G.and Bagyaraj, D.J. 1992. Agricultural Microbiology, Asia Publishing House, New Delhi.
2. Subba Rao,N.S.1999. Soil Microorganisms and plant Growth. Oxford and IBH, New Delhi
3. Osborn, M., Smith, C.J. 2005. Molecular Microbial Ecology. Taylor and Francis.

#### Web Pages

fire.biol.wvu.edu/hooper/416\_05Ncycle1.ppt  
[www.fao.org/docrep/009/a0100e/a0100e05.htm](http://www.fao.org/docrep/009/a0100e/a0100e05.htm)

|                                                                   |                                                                                                |   |   |   |   |   |          |          |          |          |   |   |   |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------|---|---|---|---|---|----------|----------|----------|----------|---|---|---|
| <b>BACE13</b>                                                     | <b>GREENHOUSE TECHNOLOGY</b>                                                                   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |   |   |   |
|                                                                   | Total Contact Hours - 45                                                                       |   |   |   |   |   | 3        | 0        | 0        | 3        |   |   |   |
|                                                                   | Prerequisite – Production of Agricultural crops/Production of Horticultural crops              |   |   |   |   |   |          |          |          |          |   |   |   |
|                                                                   | Course Designed by – Dept. of Agricultural Biotechnology                                       |   |   |   |   |   |          |          |          |          |   |   |   |
| <b>OBJECTIVES</b>                                                 |                                                                                                |   |   |   |   |   |          |          |          |          |   |   |   |
| To know about the concept and design of greenhouses               |                                                                                                |   |   |   |   |   |          |          |          |          |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                      |                                                                                                |   |   |   |   |   |          |          |          |          |   |   |   |
| CO1                                                               | to know the                                                                                    |   |   |   |   |   |          |          |          |          |   |   |   |
| CO2                                                               | to apply the concept of genomics of different organism, gene expression and mapping situations |   |   |   |   |   |          |          |          |          |   |   |   |
| CO3                                                               | to know the tools for gene identification and prediction                                       |   |   |   |   |   |          |          |          |          |   |   |   |
| CO4                                                               | to know the structural elucidation and prediction of proteins                                  |   |   |   |   |   |          |          |          |          |   |   |   |
| CO5                                                               | to get a basic knowledge of techniques related to proteomics                                   |   |   |   |   |   |          |          |          |          |   |   |   |
| CO6                                                               | To know about bioinformatics tools                                                             |   |   |   |   |   |          |          |          |          |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)            |                                                                                                |   |   |   |   |   |          |          |          |          |   |   |   |
| (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                |   |   |   |   |   |          |          |          |          |   |   |   |
| 1                                                                 | COs/POs                                                                                        | a | b | c | d | e | f        | g        | h        | i        | j | k | l |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| 2 | CO1      | H                                                      | M                   | M                  | H                      | M                  |                         | M                  |                                              | L | L | L | M |
|   | CO2      | H                                                      | M                   | M                  | H                      | H                  |                         | M                  |                                              |   | L | L | M |
|   | CO3      | H                                                      | M                   |                    | H                      | H                  |                         | M                  | M                                            |   | L | L | M |
|   | CO4      | H                                                      | M                   |                    | H                      | H                  |                         | M                  |                                              | M | L | L | M |
|   | CO5      | H                                                      | M                   | M                  | H                      | H                  |                         | M                  | L                                            |   | L | L | M |
|   | CO6      | H                                                      |                     |                    | H                      | H                  |                         | M                  |                                              |   | L | L | M |
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |   |   |   |   |
|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   | ✓ |   |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I INTRODUCTION

9

Types of green house, importance, functions and features of greenhouse- Scope and development of green house technology. **Implement in agriculture**

## UNIT II GREENHOUSE DESIGN

9

Location, planning of various components of green house- Design criteria and calculation- Construction material, covering material and its characteristics, growing media, green house irrigation system- **nutrient management and maintenance**

## UNIT III GREENHOUSE ENVIRONMENT

9

Greenhouse heating, cooling and shedding and ventilation system, Computer controlled environment.

## UNIT IV GROWING PLANTS

9

Phytotrons, fertigation, roof system, containers and benches-Growing of ornamentals and vegetables under protected environment, **physiology,growth of plants in green house**, pest and disease control.

## UNIT V CONSUMABLES

9

Various containers used for protected cultivation of vegetable and flower, special horticultural practices i.e. training, dis-budding, de-shooting, supporting and bending.

