

**B.TECH – BIOMEDICAL ENGINEERING
CURRICULUM AND SYLLABUS**

I – VIII SEMESTERS

SEMESTER -I						
THEORY						
Sub Code	Category	Subject	L	T	P	C
BEN101	HS	English – I	3	1	0	3
BMA101	BS	Mathematics – I	3	1	0	3
BPH101	BS	Engineering Physics – I	3	0	0	3
BCH101	BS	Engineering Chemistry – I	3	0	0	3
BCS101	ES	Fundamentals of Computing and Programming	3	0	0	3
	HS	Foreign Indian Languages	3	0	0	3
BME 102	ES	Engineering Graphics	1	0	3	3
BEE101	ES	Basic Electrical and Electronics Engineering	2	0	0	2
PRACTICAL						
BCS1L1	ES	Computer Practices Lab	0	0	3	1
BEE1L1	ES	Basic Electrical and Electronics Engineering Practices Lab	0	0	3	1
BSS1L4/ BSS1L5/ BSS1L6	HS	NSS/NCC/NSO* (*To be Conducted during Weekends)				1
Total No. of Contact Hours: 32			Total No. of Credits: 26			

SEMESTER - II

THEORY						
Sub Code	Category	Subject	L	T	P	C
BEN201	HS	English – II	3	1	0	3
BMA201	BS	Mathematics – II	3	1	0	3
BPH201	BS	Engineering Physics – II	3	0	0	3
BCH201	BS	Engineering Chemistry – II	3	0	0	3
BCS201	ES	Internet Programming	2	0	0	2
BSS201	HS	Personality Development	2	0	0	2
BBT202	HS	Biology for Engineers	2	0	0	2
BME203	ES	Basic Mechanical Engineering	2	0	0	2
BCE201	ES	Basic Civil Engineering	2	0	0	2
PRACTICAL						
BCS2L1	ES	Internet Practice Lab	0	0	3	1
BCM2L1	ES	Basic Civil and Mechanical Engineering Practices Lab	0	0	3	1
BPC2L1	BS	Physics and Chemistry Laboratory	0	0	3/3	1
BSS2L7	HS	Yoga* (*To be Conducted during Weekends)				1

Total No. of Contact Hours: 33

Total No. of Credits: 26

SEMESTER III

THEORY						
Sub. Code	Category	Subject Name	L	T	P	C
BMA301	BS	Mathematics III	3	2	0	4
BBM301	PC	Anatomy and Physiology	3	0	0	3
BBM302	PC	Electrical Measurements and Instrumentation	4	0	0	4
BCE406	HS	Environmental Studies	3	0	0	3
BBM303	PC	Microprocessors and its Applications	3	0	0	3
BBM304	PC	Introduction to Electronic Devices & Circuits	4	0	0	4
PRACTICAL						
BEC3L1	PC	Microprocessor Lab	0	0	3	2
BEI3L2	PC	Electrical & Electronic Measurement Lab	0	0	3	2
BBM3L2	PC	Anatomy and Physiology Lab	0	0	3	2

Total No. of Contact Hours: 31

Total No. of Credits: 27

SEMESTER IV

THEORY						
Sub. Code	Category	Subject Name	L	T	P	C
BMA403	PC	Biostatistics	4	0	0	4
BBM402	PC	Clinical Biochemistry	3	0	0	3
BBM403	PC	Biomedical Instrumentation I	4	0	0	4
BBM404	PC	Medical Electronics	3	0	0	3
BEC404	PC	Basic Principles of Communication and Circuit	4	0	0	4
BBM405	PC	Biosensors and Transducer	3	0	0	3
PRACTICAL						
BBM4L1	PC	Biosensors and Transducer Lab	0	0	3	2
BBT4L2	PC	Biochemistry lab	0	0	3	2

