

REGULATIONS 2015 (CBCS)
B.TECH GENETIC ENGINEERING
CURRICULUM – SYLLABUS

SEMESTER I

SL. NO	SUB. CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY							
1.	BEN101	HS	English - I	3	0	0	3
2.	BMA101	BS	Mathematics - I	3	0	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	0	0	2
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.	BPC1L1	BS	Physics and Chemistry Laboratory#	0	0	3/3	0
	BSS1L4/BS S1L5/BSS1 L6	HS	NCC/ NSS/ NSO (to be conducted during weekends)				1
For a given program, Total Instruction Periods per week=32; Total No. of Credits = 26							

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.	BFR 201*	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.	BCS2L2	ES	Computer Practices Lab	0	0	3	1
11.	BEE2L1	ES	Basic Electrical and Electronics Engineering Practices Laboratory	0	0	3	1
12.	BPC2L1	BS	Physics and Chemistry Laboratory#	0	0	3/3	1
	BSS1L7	HS	Yoga (to be conducted during weekends)				1
For a given program, Total Instruction Periods per week=35; Total No. of Credits = 26							

*Any one of the following courses: BFR201 – French, BGM201-German, BJP201 – Japanese, BKR201 – Korean, BCN201 – Chinese, BTM201 – Tamil

SEMESTER – III

SUB.CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
BBR 301	PC	Enzyme Technology	4	0	0	4
BBR 302	PC	Principles of Genetic Engineering	4	0	0	4
BBR 303	PC	Immunology	3	0	0	3
BBR 304	PC	Microbiology	3	0	0	3
BBR 305	PC	Principles of Biochemistry	4	0	0	4
BMA 302	BS	Biostatistics	4	0	0	4
PRACTICAL						
BBR 3L1	PC	Microbiology Laboratory	0	0	3	2
BBR 3L2	PC	Biochemistry Laboratory	0	0	3	2
BBR 3S1	PR	Technical Seminar – I	0	0	2	1
Total No. of Contact Hours: 30			Total No. of Credits: 27			

SEMESTER – IV

SUB.CODE	CATEGORY	Course	L	T	P	C
THEORY						
BBR 401	PC	rDNA Technology	4	0	0	4
BBR 402	PC	Molecular Biology	3	0	0	3
BCE 406	HS	Environmental studies	3	0	0	3
BBR 404	PC	Genomics and Proteomics	4	0	0	4
BBR 405	PC	Bio-organic chemistry	4	0	0	4
BBR 406	PC	Basics of Bio-informatics	4	0	0	4
PRACTICAL						
BBR 4L1	PC	Molecular Biology Lab	0	0	3	2
BBR 4L2	PC	Cell Biology Lab	0	0	3	2
BBR 4S2	PR	Technical Seminar-II	0	0	2	1
Total No. of Contact Hours: 30			Total No. of Credits: 27			

SEMESTER – V

SUB.CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
BBR 501	PC	Industrial Biotechnology	4	0	0	4
BBR 502	HS	Research Methodology	4	0	0	4
BBR 503	PC	Cytogenetics	3	0	0	3
BBR 504	PC	Virology	4	0	0	4
BBR 505	PC	Plant tissue Culture	4	0	0	4
	PE	Core Elective – I	3	0	0	3
PRACTICAL						
BBR 5L1	PC	Immunology Laboratory	0	0	3	2
BBR 5L2	PC	Plant Genetic Engineering Laboratory	0	0	3	2
BBR 5P2	PR	Mini Project	0	0	3	1
BBR 5C1	PR	Comprehension-I	0	0	0	1
Total No. of Contact Hours: 30			Total No. of Credits: 28			

SEMESTER – VI

SUB.CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
BBR 601	PC	Bio-Pharmaceutical Technology	3	0	0	3
BBR 602	PC	Genes and Diseases	4	0	0	4
BSS601	HS	Value Education and Professional Ethics	3	0	0	3
BBR 6E2	PE	Core Elective – II	3	0	0	3
BBR 6E3	NE	Non-Major Elective – I	3	0	0	3
BBR 6E4	OE	Open Elective – I	3	0	0	3
PRACTICAL						
BBR 6L1	PC	Gene Cloning Laboratory	0	0	3	2
BBR 6L2	PC	Bioinformatics Laboratory	0	0	3	2
Total No. of Contact Hours: 28			Total No. of Credits: 25			

SEMESTER – VII

SUB.CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
BBR 701	PC	Biosafety, Bioethics, IPR & Patents	4	0	0	4
BBR 702	PC	Animal Cell Culture and Transgenic Technology	4	0	0	4
BBR 703	PC	Gene Therapy	3	0	0	3
BBR 704	PC	Stem Cell Biology	3	0	0	3
BBR 7E5	PE	Core Elective – III	3	0	0	3
BBR 7E6	NE	Non Major Elective – II	3	0	0	3
PRACTICAL						
BBR 7L1	PC	Genome Analysis Laboratory	0	0	3	2
BBR 7L2	PC	Animal Cell Culture Laboratory	0	0	3	2
BBR 7P1	PR	Term Paper	0	0	4	2
BBR 7V1	PR	Implant Training	0	0	0	1
Total No. of Contact Hours: 30			Total No. of Credits: 27			

SEMESTER – VIII

SUB CODE	CATEGORY	COURSE TITLE	L	T	P	C
THEORY						
BBR 8E7	NE	Non Major Elective –III	3	0	0	3
BBR 8E8	OE	Open Elective –II	3	0	0	3
PRACTICAL						
BBR 8C1	PR	Comprehension II	0	0	0	1
BBR8P1	PR	Project work	0	0	18	9
Total No. of Contact Hours: 24			Total No. of Credits: 16			

Grand Total Credits: 198

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

S.No .	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences (HS)	7	8	-	3	7	-	3	-	28	12.62
2	Basic Sciences (BS)	9	10	4	-	-	-	-	-	23	13.13
3	Engineering Sciences (ES)	10	8	-	-	-	-	-	-	18	9.09
4	Professional Core (PC)	-	-	22	23	15	14	15	-	89	44.94
5	Core Electives (CE)	-	-	-	-	3	3	3	-	09	4.54
6	Non major Electives (NE)	-	-	-	-	-	3	3	3	09	4.54
7	Open Electives (OE)	-	-	-	-	-	3		3	06	3.03
8	Project Work, Seminar, Internship, Term Paper, etc. (PR)	-	-	1	1	2	-	3	9	16	8.08
	Total Credit	26	26	27	27	27	23	27	15	198	100%
	Total Contact Hour	32	35	30	30	30	25	32	24	238 hours	

LIST OF ELECTIVES

CORE ELECTIVE (CE) – I

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBR 001	Human Genetics	3	0	0	3
BBR 002	Animal Tissue engineering	3	0	0	3
BBR 003	Classical and molecular Plant breeding	3	0	0	3

CORE ELECTIVE (CE) – II

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBR 004	Cancer Biology	3	0	0	3
BBR 005	Agri, Veterinary and Medical informatics	3	0	0	3
BBR 006	Genetic Engineering of Plants	3	0	0	3

CORE ELECTIVE (CE) – III

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBR 007	Molecular Medicine	3	0	0	3
BBR 008	Microbial Genetics	3	0	0	3
BBR 009	Herbal drugs and genomics	3	0	0	3

NON-MAJOR ELECTIVE (NE) – I

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBR 010	Pharmacogenomics	3	0	0	3
BBR 011	Protein engineering	3	0	0	3
BBR 012	Bioconfinement of genetically modified organisms	3	0	0	3

NON MAJOR ELECTIVE (NE) - II

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBI 506	Molecular evolution and Phylogeny	3	0	0	3
BBR 013	Bioprocess Engineering	3	0	0	3
BBR 014	Food process technology	3	0	0	3

NON MAJOR ELECTIVE (NE) - III

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBR 015	Metabolism and Metabolomics	3	0	0	3
BBR 016	Industrial Microbiology	3	0	0	3
BBR 017	Plant Physiology	3	0	0	3

OPEN-ELECTIVE (OE) -I

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBA001	Principles of Management and Organizational Behaviors	3	0	0	3
BBI 608	Biophysics	3	0	0	3
BBM 001	Biomedical Engineering	3	0	0	3

OPEN-ELECTIVE (OE) – II

ELECTIVE CODE	ELECTIVE SUBJECTS	L	T	P	C
BBR 018	Bioreactor Design	3	0	0	3
BBR 019	Developmental Biology	3	0	0	3
BBI 404	Food and medical microbiology	3	0	0	3

BBR 301	ENZYME TECHNOLOGY				L	T	P	C
	Total Contact Hours - 60				4	0	0	4
	Prerequisite – Molecular Biology, Biopharmaceutical technology							
	Course Designed by – Dept of Genetic Engineering							
OBJECTIVES								
1. To understand the basics of enzymes and classification and enzyme kinetics								
2. To study the production, purification and characterization of enzymes								
3.To study the Instrumental Techniques In Enzymatic Analysis								
COURSE OUTCOMES (COs)								
CO1	Understand the basics of enzymes, nomenclature and classification							
CO2	Apply the knowledge to derive the kinetics for enzymes							
CO3	Learn and apply the different techniques for immobilization of enzymes and kinetics							
CO4	To gain knowledge in various enzyme kinetics							
CO5	Study and apply the knowledge on design of enzyme reactors							
CO6	Discuss the applications of enzymes in Instrumental Techniques In Enzymatic Analysis							
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					

4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016
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UNIT I: INTRODUCTION 12

Structure and functions of Enzymes. Classification of enzymes. Specificity of enzyme action – monomeric and oligomeric enzymes, -Factors modifying enzyme activity, biotechnological applications of enzymes and applications of enzymes in various industries.

UNIT II: CHEMICAL NATURE OF ENZYME CATALYSTS 12

Structural Components of Enzymes – Structure, apoenzymes, prosthetic group, cofactors, Mechanisms of reactions catalysed by enzymes – Metal activated enzymes – metalloenzymes – involvement of coenzymes.

UNIT III: FREE AND IMMOBILISED ENZYME KINETICS 12

Classification of enzymes, Kinetics of single substrate reactions, turnover number, Enzyme Inhibition, pre steady state kinetics, Kinetics of multi-substrate reactions, Allosteric enzymes – The Monad – Changeux – Wyman model (MCW) and The Koshland – Nemethy – Filmer (KNF) model, Temperature and pH effects on enzyme activity. Methods of immobilization of enzymes, Kinetics of immobilized enzymes – Effects of external mass transfer and intra – particle diffusion.

UNIT IV: EXTRACTION AND PURIFICATION OF ENZYMES 12

Methods of production of enzymes, Extraction of Enzymes – soluble enzymes – membrane bound enzymes – Nature of extraction medium – purification of enzyme – criteria of purity – Determination of molecular weight of enzymes.

UNIT V: INSTRUMENTAL TECHNIQUES IN ENZYMATIC ANALYSIS 12

Principles – Manometry – Spectrophotometry – Spectrofluorimetry – Electrochemical methods – Enthalpimetry – Radio chemical methods – Automation in enzymatic analysis.

Total contact hours: 60

REFERENCE BOOKS

1. Principles of Fermentation technology – Stanbury, 2nd edition, 2003
2. Enzyme technology by Martin F. Chaplin, C. Bucke
3. Methods in Enzymology vol. 152 by S.L. Berger and A.R. Kimmel

TEXT BOOKS

1. Enzymes by Trevor palmer
2. Enzymes by Robert A. Copeland, 2nd edition.

BBR 302	PRINCIPLES OF GENETIC ENGINEERING	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Recombinant DNA technology, Principles of Genetics				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
1. To learn various types of vector-host systems and steps in creating a recombinant DNA molecule					
2. To gain knowledge on various recombinant DNA techniques and their applications.					
COURSE OUTCOMES (COs)					
CO1	Understand the steps in Biopharmaceutical industries				
CO2	Explain the features of Transformation and selection of recombinants				
CO3	Characterization of recombinant proteins				
CO4	Chromosome engineering, Gene Therapy, Strategies of gene delivery, gene replacement/ augmentation				
CO5	Role of Genetic Engineering in Forensic Medicine				
CO6	Understand the steps in mutational studies				

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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			

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UNIT I: SCOPE OF GENETIC ENGINEERING

12

Basics of Genetic Engineering. Milestones in Genetic Engineering, Bio safety issues – Genetic engineering guidelines. Molecular Tools in Genetic Engineering – Medical Genetics, Gene Therapy, Human Genome Project, Plant Genetic Engineering. Applications of Genetic Engineering in Biopharmaceutical industries. Recombinant DNA technology. Restriction mapping of DNA fragments and Map construction, Nucleic acid Amplification (PCR analysis) and its applications. Real time PCR and **RT-PCR**.

UNIT II: GENE CLONING STRATEGIES

12

Restriction enzymes and DNA Modifying enzymes (Polymerases, Reverse Transcriptase, Ligases, Alkaline phosphatase, Terminal deoxynucleotide transferases, Nucleases - S1 nucleases etc.). Gene Cloning vectors (Plasmids, Bacteriophages, Cosmids, Phagemids, Artificial chromosomes-**BAC,YAC**, Gene Cloning strategies, Transformation and selection of recombinants; Construction of DNA libraries (Genomic library and cDNA library preparations – mRNA enrichment, reverse transcription, use of linkers and adaptors); and their screening; Alternative strategies of Gene cloning; Cloning of differentially expressed genes. Site directed Mutagenesis and Protein Engineering.

UNIT III: GENE EXPRESSION

12

Basics of Gene expression – hybridization techniques, Northern blot analysis, Primer extension, S1 mapping, RNAase protection assays, Reporter assays), Nucleic acid microarrays. Gene expression in bacteria and Yeast, expression in insects and insect cells, expression in mammalian cells, expression in plants – **selection and screening of recombinant proteins**, stabilization of proteins; Phage display, Yeast Two- and three Hybrid system.

UNIT IV: TRANSGENIC TECHNOLOGY

12

Principles of Transgene technology. Scope of Transgenic technology. Gene tagging (**T-DNA tagging and Transposons** in gene analysis (identification and isolation of gene), Transgenic and Gene Knockouts Technologies - Targeted gene replacement, Chromosome engineering, Gene Therapy, Strategies of gene delivery, gene replacement/ augmentation, gene correction, gene editing and silencing, Transgenic plants.

UNIT V: GENONIMCS AND FORENSICS

12

Role of Genetic Engineering in Forensic Medicine. Nucleic acid sequencing-**Chemical and Enzymatic method**, Structure and functions of Enzymes.NGS, Genetic defects and detection; DNA profiling.

Total contact hours: 60

TEXT BOOKS:

1. Gene Cloning and DNA Analysis, An Introduction. T.A. Brown, Wiley – Blackwell publication, 2010.
2. Principles of Gene Manipulation and Genomics, Sandy B. Primrose, Richard M. Twyman, Blackwell Scientific Publication, 2009

REFERENCE BOOKS:

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J. Cseke, CRC Press, Florida.
2. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
3. DNA Cloning: a Practical Approach, M. Glover and B.D. Hames, IRL Press, Oxford.
4. Methods in Enzymology vol. 152, Guide to Molecular Cloning Techniques, S.L. Berger and A.R. Kimmel, Academic Press, Inc. San Diego.
5. Methods in Enzymology Vol 185, Gene Expression Technology, D.V. Goeddel, Academic Press, Inc., San Diego.

<http://www.biotecharticles.com/>

BBR 303	IMMUNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Recombinant DNA technology, Principles of Genetics				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
1. To learn about the general concepts of immune system and immune organs					
2.To understand the properties of antigens and antibodies and the concept of antigen-antibody interactions					
3.To know about the mechanisms related to cell mediated immunity, complement system, Hypersensitivity and transplantation immunology.					
COURSE OUTCOMES (COs)					
CO1	Outline the general concepts of immune system and describe the cells and organs of the immune system				
CO2	To understand molecular techniques of immunogens				
CO3	Basic structures of Immunoglobulins – Ig classes and biological activities,				

CO4	Antibody Affinity and activity – Antibody specificity - Precipitation reactions					
CO5	Explain the concept of Structure and functions of T and B lymphocytes					
CO6	Illustrate the Basics of Immune disorders and inflammation.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT I: OVERVIEW OF THE IMMUNE SYSTEM

9

Types of Immune responses. **Cells of immunity**, Innate Immunity, adaptive immunity, comparative e immunity cells and organs of the immune system – Antigens. Cellular immunity. HLA antigens, MHC antigens

UNIT II: IMMUNOGLOBULIN STRUCTURE AND FUNCTIONS

9

Basic structures of Immunoglobulins – Immunoglobulin, classes and biological activities, Antigenic determinants on Ig, Plasma cells and B Cell receptors, Monoclonal antibodies – **Polyclonal antibodies**- cytokines – complement system.

UNIT III: ANTIGEN – ANTIBODY INTERACTIONS

9

Antibody Affinity and activity – Antibody specificity - Precipitation reactions- agglutination reactions-Immunological network, Immunological techniques, Radio immunoassay- **ELISA** **Types**-Western blotting, Immunoprecipitation, Immunofluorescence, Immunoelectron

microscopes, Flow cytometers -MHC Antigen processing & presentations.

UNIT IV:T & B CELL MATURATION, ACTIVATION & DIFFERENTIATION 9

Structure and functions of T and B lymphocytes. Bone marrow and Hematopoietic stem cells. T cell receptor, T Cell maturation, Dendritic cells, Lymphocyte activation and differentiation of B cells, activation and differentiation of cell mediated immune responses.

UNIT V: IMMUNE SYSTEM IN HEALTH & DISEASE 9

Basics of Immune disorders and inflammation, hypersensitive reactions, immune responses to infectious diseases, vaccines. Cancer immunology. Immunoinformatics, Clinical Immunology, Immunological databases.

Total contact hours: 45

TEXT BOOKS:

1. Kuby, Immunology by Richard A. Golds by Tharmas J. kindt fourth edition, 2000 and Barbara Osborne. W.H.Freeman and company
2. Text of Microbiology – Tortora, 10th edition

REFERENCE BOOKS

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997
2. Roitt I, Brostoff J. and Male D. Immunology, 6thed. Mosby, 2001
3. Goldsby R.A., Kindt, T.J., Osbome, B.A. and Kerby J. Immunology, 5th ed., W.H.Freeman, 2003
4. Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997
<https://www.immunology.org/>

BBR 304	MICROBIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Immunology, Clinical Pathology and Microbiology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
1. To learn about the general concepts of Microbes.					
2. To understand the properties of interactions between bacteria and Fungi.					
3. To know about the microbial biochemistry and physiology.					
COURSE OUTCOMES (COs)					
CO1	Outline the general concepts of pure culture and cultural characteristics.				
CO2	Basic structures of microbes and its properties.				
CO3	To know about microbial genetics and pathology.				
CO4	Explain the concept of Structure and functions of actinomycetes.				

CO5	Illustrate the Basics of hospital acquired infections.					
CO6	To describe the concept of fungal borne diseases.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT I: INTRODUCTION TO MICROBIOLOGY 9

Scope of Microbiology. Characterization, Classification and Identification of microorganisms, Microscopic examination of Microbes and their morphology. Fine structures of bacteria, **cultivation of bacteria and maintenance**, reproduction & growth, pure cultures and cultural characteristics.

UNIT II: MICROBIAL BIOCHEMISTRY AND PHYSIOLOGY 9

Biochemistry of Microorganisms. **Microbial metabolism**, energy production, utilization of energy & biosynthesis, Bacterial genetics. Fungi – importance, characteristics, morphology, reproduction, physiology cultivation & classification of fungi, molds & repair association with other organisms. Algae – importance of algae – **Features of algae**, classification of protozoans.

UNIT III: MICROBIAL GENETICS AND PATHOLOGY 9

Organisation of Genetic materials in Microorganisms. Microbial Genetics. Bacterial Genomics. Reproduction in microorganisms- **Bacteria**. Microbial proteomics. Pathophysiological aspects of Microorganisms.

UNIT IV: VIRUSES OF BACTERIA, ANIMAL AND PLANTS**9**

Viral Genomics. Virus infections in animals. Bacteriophages- General characteristics- Morphology and structure, Classification and Nomenclature-Bacteriophages of *E.coli*- Replication -viruses of plants - Structure- Replication- Classification, isolation and identification- **fatal diseases associated with viruses in animals**- Viroids

UNIT V: ENVIRONMENTAL AND INDUSTRIAL MICROBIOLOGY**9**

Microbiology of soil – aquatic microbiology, Microbiology of domestic water and waste water. Microbiology of fuel and Industrial microbiology- **Production of fermented foods**

Total contact hours- 45**TEXT BOOKS**

1. Text of microbiology by Tortara, 10th edition
2. Microbiology by Pelczar, JR E.C.S Chan and Noel R. Krieg. Fifth edition Tata McGraw Hill - 2006

REFERENCE BOOKS

1. Microbiology – Harly and Prescott, 10th edition 2012
2. Microbiology by Sathyanarayana, 2010
3. <http://www.vcom.edu/microbiology/links.html>

BBR 305	PRINCIPLES OF BIOCHEMISTRY	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Microbiology, Bio-organic chemistry				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
1. To be able to employ biochemical and Bio molecules, structure of water & its importance.					
COURSE OUTCOMES (COs)					
CO1	Understand Classification, structure & properties of carbohydrates				
CO2	Identify synthetic strategies Classification of Enzymes, Chemical nature, Active Site, Specificity of Enzyme catalyzed reactions				
CO3	Identify the role of enzymes in organic synthesis				
CO4	Understand the Hormones as chemical messengers: General assay of hormones – Bio assay, chemical assay & immuno assays.				