### Text / Reference books

1. Greenhouse Management of Horticultural Crops by S. Prasad and U. Kumar, Kalyani Publishers.

2. Greenhouse Technology and Management by Manohar. 2006. International Book Distribution Co., Lucknow.
  3. Greenhouse Environment by Mastalez, J. W. 1977. John-Wiley and Sons, New York.
  4. Greenhouse Management : Forcing of Flowers, Vegetables and Fruits by Taft, L. R. 2001. Daya Publication House, New Delhi.
  5. Green House Operation & Management by Nelson, 2007.
  6. Green House and Shelter structure for tropical regions/FAO by Zbeltitis.
  7. Protected Cultivation by A. S. Jadhav, P. V. Patil and M. T. Patil.
- Commercial Protected Floriculture by M. T. Patil and P. V. Patil

**BACE14      LIVESTOCK AND POULTRY MANAGEMENT      3 0 0 3**

**UNIT I      INTRODUCTION TO LIVESTOCK MANAGEMENT      9**

Significance of Livestock and Poultry in Indian Economy – Livestock and Poultry census – Different livestock development programs of Government of India and Tamil Nadu- Various systems of livestock production-extensive – semi intensive - intensive- mixed- Integrated and specialized farms.

**UNIT II      DAIRY CATTLE MANAGEMENT      9**

Important White and Black cattle breeds-classification-indigenous and exotic – Breed characteristics – Breeding - Cross breeding- Upgrading - Economic traits of cattle –Culling - Estrus Cycle – Artificial Insemination – Introduction to Embryo transfer – Housing – Space requirement calf and adult stock – System and types of housing - Feeding and Management of Calf, Heifer, Pregnant, Milch animal and working animals – Nutrition – Ration – Balanced Ration - Characteristics of ration and classification of feed and fodder –Total Mixed Ration – composition of concentrate mixture for different stage - Milking methods - Clean milk production – Factors affecting milk composition – Common diseases of cattle – classification – symptoms - preventing and control measures.

**UNIT III      SHEEP AND GOAT MANAGEMENT      9**

Breeds - Sheep and goat classification — Economic traits - system of rearing - Housing Management – Floor space requirement - Care and Management of young and adult stock – Nutrition – Feed and fodders of Small ruminants – Flushing - Common diseases – prevention and control.

**UNIT IV      MANAGEMENT OF SWINE      9**

Classification of breeds – Economic traits - Housing - Nutrition – creep feeding - Care and Management of Adult and Young Stock - Common disease- prevention and control.

**UNIT V      POULTRY MANAGEMENT      9**

Classification of breeds - Commercial Strains of broilers and layers – Housing – brooding – deep litter and cage system – care and Management of broilers and layers -Nutrition of Chick, grower, Layer and broiler – Incubation and Hatching of Eggs - Common Diseases - Control and prevention.

**Reference:**

ICAR (2002) Hand of Animal Husbandry, ICAR, New Delhi

**E- reference:**

1. <http://www.elearnvet.net/>
2. [http://agridr.in/expert\\_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html](http://agridr.in/expert_system/cattlebuffalo/Breeding%20management%20of%20cattle%20and%20buffaloes-2.html)

|                                                                                                                             |         |                                                                                   |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|---------|-----------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|
| BBTE16                                                                                                                      |         | NANOBIOTECHNOLOGY                                                                 |   |   |   |   |   |   |   | L | T | P | C |
|                                                                                                                             |         | Total Contact Hours - 45                                                          |   |   |   |   |   |   |   | 3 | 0 | 0 | 3 |
|                                                                                                                             |         | Prerequisite – Basic Biotechnology, Molecular biology                             |   |   |   |   |   |   |   |   |   |   |   |
|                                                                                                                             |         | Course Designed by – Dept of Industrial Biotechnology                             |   |   |   |   |   |   |   |   |   |   |   |
| OBJECTIVES: To provide basic knowledge about nanoscience involved in biotechnology                                          |         |                                                                                   |   |   |   |   |   |   |   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                       |         |                                                                                   |   |   |   |   |   |   |   |   |   |   |   |
| CO1                                                                                                                         |         | to understand the various nano devices                                            |   |   |   |   |   |   |   |   |   |   |   |
| CO2                                                                                                                         |         | to know about nano molecules                                                      |   |   |   |   |   |   |   |   |   |   |   |
| CO3                                                                                                                         |         | to learn the applications of nanotechnology in proteins, lipids and nucleic acids |   |   |   |   |   |   |   |   |   |   |   |
| CO4                                                                                                                         |         | to know about the applications of nanotechnology in microbiology                  |   |   |   |   |   |   |   |   |   |   |   |
| CO5                                                                                                                         |         | to know about nano technology involved in drug delivery system                    |   |   |   |   |   |   |   |   |   |   |   |
| CO6                                                                                                                         |         | To understand about nanoparticles                                                 |   |   |   |   |   |   |   |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |         |                                                                                   |   |   |   |   |   |   |   |   |   |   |   |
| 1                                                                                                                           | COs/Pos | a                                                                                 | b | c | d | e | f | G | h | I | j | k | l |
| 2                                                                                                                           | CO1     | M                                                                                 | M | M | H | M |   | H |   |   |   | L | M |
|                                                                                                                             | CO2     | H                                                                                 | M | M | H | H |   | M |   |   | L |   | L |
|                                                                                                                             | CO3     | H                                                                                 | M |   | H | H |   | M |   |   | L | L | M |
|                                                                                                                             | CO4     | H                                                                                 | M |   | H | H |   |   |   |   | L | L | M |
|                                                                                                                             | CO5     | H                                                                                 | M | M | H | H |   | M |   |   |   | L | L |
|                                                                                                                             | CO6     | H                                                                                 |   |   | H | H |   | M |   |   | L |   | M |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                                        |                     |                    |                        | √                  |                         |                    |                                              |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |

### **UNIT I INTRODUCTION 9**

Introduction to nanobiotechnology – nanodevices& techniques – micro &nanosystems – synthesis & characterization of nanoscale molecules – nanoarchitecture – fabrication technologies – self-assembly systems

### **UNIT II NANODEVICES 9**

Inorganic nanoscale systems – properties of fullerene carbon nano tubes – quantum dots & wires – gold nanoparticles – nanopores.

### **UNIT III NANOMOLECULES 9**

Nanomolecules in proteins, lipids RNA & DNA – peptide coupled nanoparticles – proteins nanodevices – cell nanotechnology – cell motility – nanomotors& cellular navigation – chemotaxis – transmembranesignaling – nanoscale artificial platform.

### **UNIT IV MICROBIAL NANOTECHNOLOGY 9**

Nanotechnology and microorganisms – PHA – magnetosomes – cyanophycin inclusions – alginates – bacteriophages – bacterial spores – S – layer proteins – bacteriorhodopsin.

### **UNIT V NANOMEDICINE 9**

Nanotechnology in drug delivery – nanoscale devices for drug delivery – micelles – protein targeting – protein interaction with other molecule – microarray – genomic chips – nanobiosensors – nanobiochips – Nanotechnology for cancer diagnosis & treatment.

### **TEXT BOOK**

1. K.K. Jain , 2006, “Nanotechnology in molecular diagnostics – current techniques & applications”, Horizon Bioscience publishers

### **REFERENCE BOOKS**

1. Microbial bionanotechnology:Biological Self-Assembly Systems and Biopolymer-Based Nanostructured: Bernd Rehm, Taylor and Francis, 2006
2. Applications of nanoparticles in biology & medicine O.V. Salata, Journal of nanobiotechnology (2004),
3. Weblink: nptel

## **BAC015 INTRODUCTORY NEMATOLOGY**

## **Unit I: History and Development of Nematology, Importance of Nematodes and Beneficial nematodes**

Introduction – Brief history and development of Nematology at National and International level  
– **Position of nematodes in animal kingdom** – Economic loss due to nematodes to crop plants.

## **Unit II: Morphology and Taxonomy of Nematodes**

Morphology and Anatomy of nematodes (cuticle, cephalic region, alimentary, excretory, reproductive and nervous system, sense organs) **Types** – Taxonomy of plant parasitic nematodes  
– Classification, of nematodes based on feeding habits.

## **Unit III: Symptoms, Interaction and Bio-ecology of nematodes**

Symptoms of nematode damage – interaction with other microorganisms (fungi, bacteria and viruses) – Biology and ecology of important plant parasitic nematodes (*Meloidogyne*, *Heterodera*, *Rotylenchulus*, *Tylenchulus* and *Radopholus*) - Life cycle of important plant parasitic nematodes (*Meloidogyne*, *Heterodera*, *Rotylenchulus*, *Tylenchulus* and *Radopholus*) – Interaction with other micro organisms.

## **Unit IV: Nematode Management**

Principles of nematode management –Legislative (plant quarantine), physical methods (soil solarisation, hot water treatment, seed cleaning); cultural methods – (deep ploughing, fallowing, solarization, crop rotation, antinemic plants - Host plant resistance to nematodes; biological control – nematode trapping fungi, egg parasitic fungi, obligate parasites, PGPR and predators - chemical control – soil fumigants - **Non fumigants-mode of action**—formulations-methods of application--Integrated nematode management.

## **Unit V: Nematode pests of crops**

Major nematode parasites and management in cereals (rice and wheat), millets (sorghum, and maize), pulses (redgram, blackgram, greengram and cowpea); oilseeds (castor, groundnut and gingely), fibre crops (cotton), **vegetables (tomato, brinjal, bhendi**, chilli and potato, cole crops (cabbage, carrot, cauliflower), fruits (banana, citrus, grapevine, guava and papaya), spices and plantation crops (turmeric, pepper, betelvine and coconut), flower crops (crossandra, jasmine, and tuberose), Carnation, rose, gerbera, chrysanthemum, eustoma medicinal and aromatic plants, (medicinal coleus, geranium and patchouli).Beet root, sugarbeet, tapioca, tuber crops (yam, dioscorea).