Total No. of Contact Hours: 27

Total No. of Credits: 25

SEMESTER V

THEORY						
Sub. Code	Category	Subject Name	L	T	P	C
BBM501	PC	Linear and Digital Integrated Circuits	3	0	0	3
BEI502	PC	Digital Signal Processing	4	0	0	4
BBM503	PC	Biomedical Instrumentation II	4	0	0	4
BBM505	PC	Biomaterials & Implantable Devices	3	0	0	3
BBM506	PC	Physiology Control System	4	0	0	4
	PE	Core Elective I	3	0	0	3
PRACTICAL						
BBM5L1	PC	Biomedical Instrumentation Lab	0	0	3	2
BBM5L2	PC	Linear and Digital Integrated Circuits lab	0	0	3	2
BBM5C1	PR	Comprehension I	0	0	0	1

Total No. of Contact Hours: 27

Total No. of Credits: 26

SEMESTER VI

THEORY						
Sub. Code	Category	Subject Name	L	T	P	C
BBM602	PC	Radiological Equipment	4	0	0	4
BSS601	HS	Value education & Professional Ethics	3	0	0	3
BBM603	PC	Pathology and Microbiology	3	0	0	3
BBM605	PC	Bio-Signal Processing	4	0	0	4
	PE	Core Elective II	3	0	0	3
	NE	Non Major Elective I	3	0	0	3
PRACTICAL						
BBM6L1	PC	Bio Signal Processing Lab	0	0	3	2
BBM6L2	PC	Pathology and Microbiology Lab	0	0	3	2
BBM6P1	PR	Mini-Project	0	0	4	1

Total No. of Contact Hours: 30

Total No. of Credits: 25

SEMESTER VII

THEORY						
Sub. Code	Category	Subject Name	L	T	P	C
BBM701	PC	Digital and Medical Image Processing	4	0	0	4
BBM702	PC	Neural Networks and Pattern Recognition	4	0	0	4
BBM703	PC	Health, Hospital & Equipment Management	3	0	0	3
	PE	Core Elective III	3	0	0	3
	PE	Non Major Elective II	3	0	0	3
	OE	Open Elective I	3	0	0	3
PRACTICAL						
BBM7L1	PC	Image Processing Lab	0	0	3	2
BBM7L2	PC	Implant Training in Hospital	0	0	1	1
BBM7P1	PR	Term Paper	0	0	3	2

Total No. of Contact Hours: 27**Total No. of Credits: 25****SEMESTER VIII**

THEORY						
Sub. Code	Category	Subject Name	L	T	P	C
	NE	Non Major Elective III	3	0	0	3
	OE	Open Elective II	3	0	0	3
PRACTICAL						
BBM8C1	PR	Comprehension II	0	0	0	1
BBM8P1	PR	Project Work	0	0	18	9

Total No. of Contact Hours: 24**Total No. of Credits: 16****TOTAL NO. OF CREDITS : 196**

**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	-	-	3	-	-	21	10.71
2	Basic Sciences (BS)	9	10	4	-	-	-	-	-	23	11.73
3	Engineering Sciences (ES)	10	8	-	-	-	-	-	-	18	9.18
4	Professional Core (PC)	-	-	20	25	22	15	14	-	96	48.98
5	Professional Electives (PE)	-	-	-	-	3	3	3	-	9	4.60
6	Non major Electives (NE)	-	-	-	-	-	3	3	3	9	4.60
7	Open Electives (OE)	-	-	-	-	-	-	3	3	6	3.06
8	Project Work, Seminar, Internship, Term Paper, etc. (PR)	-	-	-	-	1	1	2	10	14	7.14
	Total Credit	26	26	27	25	26	25	25	16	196	100%
	Total Contact Hour	32	33	31	27	27	30	27	24	231 Hrs	

LIST OF ELECTIVES

SUB.CODE	SUBJECT NAME	L	T	P	C
CORE ELECTIVE (PE) - I					
BBM504	Medical Physics	3	0	0	3
BBM502	Biofluid and Biomechanics	3	0	0	3
BBM056	Bioprocess Technology	3	0	0	3
CORE ELECTIVE (PE) –II					
BBM083	Troubleshooting of Medical Instruments	3	0	0	3
BBM055	Telemedicine	3	0	0	3
BBM058	Clinical Engineering	3	0	0	3
CORE ELECTIVE (PE) - III					
BBM084	Real Time Processor and Bio MEMS	3	0	0	3
BBM704	Modeling of Physiological Systems	3	0	0	3
BBM051	Tissue Engineering and Artificial Organs	3	0	0	3