CO5	Explain importance and influence of metal ions on protein function
CO6	To describe the concept of bio molecules.

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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
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UNIT I: INTRODUCTION TO BIOCHEMISTRY

12

Biomolecules, structure of water & its importance – Important noncovalent forces – Hydrogen bonds, electrostatic, hydrophobic & Vanderwaals forces – Acid, base & buffers – pH, Henderson Hasselbalch equation. Biological buffers and their significance – Principle of viscosity – surface tension, adsorption, diffusion, osmosis & their applications in biological systems.

UNIT II: STRUCTURE & PROPERTIES OF CARBOHYDRATES

12

Classification mono, di, oligo & polysaccharides. Classification, structure & properties of amino acids & proteins. Classification, structure & properties of Lipids – Simple lipids, Phospholipids, glycolipids & steroids . Transport of lipids: **Lipoproteins-types** Structure & functions of nucleic acids –Nucleosides , nucleotides – Cyclic AMP, cyclic GMP , ATP , GTP – DNA & RNA

UNIT III: CLASSIFICATION OF ENZYMES

12

Enzymes, Chemical nature, Active Site, Specificity of Enzyme catalyzed reactions, Regulation: Feedback, Allosteric, Covalent modification, Hormonal regulation, co-enzymes. **Assay of**

enzymes in clinical diagnosis of diseases. Introduction to Metabolism: Carbohydrate metabolism, Glycolysis Lipid metabolism: fatty acid, beta-oxidation, ketogenesis and cholesterol metabolism. TCA cycle: Structure of biological membranes, electron transport & Oxidative phosphorylation.

UNIT IV: HORMONES AS CHEMICAL MESSENGERS 12

Liver function and liver function tests, Kidney function and kidney functional tests, normal & abnormal constituents of urine and their clinical significance. **General features of hormones.** Structure, functions & disorders of thyroid, parathyroid, pituitary, adrenal and pancreatic hormones. Hormones as chemical messengers: General assay of hormones – Bio assay, chemical assay & immunoassays.

UNIT V: ANALYTICAL TECHNIQUES 12

Principle and applications of electrophoresis – PAGE, SDS PAGE, Isoelectric focusing, Two Dimensional Electrophoresis. Chromatography: Principle of adsorption & partition chromatography, Size exclusion, Ion exchange & affinity chromatography. Spectro photometry, Fluorimetry, Flame photometry, Manometry, Microcalorimetry, Electrochemical methods, biosensors, automation in clinical laboratory, **use of biosensor techniques in biochemistry.**

Total contact hours: 60

TEXT BOOKS:

1. Harper's review of biochemistry By David.W. Martin, Peter. A. Mayes, Victor. W. Rodwell .LANGE medical publications.
2. Practical Biochemistry – Principles & Techniques by Keith Wilson & John Walker. Oxford University Press.

REFERENCE BOOKS:

1. Understanding Enzymes by Trevor palmer. Published by Ellis Horwood Ltd.
2. Biochemistry Lippincott's Illustrated Reviews by Pamela. C. Champe & Richard. A. Harvey. Lippincott-Raven Publishers.
3. <http://www.bioinfo.org.cn/book/biochemistry/>

BMA 302	BIostatISTICS				L	T	P	C
	Total Contact Hours - 60				4	0	0	4
	Prerequisite – Maths-I, Analytical techniques.							
	Course Designed by – Dept of Mathematics							
OBJECTIVES								
1. To be able to employ for numerical problems								
COURSE OUTCOMES (COs)								
CO1	To Biostatistics and Basics of Bio Statistics. Applications of Biostatistics							
CO2	Identify synthetic strategies Probability concepts – conditional probability – Baye’s theorem							
CO3	Introduction – Large sample tests based on normal distribution							
CO4	Understand the ANOVA– one –way classification, Two-way classification.							
CO5	Understand the Statistical Quality Control.							
CO6	To identify numerical methods							
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					

4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016
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UNIT I: INTRODUCTION TO BIO-STATISTICS (numerical problems only) 12

Introduction and Basics of Bio Statistics. Applications of Biostatistics. Handling univariate and bi-variate data – Measures of central tendency – Measures of dispersion –Skewness & Kurtosis – Correlation and Regression.

UNIT II: PROBABILITY & THEORETICAL DISTRIBUTIONS 12

Probability concepts – Conditional probability – Baye’s theorem – one – dimensional random variables –expectation, variance, moments. Theoretical distributions: Binomial, Poisson, Normal (Problems only).

UNIT III: TESTING OF HYPOTHESIS 12

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

UNIT IV: 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.

UNIT V: STATISTICAL QUALITY CONTROL 12

Introduction – Process control – control charts for variables - X and R, X and s charts control charts for attributes: P chart, NP chart, C chart.

Total contact hours: 60

TEXT BOOKS

1. S.C. Gupta &V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi, 2003.
2. Kapur J.N. And Saxena H. C. 'Mathematical Statistics". S. Chand and Co., New Delhi 2004.
3. Veerarajan T. “Probability Statistics and Random Process” Tata McGraw Hill, New Delhi 2003.
4. S.C. Gupta and V.K. Kapoor, “Applied Statistics”. S. Chand and Sons, New Delhi 2004.

REFERENCE BOOKS:

1. Biostatistics, second edition: A Guide to Design, Analysis and Discovery by Ronalds N. Forthofer, fun sel lee, and Mike Hernandez (Hardcover-Dec 28, 2006)

2. Biostatistics: Principles and Practice by B. Antonisamy Solomom Christopher, Prasanna Samuelson 1st edition Pub Date 14 Sep 09.
3. PN.Arora and S. Arora, 'Statistics for Management', S.Chand and sons, New Delhi 2003
4. http://www.dcscience.net/Lectures_on_biostatistics-ocr4.pdf

BBR 3L1	MICROBIOLOGY LABORATORY				L	T	P	C
	Total Contact Hours - 30				0	0	3	2
	Prerequisite – Basic Microbiology techniques							
	Course Designed by – Department of Genetic Engineering							
OBJECTIVES								
1. Understand explicitly the concepts of microorganisms								
2. Develop their skills in the preparation, identification and quantification of microorganisms								
COURSE OUTCOMES (COs)								
CO1	Understand and demonstrate the working principles, procedures of microbiology Lab experiments and equipments							
CO2	To understand the concept of sterilisation							
CO3	Observe and practice different types of culture media and broth for microbial cultivation							
CO4	To know about disinfection methods							
CO5	Differentiate microbes using different staining methods							
CO6	Estimate and evaluate the microbial screening, identification and characterization							
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Sterilization techniques
2. Media preparation and preservation
3. Preparation of nutrient broth
4. Preparation of nutrient agar media
5. Staining Techniques (Simple, Gram staining, spore staining)
6. Pure culture techniques (a) streak plate method (b) pour plate method (c) Spread plate method
7. Acid fast technique
8. Antibiotic Assay - Test (Disc Diffusion Method. Agar well diffusion)
9. Biochemical Characterization of Bacteria
 - i) Oxidation/Fermentation Test
 - ii) Catalase, Oxidase and Urease Tests
10. Lethal effect of bacteria
11. Motility test by hanging drop method

TEXT BOOKS

1. Microbiology Bio 204 Laboratory Manual
2. Laboratory Manual in general Microbiology (1916)
3. Microbiology Bio1 2421L Laboratory Manual (Donna Cain, Hershell Hanks, Mary Weis, Carroll Bottoms, and Jonathan Lawson)
4. Basic Practical Microbiology (John Grainger)
5. <http://www.biotopics.co.uk/microbes/tech1.html>

BBR 3L2	BIOCHEMISTRY LABORATORY			L	T	P	C
	Total Contact Hours - 30			0	0	3	2
	Prerequisite – Basic Biochemical Techniques						
	Course Designed by – Department of Genetic Engineering						
OBJECTIVES							
1. Provides an opportunity to experimentally verify the theoretical concepts already studied. It also helps in understanding the theoretical principles in a more explicit and concentrated manner.							
2.Understand explicitly the concepts							
3. Develop their skills in the preparation, qualitative and quantitative analysis.							
COURSE OUTCOMES (COs)							
CO1	Determination of saponification number of lipids.						
CO2	Estimation of Amino acids.						
CO3	Separation of amino acids - Thin layer chromatography.						
CO4	Separation of sugars - Paper chromatography						
CO5	To detect proteins using Ramachandran Plot						
CO6	Estimate and evaluate the Proteins and amino acids						
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	
2	CO1	M	H				
	CO2		M				
	CO3			M			
	CO4		M				
	CO5		H	M			
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)	
			√				

4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016
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LIST OF EXPERIMENTS

1. pH measurements and preparation of buffers.
2. **Qualitative tests for Carbohydrates, proteins and lipids.**
3. Estimation of sugars.
4. Estimation of proteins by Lowry's method / Biuret method.
5. Estimation of cholesterol by Zak's method.
6. Determination of saponification number of lipids.
7. Estimation of Amino acids.
8. Separation of amino acids - Thin layer chromatography.
9. Separation of sugars - Paper chromatography
10. Biochemical estimation of DNA /RNA using Spectrophotometer

TEXT BOOKS

1. Biochemistry Laboratory Manual - Mark Brandt, Ph.D. 3rd edition , 2002
2. Biochemistry Laboratory Manual – Dr. Dennis Welsh, 2013
3. Biochemistry Laboratory Manual Che 4350. Andrew J. Bonham, Ph. D, 2013
<https://www.liverpool.ac.uk/~agmcclen/Medpracs/Prachomepage.html>

BBR 401	RECOMBINANT DNA TECHNOLOGY	L	T	P	C
	Total Contact Hours – 60	4	0	0	4
	Prerequisite – Cell biology, Genetics, and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
To learn various types of vector-host systems and steps in creating a recombinant DNA molecule.					
COURSE OUTCOMES (COs)					
CO1	Understand the steps in recombinant DNA/RNA modifying enzymes				
CO2	Explain the features of various types of gene cloning vectors				
CO3	Strategies for cloning PCR products				
CO4	construction subtractive cDNA library				
CO5	Plasmid expression vectors-general features, promoters used in expression vectors				

CO6	To gain knowledge on various recombinant DNA techniques and their applications.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: MOLECULAR TOOLS FOR GENE CLONING

12

Gene Introduction and Cloning tools Restriction enzymes- Dam, Dcm and CpG methylation sensitivity of restriction enzymes-star activity of restriction enzymes. Modifying enzymes, DNA and RNA polymerases, reverse transcriptase, terminal transferase, DNA/RNA modifying enzymes- methylases- M. EcoR I. Ligases – E. coli DNA ligase, T4 DNA ligase, T4 RNA ligase. RNases- RNase I, RNase A, RNase H - Nucleases – RNase free DNase- Exonuclease I, Exonuclease III Nucleases. Kinases -T4 polynucleotide kinase. Phosphatases- Topoisomerase.

UNIT II: VECTORS FOR GENE CLONING

12

Introduction to cloning vectors, plasmid vectors (high copy and low copy), phage vectors, cosmid vectors, phasmid vectors, **BAC vectors and YAC vectors**.

UNIT III: CLONING TECHNIQUES

12

Cloning after restriction digestion - blunt and cohesive end ligation – creation of restriction sites by PCR- cloning using linkers and adapters - cloning after homopolymer tailing. Strategies for cloning PCR products – TA cloning -TOPO-TA cloning-TOPO-Blunt cloning-cloning blunt end PCR product using SfrI restriction enzyme and T4 DNA ligase.

UNIT IV: CONSTRUCTION OF GENE LIBRARIES**12**

Construction of cDNA library- Construction subtractive cDNA library – Construction of genomic DNA library – BAC library – YAC library.

UNIT V: EXPRESSION OF RECOMBINANT PROTEIN IN E.COLI**12**

Plasmid expression vectors-general features, promoters used in expression vectors -cloning of genes in correct reading frame in expression vector- **purification of recombinant protein using Histidine tag**, GST tag, Chitin binding domain and intein. Codon use in different organisms- codon usage database- codon optimization to increase the expression of recombinant protein.

Total contact hours: 60**TEXT BOOKS:**

1. Principles of gene manipulation by Old and Primrose
2. Molecular Cloning – A Laboratory Manual by Sambrook and Russell

REFERENCE BOOKS

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida.
2. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
3. <http://www.ncbi.nlm.nih.gov/books/NBK9950/>

BBR 402	MOLECULAR BIOLOGY	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite – Recombinant DNA technology, Genetics and Microbiology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
To understand cellular organization, transport of molecules cell interactions and Signaling.					
COURSE OUTCOMES (COs)					
CO1	Scope and History. Structure of DNA-Nucleoside				
CO2	Types and functions of DNA polymerases in Prokaryote and Eukaryote. Replication in prokaryote and Eukaryote.				
CO3	Fine structure of prokaryotic and eukaryotic gene, structure and function of the promoters in mRNA, rRNA, tRNA genes				
CO4	Genetic code and Wobble hypothesis. Translation in prokaryote and eukaryote				
CO5	Understand the Principles of gene regulation- Transcriptional and post transcriptional gene regulation-activators, co-activators, suppressors, co-suppressors, moderators, silencers, insulators, enhancers				

CO6	To describe DNA replication, gene expression at transcriptional and translational level gene regulation and DNA repair mechanisms
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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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: - INTRODUCTION TO MOLECULAR BIOLOGY

12

Scope and History, Structure of DNA-Nucleoside, Nucleotide, Base pairing, Base stacking, Double Helix, Features of Watson and Crick model, major and minor groove, Super coiling-twist, writhe and linking number, **Forms of DNA- A, B, Z**. Structure and function of mRNA, rRNA, and tRNA. Secondary structures in RNA.

UNIT II: REPLICATION AND REPAIR

12

Types and functions of DNA polymerases in Prokaryote and Eukaryote, Replication in prokaryote and Eukaryote. Proof reading activity, 5'-3' exonuclease activity, topoisomerase activity, Telomeric DNA replication and Plasmid Replication-theta model, strand displacement model and rolling circle model, **DNA Repair- Nucleotide excision repair**, base excision repair, mismatch repair, photo-reactivation, recombination repair and SOS repair.

UNIT III: POST TRANSCRIPTIONAL MODIFICATIONS**12**

Fine structure of prokaryotic and eukaryotic gene, Structure and function of the promoters in mRNA, rRNA, tRNA genes. RNA polymerases in prokaryote and eukaryote, types and function. Transcription of mRNA, rRNA, and tRNA genes in Prokaryote and Eukaryote. Post transcriptional processing of mRNA – 5'capping, **RNA Splicing**, polyadenylation and RNA editing.

UNIT IV: TRANSLATION AND POST TRANSLATIONAL PROCESSING 12

Genetic code and Wobble hypothesis, Translation in prokaryote and eukaryote, Post translational Modifications, Principles protein sorting and targeting into endoplasmic reticulum, mitochondria, chloroplast, and nucleus.

UNIT V: GENE REGULATION**12**

Principles of gene regulation- Transcriptional and post transcriptional gene regulation - activators, co-activators, **suppressors**, **co-suppressors**, moderators, silencers, insulators, enhancers. Operon- lac operon, trp operon, ara operon and gal operon.

TEXT BOOKS:

1. S.S. Purohit “Cell and Molecular biology”, 2008, Agrobios (India).
2. Harvey Ladish “Cell Biology” W.H. Freeman, 2007.
3. Molecular Biology of Gene - Watson
4. Molecular and Cellular Biology- Stefen Wolfe

REFERENCE BOOKS

1. Molecular and Cellular Methods in Biology and Medicine, P.B. Kaufman, W. Wu. D. Kim and L.J; Cseke, CRC Press, Florida.
2. Molecular Cloning: a Laboratory Manual, J. Sambrook, E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
3. Molecular biology of Gene, Fifth edition Author James D. Watson 2004 Benjamin Cumin (Publisher)
4. <http://www.web-books.com/MolBio/>

BCE 406	ENVIRONMENTAL STUDIES				L	T	P	C
	Total Contact Hours – 45				3	0	0	3
	Prerequisite – Biology and Ecology							
	Course Designed by – Dept of Civil Engineering							
OBJECTIVES								
Genetic, Species and Ecosystem Diversity - Value Of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and Option Values.								
COURSE OUTCOMES (COs)								
CO1	Scope of Environmental education							
CO2	Endangered And Endemic Species Of India, Conservation Of Biodiversity: In-Situ And Ex-Situ Conservations.							
CO3	Hazardous Waste, Bio Medical Waste - Process Of Waste Management.							
CO4	Environmental ethics -issues and possible solutions- population explosion, climatic change, ozone layer depletion, global warming, acid rain and greenhouse effect.							
CO5	Understand the wild life conservation and forest act – functions of central and state pollution control boards							
CO6	To describe Environmental ethics -issues and possible solutions							
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					

4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016
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UNIT I: ENVIRONMENT AND ECOSYSTEMS

9

Environmental education: definition - scope - objectives and importance. Concept of an ecosystem – types (terrestrial and aquatic ecosystems) – structure and function – ecological succession - food chains, food webs and ecological pyramids

UNIT II: BIODIVERSITY

9

Introduction: definition - genetic, species and ecosystem diversity - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife - endangered and endemic species of India, Conservation of biodiversity: in-situ and ex-situ conservations.

UNIT III: POLLUTION AND WASTE MANAGEMENT

9

Air and water pollution – classification of pollutants and their effects – control measures of air pollution. Waste water treatment (general) – primary, secondary & tertiary stages. Solid waste management: causes - effects of municipal waste, hazardous waste, bio medical waste - process of waste management.

UNIT IV: CURRENT ENVIRONMENTAL ISSUES

9

Environmental ethics -issues and possible solutions- population explosion, climatic change, ozone layer depletion, global warming, acid rain and greenhouse effect. Sustainable development: definition, objectives and environmental dimensions of sustainable development- environmental audit for sustainable development.

UNIT I - ENVIRONMENTAL PROTECTION

9

National and international concern for environment: Important environmental protection acts in India – water, air (prevention and control of pollution) act, wild life conservation and forest act – functions of central and state pollution control boards - international effort – key initiatives of Rio declaration, Vienna convention, Kyoto protocol and Johannesburg summit.

TEXT BOOKS

1. Sharma. B.K. and Kaur, “Environmental Chemistry” Goel Publishing House, Meerut, 1994.
2. De. A. K., “Environmental Chemistry”, New Age International (p) Lt., New Delhi, 1996.
3. Kurian Joseph & R. Nagendran, “Essential of Environmental Studies” Pearson Education, 2004.

REFERENCE BOOKS

1. Dara S.S., A Text Book of Environmental Chemistry and pollution control, S. Chand & Company Ltd., New Delhi, 2004.

2. Jeyalakshmi. R, Principles of Environmental Science, 1st Edition, Devi Publications, Chennai 2006.
3. Kamaraj. P & Arthanareeswari. M, Environmental Science – Challenges and Changes, 1st Edition, Sudhandhira Publications, 2007.
4. Arivalagan. K, Ramar. P & Kamatchi. P, Principles of Environmental Science, 1st Edition, Suji Publications, 2007.
5. www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf

BBR 404		GENOMICS AND PROTEOMICS			L	T	P	C
		Total Contact Hours – 45			4	0	0	4
		Prerequisite – Molecular biology, Genetics, rDNA Technology, and Bioinformatics						
		Course Designed by – Dept of Genetic Engineering						
OBJECTIVES								
To Coding, non-coding chromosomes. To Applications of Proteome analysis-								
COURSE OUTCOMES (COs)								
CO1		To organization and structure of genomes, Genome Size						
CO2		To Chromosomes Micro dissection and chromosomal mapping techniques.						
CO3		To understand the Functional Genomics.						
CO4		To understand the principle of Mass spectrometry						
CO5		To Understand the Phosphoprotein analysis- Genomics Vs Proteomics.						
CO6		To know the proteomics in drug discovery research.						
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO GENOMICS

9

Organization and Structure of Genomes, Genome Size – Genome Structure in Viruses and microbes, Coding, Non-coding chromosomes and high order structures – Genomes relatedness.