### **TEXT BOOK:**

1. Dropkin, V.H.1980. Introduction to plant nematology. John Wiley and sons, INC. New York.

2. Singh, R.S and Sitaramaiah, K. 1994. Plant pathogens. The plant parasitic nematodes. Oxford & IBH pub. Co. Pvt. Ltd. New Delhi.
3. Paravata Reddy, P.1983. Plant nematology. Agricole Pub. Co., New Delhi.
4. Southey, J. F. Laboratory methods for work with plant and soil nematodes Tech. Bull. Min. Agric. Fish. Food. Her Majesty's Stationary office, London.

#### E- REFERENCES:

1. <http://agritech.tnau.ac.in/>

|                                                                                                                             |                                                          |   |   |   |   |   |   |   |   |          |          |          |          |
|-----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---|---|---|---|---|---|---|---|----------|----------|----------|----------|
| <b>BBA008</b>                                                                                                               | <b>TOTAL QUALITY MANAGEMENT</b>                          |   |   |   |   |   |   |   |   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                                                                             | Total Contact Hours - 45                                 |   |   |   |   |   |   |   |   | 3        | 0        | 0        | 3        |
|                                                                                                                             | Prerequisite – Professional ethics& Professional Courses |   |   |   |   |   |   |   |   |          |          |          |          |
|                                                                                                                             | Course Designed by – Dept of Management studies          |   |   |   |   |   |   |   |   |          |          |          |          |
| <b>OBJECTIVES:</b><br>To study about the management methods involved in quality assessment of a product                     |                                                          |   |   |   |   |   |   |   |   |          |          |          |          |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                |                                                          |   |   |   |   |   |   |   |   |          |          |          |          |
| CO1                                                                                                                         | to study the basic definition of quality                 |   |   |   |   |   |   |   |   |          |          |          |          |
| CO2                                                                                                                         | to study the importance of customer satisfaction         |   |   |   |   |   |   |   |   |          |          |          |          |
| CO3                                                                                                                         | to study the statistical methods of quality control      |   |   |   |   |   |   |   |   |          |          |          |          |
| CO4                                                                                                                         | to explore the methods of benchmarking                   |   |   |   |   |   |   |   |   |          |          |          |          |
| CO5                                                                                                                         | to classify the products into quality standards          |   |   |   |   |   |   |   |   |          |          |          |          |
| CO6                                                                                                                         | To know about quality principle                          |   |   |   |   |   |   |   |   |          |          |          |          |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                          |   |   |   |   |   |   |   |   |          |          |          |          |
| 1                                                                                                                           | COs/POs                                                  | a | b | c | d | e | f | g | h | i        | j        | k        | l        |
| 2                                                                                                                           | CO1                                                      | M | M | M | H | M |   | M |   | L        | L        | L        | M        |
|                                                                                                                             | CO2                                                      | H | M | M | H | H |   | M | L |          | L        | L        | M        |
|                                                                                                                             | CO3                                                      | H | M |   | H | H | L | M |   | M        | L        | L        | M        |
|                                                                                                                             | CO4                                                      | H | M |   | H | H |   | M | M |          | L        | L        | M        |
|                                                                                                                             | CO5                                                      | H | M | M | H | H |   | M |   | L        | L        | L        | M        |
|                                                                                                                             | CO6                                                      | H |   |   | H | H | L | M | L |          | L        | L        | M        |

|   |          |                                                        |                     |                    |                        |                    |                         |                    |                                              |
|---|----------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|
| 3 | Category | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/ Term paper Seminar/ Internship (PR) |
|   |          |                                                        |                     |                    |                        |                    |                         | √                  |                                              |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |

## **UNIT I INTRODUCTION**

**9**

Definition of Quality, Dimensions of quality, Quality planning, Quality costs- Analysis – Techniques for quality costs, Basic concepts of total Quality Management, Historical Review, Principles of TQM, Leadership- Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation

## **UNIT II TQM PRINCIPLES**

**9**

Customer satisfaction-Customer Perception of Quality, Customer complaints, Service Quality, Customer Retention and, Employee Involvement- Motivation, Empowerment, Teams, Recognition Reward, Performance Appraisal, Benefits, Continuous process improvement- Jurantrlogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership- Partnering, sourcing, Supplier selection, Supplier rating, relationship development, Performance measure- Basic concepts, Strategy, Performance measure.

## **UNIT III STATISTICAL PROCESS CONTROL (SPC)**

**9**

The seven tools of quality, Statistical Fundamentals- Measures of central Tendency and Dispersion, Population and sample, Normal curve, Control charts for variables and attributes, Process capability, Concept of six sigma, New seven management tools.