NON MAJOR ELECTIVE (NE) - I					
BBM701	Medical Informatics	3	0	0	3
BEI010	VLSI Design	3	0	0	3
BEI011	Microcontroller based System Design	3	0	0	3
NON MAJOR ELECTIVE(NE) - II					
BBM060	Medical Imaging Techniques	3	0	0	3
BBM057	Robotics and Nanotechnology	3	0	0	3
BBM075	Virtual Instrumentation	3	0	0	3
NON MAJOR ELECTIVE(NE) - III					
BBM052	Biological Effects of Radiation	3	0	0	3
BBM081	Digital System Design	3	0	0	3
BBA008	Total Quality Management	3	0	0	3

SUB.CODE	SUBJECT NAME	L	T	P	C
OPEN ELECTIVE (OE) –I					
BBA001	Principles of Management and Organization Behavior	3	0	0	3
BBM076	Regulatory Aspects in Biosciences	3	0	0	3
BBM801	Rehabilitation Engineering	3	0	0	3
OPEN ELECTIVE (OE) –II					
BBA009	Intellectual Property Rights	3	0	0	3
BBA002	Entrepreneurship Development	3	0	0	3
BBM089	Design & Development of Medical Devices	3	0	0	3

REFERENCE:

1. Kandasamy, P., Thilakavathy, K., and Gunavathy, Kk. "Engineering Mathematics", Volumes 1 and 3(4th Edition) S Chand and Co., New.
2. Narayanan, S.ManicavachangamPillay, T.K.Ramanaiah, G."Advanced mathematics for Engineering Students", Volume2 and 3(2nd Edition), S.Viswanathan (printers & publishers Pte, Ltd.,) 1992.
3. Venkataraman, M.K"Engineering Mathematics"Volumes3-A&B, 13th Edition National Publishing Company, Chennai, 1998.
4. Shanmugam,T.N.:<http://www.annauniv.edu/shan/trans.html>.

BBM301	ANATOMY AND PHYSIOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biology (Class X-XII)				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
To provide the students the exposure to the fundamentals in human anatomy and physiology.					
COURSE OUTCOMES (COs)					
CO1	Learn the basic terminologies, structural and functional elements of human body				
CO2	Understand the physiological aspects of respiratory and cardiac system				
CO3	Learn the structure and function of nervous tissue, visual and auditory pathways				
CO4	Analyze the process of temperature regulation; understand the process of GI reflex				
CO5	To understand the structure and location of every organ system				
CO6	To understand the physiology of various biosystems				

UNIT I INTRODUCTION: HUMAN BODY AND CELL PHYSIOLOGY 9

Define Anatomy, Terms of Location, Position and Planes, Cell structure, Cell membrane Transport, Resting membrane potential and ionic basis of potentials, Action potential in nerve, Muscle and Heart.

UNIT II RESPIRATORY AND CARDIAC SYSTEM 9

Cardiac Cycle – ECG – Blood Pressure – Feedback Control for Blood Pressure – Nervous control of Heart. Cardiac output – Coronary and Peripheral Circulation, Physiological aspects of respiration. Exchange of gases – Regulation of Respiration. Disturbance of respiring function. Pulmonary function test.

UNIT III NERVOUS SYSTEM AND SPECIAL SENSES 9

Structure and function of Nervous tissue – Reflex action – Peripheral Nervous System– Autonomic Nervous System, Structure of Sense Organs (Eye, Ear, Nose and Skin), Visual and Auditory Pathway.

UNIT IV DIGESTIVE AND EXCRETORY SYSTEM 9

Organization of GI system, Digestion and absorption – Movement of GI tract – Structure of Nephron – Mechanism of Urine formation – Urine Reflex – Temperature regulation and Sweat Gland.

UNIT V ENDOCRINE AND REPRODUCTIVE SYSTEM 9

Mention of Endocrine glands general hormonal action (Pituitary, Thyroid, Parathyroid, Adrenal, Pancrease), Second messengers, testis, ovaries, Fallopian tube, Uterus.