UNIT II: PHYSICAL MAPPING TECHNIQUES

9

Chromosomes Micro dissection, Chromosomal mapping techniques, Top down and bottom up approach – Linking and jumping of clones – Genome sequencing – Placing small fragments on map – STS assembly – Gap closure – **Pooling strategies** – Cytogenetic mapping techniques.

UNIT III: FUNCTIONAL GENOMICS

9

Gene finding – Annotation – ORF and functional prediction – Subtractive DNA library, screening – DNA sequencing - Hybridization techniques – Differential display and representational difference analysis – **SAGE – TOGA**, Analysis of RNA expression - Comparative genomics . Bioinformatics tools used in Genomics

UNIT IV: PROTEOMICS TECHNIQUES

9

Proteome – Bridging Genomics and Proteomics - Analysis of Proteome - Protein level estimation – Edman protein micro sequencing – Protein cleavage – 2D gel electrophoresis – Metabolic labeling – Detection of proteins on SDS gels – Pattern analysis – Mass spectrometry – Principles of MALDI-TOF – Tandem MS-MS – Peptide mass fingerprinting. **Structural prediction of proteins**

UNIT V: PROTEIN PROFILING

9

Post translational modification – Protein-protein interaction –Protein Chips – Applications of Proteome analysis- Proteomics in drug discovery- Phage antibodies as tools – Proteomics in plant genetics and breeding - **Glycoprotein analysis** –Phosphoprotein analysis- Genomics Vs Proteomics.

Total Contact Hours – 45

TEXT BOOKS

1. Primrose, S.B. and Twyman, R.H., "Principles of Genome Analysis and Genomics", Blackwell Publishing Co., 2003.
2. Liebler, D.C., "Introduction to Proteomics", Humana Press, 2002.
3. Discovering Genomics, Proteomics, & Bioinformatics. Campbell & Heyer (2003) Pearson Education, ISBN: 0-8053-4722-4.
4. Bioinformatics, Methods of Biochemical Analysis Series Vol. 43, Baxevanis & Ouellette (2001) John Wiley & Sons, ISBN 0-471-38391-0
4. Computational Molecular Biology. Pevzner, P.A. (2000) MIT Press, ISBN: 0262.

REFERENCES

1. Pennington, S.R. and Dunn, M.J., "Proteomics", BIOS Scientific Publishers, 2001.
2. Hunt, S.P., Livesey, R. and Livesey, F.J., "Functional Genomics: A Practical Approach" Oxford University Press, 2000.
3. Suhai S., "Genomics and Proteomics: Functional and Computational Aspects", Springer, 2000.
4. Cantor, C.R. and Smith, C.L., "Genomics: The Science and Technology Behind the Human Genome Project", Wiley and Sons, 1999.
5. <http://www.sciencedirect.com/science/book/9781907568107>

BBR 405	BIO-ORGANIC CHEMISTRY		L	T	P	C
	Total Contact Hours – 60		4	0	0	4
	Prerequisite – Chemistry, Biology and protein engineering					
	Course Designed by – Dept of Genetic Engineering					
OBJECTIVES						
To enable understanding chemical principles governing biochemical reactions						
COURSE OUTCOMES (COs)						
CO1	To understand molecular interaction and chemical reactions of biomolecules					
CO2	To identify synthetic strategies for proteins and oligonucleotides					
CO3	To identify the role of enzymes in organic synthesis					
CO4	To understand the orchestration of events during enzyme catalysis and the role of coenzymes					
CO5	To explain importance and influence of metal ions on protein function					

CO6	To know the lead synthesis methods and their types					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT 1: AMINO ACIDS AND PROTEINS

12

Structure, classification, Synthesis and Properties of amino acids, Biosynthesis of amino acids. Peptides: oligo and polypeptides, geometry of peptide linkage, N-terminal and C-terminal residue analysis, synthesis of peptides-amino and carboxyl protecting groups-solid phase peptide synthesis. Proteins: classification and properties (denaturation, isoelectric point and electrophoresis), collagen and triple helix.

UNIT II: Enzymes and Cofactors

12

Mechanism of enzyme catalysis, Factors influencing enzyme action, Examples of typical enzyme mechanisms: **Carboxypeptidase**, chymotrypsin, ribonuclease and lysozyme, Enzyme-catalyzed addition, elimination, condensation, carboxylation and decarboxylation, isomerization, group transfer and rearrangement reactions-structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, **NAD⁺**, **NADP⁺**, **FMN**, FAD, lipoic acid and Vitamin B12. Mechanisms of reactions catalyzed by the above cofactors.

UNIT III: Nucleic Acids and Protein Synthesis

12

Nucleotides and nucleosides, DNA: primary and secondary structure-replication of DNA. RNA and protein synthesis: Messenger RNA synthesis-transcription, Ribosomes- rRNA, Transfer RNA, genetic code translation. Determination of base sequence of DNA, Polymerase Chain Reaction (PCR). Antisense technology in chemotherapy and other nucleic acid-targeted drugs- intercalaters, sequence specific drugs. A brief account of ribosyme and iRNA.

UNIT IV: Lead and Analogue Synthesis-1

12

Designing organic synthesis-disconnection approach-Synthons and synthetic equivalents-one group disconnections: alcohol, olefin, ketone, acids-two group disconnections: 1,2-, 1,3-, 1,4- and 1,5-difunctional compounds-convergent synthesis-functional group inter conversions- functional group additions-carbon heteroatom bonds-methods for 3- to 6-membered rings.

UNIT V: Lead and Analogue Synthesis-2

12

Combinatorial synthesis in medicinal chemistry: Solid phase techniques-methods of parallel synthesis-mix and split techniques-dynamic combinatorial chemistry-screening and deconvolution - limitations of combinatorial synthesis, Asymmetric synthesis: basic principles- stereoselective and stereospecific reactions and catalysts and their applications (wherever applicable)

Total Contact Hours: 60

TEXT BOOKS

1. Designing Organic Synthesis: The Disconnection Approach by Stuart Warren, Wiley, 2nd edition, 1984.
2. Asymmetric Synthesis by H. B. Kagan, Thieme Medical Publishers, 2003.

REFERENCE BOOKS

1. Bioorganic Chemistry: A Chemical approach to Enzyme action, Hermann Dugas and C. Penny, Springer-Verlag.
2. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press.
3. Enzymatic Reaction Mechanisms, C. Walsh, W.H. Freeman.
4. <http://www.organic-chemistry.org/books/navi/bioorganicchemistry.shtm>

BBR 406	BASICS OF BIOINFORMATICS					L	T	P	C
	Total Contact Hours – 60					4	0	0	4
	Prerequisite – Biology, Enzyme Technology, and Basic computer Science								
	Course Designed by – Dept of Genetic Engineering								
OBJECTIVES									
To understand the significance of string alignment. To construct the phylogenetic tree.									
COURSE OUTCOMES (COs)									
CO1	Explain various types of network protocols and biological databases								
CO2	Demonstrate and interpret the string matching and dynamic program algorithms of macromolecular strings								
CO3	Apply, solve and interpret the heuristics based pair wise and multiple sequence analysis of macromolecules								
CO4	Construct and interpret the molecular phylogenetic trees								
CO5	Predict and understand the gene and protein structures, and microarrays								
CO6	To understand the fundamentals of protein structure prediction and microarray analysis								
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I: Introduction to Bioinformatics and Basics of Internet 12

Biology in the computer age - Introduction to Bioinformatics, Basics of computers - Servers, workstations, operating systems. UNIX, Linux, WWW. Search Engines, PubMed, Public Biological databases. Connecting to internet; Connecting to internet; Email; FTP; www; The NCBI data model: Introduction, BIOSEQ's, BIOSEQ- sets, SEQ- ANNOT, SEQ- DESCR.

UNIT II: BIOLOGICAL DATABASES 12

Biological databases-primary sequence databases - Composite sequence databases- Secondary databases composite protein pattern databases-structure classification databases. Genome Information Resources: DNA sequence databases-specialized genomic resources, GRAIL, GENSCAN.NCBI databases and PUBMED tools.

UNIT III: ALIGNMENT TECHNIQUES 12

Pair-wise Alignment Technique: Database searching-algorithms and programs-comparing two sequences identity and similarity-global and local alignment- Pair wise database searching. Multiple sequence Alignment: Goal of multiple sequence alignment-Computational Complexity-Manual methods-Simultaneous methods-Progressive methods-Databases of multiple alignment-Secondary database searching-Analysis packages.

UNIT IV: PROTEIN ANALYSIS 12

Protein Chips, Bioinformatics tools in proteomics - Protein identity based on composition, Motifs and patterns, secondary structure prediction, specialized secondary structures, tertiary structure

UNIT V: INTRODUCTION TO PERL 12

Using PERL to facilitate biological analysis, Strings, numbers, and variables, Basic input & output, File handles, Conditional Blocks & loops, Pattern matching, Arrays-Hashes.

Total Contact Hours: 60

TEXT BOOKS

1. Andreas D Baxevanis & B F Francis," Bioinformatics- A practical guide to analysis of Genes & Proteins", John Wiley, 2002.
2. T K Attwood, D J Parry-Smith," Introduction to Bioinformatics", Pearson Education.

REFERENCE BOOKS

1. Introduction to Bioinformatics, T. K. Attwood & D.J. Parry-Smith, Prentice Hall 2000.
2. Instant notes on Bioinformatics, D.R. West head.J.H. Parish R.M. Twyman, Liva Books, New Delhi, 2003
3. "Bioinformatics Sequence and Genome analysis", David W. Mount 2003.
4. "Bioinformatics Basics 'Applications in Biological science and Medicine" Hooman H. Rashidi & Lukas K. Buehie 2001.

5. Introduction to bioinformatics: A theoretical and practical approach by Stephen A wetz and David. D Woumble Publication: Humana Press. 2003
6. Sequence and Genome analysis. David W. Mount, 2004 Cold spring harbour laboratory press New York.

BBR 4L1		MOLECULAR BIOLOGY LABORATORY			L	T	P	C
		Total Contact Hours – 30			0	0	3	2
		Prerequisite – rDNA Technology, Microbiology, and Cell Biology						
		Course Designed by – Dept of Genetic Engineering						
OBJECTIVES								
To familiarize with cell counting and cell separation techniques.								
COURSE OUTCOMES (COs)								
CO1		Demonstrate cell counting and cell separation techniques						
CO2		Experiment to isolate DNA and RNA from various biological tissues.						
CO3		Analyze and interpret DNA and RNA data.						
CO4		Explain the activity of restriction enzymes and ligation of DNA.						
CO5		Demonstrate bacterial genetics through conjugation experiment and Execute the effect of UV irradiation on bacterial genome						
CO6		To gain hands on experience with action of restriction endonucleases and ligase on DNA						
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		
2	CO1	M	H					
	CO2		M					

	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Isolation of DNA from plant tissue
2. Isolation of DNA from animal tissue
3. Agarose gel electrophoresis
4. Effects of antibiotics by gradient method
5. UV induced mutagenesis
6. SDS page
7. Quantification of nucleic acids-DNA & RNA
8. Competent cell preparation
9. Transformation
10. Competent cell preparation
11. Polymerase Chain Reaction

TEXT BOOKS

1. Molecular biology laboratory manual - Hikmet Geckil.
2. Molecular Cloning – A Laboratory Manual by Sambrook and Russell.
4. https://www.inonu.edu.tr/Uploads/iys_dosyalar/1400/file/MBManual.pdf

BBR 4L2		CELL BIOLOGY LABORATORY			L	T	P	C
		Total Contact Hours – 30			0	0	3	2
		Prerequisite – Biology, Genetics and Microbiology						
		Course Designed by – Dept of Genetic Engineering						
OBJECTIVES								
To give hands-on training in basic molecular biology techniques								
COURSE OUTCOMES (COs)								
CO1		To demonstrate cell counting and cell separation techniques						
CO2		To experiment to isolate DNA and RNA from various biological tissues.						
CO3		To analyze and interpret DNA and RNA data.						
CO4		To explain the activity of restriction enzymes and ligation of DNA.						
CO5		To demonstrate bacterial genetics through conjugation experiment and Execute the effect of UV irradiation on bacterial genome						
CO6		To acquire practical skills related to DNA/ RNA isolation methods.						
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Introduction to principles of sterile techniques and cell propagation.
2. Principles of microscopy, phase contrast and fluorescent microscopy.
3. Identification of given plant, animal and bacterial cells and their components by microscopy
4. Different types of staining techniques
5. Cell viability by Trypan Blue assay
6. Estimation of chlorophyll from plant tissue
7. Lacto phenol cotton blue staining
8. Hematology experiments
 - (a) Blood smear (b) blood count
9. Cell component (a) isolation of chloroplast (b) isolation of protoplast
10. Cryopreservation

REFERENCE:

1. Laboratory Investigations in Cell and Molecular Biology, Allen Bregman Wiley, 2001.
2. Laboratory manual for Cell biology - E. Eugene Williams
<http://www.public.asu.edu/>

BBR501	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
	Total Contact Hours – 60	4	0	0	4
	Prerequisite –Bioprocess Technology, Microbiology, and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs					

COURSE OUTCOMES (COs)						
CO1	Understand the bulk production of commercially important Bioproducts, Industrial Enzymes, Products of plant and animal cell cultures.					
CO2	Explain the features of various types of gene cloning vectors					
CO3	Strategies for Upstream and Downstream process in Bioprocess, Process flow sheeting.					
CO4	Production of commercially important primary metabolites like organic acids, amino acids, alcohols and vitamins					
CO5	Plasmid expression vectors-general features, promoters used in expression vectors					
CO6	To gain knowledge on various recombinant DNA products and their applications.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO INDUSTRIAL BIOPROCESS

12

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of upstream and downstream processing in Bioprocess, Process flow sheeting - block diagrams, pictorial representation.

UNIT II: PRODUCTION OF PRIMARY METABOLITES

12

Primary Metabolites- Production of commercially important primary metabolites like organic acids, amino acids, alcohols and vitamins.

UNIT III: PRODUCTION OF SECONDARY METABOLITES 12

Secondary Metabolites- Production processes for various classes of secondary metabolites: **Antibiotics –Penicillin, Amoxycillin** and Steroids.

UNIT IV: PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS 12

Production of Industrial Enzymes, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers Biodiesel, Cheese, Beer, SCP & Mushroom culture. Bioremediation.

UNIT V: PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS 12

Production of recombinant proteins having therapeutic and diagnostic applications, **vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture.**

Total Contact Hours: 60

TEXT BOOKS:

1. Satyanarayana, U. “Biotechnology” Books & Allied (P) Ltd., 2005.
2. Kumar, H.D. “A Textbook on Biotechnology” 2 nd Edition. Affiliated East West Press Pvt.Ltd., 1998.
3. Balasubramanian, D. *et al.*, “Concepts in Biotechnology” Universities Press Pvt.Ltd., 2004.
4. Ratledge, Colin and Bjorn Kristiansen “Basic Biotechnology” 2 nd Edition Cambridge University Press, 2001.
5. Dubey, R.C. “A Textbook of Biotechnology” S.Chand & Co. Ltd., 2006.

REFERENCES:

1. A.H. Patel “Industrial Microbiology” Macmillan
2. Presscott, S.C. and Cecil G. Dunn, “Industrial Microbiology”, Agrobios (India), 2005.
3. Cruger, Wulf and Anneliese Crueger, “Biotechnology: A Textbook of Industrial Microbiology”, 2nd Edition, Panima Publishing, 2000.
4. Moo-Young, Murrey, “Comprehensive Biotechnology”, 4 Vols. Pergamon Press, (An Imprint of Elsevier) 2004.
5. C.F.A Bryce and EL.Mansi, Fermentation microbiology & Biotechnology, 1999.
6. K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.
7. <https://app.knovel.com/>

BBR 502	RESEARCH METHODOLOGY	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Biophysics				
	Course Designed by – Dept of Genetics Engineering				
1. Early entry graduate-level survey of research methods with an emphasis on comprehension of the educational research literature.					

2. Course includes scientific method, locating.						
3. Summarizing published research, sampling, measurement, statistics.						
4. Increase the knowledge on research design, and critique of published research.						
COURSE OUTCOMES (COs)						
CO1	Basic descriptive statistics including measures of central tendency, dispersion, and relationships.					
CO2	Basic measurement concepts including validity and reliability and the role of measurement in inquiry.					
CO3	Common and differentiating features of basic, applied, and evaluation research					
CO4	Common and differentiating features of typical research designs (e.g. quantitative vs. qualitative, experimental vs. non-experimental, group vs. single-case).					
CO5	Quality indicators in published research.					
CO6	To Understand the research and development.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO RESEARCH 12

Introduction: Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem, Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.

UNIT II: APPLICATIONS OF PROBABILITY DISTRIBUTIONS 12

Quantitative Methods for problem solving: Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

UNIT III: FREQUENCY DISTRIBUTIONS 12

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis

UNIT IV: NEURAL NETWORK ANALYSIS 12

Soft Computing: Computer and its role in research, Use of statistical soft ware SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

UNIT V: RESEARCH REPORT ANALYSIS 12

Structure and components of research report, Types of report, Layout of research report, Mechanism of writing a research report, referencing in academic writing.

TOTAL CONTACT HOURS: 60

TEXT BOOKS

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006
2. Donald H. Mc Burney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047- 0,2006

REFERENCE BOOKS

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
2. Fuzzy Logic with Engineering Applications, Timothy J.Ross, Wiley Publications, 2nd Ed
3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven & E.H. Aarts
4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E. Goldberg.

5. <https://docs.google.com/viewer?a=v&pid=forums&srcid=MTAxNDI0NTM4NjczMzU3MTYzMtIBMTQyOTU2MzI2MDIwMDM2MTc5NDQBSm05QUZ1UENMOFVKATAuMQEBdJl>

BBR 503	CYTOGENETICS			L	T	P	C
	Total Contact Hours - 45			3	0	0	3
	Prerequisite – Cell Biology, Cytology						
	Course Designed by – Dept of Genetics Engineering						
1. Early entry graduate-level survey of research methods with an emphasis on comprehension of the educational research literature.							
2. Course includes scientific method, locating.							
3. Summarizing published research, sampling, measurement, statistics.							
4. Increase the knowledge on research design, and critique of published research.							
COURSE OUTCOMES (COs)							
CO1	Basic descriptive statistics including measures of central tendency, dispersion, and relationships.						
CO2	Basic measurement concepts including validity and reliability and the role of measurement in inquiry.						
CO3	Common and differentiating features of basic, applied, and evaluation research						
CO4	Common and differentiating features of typical research designs (e.g. quantitative vs. qualitative, experimental vs. non-experimental, group vs. single-case).						
CO5	Quality indicators in published research.						
CO6	To Understand the research and development.						
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	
2	CO1	M	H				
	CO2		M				
	CO3			M			
	CO4		M				

	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: MENDELIAN GENETICS

9

Genetic inheritance, Mendelian Genetics **Mendelian Laws**- Mendel's experiments, principles of segregation, monohybrid cross – Independent Assortment, Gene interaction, multiple alleles.

UNIT II: CHROMOSOME STRUCTURE AND ORGANIZATION

9

Chromosome structure and organization in prokaryotes and eukaryotes, **Giant chromosomes, polytene and lampbrush**, Sex determination and sex linkage, techniques in cytogenetic.

UNIT III: LINKAGE AND CROSSING OVER

9

Linkage, Crossing over, cytological basis of crossing over, chromosome mapping, two and three factor cross, interference, somatic cell hybridization.

UNIT IV: VARIATION IN CHROMOSOME STRUCTURE AND NUMBER

9

Deficiencies, duplication, inversion, translocation, positive effects-human chromosome techniques (karyotyping), chromosome aberration in humans-classification of mutation, classification of ploidy, variation in chromosome number, extra chromosomal inheritance-cytogenetical abnormalities in humans

UNIT V: RECOMBINATION IN BACTERIA

9

Bacterial Genomics, Transformation, Transduction, Conjugation – mapping, fine structure mapping in merozygotes- **plasmids and episomes**.

Total Contact Hours: 45

TEXT BOOKS

1. Principles of Genetics by Gardner, Simmons, Snustad, 8th edition – John Wiley and Sons, Inc., 2003.

2. The Cell: A molecular approach by Geoffrey M. Cooper. ASM Press, Pages: 673.

REFERENCE BOOKS

1. Molecular Cell Biology, Sixth Edition., by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira Bioenergetics at a Glance: An Illustrated Introduction D. A. Harris, 1995 John Wiley & Sons Publishers, Inc
2. Biology of Microorganisms – Michael T. Madigan

BBR 504		VIROLOGY				L	T	P	C
		Total Contact Hours – 60				4	0	0	4
		Prerequisite –Microbiology, Cell biology and Basic Biology							
		Course Designed by – Dept of Genetic Engineering							
OBJECTIVES									
To make the students aware of the overall industrial bioprocess so as to help them to manipulate the process to the requirement of the industrial needs									
COURSE OUTCOMES (COs)									
CO1		Understand the bulk production of commercially important products of viral culture.							
CO2		Explain the method of introducing viral genomes into the cells							
CO3		Strategies for microbial metabolites from industries.							
CO4		Understand the pathogenesis of viral infection							
CO5		To know the viral vectors-general features, promoters used in expression vectors							
CO6		To gain knowledge on prevention and treatment of viral infection.							
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: CULTIVATION OF VIRUSES 12

Introduction – Virulence, Cultivation of plant, animal and bacterial virus; one step growth curve; estimation of yields; methods for purification of viruses; quantitative measure of infectious centers: plaque assay; generation of transformed cell foci.