## **UNIT IV TQM TOOLS**

**9**

Benchmarking- Reasons to Benchmark, Benchmarking process, Quality function Deployment (QFD)- House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM)- Concept, Improvement Needs, FMEA- Stages of FMEA.

## **UNIT V QUALITY SYSTEMS**

**9**

Need for ISO 9000 and other Quality Systems, ISO 9000:2000 Quality system- Elements, Implementation of Quality systems, Documentation, Quality Auditing, QS 9000, ISO 14000- Concept, Requirements and Benefits.

## **TEXT BOOK**

1. R.Ramakrishnan, 2004, “A Text Book of Total Quality Management” V Ed.

## **REFERENCE BOOKS:**

1. Ronald A. Armstrong , 2006, "Total Quality management", Chapman and Hall,
2. Suresh Lulta, 2002"Total Quality management" Vol. I and II, ShahTrust, Mumbai

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|---------------------------------------------|---|---|---|---|
| BBA009                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | INTELLECTUAL PROPERTY RIGHTS                                                                                   |                                                        |                     |                    |                        |                    | L                       | T                  | P                                           | C |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Total Contact Hours - 45                                                                                       |                                                        |                     |                    |                        |                    | 3                       | 0                  | 0                                           | 3 |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Prerequisite – Value Education and Professional Ethics & Professional Courses                                  |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Course Designed by – Dept of Management Studies                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| <b>OBJECTIVES</b><br>Strong intellectual property rights (IPR) protection is crucial to fostering trade, and achieving the goals and benefits of global integration. Countries with high standards of IPR protection tend to attract more investment, stimulate more innovation, thereby developing more rapidly. Countries with inadequate protection are often vulnerable to infringements of intellectual property rights that hinder trade flow and economic development.<br>Hence, the objective is to introduce IPR to the UG Engineering and Technology students. |                                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| <b>COURSE OUTCOMES (COs)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Understand the principles, function and basic legal rules of IP Law.                                           |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Recognize the relevant criteria for generating and protecting intellectual works.                              |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Recognize the intellectual property likely to be produced in the academic and professional environment.        |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Demonstrate appreciation and critical awareness of pertinent IP issues in the academic and professional lives. |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Understand the relevance and impact of IP Law on academic/scientific works/studies.                            |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| CO6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Understand the different forms of infringement of intellectual property rights.                                |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | COs/POs                                                                                                        | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                           | i | j | k | l |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | CO1                                                                                                            | H                                                      |                     |                    |                        |                    | H                       |                    |                                             |   |   | H |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CO2                                                                                                            |                                                        | H                   |                    | M                      |                    |                         |                    |                                             | H |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CO3                                                                                                            | M                                                      |                     |                    |                        |                    |                         |                    | M                                           |   | H |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CO4                                                                                                            |                                                        |                     | M                  | H                      |                    |                         |                    |                                             |   |   | H |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CO5                                                                                                            |                                                        |                     |                    |                        |                    |                         | M                  |                                             |   |   |   |   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | CO6                                                                                                            | H                                                      |                     |                    | H                      |                    |                         |                    |                                             | M |   |   | L |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Category                                                                                                       | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Project/Term Paper Seminar/ Internship (PR) |   |   |   |   |
| 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Approval                                                                                                       | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                             |   |   |   |   |

**UNIT I PROPERTIES AND TYPES****9**

Introduction – Invention and Creativity – Intellectual Property (IP) – Importance – Protection of IPR – Basic types of property (i). Movable Property ii. Immovable Property and iii. Intellectual Property.

**UNIT II PATENTS AND RIGHTS****9**

IP – Patents – Copyrights and related rights – Trade Marks and rights arising from Trademark registration – Definitions – Industrial Designs and Integrated circuits – Protection of Geographical Indications at national and International levels – Application Procedures..

**UNIT III INTERNATIONAL TRADE****9**

International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities – History – General Agreement on Trade and Tariff (GATT).

**UNIT IV WTO****9**

Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO-Patent Ordinance and the Bill – Draft of a national Intellectual Property Policy – Present against unfair competition.

**UNIT V CASE STUDIES****9**

Case Studies on – Patents (Basmati rice, turmeric, Neem, etc.) – Copyright and related rights – Trade Marks – Industrial design and Integrated circuits – Geographic indications – Protection against unfair competition.