TEXTBOOKS:

1. Arthur C, Guyton, John Hall.E “Textbook of Medical Physiology”, W.B. Saunders Company, Twelfth edition, 2006

REFERENCES:

1. Guyton „Text book of Medical Physiology – WB Jaunder company Philadelphia - 10 edition 2002
2. Cyrul A Keele and Eric Neil – Samsons Wrights Applied physiology – Oxford University press New Delhi – 1991
3. Ranganathan T S,Text Book of human Anatomy S. Chand and company New Delhi – 1994
4. Best and Taylor, The livery Body – BC publication New Delhi 1980
5. <http://vet.uokufa.edu.iq/staff/falah/Textbook%20of%20Medical%20Physiology.pdf>

BBM302	Electrical Measurements and Instrumentation	L	T	P	C
	Total Contact Hours - 45	4	0	0	4
	Prerequisite – Basic Electrical				
	Course Designed by – Dept of E&I				
OBJECTIVES					
The student will be made to understand:					
• Magnetic circuits, principle and application of transformers • Principle of operation of DC motors and AC Machines • Principle of fractional-kW motors and their applications.					
COURSE OUTCOMES (COs)					
CO1	Describe principles and applications of different ammeters and voltmeters				
CO2	Explain the types and working of watt meters and energy meters				
CO3	Learn the types, construction, and working of different types of potentiometers				
CO4	Describe in detail the different methods of resistance measurements				
CO5	Describe in detail the different methods of impedance measurements				

UNIT – 1

9

DIFFERENT TYPES OF AMMETERS AND VOLTMETERS

Galvanometers – Principle of operation, Construction and sources of errors and compensation in PMMC and Moving iron Instruments – Dynamometer and Rectifier type Ammeter and Voltmeters

UNIT –II

9

WATTMETERS AND ENERGY METERS

Electrodynamics type wattmeter – Theory and its errors – methods of correction – LPF Wattmeter – Phantom loading – Induction type Kwh meter – theory and adjustments – calibration of wattmeter's and energy meters

UNIT – III

9

POTENTIOMETERS AND INSTRUMENT TRANSFORMERS

Student type potentiometer & L and N type potentiometer – precision potentiometer – polar and co – ordinate type – A.C. potentiometers – their applications – construction and theory of operation C.T. and V.T. phasor diagrams – Characteristics- applications.

UNIT IV

9

RESISTANCE MEASUREMENT

Measurement of low , medium & High resistances ammeter Voltmeter method – Wheatstone Bridge – Precision form wheat stone Bridge – Kelvin Double Bridge – Ductor Ohmmeter – Series Shunt type ohmmeters – High Resistance measurement – Megger – Direct deflection methods – price's Gauard wire method – Megohm Bridges – loss of charge method – earth resistance measurement.

UNIT – V

9

IMPEDANCE MEASUREMENT

A.C.Bridges – Measurement of inductance , capacitance – Q of coil – Maxwell's Bridge – Maxwell's Wien Bridge – Hay's Bridge Schering Bridge - Anderson Bridge – Campbell Bridge to measure mutual inductance – errors in A.C Bridge method and their compensation – Detectors and excited field A.C Galvanometer – Vibration Galvanometer

L:45

L = 45 TOTAL: 45 PERIODS

TEXT BOOKS:

1.Sawhney A.K., *A. Course in Electrical and Electronics Measurements and Instrumentation*,
Dhanpat Rai and Sons, New Delhi, 1995.

BCE406	ENVIRONMENTAL STUDIES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Physical Sciences				
	Course Designed by – Dept of Civil Engineering				
OBJECTIVES					
1. To study the nature and facts about environment. 2. To find and implement scientific, technological, economic and political solutions to environmental problems. 3. To study the interrelationship between living organism and environment. 4. To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value. 5. To study the dynamic processes and understand the features of the earth’s interior and surface. 6. To study the integrated themes and biodiversity, natural resources, pollution control and waste management.					
COURSE OUTCOMES (COs)					
CO1	Play an important role in transferring a healthy environment for future generations				
CO2	Analyze the impact of engineering solutions in a global and societal context				
CO3	Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems				
CO4	Ability to consider issues of environment and sustainable development in his personal and professional undertakings				
CO5	Highlight the importance of ecosystem and biodiversity				

UNIT I THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

9

Definition, scope and importance, Need for public awareness.