UNIT II: REPLICATION CYCLE 12

Entry of enveloped and non-enveloped animal virus; plant virus and bacteriophage; replication and expression of viral genome- dsDNA, ssDNA, dsRNA, +ssRNA; -ssRNA; **bacteriophages-lytic and lysogenic cycle and its regulation**; late events of viral infection- capsid assemble and virion release; non-specific method of introducing viral genomes into the cells.

UNIT III: PATHOGENESIS OF VIRAL INFECTION 12

Typical modes of virus spread; initial stages of infection; incubation period and spread; multiplication and occurrence of disease; the immune response; virus spread to the next individual; **fate of the host; pathogenesis of hepatitis**, HIV, EBV and influenza virus.

UNIT IV: PREVENTION AND TREATMENT OF VIRAL INFECTION 12

Vaccination strategy; chemotherapy of viral diseases; interferon-its induction and action.

UNIT V - PRIONS AND VIROIDS 12

General properties; hypothesis about prion generation; disease caused by prions and viroids. Viruses-promise and problems: Cloud of horizon-emerging disease; source and caused of emergent virus diseases; **silver linings-virus as therapeutic agent**; viruses for gene delivery.

Total Contact Hours: 60

Text books

1. Culture of Animal Cells: A Manual of Basic Technique. R. Ian Freshney. Latest edition / Pub. Date: September 2005. Wiley.
2. Culture of Cells for Tissue Engineering. R. Ian Freshney. Pub.Date: March 2006. Wiley.
3. Invertebrate Tissue Culture Methods. Jun Mitsuhashi. Latest edition /Pub. Date: February 2002. Publisher: Springer-Verlag New York, LLC.

Reference books

1. Essential Cell Biology. Bruce Alberts, Dennis Bray, Keith Roberts, Julian Lewis, Martin Raff. latest edition/Pub. Date: October 2003. Publisher: Taylor & Francis, Inc.
2. Molecular Cell Biology. Harvey Lodish, James Darnell, Paul Matsudaira, Arnold Berk, S. Lawrence Zipursky. Latest edition/Pub. Date: August 2003. Publisher: W. H. Freeman Company.
3. www.virology.net/Big_Virology/BVHomePage.html

BBR 505	PLANT TISSUE CULTURE			L	T	P	C
	Total Contact Hours - 45			4	0	0	4
	Prerequisite – Recombinant DNA Technology						
	Course Designed by – Dept of Genetics Engineering						
OBJECTIVES							
1. This course deals with engineering gene of interest to produce transgenic animals and plants for human welfare							
2. To make the students to understand the basic concepts and applications of plant tissue culture.							
3. To impart knowledge on production of transgenic plants and exploiting it as bioreactors.							
4. To improve awareness on the applications of transgenic plants							
COURSE OUTCOMES (COs)							
CO1	Acquired the concept and basics of plant tissue culture.						
CO2	Improved the experience in preparation of tissue culture media.						
CO3	To know the working principles of tissue culture techniques.						
CO4	understood the plant transformation methods and its uses						
CO5	Improved idea about the applications in transgenic plants						
CO6	Understood the competency methods.						
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	
2	CO1	M	H				
	CO2		M				
	CO3			M			

	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: BASICS OF PLANT TISSUE CULTURE 9

History of plant tissue culture- totipotency- Organizing a tissue culture lab-sterilization techniques- callus differentiation of cell and organs - clonal propagation- Regeneration and hardening-somatic clonal variation

UNIT II: PREPARATION OF TISSUE CULTURE MEDIA 9

Different media used for plant tissue culture-**Composition of MS media**, Gamborg, White media- Use of hormones-Auxins- Cytokinins.

UNIT III : TISSUE CULTURE TECHNIQUES 9

Callus culture- suspension culture -**micropropagation-somatic embryogenesis**- embryo culture – protoplast fusion- synthetic seeds - anther culture. Applications of tissue culture.

UNIT IV: PLANT TRANSFORMATION 9

Agrobacterium – mechanism of T-DNA transfer -Ti plasmids derived vector system – biolistic gene transfer –reporter genes-**GUS,CRY—marker genes**-selectable and scorable markers- constitutive and tissue specific promoters strategies for developing marker free transgenic plants- chloroplast transformation.

UNIT V: APPLICATIONS OF TRANSGENIC PLANTS 9

Bt transgenics – virus resistant plants (coat protein, antisense RNA) – Glyphosate resistant transgenics – Genetic manipulation of flower pigmentation (Blue Rose) – Vitamin A and iron fortified rice – Plant-made antibodies and edible vaccines.

TEXT BOOKS

1. Molecular Biotechnology by Bernard R. Click and Jack. J. Pasternek

2. Plant Biotechnology by S. Ignacimuthu.
3. Text book of Plant tissue culture – Sathyanarayana

REFERENCE BOOKS

1. Introduction to Plant tissue culture – M.k. Razdan
2. Plant tissue culture – PR white
3. Plant propagation by plant tissue culture – EF George

BBR 5L1	IMMUNOLOGY LABORATORY			L	T	P	C
	Total Contact Hours - 30			0	0	3	2
	Prerequisite – Cell Biology lab						
	Course Designed by – Dept of Genetics Engineering						
OBJECTIVES 1. The students should be able to develop their skills. 2. Provides an opportunity to experimentally verify the theoretical concepts already studied. 3. It also helps in understanding the theoretical principles in a more explicit and concentrated manner. 4. Explore the antigen and antibody reaction methods.							
COURSE OUTCOMES (COs)							
CO1	Understood the blood grouping and types of blood groups.						
CO2	Experienced in leucocytes count and PBMC preparation and their enumeration.						
CO3	Production of polyclonal antibodies using immunization.						
CO4	Antigen and Antibody reaction - types.						
CO5	Blotting Techniques and ELISA types.						
CO6	Antibody production						
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	
2	CO1	M	H				
	CO2		M				

	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Blood grouping
2. Leukocyte count, **RBC count**
3. PBMC preparation and their enumeration
4. **Production of polyclonal antibodies** – preparation of antigen – protocol for immunization in rabbits /mice
5. Antigen-antibody reaction- Haemagglutination, precipitation- Widal and VDRL
6. Immunodiffusion, Immuno electrophoresis.
7. Affinity chromatography for antibody purification.
8. ELISA-DOT and plate ELISA
9. Immuno Blotting techniques
10. Agglutination reactions (a) direct (b) indirect

REFERENCE BOOK

1. Immunology Laboratory methods manual, 2009
2. Cell biology and immunology manual, Dr. Bea Holton

BBR 5L2	PLANT GENETIC ENGINEERING LABORATORY		L	T	P	C
	Total Contact Hours – 30		0	0	3	2
	Prerequisite – Plant Tissue Culture lab					
	Course Designed by – Dept of Genetics Engineering					
OBJECTIVES						
1. Provides an opportunity to understand the basic practices of plant tissue culture.						
2. It also helps in understanding the theoretical principles of producing transgenic plants in a more explicit and concentrated manner.						
3. The students should be able to Understand explicitly the concepts.						
4. To develop their skills in the plant tissue culture techniques						
COURSE OUTCOMES (COs)						
CO1	Acquired the knowledge and experience on preparation of Tissue Culture Media.					
CO2	Understood the callus induction, using rice embryo/endosperm culture and Transformation of Agrobacterium into plant					
CO3	Selection and sub-culture of algal species					
CO4	Bacterial antibiotic sensitivity and replica plate method					
CO5	Transgene Analysis by PCR					
CO6	Identification of Biofertilizer.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Preparation of Tissue Culture Media
2. Callus Induction, using rice embryo/endosperm culture
3. Transformation of Agrobacterium
4. Selection and sub-culture of algal species
5. Bacterial antibiotic sensitivity
6. Isolation of mutant clones by replica plate method – MSGEN208
7. Collection and culture of marine algae
8. Identification of bio-fertilizer
9. GUS assay
10. Transgenic analysis by PCR

REFERENCE BOOK

1. Plant biotechnology Laboratory Manual (Dr. Lingaraj Sahoo).
2. Principles of Plant Genetics and Breeding - George Acquaah, 2007

BBR 601	BIOPHARMACEUTICAL TECHNOLOGY	L	T	P	C
	Total Contact Hours - 60	3	0	0	3
	Prerequisite – Molecular modeling and drug designing				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES					
1. This programme will provide students with a solid foundation in Pharmaceutical Chemistry.					
2. Pharmacology and Pharmacognosy as per the requirement of Pharmaceutical Industries, and also to pursue higher studies.					
3.This programme will facilitate the students to acquire knowledge in fields such as genetic engineering.					

4. It will also empower the students to have advanced focus on the molecular pathogenesis of infectious diseases and necessary pharmacological approach.						
COURSE OUTCOMES (COs)						
CO1	Graduates of the program will be having fundamental knowledge in biosciences					
CO2	chemical engineering and strong background in pharmaceutical technology					
CO3	And be able to use these tools in industry and/or institutes where ever necessary.					
CO4	It will also help the students to know about the pharmacokinetics of drug, its metabolism					
CO5	Its immune pharmacological response through in depth understanding about the Human physiology.					
CO6	Biopharamaceutical background					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION 12

Pharmaceutical industry & development of drugs; types of therapeutic agents and their uses; economics and regulatory aspects. Various steps in new drug developments, **CADD**

UNIT II: DRUG ACTION, METABOLISM AND PHARMACOKINETICS 12

Mechanism of drug action; **physico-chemical properties** principles of drug metabolism; radioactivity; Pharmacology, Pharmacogenomics and Pharmacokinetics.

UNIT III: MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS 12

Types of reaction process and special requirements for bulk drug manufacture. Toxicology. Fermentation technology. **Bioprocess technologies**.

UNIT IV: PRINCIPLES OF DRUG MANUFACTURE 12

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oral liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; **GMP**.

UNIT V: BIOPHARMACEUTICALS 12

Various categories of therapeutics like Vaccines, life saving drugs, antibodies, vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

Total Contact Hours: 60

TEXT BOOKS

1. Gareth Thomas, Medicinal Chemistry. An introduction by John Wiley. 2000.
2. Katzung B.G., Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

REFERENCE BOOKS

1. Niazi, Sarfaraz K. "Handbook of Bio-generic Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues". CRC Press, 2006.
2. Ho, Reedney J. Y., Milogibaldi. "Biotechnology & Biopharmaceuticals Transforming Proteins and Genes into Drugs". Wiley Liss, 2003.
3. <http://www.btc.org/aket.bt>

BBR 602	GENES AND DISEASES					L	T	P	C
	Total Contact Hours - 60					4	0	0	4
	Prerequisite – Gene therapy, Bio-Pharmaceutical technology								
	Course Designed by – Dept of Genetics Engineering								
OBJECTIVES									
To understand the genes that control or influence the heritable human diseases									
1. To understand the pattern of inheritance of heritable diseases									
2. To learn about the genetics of most prevalent cancers in India									
3. To learn about the genetics of metabolic disorders and disease of nervous system									
4. To learn about the genetics of ear, eye and blood disorders									
COURSE OUTCOMES (COs)									
CO1	Mechanism of Genetic Diseases.								
CO2	Genetics of metabolic disorders								
CO3	Genetics of the diseases of nervous system								
CO4	Genetics of ear, eye and blood disorders								
CO5	Congenital disorders and Neonatal diseases								
CO6	Treatment of genetic disorders.								
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO DEFECTIVE GENES

12

Introduction to the diseases due to **genetic defeat**. Genomics and Health. Mechanism of Genetic Diseases, Types of Mutations. Dominance, recessive, co-dominance, autosomal and sex linked inheritance of diseases. Chromosomal maps.

UNIT II: GENETIC DISORDERS

12

Single Gene disorders, X-linked recessive, Y-linked and Mitochondrial disorders. Multifactorial and polygenic (complex) disorders. FIND base (the Frequency of Inherited Disorders database). Genetic epidemiology. Inborn errors of metabolism. **Hereditary disorders**. Medical genetics. Population groups in biomedicine. Mendelian error.

UNIT III: GENETIC TESTING

12

Genetic Testing, Genetic diseases prevention, Genetic counselling. Pharmacogenomics. Public Health Genomics at CDC. OMIM — Online Mendelian Inheritance in Man, a catalog of human genes and genetic disorders. Genetic and Rare Diseases Information Center (GARD) Office of Rare Diseases (ORD), National Institutes of Health (NIH). CDC's National Center on Birth Defects and Developmental Disabilities. **Genetic Disease Information from the Human Genome Project**. Global Genes Project, Genetic and Rare Diseases Organization

UNIT IV: GENETIC DISEASES

12

Genetic diseases of Blood and lymph diseases, cancers, diseases of the digestive system. Diseases of ear, nose and throat, Diseases of the eye, female-specific diseases, diseases of glands and hormones. Diseases of heart and blood vessels, diseases of the immune system, male specific diseases, disease of muscle and bone

UNIT V: GENETIC DISORDERS**12**

Congenital disorders and Neonatal diseases, Diseases of the nervous system, nutritional and metabolic diseases. Respiratory diseases, diseases of skin and connective tissue, Chromosome map. **Prognosis and treatment of genetic disorders**

TEXT BOOKS

1. Genes and Diseases, NCBI Bookshelf, free e-book.
2. The principles of gene manipulation (Primrose – sixth edition).

REFERENCE BOOKS

1. Genes, Benjamin and Lewin, 8th edition. Pearson Prentice Hall, 2004
2. Rodney J Y Ho, MILO Gibaldi, Biotechnology & Biopharmaceuticals Transforming proteins and genes into drugs, 1st Edition, Wiley Liss, 2003.
3. Human Genetics and Genomics, Third Edition - Bruce R. Korf
4. Human Genetics: Principles and Approaches - Friedrich Vogel and Arno G. Motulsky
5. <http://www.ncbi.nlm.nih.gov/books/bookres.fcgi/gnd/tocstatic.html>

BSS 601	VALUE EDUCATION AND PROFESSIONAL ETHICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	prerequisite – social values (individual and social welfare)				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES - To teach the philosophy of Life, personal value, social value, mind cultural value and personal health - To teach professional ethical values, codes of ethics, - To take responsibilities, safety, rights and related global issues.					
COURSE OUTCOMES (COs)					
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) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low						
1	COs/Pos	a	b	c	d	e
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

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, Thriftness (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, Channelising 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: EXPERIMENTATION AND ENGINEERS RESPONSIBILITIES 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: 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

Total Contact Hours: 45

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, New york 2005 (Units IV & V)

REFERENCE BOOKS:

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 (for Units I - III)
3. R S Nagarajan, 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
5. www.ncert.nic.in/new.../value_education/value_edu.../value_edu2005.pdf
<https://books.google.co.in/books?isbn=9048186757>

BBR 6L1	GENE CLONING LABORATORY			L	T	P	C
	Total Contact Hours - 30			0	0	3	2
	Prerequisite – Molecular Biology laboratory						
	Course Designed by – Dept of Genetics Engineering						
OBJECTIVES 1.The practical deals with creating recombinant DNA molecules 2.To give hands-on training in creating recombinant DNA molecules 3. Molecular analysis indirectly by restriction digestion and PCR as well as directly by DNA sequencing. 4. To give hands-on training Ligation and transformation							
COURSE OUTCOMES (COs)							
CO1	The studentcan able to isolate total DNA, Plant DNA and plasmid DNA.						
CO2	The studentcan able to do molecular digestion and gel elution of vector and inserts and Ligation and transformation.						
CO3	The studentcan able to do plasmid isolation from PCR positive colonies						
CO4	The studentcan able to do Confirmation of cloning by restriction digestion						
CO5	The studentcan able to do Ligation and transformation						
CO6	Sequencing product						
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	
2	CO1	M	H				
	CO2		M				
	CO3			M			
	CO4		M				
	CO5		H	M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Isolation of total DNA.
2. Isolation of plasmid DNA.
3. Microbial cultures and characterization of DNA
4. Digestion and gel elution of vector and inserts
5. Ligation and transformation
6. Verification of cloning by colony PCR and patching the positive colonies
7. Plasmid isolation from PCR positive colonies
8. Confirmation of cloning by restriction digestion
9. Set up DNA sequencing reaction
10. Cleaning the sequencing reaction product

REFERENCE BOOK

1. Molecular Cloning - A Laboratory Manual. 4th ed, 2012 - Cold Spring Harbor Laboratory Press.
2. Molecular Biology I Biochemistry Level II: Practical Manual. Dr Peter Kille.
3. Molecular cloning – A laboratory manual. Joseph sambrook and David w. Russell
4. <http://www.mclab.com/>

BBR 6L2	BIOINFORMATICS LABORATORY				L	T	P	C
	Total Contact Hours - 30				0	0	3	2
	Prerequisite – Molecular modeling laboratory							
	Course Designed by – Dept of Genetics Engineering							
OBJECTIVES 1.To know about databases and their use 2. To understand sequence alignment and programming 3. To analyze the protein sequence using bioinformatics tools 4. To understand the use of PERL, Python in programming and executing research								
COURSE OUTCOMES (COs)								
CO1	The student can able to perform Sequence retrieval from biological database							
CO2	The student can able to perform Identification of protein sequence							
CO3	The student can able to perform Sequence similarity searching of protein sequences							
CO4	The student can able to perform dynamic programming method- global and local alignment							
CO5	The student can able to perform Phylogenetic analysis with Clustal W and Blast software							
CO6	Phylogenetic analysis.							
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Knowledge of different biological database
2. Sequence retrieval from biological database
3. Identification of protein sequence
4. Sequence similarity searching of protein sequences
5. Variants of Blast and **FASTA**
6. Multiple sequence alignment
7. Dynamic programming method- local alignment
8. Dynamic programming method- global alignment
9. **Pattern finding in proteins**
10. Phylogenetic analysis with Clustal W and Blast software

REFERENCE BOOK

1. "Introduction to Bioinformatics", T.K. Attwood & D.J.Parry-Smith, Prentice Hall 2000.
2. "Instant notes on Bioinformatics", D.R. West head. J.H.Parish R.M. Twyman, Liva Books, New Delhi, 2003
3. "Bioinformatics Sequence and Genome analysis", David W. Mount 2003.
4. "Bioinformatics Basics 'Applications in Biological science and Medicine" Hooman H. Rashidi & Lukas K. Buehie 2001.
5. <https://www.amc.nl>

BBR 701		BIOSAFETY, BIOETHICS, IPR & PATENTS			L	T	P	C
		Total Contact Hours – 60			4	0	0	4
		Prerequisite – Intellectual property rights						
		Course Designed by – Dept of Genetic Engineering						
OBJECTIVES: To enable understanding chemical principles governing biochemical reactions								
COURSE OUTCOMES (COs)								
CO1		Understand Handling of recombinant DNA process and products.						
CO2		Biosafety assessment of biotech pharamaceutical products.						
CO3		Understand the moral status of animal						
CO4		Understand the intellectual property rights.						
CO5		understand the patent registration						
CO6		Advanced updated of IPR						
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)		
			√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016						

UNIT I: INTRODUCTION TO BIOSAFETY 12

Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, Handling of recombinant DNA processes and products in institutions and industries, biosafety assessment procedures in India and abroad.

UNIT II: BIOETHICS 12

Legality, morality and ethics, the principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. **Transgenic products** and Bioethics: Ecological safety assessment of recombinant organisms and transgenic crops, case studies of relevance (Eg. Bt cotton). Biosafety assessment of biotech pharmaceutical products such as drugs / vaccines etc.

UNIT III: ANIMAL BIOTECHNOLOGY 12

Chronology of Biotechnological studies on animals – Law & legislation on animal experimentation in India and world Moral status of animals as objects of experiments –Moral responsibility of scientists over animal experiments. Personhood – Abortion – Bioethical issues in reproduction, **population explosion and control** – Voluntary euthanasia & physician assisted suicide – Organ donation & Transplantation.

UNIT IV: INTELLECTUAL PROPERTY RIGHTS 12

Sovereignty rights, CBD, bioethics and patenting General agreement on trade and tariffs Indian sui-generis system for animal variety and farmer's rights protection act. WTO with reference to biotechnological affairs, TRIPs.

UNIT V: PATENT SYSTEMS 12

General Introduction: Patent claims, the legal decision, Basic Requirements of Patentability: Patentable subject matter, novelty and the public domain, non obviousness Special issues in Biotechnology Patents: Disclosure requirements, Collaborative research, Competitive research, **Recent Developments in Patent protocols** Patentability of biotechnological inventions.