**TEXT BOOKS:**

1. Subbaram N.R. “Handbook of Indian Patent Law and Practice “, S. Viswanathan Printers and Publishers Pvt. Ltd., 1998.

**REFERENCES:**

1. Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1794.
2. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].
3. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000.
4. www.ipmatters.net/features/000707\_gibbs. html.
5. [http://www.metastudio.org/Science%20and%20Ethics/file/readDoc/535a76367d9d331598f49e2d/34\\_Hb\\_on\\_IPR.pdf](http://www.metastudio.org/Science%20and%20Ethics/file/readDoc/535a76367d9d331598f49e2d/34_Hb_on_IPR.pdf)

|                                                                                                                                     |                                                                                   |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---|---|---|---|
| BACE17                                                                                                                              | MARKETING AND EXPORT OF<br>BIOTECHNOLOGICAL PRODUCTS                              | L | T | P | C |
|                                                                                                                                     | Total Contact Hours - 45                                                          | 3 | 0 | 0 | 3 |
|                                                                                                                                     | Prerequisite – Bioorganic chemistry, Basic Biotechnology                          |   |   |   |   |
|                                                                                                                                     | Course Designed by – Dept. of Industrial Biotechnology                            |   |   |   |   |
| OBJECTIVES                                                                                                                          |                                                                                   |   |   |   |   |
| To provide a basic understanding of genomics and proteomics using software and their applications from the perspective of engineers |                                                                                   |   |   |   |   |
| COURSE OUTCOMES (COs)                                                                                                               |                                                                                   |   |   |   |   |
| CO1                                                                                                                                 | to understand the classification of biological databases and its role in research |   |   |   |   |

|                                                                                                                             |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------|--------------------|------------------------|--------------------|-------------------------|--------------------|----------------------------------------------|---|---|---|---|
| CO2                                                                                                                         | to apply the concept of genomics of different organism, gene expression and mapping situations |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO3                                                                                                                         | to know the tools for gene identification and prediction                                       |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO4                                                                                                                         | to know the structural elucidation and prediction of proteins                                  |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO5                                                                                                                         | to get a basic knowledge of techniques related to proteomics                                   |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| CO6                                                                                                                         | To know about bioinformatics tools                                                             |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 1                                                                                                                           | COs/POs                                                                                        | a                                                      | b                   | c                  | d                      | e                  | f                       | g                  | h                                            | i | j | k | l |
| 2                                                                                                                           | CO1                                                                                            | H                                                      | M                   | M                  | H                      | M                  |                         | M                  |                                              | L | L | L | M |
|                                                                                                                             | CO2                                                                                            | H                                                      | M                   | M                  | H                      | H                  |                         | M                  |                                              |   | L | L | M |
|                                                                                                                             | CO3                                                                                            | H                                                      | M                   |                    | H                      | H                  |                         | M                  | M                                            |   | L | L | M |
|                                                                                                                             | CO4                                                                                            | H                                                      | M                   |                    | H                      | H                  |                         | M                  |                                              | M | L | L | M |
|                                                                                                                             | CO5                                                                                            | H                                                      | M                   | M                  | H                      | H                  |                         | M                  | L                                            |   | L | L | M |
|                                                                                                                             | CO6                                                                                            | H                                                      |                     |                    | H                      | H                  |                         | M                  |                                              |   | L | L | M |
| 3                                                                                                                           | Category                                                                                       | Humanities & Social Studies (HS)                       | Basic Sciences (BS) | Engg Sciences (ES) | Professional Core (PC) | Core Elective (CE) | Non-Major Elective (NE) | Open Elective (OE) | Term Project/ paper Seminar/ Internship (PR) |   |   |   |   |
|                                                                                                                             |                                                                                                |                                                        |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |
| 4                                                                                                                           | Approval                                                                                       | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |                     |                    |                        |                    |                         |                    |                                              |   |   |   |   |

## UNIT I

External trade in Agricultural products, Present status, policy and prospects under WTO regime, Export import policy, Regulation of Agricultural marketing system

## UNIT II

Infrastructural facilities for exporting efficiency, Biotechnological Products in India, Quality parameters and quarantine procedures of export- Market integration: Types and effects Marketing costs margins and price spread.

## UNIT III

Biotech industries & institutes in India & world, Concepts of Biotech park/ Biotech Hub to different small scale and large scale Agro-based products. Study the production techniques of biotech products.

## UNIT IV

Collecting the information on export import data on biotech products, quality standards for export and their potential-Analyze data in relation to demand supply.

## UNIT V

Comparison between non biotechnological products and biotechnological products. Safety and licensing for import and export of biotechnological products.

**Text/Reference books:**

1. Agriculture Marketing in India by Acharya and Agrawal 1999, Oxford IBH, N. Delhi.

Principles of Marketing by Kotlar and Armstrong 1997, Prentice-Hall, N. Delhi.