Natural Resources : Renewable And Non – Renewable Resources

Natural resources and associated problems

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

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

UNIT II ECOSYSTEMS

8

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

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

UNIT III BIODIVERSITY AND ITS CONSERVATION

7

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

Environmental Pollution

7

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

8

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

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

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

6

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

TEXTBOOKS:

1. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.

REFERENCES:

1. Bharucha Erach, “The Biodiversity of India”, Mapin Publishing Pvt. Ltd., Ahmedabad India.2002
2. Trivedi R.K., “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Vol.I and II, EnviroMedia 2009
3. Cunningham, W.P.Cooper, T.H.Gorhani, “Environmental Encyclopedia”, Jaico Publ., House, Mumbai, 2001.
4. Wager K.D. “Environmental Management”, W.B. Saunders Co., Philadelphia, USA, 1998.
5. Trivedi R.K. and P.K. Goel, “Introduction to Air Pollution”, Techno Science Publications 2013

	MICROPROCESSORS AND ITS APPLICATIONS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

REFERENCE:

1. Mature . A “Introduction of microprocessor “ Tata McGraw Hill Publishing, Co Ltd., New Delhi 1989.
2. Theagarajan “Microprocessor and Microcontroller - 2ndEdn”. SCITECH Publications chennai.2003.
3. <http://nptel.ac.in/courses/108107029/>

	INTRODUCTION TO ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
BBM304	Total Contact Hours - 60	4	0	0	4

REFERNCES:

1. <http://nptel.ac.in/courses/122104013/main1.html>

	MICROPROCESSOR LAB	L	T	P	C
	Total Contact Hours - 45	0	0	3	2

BEC 3L1	Prerequisite – Digital Electronics
	Course Designed by – Department of Electronics and Communication Engineering.
OBJECTIVES	
1. Study the Architecture of 8085 microprocessor. 2. Learn the design aspects of I/O and Memory Interfacing circuits. 3. Study about communication and bus interfacing. 4. Study the Architecture of 8051 microcontroller.	
COURSE OUTCOMES (COs)	
CO1	Design and implement programs on 8085 microprocessor.
CO2	Design I/O circuits.
CO3	Design Memory Interfacing circuits.
CO4	Design and implement 8051 microcontroller based systems.
CO5	Design the instruction sets and interfacing
CO6	Design the instruction sets and programming for microprocessor

1. Familiarization of 8085 microprocessor kit.
2. Familiarization of 8051 microcontroller kit
3. 8085 and 8051 assembly language programming exercises
4. Interfacing of switches and display devices
5. Interfacing of D/A and A/D converters
6. Interface of key board and display using programming controllers
7. Interface of programmable timer
8. Stepper motor control using microprocessor
9. Interface of printer using UART

	ELECTRICAL AND ELECTRONIC MEASUREMENT LAB	L	T	P	C
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BEI3L2	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Basic Electronics				
	Course Designed by – Department of Electronics and Communication Engineering.				
OBJECTIVES 1. To introduce electric circuits and its analysis. 2. To impart knowledge on solving circuits using network theorems. 3. To introduce the phenomenon of resonance in coupled circuits. 4. To educate on obtaining the transient response of circuits.					
COURSE OUTCOMES (COs)					
CO1	Design electric circuits and do various tests on it				
CO2	Gain knowledge on solving circuits using network theorems.				
CO3	Attain in-depth knowledge on the phenomenon of resonance in coupled circuits.				
CO4	Work on obtaining the transient response of circuits.				
CO5	Plot the phase or diagrams and analysis of three phase circuits.				
CO6	To Study of feedback in amplifiers.				

LIST OF EXPERIMENTS:

1. Use of Wheat Stone bridge as resistance to voltage converter and to determine its Sensitivity for various ratios.
2. Kelvin double bridge.
3. Determination of critical damping resistance of a D"Arsonval Galvanometer.
4. Tests on a single - phase energy meter.
5. Calibration of wattmeter at different power factors.
6. Testing of current transformers.
7. Calibration of ammeter, voltmeter and wattmeter using student type potentiometer.
8. Design construction and calibration of series and shunt type ohmmeters.
9. Operational amplifier applications.
10. Regulated power supply using fixed voltage IC regulators and LM 723.
11. Frequency response characteristics of CE and CB amplifiers.
12. Study of feedback in amplifiers.
13. RC phase shift and Wien Bridge Oscillator.