Total Periods : 60

TEXT BOOKS

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra, Information Solution Pvt. Ltd., 2007
3. S.S. Kanka Entrepreneurship Development, S. Chand and Co, New Delhi 1997

REFERENCE BOOKS

1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. New Delhi.
2. Sasson A, Biotechnologies and Development, UNESCO Publications.

3. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi
4. Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, New Delhi
5. www.nordicipr.com
6. www.ip-links.de

BBR 702	ANIMAL CELL CULTURE AND TRANSGENIC TECHNOLOGY				L	T	P	C
	Total Contact Hours – 60				4	0	0	4
	Prerequisite – Transgenic technology, animal science, techniques							
	Course Designed by – Dept of Genetic Engineering							
OBJECTIVES: To enable understanding chemical principles governing biochemical reactions								
COURSE OUTCOMES (COs)								
CO1	Understand Importance of aseptic techniques							
CO2	Preservation And Characterization Of Cell Lines.							
CO3	Understand the Cell quantification							
CO4	Understand the Methodology of production of transgenic animals.							
CO5	understand the the production of recombinant proteins							
CO6	Principles and advanced methods of animal cell culture techniques							
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: BIOLOGY OF CULTURED ANIMAL CELLS 12

Animal Cell Culture-Introduction-the use, advantages & disadvantages-Cell types & its characters, differentiation- Growth of cells in culture-Importance of aseptic techniques. Culture media & culture conditions-Maintenance and storage of cell cultures- Biosafety and biohazards.

UNIT II: PRESERVATION AND CHARACTERIZATION OF CELL LINES 12

Primary culture, subculture, and cell lines-Cloning and selection-Cell separation and characterization- **Differentiation -Transformation and Immortalization**-Contamination- Cryopreservation techniques.

UNIT III: SCALING UP OF ANIMAL CELL CULTURE 12

Cell quantification methods-Cell viability measurements-Growth kinetics-Scale up of suspension & monolayer cultures-Air lift bioreactors.

UNIT IV: PRODUCTION OF TRANSGENIC ANIMALS 12

Transgenic animals Methodology of production of transgenic animals – Retroviral vector method – DNA micro injection – Engineered embryonic stem cell method, Oocyte culture and Transgenic animals- Dolly – **Transgenic Cattle, Sheep** – Transgenic Goat and Pigs – Transgenic Birds.

UNIT V : APPLICATIONS OF ANIMAL CELL CULTURE 12

Animals cells as bioreactors – therapeutic proteins – Enzymes – Vaccines– applications of transgenic animals for the production of recombinant proteins, better nutrition, bioindicator-ornamental transgenic fish.

Total Periods: 60

TEXT BOOKS

1. Culture of Animal cells by R.I. Freshney, Fifth edition
2. Culturing of Animal cells. Biotol publications

3. Molecular Biotechnology by Bernard R. Click and Jack. J. Pasternek

REFERENCE BOOKS

1. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 1998
2. Freshney R.I. Animal Cell Culture- a practical approach, 1987
3. Bernhard Palsson and Sangeetha N Bhatia, Tissue Engineering, 2nd Edition, Prentice Hall, 2004.
4. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine, 1st Edition, Springer, 2008.
5. biology.tutorvista.com/organism/animal-tissue.html
6. www.ivyroses.com/HumanBody/Tissue/Tissue_4-Tissue-Types.php

BBR 703		GENE THERAPY				L	T	P	C
		Total Contact Hours - 60				3	0	0	3
		Prerequisite – Genes and diseases, Molecular evolution and Phylogeny							
		Course Designed by – Dept of Genetics Engineering							
COURSE OUTCOMES (COs)									
CO1		Principles Of Gene Therapy							
CO2		Somatic And Germline Gene Therapy							
CO3		Viral And Non Viral Vectors For Gene Therapy							
CO4		Classical Gene Therapy							
CO5		Applications Of Gene Therapy							
CO6		cardiovascular gene therapy							
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: PRINCIPLES OF GENE THERAPY

12

Gene therapy – concepts- Principles of Gene therapy- Basics and Advanced techniques in Gene therapy- vector for gene therapy- ex vivo and in vivo gene therapy somatic gene therapy – germ line gene therapy.

UNIT II: SOMATIC AND GERMLINE GENE THERAPY

12

Prenatal somatic gene therapy- embryo somatic gene therapy-fetal somatic gene therapy- **postnatal somatic gene therapy**- germ line gene therapy.

UNIT III: VIRAL AND NON VIRAL VECTORS FOR GENE THERAPY

12

Gene transfer agents – Viral- Retro, adeno associated and herpes virus-non-viral agents- modes of gene delivery

UNIT IV: CLASSICAL GENE THERAPY

12

Increasing gene dose in deficient cell- on suppressor genes – Disease with recessive heredity- direct killing by suicide gene therapy- indirect killing – **secretion gene therapy**

UNIT V: APPLICATIONS OF GENE THERAPY

12

Gene repair- stem cells and **Recent gene therapy methods and application** – treatment of genetic diseases – cancer-bone regeneration – cardiovascular gene therapy – neurological diseases

Total Contact Hours: 60

TEXT BOOK

1. Gene therapy by Keith Green berg
2. Stem cells biology and gene therapy by Peter J. Quesen Horry
3. Medical Genetics 3rd Edition- Jorde, Carey, Bamshad& White.

REFERENCE BOOKS

1. Pamela Greenwell, Michelle McCulley, Molecular Therapeutics: 21st century medicine. 1st Edition, Springer, 2008.
2. Winnacker E.L. From Genes to clones: Introduction to Gene Technology, Panima, 2003.
3. Lemonie, N.R. and Cooper, D.N. Gene therapy, BIOS Scientific, 1996
4. <https://ghr.nlm.nih.gov/>

BBR 704		STEM CELL BIOLOGY			L	T	P	C
		Total Contact Hours – 45			3	0	0	3
		Prerequisite – Stem Cell In Drug Discovery, tissue engineering						
		Course Designed by – Dept of Genetic Engineering						
OBJECTIVES:								
To enable understanding chemical principles governing biochemical reactions								
COURSE OUTCOMES (COs)								
CO1		Understand Unique properties of stem cells.						
CO2		Invitrofertilization						
CO3		Understand the Somatic stem cells						
CO4		Understand the Target identification differentiation pathways.						
CO5		understand the production of complete organ						
CO6		Characteristics of application in stem cell therapy						
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: STEM CELL BASICS

9

Stem cell formation, Unique properties of stem cells – embryonic stem cells - adult stem cells – umbilical cord stem cells – similarities and differences between embryonic and adult stem cells. Properties of stem cells – pluripotency – totipotency – multipotency.

UNIT II: EMBRYONIC STEMCELLS

9

Invitro fertilization – human embryonic stem cells – blastocyst – innercell mass – growing ES cells in lab – laboratory tests to identify ES cells – stimulation ES cells for differentiation – properties of ES cells – human ES cells – Monkey and Mouse ES cells.

UNIT III: ADULT STEM CELLS

9

Somatic stem cells – test for identification of adult stem cells – adult stem cell differentiation – trans differentiation – plasticity – different types of adult stem cells.

UNIT IV: STEM CELL IN DRUG DISCOVERY AND TISSUE ENGINEERING

9

Target identification – Manipulating differentiation pathways – stem cell therapy Vs cell protection - stem cell in cellular assays for screening – **stem cell based drug discovery platforms, drug screening and toxicology.**

UNIT V: GENETIC ENGINEERING AND THERAPEUTIC APPLICATION OF STEM CELLS

9

Gene therapy – genetically engineered stem cells – stem cells and Animal cloning – transgenic animals and stem cells –Cancer Biomarkers– Therapeutic applications – Parkinson disease - Neurological disorder – limb amputation – heart disease - spinal cord injuries – diabetes –burns Matching the stem cell with trans plant recipient - HLA typing Alzheimers disease – spinal cord injuries tissue engineering application – production of complete organ - kidney – eyes - heart – brain.

Total Contact Hours: 45

TEXT BOOKS

1. Stem cells Hand Book by Stewart Sell
2. Stem cell Research by Nancy E. Snow

REFERENCE BOOKS

1. Human Embryonic Stem cells by Ann.A. Kiessling
2. Stem cell and future of regenerative medicine. National Academic press
3. Stem cell and Cloning by David A. Prentice and Michael A. Palladin.
4. www.nature.com/stemcells/links.html
5. www.ukaachen.de/.../division-of-stem-cell-biology-and-cellular-engineer

BBR 7L1		GENOME ANALYSIS LABORATORY				L	T	P	C
		Total Contact Hours – 30				0	0	3	2
		Prerequisite – BLAST, Database, Protein targeting signal sequence							
		Course Designed by – Dept of Genetic Engineering							
OBJECTIVES:									
To enable understanding chemical principles governing biochemical reactions									
COURSE OUTCOMES (COs)									
CO1		Knowledge on variants of BLAST							
CO2		Gene prediction							
CO3		Translation the sequences and ORF finding							
CO4		Splice site junction prediction							
CO5		Protein targeting signal sequence prediction							
CO6		Pattern searching							
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

LIST OF EXPERIMENTS

1. Sequence retrieval from biological database
2. Knowledge on variants of BLAST and applications
3. Gene prediction
4. Translation the sequences and ORF finding
5. Splice site junction prediction
6. Protein targeting signal sequence prediction
7. Pattern searching
8. Comparative genome analysis
9. Phylogeny analysis
10. FASTA ,BLAST Variance analysis

REFERENCE BOOK

1. Basics of Molecular Cloning – promega
2. Sequence and Genome anlysis David W. Mount, 2004. Cold spring harbor laboratory press New york.
3. Molecular cloning – A laboratory manual. Joseph sambrook and David w. Russell
4. www.plantgenome.uga.edu/links.htm

BBR 7L2		ANIMAL CELL CULTURE LABORATORY				L	T	P	C
		Total Contact Hours – 30				0	0	3	2
		Prerequisite – animal Cell Culture, anti cancer agent in cell culture							
		Course Designed by – Dept of Genetic Engineering							
OBJECTIVES:									
To enable understanding chemical principles governing biochemical reactions.									
COURSE OUTCOMES (COs)									
CO1		Preparation of culture media							
CO2		Sterilization techniques of cell and tissue culture labwares/Glasswares							
CO3		Adaptation of Animal virus in cell lines.							
CO4		Study of effect of anti cancer agent in cell culture.							
CO5		Preparation of culture media							
CO6		Sterilization techniques of cell and tissue culture labwares/Glasswares							
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
			√						
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

LIST OF EXPERIMENTS

1. Preparation of culture media and maintenance
2. Sterilization techniques of cell and tissue culture labwares/Glasswares
3. Adaptation of Animal virus in cell lines.
4. Study of effect of anti cancer agent in cell culture.
5. Organ Culture
5. MTT Assay
6. Live cell counting
7. Leukocyte culture
8. Culturing of spleen cells
9. PBMC or Myeloma cell culture
10. Fusion of cells by PEG

REFERENCE BOOK

1. Basics of Cell Culture - A student laboratory manual By Golnar Afshar PhD Laboratory Manual
2. Introduction to animal Cell Culture, John A Ryan
www.anl.gov/safety/biosafety/biosafety-links
www.bio-link.org/home/sites/files/instructor_manualv8.pdf

ELECTIVES

BBR 001	HUMAN GENETICS		L	T	P	C
	Total Contact Hours - 45		3	0	0	3
	Prerequisite – Principles of Genetics, Microbiology					
	Course Designed by – Department of Genetic Engineering					
OBJECTIVES						
1. To understand fundamental laws of genetics.						
2. To know techniques in <i>in situ</i> genetic analysis for mutation and aberration studies.						
3. To identify and relate phenotype to changes in chromosome structure and number.						
COURSE OUTCOMES (COs)						
CO1	This course introduces the principles of genetics.					
CO2	It discusses the basics laws of inheritance.					
CO3	It gives chromosome structure and cytological techniques.					
CO4	Properties of chromosome variation, linkage mapping and population genetics.					

CO5	To understand the linkage analysis and recombination mapping.					
CO6	To study population genetics and analyze quantitative characters.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: GENOME ORGANIZATION AND INHERITANCE

9

Organization of genome, Human multigene families and repetitive coding DNA, Extragenic repeated DNA sequences and transposable elements, Inheritance-Autosomal Dominant Inheritance-Autosomal Recessive Inheritance- Factors that May Complicate Inheritance Patterns- **Consanguinity in Human Populations**, Sex-Linked and Mitochondrial Inheritance, X inactivation- Sex-Linked Inheritance- Sex-Limited and Sex-Influenced Traits- Mitochondrial Inheritance.

UNIT II: GENOME MAPPING AND DEVELOPMENTAL GENETICS

9

Physical Mapping - Low resolution physical mapping, High resolution physical mapping, Genetic mapping- Two-point mapping, Multipoint mapping, parametric linkage analysis, Nonparametric linkage analysis, Development genetics- Genetic Mediators of Development, the Molecular Toolbox- Pattern Formation.

UNIT III: MEDICAL GENETICS**9**

The Chromosomal Basis of Human Disease- Nomenclature-Abnormalities of Chromosome Number- Abnormalities of Chromosome Structure- Pregnancy Loss- Cancer genetics- Cancer Genes- Oncogenes, Activation of proto-oncogenes, Tumor suppressor genes, Molecular Basis of Cancer, Control of the cell cycle, Defects of Metabolic Processes- Pharmacogenetics.

UNIT IV: IDENTIFICATION OF DISEASE GENES**9**

Identifying human disease genes - Principles and strategies in identifying disease genes, Position-independent strategies for identifying disease genes, positional cloning, Positional candidate strategies to identify candidate genes by a combination of their map position and expression, function or homology, confirming a candidate gene

UNIT V: THE GENETICS OF COMMON DISEASES**9**

Genetic Screening, Genetic Diagnosis, and Gene Therapy, Population Screening for Genetic Diseases, **Molecular Tools for Screening and Diagnosis**, Prenatal Diagnosis of Genetic Disorders and Congenital Defects, Fetal Treatment, Pedigree analysis and Genetic Counseling.

Total Contact Hours: 45

TEXT BOOKS

1. Human Molecular Genetics – Tom Strachan and Andrew P. Read
2. Medical Genetics 3rd Edition- Jorde, Carey, Bamshad& White.

REFERENCE BOOKS

1. Human Genetics and Genomics, Third Edition - Bruce R. Korf
2. Human Genetics: Principles and Approaches - Friedrich Vogel and Arno G. Motulsky
3. Watson, J.D., Gilman, M., Witowski J.and Zoller, M. Recombinant DNA, 2nd ed., Scientific American Books, 1983
4. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1684911/>

BBR 002	ANIMAL TISSUE ENGINEERING	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite –Microbiology, Animal biotechnology, Tissue Engineering, Cell biology and Basic Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
To make understand of the animal tissue culture engineering so as to help them to manipulate the cell to the requirement of the grafting needs					
COURSE OUTCOMES (COs)					
CO1	Understand the bulk development of serum free media.				

CO2	Explain the method of Organ cultures and types of organ cultures					
CO3	Strategies for gene transfer techniques in mammalian cells.					
CO4	Understand the commercial production of monoclonal antibodies and their use for mankind					
CO5	To know the viral vectors-general features, promoters used in expression vectors					
CO6	To gain knowledge on Medical devices used for animal tissues cultures..					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Unit I: INTRODUCTION TO SEROLOGY

9

Biology of cells in culture, Origin and characterization of different cell types, Characteristics of cultured cells, Subculture, selection of medium, Chemically defined and serum free media, Development of serum free media Advantages and disadvantages of serum free media

Unit II: STERILIZATION AND DISINFECTION

9

Aseptic techniques, **Media preparation and preservation** Cell counting methods, Growth of adherent and suspension cultures, survival curves of primary cell culture, Sub culturing techniques, Measurement of growth parameters of cultured cells, Maintenance and **cryopreservation of cell lines**, Mycoplasma and virus testing, Cell transfection, Characterization of cells and cell products, types of substrates for cell growth Scale-up of adherent and

suspension cultures. Identification of specific cell lines, Organ cultures and types of organ cultures.

Unit III: ANIMAL CELL CULTURE 9

Animal handling techniques and care, Preparation of established cell lines, Mass cell cultivation, Mouse embryo fibroblast culture, staining techniques for animal cells, preparation of mice splenocytes, culture of virus in chick embryo, adaptation of virus in animal (in vitro) cell culture.

Unit IV: HYBRIDOMA TECHNOLOGY 9

Hybridomas and cell transformation: The basis of hybridoma technology, Storage of hybridoma cells, **Monoclonal antibodies and their commercial production**, Commercial production of monoclonal antibodies and their use for mankind.

Unit V: MAMMALIAN CELL CULTURE 9

Genetic engineering of mammalian cells: Gene transfer techniques in mammalian cells, Sexing of embryos, Somatic cell nuclear transfer and transgenic animals, Basic characteristics of cancer cell growth in culture and senescence. Cell banks, Medical devices used for animal tissues cultures.

Total Contact Hours: 45

Text Books:

1. Campbell, N. A. and Jane B. Reece. Biology. 6th Edition. USA. Pearson Education, Inc. 2002. 198 199 199 Freshney, R.I. Culture of Animal Cells: A Manual of basic techniques. 5th Edition. USA. Wiley-Liss Inc. 2005.
2. Gamborg, O. L. and G. C. Phillips. Plant cell, tissue, and organ culture: fundamental methods. Germany. Springer-Verlag. 1995.

Reference Books:

1. Masters J. R. W. (2000): Animal cell culture 3. iz. Oxford University Press, Oxford Butler M (2004): Animal cell culture & technology, 2. iz. Bios Scientific Publishers, London i New York
2. Freshney R. I. (2000): Culture of animal cells: A manual of basic technique. 4. iz. Willey-Lys, J.Willey & Sons. New York
3. Culture of Animal Cells: A Manual of Basic Technique (5th Edition) R. Ian Freshney. Wiley-Liss. It is in your best interest to bring this book to class.
4. www.zora.uzh.ch

BBR 003		CLASSICAL AND MOLECULAR PLANT BREEDING				L	T	P	C
		Total Contact Hours – 60				3	0	0	3
		Prerequisite – Molecular biology, plant biotechnology							
		Course Designed by – Dept of Genetic Engineering							
COURSE OUTCOMES (COs)									
CO1		To understand the molecular biology							
CO2		To know the methods of plant breeding.							
CO3		To understand the Breeding methods in cross pollinated crops							
CO4		To know Concept of plant ideo type and its role in crop improvement							
CO5		To understand how to Maintain of experimental records							
CO6		Learning techniques in hybrid seed production using male-sterility in field crops.							
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			
2	CO1	M	H						
	CO2		M						
	CO3			M					
	CO4		M						
	CO5		H	M					
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)			
				√					
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016							

UNIT I : INTRODUCTION TO PLANT BREEDING 12

History of Plant Breeding (Pre and post-Mendelian era); Objectives of plant breeding, Characteristics improved by plant breeding; Patterns of Evolution in Crop Plants- Centers of Origin-biodiversity and its significance. Genetic basis of breeding self- and cross - pollinated crops including mating systems and response to selection - nature of variability, components of variation; Heritability and genetic advance, genotype environment interaction; General and specific combining ability; Types of gene actions and implications in plant breeding; Plant introduction and role of plant genetic resources in plant breeding.

UNIT II: PEDIGREE ANALYSIS 12

Self-incompatibility and male sterility in crop plants and their commercial exploitation. Pure line theory, pure line selection and mass selection methods; Line breeding, pedigree, bulk, backcross, single seed descent and multi-line method; Population breeding in self pollinated crops (diallel selective mating approach).

UNIT III: BREEDING METHODS 12

Breeding methods in cross pollinated crops; Population breeding-mass selection and earrow methods; S1 and S2 progeny testing, progeny selection schemes, recurrent selection schemes for intra and inter-population improvement and development of synthetics and composites; Hybrid breeding - genetical and physiological basis of heterosis and inbreeding, production of inbreds, breeding approaches for improvement of inbreds, predicting hybrid performance; seed production of hybrid and their parent varieties/inbreds. Breeding methods in asexually/clonally propagated crops, clonal selection apomixes, clonal selection.

UNIT IV: CROP IMPROVEMENT 12

Concept of plant ideotype and its role in crop improvement; Transgressive breeding. Special breeding techniques- Mutation breeding; Breeding for abiotic and biotic stresses. 8 Cultivar development- testing, release and notification, maintenance breeding, Participatory Plant Breeding, Plant breeders' rights and regulations for plant variety protection and farmers rights.