|                                                                                                                             |          |                                                                                 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|-----------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------|---|---------------------|---|--------------------|---|------------------------|---|--------------------|---|-------------------------|---|--------------------|--|----------------------------------------------|--|
| BBTE18                                                                                                                      |          | INDUSTRIAL SAFETY ENGINEERING                                                   |   |                     |   |                    |   |                        |   |                    | L | T                       | P | C                  |  |                                              |  |
|                                                                                                                             |          | Total Contact Hours - 45                                                        |   |                     |   |                    |   |                        |   |                    | 3 | 0                       | 0 | 3                  |  |                                              |  |
|                                                                                                                             |          | Prerequisite – Bioprocess, Enzyme Engineering & Technology, Basic Biotechnology |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
|                                                                                                                             |          | Course Designed by – Dept of Industrial Biotechnology                           |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| OBJECTIVES: To provide a basic knowledge about Safety engineering                                                           |          |                                                                                 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| COURSE OUTCOMES (COs)                                                                                                       |          |                                                                                 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO1                                                                                                                         |          | to understand basic concepts in hazard analysis                                 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO2                                                                                                                         |          | to know about safety and its management                                         |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO3                                                                                                                         |          | to know about accidents and its preventive measures                             |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO4                                                                                                                         |          | to understand various personal protective equipment and first aid               |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO5                                                                                                                         |          | to know about personal protective equipment                                     |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| CO6                                                                                                                         |          | To know about fire and safety                                                   |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |          |                                                                                 |   |                     |   |                    |   |                        |   |                    |   |                         |   |                    |  |                                              |  |
| 1                                                                                                                           | COs/POs  | a                                                                               | b | c                   | d | e                  | f | g                      | h | i                  | j | k                       | l |                    |  |                                              |  |
| 2                                                                                                                           | CO1      | H                                                                               | M | M                   | H | M                  |   | M                      | M |                    | L |                         | M |                    |  |                                              |  |
|                                                                                                                             | CO2      | H                                                                               | M | M                   | H | H                  |   | M                      |   |                    | L | L                       | M |                    |  |                                              |  |
|                                                                                                                             | CO3      | H                                                                               | M |                     | H | H                  |   | M                      |   | M                  | L | L                       | M |                    |  |                                              |  |
|                                                                                                                             | CO4      | H                                                                               | M |                     | H | H                  |   | M                      | L |                    | L | L                       |   |                    |  |                                              |  |
|                                                                                                                             | CO5      | H                                                                               | M | M                   | H | H                  |   | M                      |   | L                  | L |                         | M |                    |  |                                              |  |
|                                                                                                                             | CO6      | H                                                                               |   |                     | H | H                  |   | M                      |   |                    | L | L                       |   |                    |  |                                              |  |
| 3                                                                                                                           | Category | Humanities & Social Studies (HS)                                                |   | Basic Sciences (BS) |   | Engg Sciences (ES) |   | Professional Core (PC) |   | Core Elective (CE) |   | Non-Major Elective (NE) |   | Open Elective (OE) |  | Project/ Term paper Seminar/ Internship (PR) |  |

|   |          |                                                        |  |  |  |   |  |  |  |
|---|----------|--------------------------------------------------------|--|--|--|---|--|--|--|
|   |          |                                                        |  |  |  | √ |  |  |  |
| 4 | Approval | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |  |  |  |   |  |  |  |

### **UNIT I INDUSTRIAL HAZARDS**

**9**

Safety in Process Plants – Hazard Analysis – Types of Hazard – hazard Identification techniques  
Hazard Evaluation – Important Factories Act.

### **UNIT II CHEMICAL HAZARD**

**9**

Hazards in work place: safety in the use of chemicals at work – Chemical hazard - Air-Borne Contaminants – particulate matter – Hazard and safety methods – hazards and Safety measures in Refineries , Paper and Pulp Industries- Safety Conditions in tanneries –Hazards of Pesticide – Sugar industry.

### **UNIT III SAFETY MANAGEMENT AND FIRE SAFETY**

**9**

Introduction- Safety policy- Safety in electrical installation: Electrical shock and prevention- safety precautions for residential and commercial installation - Case study-Four stages of Fire- types of Fire Detectors – Fire safety in Industry – chemistry of fire- Types of Combustion- Fire Triangle- Fire extinguishing Technique – Engineering consideration for safety consideration

### **UNIT IV INDUSTRIAL ACCIDENTS**

**9**

Industrial accidents – Classification – prevention – accident cost – Steps of investigation – Analysis of Accidents – Remedial Measures – Methods of Prevention – Safety Slogans – Case study

### **UNIT V PROTECTIVE EQUIPMENTS**

**9**

Personal protective Equipment and personal Protection – Aim – Need – Types: Non Respiratory Protective equipment- Respiratory type First aid – principles and methods – First aid training – Scope of first aid – Golden rules– First aid treatment : for wounds and Hemorrhage , Shock , respiration : Schafer's Method, Shock. Fractures, Burns and Scalds, Unconsciousness, Heat exhaustion and Stroke– First aid Kit box A and B.