BBM3L2	ANATOMY AND PHYSIOLOGY LAB	L	T	P	C
	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Biology (Class X-XII)				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
To provide the students the exposure to the fundamentals in human anatomy and physiology.					
COURSE OUTCOMES (COs)					
CO1	Study on bone				
CO2	Study of Electrocardiogram				
CO3	Analyze the Total count and Hemoglobin estimation.				
CO4	Analyze the process of blood Pressure Monitoring				
CO5	To understand the structure and location of every organ system				
CO6	To understand the physiology of tests.				

LIST OF EXPERIMENTS:

1. Study on Upper Extremity bone.
2. Study in Lower Extremity bone.
 - Identification of Bone
 - Side identification
 - Identification of Important feature
3. Study of ECG.
4. Blood Pressure Monitoring.
5. Blood Cell Count – Total count and Hemoglobin estimation.
6. ESR estimation.
7. Blood group identification and differential count of differential WBC Count.
8. Auscultation for Heart Sounds
9. Weber's and Kinney's test too auditory conduction.

BBM401	BIOSTATISTICS	L	T	P	C
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	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Numerical Methods				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.					
To acquaint the student with Fourier transform techniques used in wide variety of situations.					
To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes					
To develop Z transform techniques for discrete time systems.					
COURSE OUTCOMES (COs)					
CO1	To learn the basics of statics in biomedicine				
CO2	To learn basic concepts of various probability distributions				
CO3	To have a clear understanding about various hypotheses and testing				
CO4	To analyze any given model in terms of variance				
CO5	To understand the basics of Statistical Quality Control				
CO6	To know the probability based problems				

UNIT I - INTRODUCTION TO BIO-STATISTICS (numerical problems only) 9+3

Handling univariate and bivariate data – Measures of central tendency – Measures of dispersion –Skewness & Kurtosis – Correlation and Regression .

UNIT II – PROBABILITY & THEORETICAL DISTRIBUTIONS 9+3

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 9+3

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 9+3

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 9+3

Introduction – Process control – control charts for variables - $\bar{X}$ and R, $\bar{X}$ and s charts control charts for attributes : p chart, np chart, c chart.

TEXT BOOKS

1. S.C.Gupta & V.K.Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi , 2003.
2. W.Ewans & G.Grant, Statistical Methods in Bio informatics – An Introduction.
3. <https://medschool.vanderbilt.edu/biostatistics/content/what-biostatistics>

	CLINICAL BIOCHEMISRTY	L	T	P	C
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BBM402	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Biology				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
1. Introduced to the basics of biochemistry, i.e, synthesis and carbohydrates, lipids etc					
2. Familiarized with the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzyme					
COURSE OUTCOMES (COs)					
CO1	Classification, properties, metabolism and synthesis of carbohydrates, glucose.				
CO2	Classification of amino acids, proteins, metabolism of urea etc				
CO3	Types and properties of lipids, metabolic disorders etc				
CO4	Chemical nature and properties of Enzymes, hormones and nucleic acids and related disorders				
CO5	Basic functional tests, measurement of electrolytes etc.				
CO6	To understand the metabolism based problems				

UNIT-I CARBOHYDRATE 9

Carbohydrate classification, structure and Properties of Mono-di and Polysaccharides with its clinical importance and its uses Biological importance of carbohydrates metabolism – glycolysis, TCA cycle, Glyes, resgenesis, Pentose phosphate pathway, Uronic acid pathway, metabolism of fructose, Sorbitol pathway, metabolism of gelatos and its dysfunction

UNIT-II PROTEIN 9

Classification of amino acids – characteristics of amino acids – Zwitterions, Iso-electric point. Protein classification. Structure of proteins, primary, secondary, tertiary and quaternary structure. Biological importance of polypeptides. Metabolism of ammonia, Urea cycle Metabolic disorders of glacier, Phenyl alumina, tyrosine, Tryptophan. Metabolic defects of branched chain amino acids maple syrup urine disease.