UNIT V: ADVANCE BREEDING ANALYSIS 12

Practical Floral biology in self and cross pollinated species, selfing and crossing techniques. Selection methods in segregating populations and evaluation of breeding material; Analysis of variance (ANOVA); Estimation of heritability and genetic advance; Maintenance of experimental records; Learning techniques in hybrid seed production using male-sterility in field crops.

Total Contact Hours: 45

Text Books:

1. Allard RW. 1981. Principles of Plant Breeding. John Wiley & Sons.
2. Chopra VL. 2001. Breeding Field Crops. Oxford & IBH.
3. Chopra VL. 2004. Plant Breeding. Oxford & IBH.
4. Gupta SK. 2005. Practical Plant Breeding. Agribios.

5. Pohlman JM & Bothakur DN. 1972. Breeding Asian Field Crops. Oxford & IBH. • Roy D. 2003. Plant Breeding, Analysis and Exploitation of Variation. Narosa Publ House.

Reference Books:

1. Sharma JR. 2001. Principles and Practice of Plant Breeding. Tata McGraw-Hill.
2. Simmonds NW. 1990. Principles of Crop Improvement. English Language Book Society
3. Singh BD. 2006. Plant Breeding. Kalyani. • Singh P. 2002. Objective Genetics and Plant Breeding. Kalyani.
4. Singh P. 2006. Essentials of Plant Breeding. Kalyani.
5. Singh S & Pawar IS. 2006. Genetic Bases and Methods of Plant Breeding CBS.
6. <http://sharebooks.com/system/files/Crop-Histories.pdf>

BBR 004		CANCER BIOLOGY			L	T	P	C
		Total Contact Hours - 45			3	0	0	3
		Prerequisite – System Biology, Genomics and proteomics						
		Course Designed by – Department of Genetic Engineering						
OBJECTIVES								
1 To provide knowledge about biological aspects of cancer.								
2. To impart basic concepts of cancer biology.								
3. Various stages in carcinogenesis, molecular cell biology of cancer.								
COURSE OUTCOMES (COs)								
CO1		Fundamentals Of Cancer Biology						
CO2		Principles Of Carcinogenesis						
CO3		Principles Of Molecular Cell Biology Of Cancer						
CO4		Principles Of Cancer Metastasis						
CO5		New Molecules For Cancer Therapy						
CO6		Cancer metastasis and cancer therapy.						
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				

	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper/ Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: FUNDAMENTALS OF CANCER BIOLOGY 9

Cell cycle, Regulation of cell cycle, mutations that cause changes in signal molecules, effects on receptor, signal switches, tumor suppressor genes, modulation of cell cycle in cancer, different forms of cancers, diet and cancer. Cancer screening and early detection, Detection using biochemical assays, tumor markers, molecular tools for early diagnosis of cancer. Cancer Epidemiology

UNIT II: PRINCIPLES OF CARCINOGENESIS 9

Theory of carcinogenesis, Chemical carcinogenesis, metabolism of carcinogenesis, principles of physical carcinogenesis, x-ray radiation-mechanisms of radiation carcinogenesis.

UNIT III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER 9

Signal targets and cancer, activation of kinases; Oncogenes, identification of oncogenes, retroviruses and oncogenes, detection of oncogenes, Oncogenes/ proto oncogene activity, Growth factors related to transformation, Telomerases.

UNIT IV: PRINCIPLES OF CANCER METASTASIS 9

Clinical significances of invasion, Heterogenicity of metastatic phenotype, metastatic cascade, basement **membrane disruption**, three step theory of invasion, Proteinases and tumor cell invasion.

UNIT V: NEW MOLECULES FOR CANCER THERAPY 9

Different forms of therapy, chemotherapy, radiation therapy, detection of cancers, prediction of aggressiveness of cancer, advances in cancer detection. Use of signal targets towards therapy of cancer; Gene therapy. **Modern treatments**

Total Contact Hours: 45

TEXT BOOKS

1. Maly B.W.J, "Virology. A Practical Approach", IRL Press, Oxford, 1987.
2. Dunmock N. J and Primrose S.B., "Introduction to Modern Virology", Blackwell Scientific Publications, Oxford, 1988.

REFERENCE BOOKS

1. An Introduction Top Cellular and Molecular Biology of Cancer, Oxford Medical Publications, 1991.
2. Molecular Cell Biology, Sixth Edition by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew.
3. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology Michael Wink (Editor) 2006, John Wiley & Sons Publishers, Inc
4. https://biology.mit.edu/research/cancer_biology

BBR 005	AGRI,VETERINARY AND MEDICAL INFORMATICS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biopharmaceutical technology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
1. To introduce the basic principles of computerized patent record					
2. To understand the recent trends in medical informatics					
COURSE OUTCOMES (COs)					
CO1	To learn about HIS				
CO2	It also gives knowledge on veterinary informatics				
CO3	To understand the clinical information system				
CO4	It deals with CPR in radiology				
CO5	It imparts health care information				
CO6	Ability to do docking methods				

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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: AGRICULTURAL INFORMATICS

9

Introduction – plant genome, and Analysis of plant genome sequence, analysis of metabolites in plants, targeting study of compound against plant pathogens using bioinformatics tools.

UNIT II: VETERINARY INFORMATICS

9

Introduction - history of pathogens, interaction between pathogens and host cell molecules using bioinformatics tools. Genome analysis for identification of diseases. Study of molecules and functional domain structure using bioinformatics tools

UNIT III: MEDICAL INFORMATICS

9

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics – Medical Informatics, Bioinformatics

UNIT IV: COMPUTERISED PATIENT RECORD

9

Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT V: RECENT TRENDS IN MEDICAL INFORMATICS**9**

Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health - Medical education and health care information.

Total No. of Contact Hours: 45**TEXT BOOKS:**

- 1.R.D. Lele Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd,2005, New Delhi
- 2.Mohan Bansal, Medical informatics Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi

REFERENCE BOOKS

1. Role of bioinformatics in agricultural - Santosh Kumar, 2014
2. Bioinformatics Sequence and Genome analysis - David W. Mount, 2003.
3. Bioinformatics Basics 'Applications in Biological science and Medicine" Hooman H. Rashidi & Lukas K. Buehie 2001.

<http://www.omicsonline.org/>

BBR 006	GENETIC ENGINEERING OF PLANTS	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite – Genetics, plant biotechnology, Genomics.				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
To impart theoretical knowledge and practical skills about plant breeding objectives, modes of reproduction and genetic consequences, breeding methods for crop improvement					
COURSE OUTCOMES (COs)					
CO1	To understand the Importance of plant genetic resources;				
CO2	To know the Basic genetic resources and transgenes				
CO3	To understand the Germplasm conservation				
CO4	To know the Role of CGIAR system in the germplasm exchange				
CO5	To understand how to Maintain of experimental records				

CO6	Learning techniques of Intellectual property, Patents, copyrights, trademarks and trade secrets. .					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I : PGR CONSERVATION METHODS

9

Historical perspectives and need for PGR conservation; Importance of plant genetic resources; Taxonomical classification of cultivated plants; Gene pool: primary, secondary and tertiary; Centers of origin and global pattern of diversity; Basic genetic resources and transgenes.

UNIT II: GERM PLASM THEORY

9

Germplasm Principles, strategies and practices of exploration, collection, characterization, evaluation and cataloging of PGR; Plant quarantine and phytosanitary certification; Germplasm introduction and exchange; Principles of in vitro and cryopreservation.

UNIT III: GERMLASM CONSERVATION

9

Germplasm conservation- in situ, ex situ, and on-farm; short, medium and long term conservation **strategies for conservation of orthodox** seed and vegetatively propagated crops; Registration of plant genetic resources.

UNIT IV: DATABASE MANAGEMENT**9**

PGR data base management; Multivariate and clustering analysis, descriptors; National and international protocols for PGR management; PGR for food and agriculture (PGRFA); PGR access and benefit sharing; Role of CGIAR system in the germplasm exchange; PBR, Farmers rights and privileges; Seed Act, sui generis system; Geographical indicators, Intellectual property; Patents, copyrights, trademarks and trade secrets.

UNIT V : GENE ENHANCEMENT METHODS**9**

Journey from wild to domestication; Genetic enhancement- need for genetic enhancement; **Genetic enhancement in pre Mendelian era and 21st century**; Genetic enhancement and plant breeding; Reasons for failure in genetic enhancement; Sources of genes/ traits- novel genes for quality.

Total Contact Hours: 45**Text Books:**

1. Frankel OH & Bennett E. 1970. Genetic Resources in Plants – their Exploration and Conservation. Blackwell. Gautam PL, Dass BS, Srivastava U & Duhoon SS. 1998. Plant Germplasm Collecting: Principles and Procedures. NBPGR, New Delhi.
2. Painting KA, Perry MC, Denning RA & Ayad WG. 1993. Guide Book for Genetic Resources Documentation. IPGRI, Rome, Italy.

Reference Books:

1. Paroda RS & Arora RK. 1991. Plant Genetic Resources, Conservation and Management. Concepts and Approaches. IPGRI Regional office for South and South Asia, New Delhi. Puzone L & Hazekamp TH. 1996. Characterization and Documentation of Genetic Resources Utilizing Multimedia Database. NBPGR, New Delhi.
2. Rana RS, Sapra RL, Agrawal RC & Gambhir R. 1991. Plant Genetic Resources, Documentation and Information Management. NBPGR, New Delhi. Singh RJ & Jauhar PP. 2005. Genetic Resources, Chromosomal Engineering and Crop Improvement. Vol. I. Grain Legumes, Vol. II. Cereals. CRC Press, Taylor & Francis Group, USA.
3. http://50.30.47.15/Ebook/Course_SUST_BMB/BMB_328/An_Introduction_to_Genetic_Engineering.pdf

BBR 007	MOLECULAR MEDICINE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Molecular modelling				
	Course Designed by – Dept of Genetics Engineering				

OBJECTIVE:						
1. To gain knowledge of basic cytogenetic techniques.						
2. To learn about biochemical method used to detect metabolic changes.						
3. To learn about molecular methods to detect changes in the DNA.						
4. To learn about molecular methods to detect changes in the RNA and protein						
COURSE OUTCOMES (COs)						
CO1	To learn about various diagnostic strategies to detect large deletions in chromosomes.					
CO2	It also gives knowledge on efficient utilization of changes in gene expression at RNA and protein level.					
CO3	It deals with protein truncation.					
CO4	It imparts determination of splicing variants					
CO5	Molecular pharmacology					
CO6	Transgenic animals study					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO MOLECULAR MEDICINE 9

Introduction to Molecular Medicine: Overview of the subject -Molecular mechanisms in development and differentiation -Molecular and biomedical aspects of ageing

UNIT II: GENE EXPRESSION AND PROTEIN FUNCTIONAL DEFECTS IN DISEASE 9

Gene expression in disease -Vesicle trafficking in cells -Abnormal protein function and disease -Diseases of DNA repair and genomic instability -RNA processing and disease-Oncology-Chromosomal translocations and leukemia: identification of novel therapeutic targets -Lymphoma -**Skin cancer-Solid tumors': renal carcinoma**-Lung and circulatory disease-Coagulation and hemophilia -Atherosclerosis - Cystic fibrosis -Molecular aspects of neurodegenerative disease-Prion proteins -Alzheimer's and Huntington's diseases

UNIT III: MOLECULAR PHARMACOLOGY 9

Pharmacogenetics -Drug discovery -Drug design and development -Molecular aspects of infectious diseases- Intracellular pathogens: Bacillary dysentery Extracellular pathogens: Botulism and tetanus -Viral pathogens: Dengue hemorrhagic fever

UNIT IV: IMMUNOLOGICAL ASPECTS OF MOLECULAR MEDICINE 9

Autoimmunity and transplantation -**Human genome and predisposition to autoimmunity** - Transgenic models of autoimmunity-Lessons from animal models for manipulation of the immune system.

UNIT V: MOLECULAR BIOTECHNOLOGY 9

Recombinant proteins; state of the art, problems, new developments -Antibodies, design production, engineering -Peptides and derivatives as therapeutic agents-Gene therapy and delivery – Nanotechnology and pharmaceuticals – Drug delivery systems-Commercialization - Clinical trials/ethics

Total Contact Hours: 45

TEXT BOOKS

1. Medical Genetics 3rd Edition- Jorde, Carey, Bamshad & White.
2. Molecular pharmacology A short course by Jerry Kenatin: John Wiley and Sons publications.

REFERENCES:

1. Gary Walsh – “Proteins – Biochemistry and Biotechnology” Robert A. Meyers – Encyclopedia of Molecular Cell Biology and Molecular Medicine (Ed) – Vol I, II ed.
2. Barry Halliwell - Free Radicals in Health and Disease.
3. <http://molmed.org/>

BBR 008	MICROBIAL GENETICS	L	T	P	C
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		Total Contact Hours – 60	3	0	0	3
		Prerequisite – Cell biology, Genetics, and Basic Biology				
		Course Designed by – Dept of Genetic Engineering				
OBJECTIVES						
To learn various types of physical organization of bacterial genomes; genotype and phenotype						
COURSE OUTCOMES (COs)						
CO1	Understand the steps in dominance and recessive characters					
CO2	Explain the features of various types of Gene transfer					
CO3	mechanism of transposition					
CO4	gene expression; transcriptional control;					
CO5	Plasmid expression vectors- restriction and modification					
CO6	To gain knowledge on various Genetics of yeast and their applications.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

- UNIT I: INTRODUCTION 9**
Differences between eukaryotic and prokaryotic Genetics; physical organization of bacterial genomes; genotype and phenotype; dominance and recessive characters, molecular biology of bacterial cell division and plasmid replication. **Gene expression**
- UNIT II: GENE TRANSFER METHODS 9**
Molecular mechanism of transformation, conjugation and transduction; consequences of recombination; gene mapping; mosaic genes and chromosome plasticity.
- UNIT III: MOVABLE GENETIC ELEMENTS 9**
Plasmids: structure, properties, functions and stability; transposons; mechanism of transposition; phase variation; **CRISPR Technology**
- UNIT IV: REGULATION OF GENE EXPRESSION 9**
Induction and repression; operon model of gene expression; transcriptional control; promoter, terminator, attenuator and anti-terminator; two component regulatory pathway; global regulatory systems; translational control. Bacteriophage structure; ssDNA bacteriophage; RNA containing phages; dsDNA phages; **genetics and molecular biology of λ (lambda) phage**; lytic and lysogenic cycle; restriction and modification; and bacterial resistance to phage attack.
- UNIT V: GENETICS OF YEAST 9**
Yeast as a model organism; advantages, life cycle, mating type switching in yeast; transformation and recombination; yeast artificial chromosome; yeast two-hybrid systems.

Text Book:

1. Briggs D. 1997. Plant Variation and Evolution. Science Publ.
2. Cronquist AJ. 1981. An Integrated System of Classification of Flowering Plants. Columbia Univ. Press. 24
3. Dhillon BS, Varaprasad KS, Kalyani S, Singh M, Archak S, Srivastava U & Sharma GD. 2001. Germplasm Conservation A Compendium of Achievements. NBPGRI, New Delhi.
4. Castri F & Younes T. 1996. Biodiversity Science and Development: Towards New Partnership. CABI & International Union for Biol. Sci. France.
5. Gurcharan Singh. 2004. Plant Systematics: An Integrated Approach. Science Publ.

Reference Book:

1. Lawrence GMH. (Ed.). 1951. Taxonomy of Vascular Plants. London.
2. Paroda RS & Arora RK. 1991. Plant Genetic Resources Conservation and Management Concepts and Approaches. IPGRI Regional office for South and South Asia, New Delhi.
3. www.lamission.edu/lifesciences/steven/micro20%20chapter%208.pdf

BBR 009	HERBAL DRUGS AND GENOMICS	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite – Herbal studies, Principles of genomics, Plant biology				

		Course Designed by – Dept of Genetic Engineering				
OBJECTIVES						
To learn various types of physical organization of Medicinally important Plants						
COURSE OUTCOMES (COs)						
CO1	Understand the steps in Herbarium techniques					
CO2	Explain the Current approaches for drug discovery from herbal medicines.					
CO3	Definition and scope of pharmacognosy					
CO4	Chemistry of drugs and its evaluation					
CO5	drug interactions and their influence in gene expression					
CO6	To gain knowledge on various Psychoactive drugs					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO HERBAL DRUGS

9

Introduction to Medicinally important Plants. Plant parts: Fruits, Leaves, Stem and its modifications. Plant identification – Herbarium techniques. Medicinal plants – role in human

health care. Medicinally important plant families : Meliaceae, Myrtaceae, Apiaceae, Asclepiadaceae, Solanaceae, Lamiaceae, Euphorbiaceae, Zingiberaceae, Musaceae and Poaceae. Current approaches for drug discovery from herbal medicines.

UNIT II: SCOPE OF ETHNOMEDICINE 9

Ethnomedicine – definition, history and its scope – Traditional knowledge and utility of some medicinal plants in Tamilnadu – *Solanum trilobatum*, *Cardiospermum halicacabum*, *Adathoda vasica*, *Azadirachta indica*, *Phyllanthus fraternus* and *Boerhaavia diffusa*. Plants in day to day life – *Ocimum sanctum*, *Aloe vera*, *Amla*, *Neem*. Nutritive and medicinal value of some fruits (*Guava*, *Sapota*, *Orange*, *Mango*, *Banana*, *Lemon*, *Pomegranate*) and vegetables - *Greens* (*Moringa*, *Solanum nigrum*)

UNIT III: PHARMOCOGNOSY 9

History, Definition and scope of pharmacognosy; Systems of Indian Medicines – Siddha, Unani, Ayurveda, Homeopathy; Terminologies. Ayurveda, Traditional Chinese medicine and Korean medicines. Classification of Crude drugs – Taxonomical, Morphological, Pharmacological and chemical classifications; Chemistry of drugs and its evaluation. Current extraction techniques in herbal medicines. Biological testing of herbal drug.

UNIT IV: HERBAL MEDICINE GENOMICS 9

Introduction to Herbal medicine genomics, Pharmacogenomics of Herbal drugs, application of Bioinformatics tools in Herb- drug interactions and their influence in gene expression, Herbal drugs used for Asthma, cancer , genetic disorders, antimicrobials, acute and chronic diseases. Psychoactive drugs –Depressants, Stimulants, hallucinogens – sources, effects, basic mechanism of action.

UNIT V: GENE EXPRESSION METHODS 9

Ayugenomics, Plant medicine genomics, case studies on herbal medicines and their effects in gene expression.

Tex Books:

1. Kumar, N.C. (1993). An Introduction to Medical botany and Pharmacognosy. Emkay Publications, New Delhi.
2. Rao, A.P. Practicals: 2. Gokhale, S.S., C.K.Kokate and A.P. Purohit (1994) Pharmacognosy. Nirali Prakashan. Pune.
3. Tyagi, Dinesh Kumar (2005) Pharma Forestry. Field Guide to Medicinal Plants. Atlantic Publishers and Distributors, New Delhi.
3. Farooqi, A.A., and B.S. Sreeramu (2004). Cultivation of Medicinal and Aromatic Crops. University Press (India) Pvt. Ltd., Hyderabad.

Reference:

1. Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.
2. Tribal medicine – D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta – 700 006.
3. Contribution to Indian ethnobotany – S.K. Jain 1995, 3rd edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
4. A Manual of Ethnobotany – S.K.Jain, 1995, 2nd edition.
5. <http://www.sciencemag.org/>. [/art-and-science-traditional-medicine-part](http://www.sciencemag.org/art-and-science-traditional-medicine-part)

BBR 010	Pharmacogenomics	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite –Pharmacology, Principles of genomics,				
	Course Designed by – Dept of Genetic Engineering				

OBJECTIVES

To learn various Pharmaceutical industry & development of drugs

COURSE OUTCOMES (COs)

CO1	Understand the steps in Various steps in new drug developments
CO2	Explain the Current approaches for Mechanism of drug action.
CO3	special requirements for bulk drug manufacture
CO4	Chemistry of drugs and its evaluation
CO5	Tests used in drug manufacture; packing techniques
CO6	Various categories of therapeutics like Vaccines

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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION 9

Pharmaceutical industry & development of drugs; types of therapeutic agents and their uses; economics and regulatory aspects. Various steps in new drug developments and marketing

UNIT II: DRUG ACTION, METABOLISM AND PHARMACOKINETICS 9

Mechanism of drug action; physico-chemical principles of drug metabolism; radioactivity; Pharmacology, Pharmacogenomics and pharmacokinetics.

UNIT III: MANUFACTURE OF DRUGS, PROCESS AND APPLICATIONS 9

Types of reaction process and special requirements for bulk drug manufacture. Toxicology. Fermentation technology. Bioprocess technologies.

UNIT IV: PRINCIPLES OF DRUG MANUFACTURE 9

Compressed tablets; dry and wet granulation; slugging or direct compression; tablet presses; coating of tablets; capsule preparation; oval liquids – vegetable drugs – topical applications; preservation of drugs; analytical methods and other tests used in drug manufacture; packing techniques; quality management; GMP.