### **TEXT BOOK:**

1. Nicholas, 2008, "Practical Guidance to Industrial Safety" 3<sup>rd</sup>ed
2. M.H.Fulekar, 2007, "Industrial Hygiene & chemical Safety" 2<sup>nd</sup>ed

### **REFERENCE BOOKS:**

1. Rudd, 2005, "Strategy of process engineering" Willey
2. Wang, Shannmas Hung, 2008, "Advanced hazardous industrial waste treatment" CRC Press.

|                                                                      |                                                       |          |          |          |          |
|----------------------------------------------------------------------|-------------------------------------------------------|----------|----------|----------|----------|
| <b>BBTE19</b>                                                        | <b>BIOENTREPRENEURSHIP DEVELOPMENT</b>                | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|                                                                      | Total Contact Hours - 45                              | 3        | 0        | 0        | 3        |
|                                                                      | Prerequisite – Professional Courses                   |          |          |          |          |
|                                                                      | Course Designed by – Dept of Industrial Biotechnology |          |          |          |          |
| <b>OBJECTIVES:</b> To provide basic knowledge about Entrepreneurship |                                                       |          |          |          |          |

| COURSE OUTCOMES (COs)                                                                                                       |                                                         |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
|-----------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------|---|------------------------|---|-----------------------|---|---------------------------|---|-----------------------|---|----------------------------|---|-----------------------|--|-------------------------------------------------------|--|
| CO1                                                                                                                         | to understand the fundamentals of Entrepreneurship      |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| CO2                                                                                                                         | to know about time management                           |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| CO3                                                                                                                         | to explore the avenues for financing a business venture |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| CO4                                                                                                                         | to know about various company laws                      |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| CO5                                                                                                                         | to understand Entrepreneurship in biotechnology         |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| CO6                                                                                                                         | To get knowledge about decision making                  |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| Mapping of Course Outcomes with Program outcomes (POs)<br>(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low |                                                         |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| 1                                                                                                                           | COs/Pos                                                 | a                                                      | b | c                      | d | e                     | f | G                         | h | I                     | j | k                          | l |                       |  |                                                       |  |
| 2                                                                                                                           | CO1                                                     | H                                                      |   | M                      | H | M                     | M | M                         |   |                       |   | L                          |   |                       |  |                                                       |  |
|                                                                                                                             | CO2                                                     | H                                                      | M | M                      | H | H                     |   | M                         |   | M                     | L | L                          | M |                       |  |                                                       |  |
|                                                                                                                             | CO3                                                     | H                                                      | M | M                      | H | H                     | L |                           | H |                       | L |                            | M |                       |  |                                                       |  |
|                                                                                                                             | CO4                                                     | H                                                      | M |                        |   | H                     |   | M                         |   |                       | L | L                          | M |                       |  |                                                       |  |
|                                                                                                                             | CO5                                                     | H                                                      | M | M                      | H | H                     |   | M                         |   | M                     | L | L                          | M |                       |  |                                                       |  |
|                                                                                                                             | CO6                                                     | H                                                      |   |                        | H | H                     | M | M                         | M |                       | L | L                          |   |                       |  |                                                       |  |
| 3                                                                                                                           | Category                                                | Humanities &<br>Social Studies<br>(HS)                 |   | Basic Sciences<br>(BS) |   | Engg Sciences<br>(ES) |   | Professional<br>Core (PC) |   | Core Elective<br>(CE) |   | Non-Major<br>Elective (NE) |   | Open Elective<br>(OE) |  | Project/ Term<br>paper<br>Seminar/<br>Internship (PR) |  |
|                                                                                                                             |                                                         |                                                        |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |
| 4                                                                                                                           | Approval                                                | 37 <sup>th</sup> Meeting of Academic Council, May 2015 |   |                        |   |                       |   |                           |   |                       |   |                            |   |                       |  |                                                       |  |

## **UNIT I ENTREPRENEURSHIP FUNDAMENALS 9**

Entrepreneur – Entrepreneurship – Enterprise – Writing good business plan – operations and management.

## **UNITII DECISION MAKING AND TIME MANAGEMENT 9**

Entrepreneur psychology – personal decision making style – Decision making process – setting personal and Business goals – Setting time priorities – Business person working at home.

## **UNIT III FINANCE AND ECONOMIC FEASIBILITY 9**

Financing the business– Raising venture capital – Financing sources – Pricing the product (or) Service – operating expenses Economic Analysis – Basic financial Analysis worksheets

## **UNIT IV COMPANY LAWS AND REGULATIONS 9**

Forming company – Types of companies – Types of market – Proprietary information: Intellectual property, copy right, ownerships, Trademark, Patent – International Trade

## **UNIT V ENTREPRENEURSHIP IN BIOTECHNOLOGY 9**

Various business opportunities in Biotechnology – Development of Biotech companies in India – Case studies on Biotech companies and its growth

**TEXT BOOK**

1. Exploring Entrepreneurship: D. Allan Barefield and George F. Smith, Ettmae Westbrook, Tennessee State University, 2006

**REFERENCE BOOK**

1. Entrepreneurship fundamentals by ZobiasKollmann International journal of Technology management,2007