UNIT-III LIPIDS 9

Classification of lipids. Compound lipids. Structure and properties of compound lipids, glycolipids, glycerophosphatides, Phospoinositides. Derived lipids – cholesterol – Biosynthesis of cholesterol Bile acids and its importance. B oxidation of fatty acids. Disorder sol lipid metabolism. Arthosclerosis, hypercholesterolemia, hyperlipoproteinemias and fatty, liver diseases.

UNIT-IV ENZYMES, HARMONES AND NUCLEIC ACID 9

Enzymes – chemical nature. Hormones – chemical nature, properties of hormones and hormonal disorders. Nucleic acid. Composition and function of nucleic acid. Structure of DNA, RNA, Synthesis and degeneration of Purine and Pyramidine metabolism.

UNIT-V BIOCHEMISTRY OF BLOOD AND BODY FLUIDS 9

Liver function test. Renal function test. Acid base balance and imbalance measurements of electrolytes, their abnormal and normal values and conditions. Biochemistry of urine testing, uses of isotopes in Biochemistry.

TEXT BOOKS:

1. Text book of medical biochemistry – Rana shine, MN Chatterje 3rd edition.
2. Sathyanarayana, Textbook of Biochemistry, 2003.

REFERENCES:

1. Saini A.S “Clinical Biochemistry in Diagnosis and Management” CBS Publishers. Chennai 2005
2. Varley / Harold “Practical Clinical Biochemistry” CBS Publishers. Chennai 2005
3. <http://as.wiley.com/WileyCDA/WileyTitle/productCd-EHEP002746.html>

BBM403	BIO MEDICAL INSTRUMENTATION - I	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Fundamentals of Electronics and Instrumentation				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
The students will be exposed to electrical and non-electrical physiological measurements and bioamplifiers					
COURSE OUTCOMES (COs)					
CO1	Understand the purpose of measurement, the methods of measurements, errors associated with measurements.				
CO2	Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications.				
CO3	Know the different display and recording devices for various biosignals				
CO4	Know the measurement techniques for blood flow measurement and cell counting				
CO5	Learn the uses of pH, spectrometers and auto-analyzer				
CO6	To learn about the characteristics of various biopotentials				

UNIT-I INTRODUCTION TO MEDICAL INSTRUMENTS 12

Design of medical instruments – components of biomedical instrument system, Electrodes & Transducers.

UNIT-II BIOSIGNAL ACQUISITION 12

Physiological signal amplifiers. Biosignal analysis signal recovery and data acquisition. Pattern recognition.

UNIT-III BIOPOTENTIAL RECORDS 12

ECG, EMO, EEG, ERO, EOG, Echo cardiography – characteristics of the recording systems – lead systems and recording methods – waveforms.

UNIT-IV BLOOD FLOWMETERS AND BLOOD CELL COUNTING 12

EM and Ultrasonic blood flow meters. Indicator dilution method, thermo dilution method, Manual and automatic counting of RBC, WBC and platelets.

UNIT-V BIOCHEMICAL MEASUREMENTS 12

Ph, pco₂, po₂, - calorimeter, spectrophotometer, flame photometer. Autoanalyser.

TEXT BOOKS:

1. Arumugam.M, Textbook of Biomedical Instrumentation,2003.
2. Richard A. Norman “Principles of Biomedical Instrumentation” John Wiley and sons. New York.1988.

REFERENCE:.

1. Khanpur R.R., Handbook of Biomedical Instrumentation, Tata McGraw hill publishing company. New Delhi 1999.
2. Scott / Mathur "Textbook of Biomedical Instrumentation" CBS Publishers. Chennai 2007.
3. <http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html>

BBM404	MEDICAL ELECTRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic knowledge of electronic devices, and physiological system				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
1. To provide practice on recording and analysis of different Bio potentials					
2. Study the function of different Therapeutic equipments.					
COURSE OUTCOMES (COs)					
CO1	IC circuits, Op-amps, rectifiers and its applications				
CO2	Safety concerns in hospitals				
CO3	Use of filters in biomedical applications				
CO4	Different types of read-out devices used				
CO5	Use of timers and counters				
CO6	To know the protection and over voltage protection circuits				

UNIT-I LINER INTEGRATED CIRCUITS 9

Introduction to liner integrated circuits, operational amplifiers, characteristics, application, Op amp circuits, Bio medical applications. Rectifiers op amp circuits using diodes, SMPS basic ECG amp, was form generation using Op amps.