UNIT V: BIOPHARMACEUTICALS 9

Various categories of therapeutics like Vaccines, life saving drugs, antibodies, vitamins, laxatives, analgesics, contraceptives, antibiotics, hormones and biologicals.

Total Contact Hours: 45

TEXT BOOKS

1. Gareth Thomas, Medicinal Chemistry. An introduction by .John Wiley. 2000.
2. Katzung B.G., Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.
3. Brahmankar, D.M., “Biopharmaceutical and Pharmacokinetics: A Treatise”, Vallabh Prakashan, 1995.

REFERENCE BOOKS

1. Niazi, Sarfaraz K. “Handbook of Bio-generic Therapeutic Proteins: Regulatory, Manufacturing, Testing, and Patent Issues”. CRC Press, 2006.
2. Ho, Reedney J. Y., MiloGibaldi. “Biotechnology & Biopharmaceuticals Transforming Proteins and Genes into Drugs”. Wiley Liss, 2003.
3. <http://www.btc.org/aket.bt>

BBR 011	PROTEIN ENGINEERING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

		Prerequisite – Genomics and Proteomics, System Biology				
		Course Designed by – Department of Genetic Engineering				
OBJECTIVES						
1. To understand the principle of nucleic acid isolation.						
2. To understand the principles of PCR and their uses in genetic engineering.						
COURSE OUTCOMES (COs)						
CO1	This course imparts the knowledge on the principles on nucleic acid isolation and purification.					
CO2	It also gives knowledge on history and latest methods of DNA sequencing..					
CO3	It deals with the protein – protein interaction.					
CO4	It imparts protein sequencing methods.					
CO5	To gain a thorough knowledge about nucleic acid hybridization.					
CO6	To learn history of DNA sequencing and current methods and gene synthesis.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Introduction to proteins. Genes and proteins. Proteomics. Basics of protein synthesis. Types and classification of proteins. Primary structure, secondary structure, tertiary structure, quaternary structure, Ramachandran plot. **Structural characteristics of proteins**

UNIT II: PROTEIN STRUCTURE PREDICTION 9

Strategies for design of novel proteins-strategies for the design of structure and function, computer methods in protein modelling. Bioinformatics tools in protein studies.

UNIT III: PRODUCTION OF NOVEL PROTEINS 9

Site and strategies for heterologous **expressions, methods for expressing recombinant proteins in yeast, in vitro mutagenesis**. Yeast two Hybrid system.

UNIT IV: CHARACTERIZATION OF PROTEINS 9

Traditional and advanced methods in protein characterizations. NMR spectroscopy, crystallography, spectroscopic and calorimetric methods.

UNIT V: APPLICATIONS OF PROTEIN ENGINEERING 9

Application of protein engineering in industries. Design of polymeric biomaterials, nicotinic acetylcholine receptors as a model for a super family of ligand - **gated ion channel proteins**

Total Periods: 45

TEXT BOOK:

1. Protein engineering and design by Paul R. Carey, academic press, 1996, 361 pages
2. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002
3. Models of Proteins and Nucleic Acids. Cambridge University Press, 1998

REFERENCE BOOKS

1. Proteomics from protein sequence to function: Edited by S.R.Pennington and M.J.Dunn, Taylor and Francis Group, 2001.
2. Biophysical Chemistry, Cantor and Schimmel, part I and II, W.H. Freeman and co 1997.
3. <http://nptel.ac.in/courses/102103017/pdf/lecture%2022.pdf>

BBR 012	BIOCONFINEMENT OF GENETICALLY MODIFIED ORGANISMS	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biology, Plant and animal biotechnology and rDNA Technology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES Gain knowledge on basic developmental aspects of plant that can be transformed into research application.					

COURSE OUTCOMES (COs)						
CO1	The course imparts advanced knowledge on genetically modified organisms.					
CO2	It also gives knowledge on efficient utilization of the principles of bioconfinement.					
CO3	It deals with transgenic algae.					
CO4	It imparts determination of bioconfinement research.					
CO5	To apply the modular approach and regulatory networks present in a cell.					
CO6	To Possess requisites for plant signal transduction research.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO BIOCONFINEMENT

9

Genetically Engineered Organisms – Applications of Genetically modified organisms in medicine and Agriculture. Bio confinement - Methods of Bio confinement, International Aspects - History of Confinement - Social Acceptability of Bio confinement Methods,

UNIT II: NEED FOR BIOCONFINEMENT

9

Risk factors - Effects on Non-target Species - Delaying the Evolution of Resistance - Food Safety and Other Issues - Need for Bio confinement

UNIT III: BIOCONFINEMENT OF PLANTS AND ANIMALS 9

Genetically Engineered Trees - Transgenic Grasses - Transgenic Algae-Effectiveness at Different Spatial and Temporal Scales - Monitoring and Managing Confinement Failure -bio confinement of fish, and insects.

UNIT IV: BIOCONFINEMENT OF VIRUSES, BACTERIA, AND OTHER MICROBES 9

Introduction - Potential Effects or Concerns, and Need for Bio confinement in Viruses, Fungi, and Bacteria

UNIT V: BIOLOGICAL AND OPERATIONAL CONSIDERATIONS FOR BIOCONFINEMENT 9

Execution of Confinement - International Aspects - Bio confinement - Bio confinement Research

Total Contact Hours: 45

TEXT BOOK

1. Biological confinement of genetically engineered organisms by national research council: National Academic press.
2. Piefzer F.M. Food Microbiology, Academic Press, 1989.

REFERENCE BOOKS

1. Sasson A, Biotechnologies and Development, UNESCO Publications

BBI 506	MOLECULAR EVOLUTION AND PHYLOGENY	L	T	P	C
	Total Contact Hours – 45	3	1	0	3
	Prerequisite – rDNA Technology, Microbiology, and Cell Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
To familiarize with cell counting and cell separation techniques.					
COURSE OUTCOMES (COs)					
CO1	To learn about Nature of molecular evolution -driving forces in evolution				
CO2	It also gives knowledge on Phylogenetic models-Universal phylogeny				
CO3	It deals with protein truncation				
CO4	It imparts determination of splicing variants				

CO5	It impliments of the genetic variation					
CO6	It gives the Knowledge about the Neutral theory					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION

9

Introduction in molecular evolution- Archaeology of the genome-Nature of molecular evolution - driving forces in evolution.

UNIT II: INTRODUCTION TO PHYLOGENETICS

9

Fundamental elements of phylogenetic models-Identifying Orthologs and Paralog- Trees and distances-Molecular Phylogenetic models-Universal phylogeny

UNIT III: EVOLUTIONARY CHANGE

9

Measuring genetic change-Genetic distance- Substitution models-Tree building methods-Distance based methods-Character based methods-Tree evaluation-Randomized trees Bootstrap-Phylogenetic software's

UNIT IV: MODELS OF MOLECULAR EVOLUTION

9

Models of evolutionary process-Functional constraints-Molecular clocks Evaluation of molecular clock hypothesis-Neutral theory-Genetic variation with species

UNIT V: PHYLOGENETIC APPLICATIONS

9

Applications of molecular phylogenetics -Gene trees and Species trees, Organism phylogeny-Age and rates of diversification-Host parasite co-specification.

Total Contact Hours: 45

TEXT BOOK:

1. "Evolution and population genetics" by Rashma sisodia 2006 (pg no.175 - 297)

REFERENCE:

1. Fundamentals of Molecular evolution", Dan Graur and Wen-Hsiung Li, Iled, 2000, Sinauer associates.
2. Molecular evolution: A Phylogenetic approach", Roderic D. M. Page, Edward C. Holmes Blackwell science Inc 2003. (pg no 1-172)(280-312).
3. www.ncbi.nlm.nih.gov/pubmed/1784710
4. <https://www.biomedcentral.com/>

BBR 013	BIOPROCESS ENGINEERING		L	T	P	C
	Total Contact Hours – 45		3	0	0	3
	Prerequisite – Biology, Enzyme Technology and Bioreactors design					
	Course Designed by – Dept of Genetic Engineering					
OBJECTIVES To understand the basic concepts of filtration and agitation and mixing. To study the nature of fluids and flow characteristics.						
COURSE OUTCOMES (COs)						
CO1	To learn about design and analysis of bioreactors.					
CO2	It also gives knowledge on bioreactor scale up.					
CO3	It deals with modern biotechnological processes.					
CO4	It imparts modeling and simulation of bioprocesses					
CO5	To familiarize the mass transfer operations like molecular diffusion					
CO6	4. To understand the principles extraction and distillation processes involved in industries					

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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: DESIGN AND ANALYSIS OF BIOREACTORS

9

Modeling of Non-ideal Behavior in Bioreactors-Tanks-in-series and Dispersion models-applications to design of continuous sterilizers; Design and operation of novel bioreactors-Air-lift loop reactors; Fluidized bed bioreactors; Stability analysis of bioreactors.

UNIT II: BIOREACTOR SCALE-UP

9

Transport phenomena in Bioprocess systems, Regime analysis of bioreactor processes, Correlations for oxygen transfer; Scale-up criteria for bioreactors based on oxygen transfer and power consumption.

UNIT III: MONITORING OF BIOPROCESSES

9

On-line data analysis for measurement of important physio-chemical and biochemical parameters; Methods of on-line and off-line biomass estimation; microbial calorimetry; Flow injection analysis for measurement of substrates, products and other metabolites; State and parameter estimation techniques for biochemical processes; computers and interfaces, Computer-based data acquisition, monitoring and control-LABVIEW Software.

UNIT IV: MODERN BIOTECHNOLOGICAL PROCESSES

9

Recombinant cell culture processes, guidelines for choosing host-vector systems, plasmid stability in recombinant cell culture, limits to over expression, Modeling of recombinant bacterial cultures; Bioreactor strategies for maximizing product formation; Bioprocess design considerations for plant and animal cell cultures.

UNIT V: MODELLING AND SIMULATION OF BIOPROCESSES 9

Study of structured models for analysis of various bioprocesses; Model simulation using MATLABS IMULINK and ISIM software packages.

Total Contact Hours: 45

TEXT BOOKS

1. Alba S., Humphrey E and Milli N.R., “Bio Chemical Engineering” Academic Press, 1973.
2. Scragg. A.H “Bioreactors in Biotechnology”- A Practical approach
3. Bailey and Ollis, “Biochemical Engineering Fundamentals”, McGraw Hill (2nd Ed.). 1986.
4. Peter F. Stanbury, Allan Whitaker, “Principles of Fermentation Technology”

BBR 014	FOOD PROCESS TECHNOLOGY			L	T	P	C
	Total Contact Hours – 60			3	0	0	3
	Prerequisite – Biotechnology, Food Toxicology, microbiology, Food Engineering						
	Course Designed by – Dept of Genetic Engineering						
OBJECTIVES Impart education in the field of Food processing Technologies in order to generate competent resources to meet the demands of the fast-growing Dairy and Food Industry.							
COURSE OUTCOMES (COs)							
CO1	To gain knowledge on storage, preparation, preservation and packaging of food products and beverages						
CO2	Understand the Food Laws, food rules and standards, Statistical Quality Control						
CO3	To learn about commercial handling of fish						
CO4	To gain knowledge on slaughtering techniques and meat products						
CO5	Impart knowledge on dairy and food industry						
CO6	Know about the importance and processing of oil						
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	

2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I : QUALITY CONTROL ANALYSIS

12

Storage of cereals, Processing of rice and rice products. Milling of wheat and production of wheat products, Processing of tea, coffee and cocoa, Storage and handling of fresh fruits and vegetables, Preservation of fruits and vegetable by heat treatment. Production and preservation of fruits and vegetable juices, Preparation of Jam, Jelly and marmalade, pickles, vinegar and tomato product, Non-alcoholic beverages; Food Laws, food rules and standards, Statistical Quality Control; Various types of packaging and **quality assurance**.

UNIT II: PRESERVATION METHODS

12

Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of Fish; **Methods of Preservation of fish**: Canning, Freezing, Drying, Salting, Smoking and Curing.

UNIT III: FERMENTATION TECHNOLOGY

12

10L Slaughtering technique of animal; Meat cuts and portions of meat, muscle; Color of meat; Post mortem changes of meat; Meat processing - curing and smoking; Fermented meat products (meat sausages & sauces); Frozen meat & meat storage; By-products from meat industries and their utilization; **Meat industries in India**.

UNIT IV: FERMENTATION TECHNOLOGY

12

Composition of milk; Varieties of milk; Checks for purity of milk; Handling of fresh milk. Module II: 10L Pasteurization of milk; HTST and UHT techniques; Packaging of milk;

Fermentation of milk and fermented milk products. Manufacture of milk products like evaporated milk, powder milk, condensed milk, cream butter, cheese, yogurt, ice cream, ghee, baby food and sweet meat. Quality control of milk and milk products; Milk plant hygiene and sanitation.

UNIT V : EXTRACTION METHODS

12

Importance of fats and oils in foods; Sources of fats and oils; Extraction of fats and oils – rendering, pressing, solvent extraction; Processing of oils – degumming, refining, bleaching, deodorization, fractionation; Reversion and rancidity of fats and oils

Total Contact Hours: 45

TEXT BOOKS:

1. Food Science by Potter
2. Technology of Food Preservation by Desrosier
3. Principles of Food Science, Vol-I by Fennema Karrel
4. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon
5. Post Harvest Technology of cereal pulse and oil seeds by Chakraborty, AC
6. Food Science by Mudambi.

REFERENCE BOOKS

1. Processed Meats; Pearson AM & Gillett TA; 1996, CBS Publishers.
2. Meat; Cole DJA & Lawrie RA; 1975, AVI Pub.
3. Egg and poultry meat processing; Stadelman WJ, Olson VM, Shemwell GA & Pasch S; 1988, Elliswood Ltd.
4. Fish as Food; Vol 1 & 2; Bremner HA; 2002, CRC Press.
5. Robinson RK; 1996; Modern Dairy Technology, Vol 1 & 2; Elsevier Applied Science Pub
6. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.
7. <https://www.uoguelph.ca/foodscience/book-page/dairy-science-and-technology-ebook>

BBR 015	Metabolism and Metabolomics	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biopharmaceutical technology				
	Course Designed by – Dept of Genetics Engineering				
OBJECTIVES					
1. This course provides the fundamental knowledge on upcoming field of metabolomics					
2. The metabolic engineering in post genomic era.					

3. Understand Regulation of metabolic pathways and examples of pathway manipulations						
4. Provides knowledge about the metabolic engineering in database.						
COURSE OUTCOMES (COs)						
CO1	Metabolic engineering					
CO2	Comprehensive models cellular reactions					
CO3	Metabolic flux analysis and its applications					
CO4	Metabolomics and its study					
CO5	Applications of metabolomics					
CO6	Metabolism of Plants and animals					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION

9

Introduction to metabolic engineering-Metabolism- Stoichiometry, reaction rates and dynamic mass balances-Growth Energetic-Yield coefficients and linear rate equations-Material balances and data consistency. Permeability control passive diffusion, active transport group transportation

UNIT II: METABOLIC PATHWAY REGULATION 9

Regulation of metabolic pathways-Examples of pathway manipulations. Metabolic engineering in practical metabolic pathway synthesis. Alteration of feedback regulation, limiting accumulation of end products. Induction-jacob & monod model, catabolic regulation. Strain selection, improving fermentation,

UNIT III: METABOLIC FLUX ANALYSIS 9

Metabolic flux analysis-Methods for the experimental determination of metabolic flux using isotope labelling-Applications of Metabolic flux labelling. Metabolic control analysis-Regulation of Metabolic network

UNIT IV: BIOCONVERSIONS 9

Advantages of bioconversions, specificity, yields, factors important to bioconversion, regulation of enzyme synthesis, mutation, permeability, co-metabolism, avoidance of product inhibition, mixed or sequential bioconversions, conversion of insoluble substances.

UNIT V: PLANT METABOLIC ENGINEERING 9

Metabolic Engineering in plants- Metabolomics and Metabolic engineering-Introduction to Databases on the web.

Total Contact Hours: 45

TEXT BOOKS

- 1.Fermentation and Enzyme Technology, John Wiley and Sons, 1980.
- 2.Stanbury P.F., and Whitaker A., "Principles of Fermentation Technology", Pergamon Press, 1984.

REFERENCE

- 1.Zubay G., "Biochemistry ", Macmillan Publishers, 1989.
- 2.Harper's review of biochemistry By David, W. Martin, Peter.A.Mayes, Victor.W. Rodwell, LANGE medical publications.
3. Practical Biochemistry – Principles & Techniques By Keith Wilson & John Walker. Oxford University press.
- 4.Gregory N. Stephanopoulos, Aristos A. Aristidou, Jens Nielsen, Metabolic engineering: Principles and Methodologies San Diego: Academic Press, 1998.

BBR 016	INDUSTRIAL MICROBIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Bioprocess technology, Industrial Biotechnology				

		Course Designed by – Department of Genetic Engineering				
OBJECTIVES						
1. To develop their practical skills in microbial fermentation techniques.						
2. To evaluate enzyme kinetics.						
COURSE OUTCOMES (COs)						
CO1	Enables the student to develop their skills in the field of microbial fermentation technology.					
CO2	It also gives knowledge on history and latest methods of enzyme kinetics.					
CO3	It deals with the antibiotic production.					
CO4	It imparts anaerobic fermentation methods.					
CO5	To carry out enzyme immobilized reaction.					
CO6	To develop the practical skills in solid substrate fermentation in wine production.					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

Definition, scope and roles of microbiology and its relation to other disciplines; fundamentals and characteristics of the roles of microbes in bioprocess technology; nomenclature and classification of microbes; review of microbes commonly used in bioprocess industries: bacteria, actinomycetes, yeasts, fungi, viruses and algae; history of industrial microbiology; Role of microorganisms in petroleum degradation and bioleaching.

UNIT II: MICROORGANISMS OF INDUSTRIAL IMPORTANCE 9

Selection of Microorganisms; Primary and Secondary Screening; Types of stock culture, Strain Improvement Strategies; Strain Identification & Strain Preservation of Industrial Microorganisms for overproduction of Primary and Secondary metabolites; Medium requirements for fermentation process-carbon, nitrogen, minerals, vitamins and other nutrients-examples of simple and complex media. **Production of Industrial products**

UNIT III: PRODUCTION OF PRIMARY AND SECONDARY METABOLITES 9

A brief outline of processes for the production of some commercially important Organic acids (citric acid, tartaric acid, lactic acid, acetic acid, gluconic acid) and amino acids (glutamic acid, lysine, aspartic acid, phenylalanine etc.) and Alcohols (ethanol, 2,3-butanediol etc.) Study of production process for various classes of low molecular weight secondary metabolites: Antibiotics-beta-lactams (Penicillins, Cephalosporins etc.), Aminoglycosides (streptomycin, kanamycin etc.), macrolides (erythromycin), quinines, aromatics etc.; **Vitamins and Steroids.**

UNIT IV: PRODUCTION OF COMMERCIALLY IMPORTANT ENZYMES AND PROTEINS 9

Proteases, Amylases, Lipases, Cellulases, **Pectinases, Isomerases** and other commercially important enzymes for the food and pharmaceutical industries; Production of recombinant proteins having therapeutic and diagnostic applications; production of vaccines.

UNIT V: FERMENTATION 9

Definition of fermentation; fermentor/bioreactor; fermentation media; raw materials – molasses and types, corn steep liquor, sulphite waste liquor and whey. Buffers, precursors, inhibitors, and antifoam agents, inoculum preparation. Types of Fermentation Processes: Surface, Submerged and Solid state fermentation, Batch and Continuous fermentation. Downstream processing – Precipitation, filtration, centrifugation, distillation, cell disruption, solvent recovery, drying.

Total Contact Hours: 45

TEXT BOOKS

1. L. E. Casida, Industrial Microbiology. Wiley Eastern Ltd., 1989
2. Text book of microbiology by Tortara, 2005

REFERENCE BOOK

1. G. Reed, Prescott and Dunn's Industrial Microbiology (4th Ed.).CBS Publishers, 1987.

2. H. J. Rehm, G. Reed and H. Pape (Eds.) Biotechnology (A Comprehensive Treatise vols. 1-8). VCH, 1986
3. Crueger and A. Crueger; Biotechnology: A Textbook of Industrial Microbiology (Eng. Ed. T. D. Brook). Sinauer Associates, 1990.
4. <http://www.sysmex-partec.com/applications/microbiology-industrial-applications.html>

BBR 017		PLANT PHYSIOLOGY			L	T	P	C
		Total Contact Hours – 60			3	0	0	3
		Prerequisite – Cell biology, Genetics, Phytochemistry and Botany						
		Course Designed by – Dept of Genetic Engineering						
OBJECTIVES								
To learn various aspects of plant physiology, such as respiration, enzyme action, and water relations								
COURSE OUTCOMES (COs)								
CO1		To learn about plant breeding						
CO2		To gain knowledge on tissue culture and hybridization techniques						
CO3		Understand Genotyping and Sequencing techniques						
CO4		To know about Molecular mapping and tagging of agronomical traits						
CO5		To learn about Gene pyramiding						
CO6		To gain knowledge on Genomics and genoinformatics for crop improvement.						
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		
2	CO1	M	H					
	CO2		M					
	CO3			M				
	CO4		M					
	CO5		H	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				✓		
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION TO PLANT PHYSIOLOGY

12

Biotechnology and its relevance in agriculture; Definitions, terminologies and scope in plant breeding. Generation of EDVs.

UNIT II: TISSUE CULTURE TECHNOLOGY

12

Tissue culture- History, callus, suspension cultures, cloning; Regeneration; Somatic embryogenesis; Anther culture; somatic hybridization techniques; Meristem, ovary and embryo culture; cryopreservation.

UNIT III: RFLP ANALYSIS

12

Techniques of DNA isolation, quantification and analysis; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs etc.), mapping populations (F₂s, back crosses, RILs, NILs and DH).

UNIT IV: MOLECULAR MAPPING METHODS

12

Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Robotics; Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants, Gene pyramiding.

UNIT V: CROP IMPROVEMENT METHODS

12

Marker assisted selection and molecular breeding; Genomics and genoinformatics for crop improvement; Integrating functional genomics information on agronomically/economically important traits in plant breeding; Marker-assisted backcross breeding for rapid introgression.

Total Contact Hours: 45

TEXT BOOKS:

1. Chopra VL & Nasim A. 1990. Genetic Engineering and Biotechnology: Concepts, Methods and Applications. Oxford & IBH.
2. Gupta PK. 1997. Elements of Biotechnology. Rastogi Publ.

3. Hackett PB, Fuchs JA & Messing JW. 1988. An Introduction to Recombinant DNA Technology - Basic Experiments in Gene Manipulation. 2nd Ed. Benjamin Publ. Co.

REFERENCE BOOKS

1. Sambrook J & Russel D. 2001. *Molecular Cloning* - a Laboratory Manual. 3rd Ed. Cold Spring Harbor Lab. Press.
2. Singh BD. 2005. *Biotechnology, Expanding Horizons*. Kalyani.
3. https://archive.org/details/PlantPhysiology_201408

BBA001	PRINCIPLES OF MANAGEMENT AND ORGANIZATIONAL BEHAVIOUR			L	T	P	C
	Total Contact Hours – 45			3	0	0	3
	Prerequisite – Management						
	Course Designed by – Department of Management Studies						
OBJECTIVES							
Familiarize the students with the fundamental concepts of Management and to highlight the approaches in organization behavior							
COURSE OUTCOMES (COs)							
CO1	Understanding the concepts of Management						
CO2	Knowledge on Management Function						
CO3	Understanding the Organization Theory & Approach.						
CO4	Knowledge on the Concepts of Motivation						
CO5	Clear insight on the factors contributing to discipline						
CO6	In-depth Understanding about the concepts of Group Behavior						
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	
2	CO1	M	H				
	CO2		M				
	CO3			M			
	CO4		M				

	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: NATURE OF MANAGEMENT

9

Nature of management – definition – theory and practice – effective management – Management : Science of Art – Management in India. Development of Management thoughts – Taylor’s – Henry Fayol – Hawthorne experiment – Barnard & Social system – Herbert Simon – Peter Drucker – Various approaches – Management thoughts.

UNIT II: MANAGEMENT FUNCTIONS

9

Management process and co-ordination – Functions of management – Managers and environment – External and internal Business Ethics – Planning – Fundamentals – Definitions & Features – Steps in planning – types of planning – Objectives – Concepts and features – Hierarchy of objectives – role – Process of MBO – Policy & Strategy – Decision making process – Individual Vs Group Decisions.

UNIT III: ORGANIZATION STRUCTURE

9

Organizing – Theory & Approach – Organization Structure – Authority & Responsibility – Delegation – Centralization & Decentralization – Line & Staff Relationship – Staffing – Fundamentals – System approach – Manpower Planning – Recruitment & Selection – Training and development – Performance appraisal – Direction – Fundamentals Motivation – Theories of Motivation-Maslow’s Hersberg’s MacClelland’s theory X,Y & Z leadership – Theories and Styles – Communication – Type – Controlling – System and Process.

UNIT IV: ORGANIZATIONAL BEHAVIOUR

9

Organizational Behaviour – Definition – Organization – Managerial Role and Functions – Organizational Approaches, Individual behaviour – Causes – Environmental effect – Behaviour and performance, perception – Organizational implications, Personality – Contributing factors –

Dimension, Motivation – Need Theories – Process Theories – Job satisfaction, Learning and Behaviour – Learning Curves, Work Design and Approaches.

UNIT V : GROUP BEHAVIOUR

9

Group Behaviour – Groups – Contributing factors –Group Norms, types – Causes – Intergroup relations – Conflict and Resolution – Change Process –Resistance to change.

Total Contact Hours: 45

REFERENCES:

1. Herald Knootz and Heinz weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 2004.
2. Ties AF, Stoner and R. Edward Freeman, "Management" Prentice Hall of India Pvt. Ltd., New Delhi -110011, 1995.
3. Joseph I. Massie 'Essentials of Management', Prentice Hall of India Pvt. Ltd., New Delhi -110 011, 2004.
4. L.M. Prasad "Principles and Practice of Management", Sultan Chand & Sons.2001
5. Uma Sekaran, "Organizational Behaviour", Tata McGraw Hill, 2007.

BBI 608	BIOPHYSICS		L	T	P	C
	Total Contact Hours - 45		3	0	0	3
	Prerequisite – Molecular modeling, Bio organic chemistry					
	Course Designed by – Dept of Genetics Engineering					
OBJECTIVE:						
1. To gain knowledge of basic cytogenetic techniques.						
2. To learn about biochemical method used to detect metabolic changes.						
COURSE OUTCOMES (COs)						
CO1	To learn about various light and optics method.					
CO2	It also gives knowledge on electricity and magnetism					
CO3	It deals with electromagnetic radiation					
CO4	It imparts determination of alternating current circuits					
CO5	To know about basic electronics					
CO6	Atomic and nuclear physics					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: LIGHT AND OPTICS

9

Light: Reflection and Refraction; Wave nature; Interference; Diffraction; Polarization; Geometrical Optics: Thick lenses and lens defects; Focussing action of human eye; Fiber optics and insect eyes. Optical and Acoustical Wave Interference: Diffraction from a circular aperture; applications in animal vision; Interference in thin films; Polarization of light; Acoustic diffraction; use by bats for echolocation. The eye and optical instruments – Microscopes.

UNIT II: ELECTRICITY AND MAGNETISM

9

The nature of electric charge; Electric field; Capacitance; Electric energy; Emf; Ohm's law; Resistivity; Electrical power; Direct current; Electric circuits; Alternating current circuits; Electromagnetic wave; Relevance to biology; Dynamic electrical properties of biological membranes; The electric organ of Mormon eels.

UNIT III: ELECTROMAGNETIC WAVES

9

The electromagnetic spectrum; Blackbody radiation; Radiant emission from a human; the greenhouse effect; Infrared radiation and ultraviolet radiation in biology.

UNIT IV: BASIC ELECTRONICS

9

Overview of vacuum tube technology; Solid state electronics devices and their applications; Diodes; Transistors and amplifiers; oscillators; Introduction to operational amplifiers; Integrated

circuits; Digital electronics; Special electronics devices like photocells; photomultipliers; Cathode ray tubes.

UNIT V : ATOMIC AND NUCLEAR PHYSICS

9

Determination of the charge and mass of an electron; The photoelectric effect; De Broglie waves; The Heisenberg uncertainty principle; Electron microscopy; The nuclear atom model; The Bohr model for the hydrogen atom; Quantum mechanics; Characteristic X-rays: X-ray diffraction; Absorption spectra and colour vision; Radiation effect in biology; Radiation dosage; Diagnostic use of X-ray.

Total Contact Hours: 45

TEXT BOOKS:

1. Biophysical Chemistry, Cantor and Schimmel, Part I and II, W.H. Freeman and co 1997
2. "Biophysics" by Dr.S. Thiraviaraj Saras publications 2004 (Pg no 1- 71, 88 – 137, 147 – 209).
3. "Biochemistry and Biophysics" by N. Arumugam& Annie Ragland by Saras publications 2004 (Pg no. 248 – 297).

REFERENCE BOOKS:

1. "Essentials of Biophysics" by P. Narayanan New age international publishers second edition 2007 (pg no. 2 -12, 168 -186, 192 – 216,340 – 368).
- 2."Biophysical chemistry" by Upadhyay Nath Himalaya publishing house Delhi Reprint 2003. (pg no. 90 – 280).
- 3."Biophysics" Vasanthapattabhi and N. Gautham. Narosa publishing house. Reprint 2004 (pg no. 2-140).
4. <http://www.biophysics.org/>

BBM 001	BIOMEDICAL ENGINEERING	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Biomechanics, Anatomy				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
1. To understand the working principle of various equipments.					
2. To analyze the results of different spectrophotometer and identify the chemical nature of the samples.					
3. To analyze the results of MS spectrophotometer and able to calculate the mass by interpreting the results.					
4. To understand the differences in the application of different microscopic methods.					
COURSE OUTCOMES (COs)					

	CO1	Enables the student to develop their skills in the medical devices				
	CO2	To learn diagnosis and therapy; biomedical information storage and retrieval				
	CO3	Provides knowledge on muscular structure and functions				
	CO4	It also gives knowledge on rehabilitation biomechanics				
	CO5	It deals with bio signal analyzer biosystem modelling				
	CO6	It imparts determination of ultrasound in diagnosis				
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: INTRODUCTION

9

Anatomy of human-various bones-functions-muscles-types-function. Medical devices. Medical imaging. Implants. Bionics. The improvement of diagnosis and therapy; biomedical information storage and retrieval.

UNIT II: MUSCLE STRUCTURE AND ITS FUNCTIONS

9

Muscle structure and its attachment with skeleton-rate of contraction and force generation-Activation contraction-locomotion-stability-forces on ground-forces on muscles-energy requirement-mechanisms of walking, running and trotting-sports.

UNIT III: BIOMECHANICS 9

Mechanical analysis of performance- rehabilitation biomechanics-mechanics of prosthetics and orthotics biomechanics of human injury and orthopaedics fixation-mechanics of bones and joint-dynamics of man machine interaction.

UNIT IV: BIOSYSTEM MODELING 9

Electrical impedance Cephalography- biotelemetry-biosignal analyzer-biosystem modelling.

UNIT V: ULTRASOUND IN DIAGNOSIS 9

Ultrasound in diagnosis-limb prosthetics and orthotics-sensory aids for the blinds-assisting the heart and kidney- ECG-EEG-Physiological equipments.

Total Contact Hours: 45

TEXT BOOKS:

1. AtillaHincal A., Suheylakas, H, BiomedicalScience & Technology, Plenum Press NewYork.
2. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.

REFERENCES BOOKS

1. Ernest Doebelin and dhanesh N manik, Measuremet systems, Application and design,5th edition ,McGraw-Hill, 2007.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.
3. Standard Handbook of Biomedical Engineering & Design – Myer Kutz, McGraw-Hill Publisher, 2003.
4. <http://accessengineeringlibrary.com/browse/biomedical-engineering-and-design-handbook-volume-1>

BBR 018	BIOREACTOR DESIGN	L	T	P	C
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Genetics and Microbiology, Biotechnology, Instrumentation				
	Course Designed by – Dept of Genetic Engineering				

OBJECTIVES

1. To study the historical development of bio process technology, design of fermenter and types of fermentation process.
2. To gain knowledge about formulation of medium and principles of sterilization.
3. To study the stoichiometry and energetics of cell growth and product formation.

4. To evaluate the kinetics and mechanism of microbial growth.						
COURSE OUTCOMES (COs)						
CO1	Improves ability to analyse, design and construct bioreactors					
CO2	Enables the student to develop their skills in the field of hydrodynamics					
CO3	It also gives knowledge on Kinetics of cell growth in batch culture					
CO4	It deals with the temperature measurement control					
CO5	It imparts determination of biomass and application of biosensors					
CO6	Enhances the skills in modeling and programming plant and animal cell bioreactors					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: BIOREACTOR DESIGN

9

Introduction to Bioreactor and Fermentor. Types of Bioreactor, Heat transfer, Scale – up, Airlift Bioreactors, Introduction, Design and construction of the airlift – loop reactor, Hydrodynamics, Three – phase flow, Mixing, Oxygen transfer.

UNIT II: BATCH AND CONTINUOUS GROWTH

9

Growth, Measurement of microbial growth (direct), Measurement of microbial growth (indirect), Kinetics of cell growth in batch culture, Continuous culture.

UNIT III: MIXING, MASS TRANSFER AND INSTRUMENTATION CONTROL OF BIOREACTORS 9

Introduction, Mass transfer, Theory of mixing, Rheological properties, Bioreactor sensor characterizes, Temperature measurement control, principles of dissolved oxygen measurement and control, principles of PH / redox measurement and control, deduction and prevention of foam, determination of biomass and application of biosensors.

UNIT IV: BIOREACTOR OFF – GAS ANALYSIS 9

Introduction, generalized gas balance equations, Steady – state balancing, Derived quantities based on combined gas analysis and gas mass balancing techniques, Gas analysers.

UNIT V: MODELING OF PLANT AND ANIMAL CELL BIOREACTORS 9

Modelling, digital simulation, formulation and solution of problems by simulations, digital simulation programming languages, ISIM (interactive simulation language) Plant cells, Animal cells.

Total Contact Hours: 45

TEXT BOOKS:

1. “Bioreactors in Biotechnology”, Ellis Horwood series, 1991. A. H. SCRAGG.
2. Peter, Max S. and Timmerhaus, Klaus D. Plant Design and Economics for Chemical Engineers, 4th ed., McGraw Hill, 1991.

REFERENCE BOOKS

1. Bailey, J.E. and Ollis, D.F. Biochemical Engineering Fundamentals", 2nded., McGraw Hill 1986.
2. Stanbury, P.F., Stephen J. Hall & A. Whitaker, Principles of Fermentation Technology, Science & Technology Books.
3. Nielsen, J. and Villadsen, J. “Bioreaction Engineering Principles”. Springer, 2007.
4. <http://www.freebookcentre.net/biology-books-download/Biotechnology-Fundamentals.html>

BBR 019	DEVELOPMENTAL BIOLOGY	L	T	P	C
	Total Contact Hours – 60	3	0	0	3
	Prerequisite – Cell biology, Molecular Biology, Biology				
	Course Designed by – Dept of Genetic Engineering				
OBJECTIVES					
To gain knowledge on animal development and places special emphasis on mammalian and human development.					

COURSE OUTCOMES (COs)						
CO1	Understand the mechanism of animal development					
CO2	Explain the structure, function and regulation of Actin filaments					
CO3	To know how cell’s fate is determined					
CO4	Understand Drosophila Development and organogenesis					
CO5	To learn about Blastula and Gastrulation					
CO6	To gain knowledge on Neurulation in embryos					
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
2	CO1	M	H			
	CO2		M			
	CO3			M		
	CO4		M			
	CO5		H	M		
3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: DEVELOPMENT OF MULTI-CELLULAR ORGANISMS

12

Universal mechanisms of animal development; basic anatomical features of animal; genes controlling developmental processes; cell fate and determination, positional values, inductive interaction and morphogenic effects.

UNIT II : CYTOSKELETON**12**

Assembly and dynamic structure of actin filaments, microtubules and intermediate filaments; effects of drugs on filament polymerization; regulation of cytoskeletal filaments; molecular motor proteins- structural features and function of myosins, kinesins and dyenins.

UNIT III: APOPTOSIS PROCESS**12**

Caenorhabditis elegans- Cell fates; asymmetric division of egg; pattern formation; developmental signal and changes in cell; apoptotic cell death.

UNIT IV: DROSOPHILA MELANOGASTER SYSTEM ANALYSIS**12**

Synopsis of Drosophila development; syncytium development; genes involved in early patterning- role of egg-polarity genes, dorsoventral signaling genes, mutations and segmentation genes, homeotic selector genes and patterning of anteroposterior axis, organogenesis and patterning of appendages.

UNIT V: NEURAL DEVELOPMENT IN HIGHER ANIMALS**12**

Synopsis of Xenopus development; asymmetries of Xenopus egg, blastula formation and gastrulation; convergent extension; neural tube formation. Neurulation in chick and human embryos.

Total Contact Hours: 45**TEXT BOOKS:**

1. Blum A. 1988. *Plant Breeding for Stress Environments*. CRC Press.
2. Christiansen MN & Lewis CF. 1982. *Breeding Plants for Less Favourable Environments*. Wiley International.
3. Fritz RS & Simms EL. (Eds.). 1992. *Plant Resistance to Herbivores and Pathogens: Ecology, Evolution and Genetics*. The University of Chicago Press.

REFERENCE BOOKS

1. 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.
2. Maxwell FG & Jennings PR. (Eds.). 1980. *Breeding Plants Resistant to Insects*. John Wiley & Sons.
3. Painter RH. 1951. *Insect Resistance in Crop Plants*. MacMillan, New York.
4. Russel GE. 1978. *Plant Breeding for Pest and Disease Resistance*. Butterworths.
5. Sakai A & Larcher W. 1987. *Frost Survival in Plants*. Springer-Verlag.
6. an der Plank JE. 1982. *Host-Pathogen Interactions in Plant Disease*. Academic Press.
7. <http://www.aazea.com/book/developmental-biology-6th-edition>

BBI404	FOOD AND MEDICAL MICROBIOLOGY			L	T	P	C
	Total Contact Hours - 60			4	0	0	4
	Prerequisite – Microbiology, Industrial microbiology, Food Toxicology						
	Course Designed by – Dept of Genetic Engineering						
OBJECTIVES							
1. To learn about micro organisms and their impact							
2. To gain knowledge on the importance of microbes in fermentation, antibiotics							
3. To identify clinical microbes, diagnose microbial infections and treatment							
COURSE OUTCOMES (COs)							
CO1	To learn Bergey's mannual of classification and identification of micro organisms						
CO2	To know about food poisoning and preservation techniques						
CO3	Analyse the medically important microbes						
CO4	The impact of microbial infections						
CO5	Understand the microbial borne diseases and treatment						
CO6	To gain knowledge in uses of microbes in drug production-						
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	
2	CO1	M	H				
	CO2		M				
	CO3			M			
	CO4		M				
	CO5		H	M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	37 th , 38 th & 39 th Meeting of Academic Council, May 2015, Jan 2016 & April 2016				

UNIT I: GENERAL MICROBIOLOGY

12

Morphology of bacterial, Viruses and actinomycetes-bacterial stainings, structure of bacteria-viruses-actinomycetes-Bergey's manual of classification identification of bacteria Biochemical text culture techniques-sterilization and disinfection-growth and nutrition of bacteria-biochemical tests.

UNIT II: FOOD AND INDUSTRIAL MICROBIOLOGY:

12

General spoilage of foods by bacteria, fungi, Preservation techniques. Microbial spoilage of milk and milk products, meat and fish products, canned foods-industrial production of vitamins, amino acids, antibiotics of microorganisms-fermentation-aerobic and anaerobic-Fermentors-applications-microbial production of wine, beer and miscellaneous beverages

UNIT III: MEDICAL MICROBIOLOGY

12

Identification of medically important microbes-Staphylococcus aureus, Streptococcus, E.coli, Proteus, Shigella Salmonella, Vibrio, Pseudomonas, Clostridium- Corynebacterium- Mycobacterium tuberculosis. Viruses- Herpes viruses, Adeno viruses-Rhabdo viruses- Bacteriophage.

UNIT IV: CLINICAL MICROBIOLOGY:

12

Normal flora of human body-urinary tract infections-respiratory infections-food poisoning-sexually transmitted diseases-hospital acquired infections-diagnosis and treatment of fungal infections-mycosis and super mycosis.

UNIT V: ENVIRONMENTAL MICROBIOLOGY:

12

Microbiology of air-airborne diseases and treatment-microbiology of water(fresh water),waterborne diseases-cholera, diarrhea, Waste water treatment-marine microbiology-microbes in marine water, role of microbes in desalination-uses of microbes in desalination-uses of microbes in drug production-reclamation of marine water microbiologically for domestic purposes.

Total Contact Hours: 45

TEXT BOOK:

1. "Text book of Microbiology" by Dubey C. Maheshwari DK. S. Chand Publications,2006.

2. "Microbiology- A laboratory Manual by Cappucino 2004.

REFERENCES:

1. "Medical Microbiology" a guide to Microbial infections" by David green wood, Richard C.B. Stock practical medical Microbiology, 2002
2. "Modern food Microbiology" by Jay, Loernsner, David A. Golden Springer Publications 2005.

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