UNIT-II SAFETY INSTRUMENTATION 9

interference and instability of biomedical signals. Electrical and magnetic components – leads as path of resistance – minimizing interference. Introduction – Physiological effects micro shock. Macro shock – electrical accidents in hospitals – Electrical Hazards – Safety Measures.

UNIT-III FILTERS 9

Carrier current and line noise HP,BP, BR – radio frequency interference, RF power, measurement – base line shift.

UNIT-IV READ OUT DEVICES 9

Recorders – types –Strip chart – XY Recorders, Magnetic tape Recorders – UV recorders – direct recording – other types.

UNIT-V TIMERS AND COUNTERS 9

Delay timer, interval timer, design of ADC and DAC circuits, frequency counters, multivibrator, flip flop.

TEXT BOOKS:

1. Ramakant A. Gayakwad, op Amps and Linear Integrated circuits “Prentice Hall of India, New Delhi, 3rd Edition , 1997.
2. Roy choudhury and Shah Jain, „Linear Integrated circuits“, 1995.

REFERENCES:

1. Milam"s and Halkias, "Electronic devices and circuits" Tata McGraw Hill publishing Co. Ltd., Delhi, 1996.
2. Joseph Dubay, Introduction to Bio medical electronics, McGrew Hill book Co., 2008.
3. Terra behilla "Bio medical and clinical Engineering" Brent ice hall inc., 2001
4. Geddas I.A and Baker I.JF. Principles of applied biopmedical instrumentation" , John Wiley and Sons,1992.
5. http://www.academia.edu/6243100/EC2021-_Medical_Electronics_notes_for_all_five_units

BEC404	BASIC PRINCIPLES OF COMMUNICATION AND CIRCUITS	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Basic knowledge of electronic devices				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
1. Understand analog and digital communication techniques					
2. Learn data and pulse communication techniques					
3. Be familiarized with source and Error control coding					
4. Gain knowledge on multi-user radio communication					
COURSE OUTCOMES (COs)					
CO1	Apply analog and digital communication techniques				
CO2	Use data and pulse communication techniques				
CO3	Analyze Source and Error control coding				
CO4	Utilize multi-user radio communication				
CO5	Modulate and demodulate a signal.				
CO6	To understand the principles of both digital and analog communication				

UNIT I BASIC OF CIRCUIT ANALYSIS

12

Kirchoffs law, DC and AC excitation, series and parallel circuit, sinusoidal steady state analysis. Mesh current and nodes voltage method of analysis, matrix method of analysis. Thevenins and Norton theorems, super position theorem, compensation theorem, Reciprocity theorem, maximum power transfer theorem and parallel resonance, quality factor and bandwidth.

UNIT II STATICS ELECTRIC FIELD

12

Coulomb's law. Electric field intensity. Gaussi law and its applications, permittivity, polarization, Boundary relation, capacitance, Dielectric strength. Energy and Energy density. Poisson's and Laplace equations and applications. Electric current Density. Ohm's law at a point. Resistance and conductance, continuity relations for current problems.

UNIT III STEADY MAGNETIC FIELD

12

The Biot stewart law. Gauss's law for magnetic fields. Torque on a loop. Ampere's law and magnetic field intensity, magnetic materials. Magnetic dipoles. Loops and solenoids. Magnetization, Inductance, Energy in an inductor and Energy density, boundary relation, Ferromagnetism, Hysterical, Reluctance and presence problem.

UNIT IV ANALOG MODULATION SYSTEM

12

Basic principle of AM, FM and PM spectra power consideration. Receivers characteristic and deduction of AM, FM and system performance Threshold effect reduction.

UNIT V BASE BAND DATA COMMUNICATION AND DIGITAL MODULATION

Sampling and quantization PCM, ADPCM, DM, ADM, Base and pulse shaping binary data formats. Base band transmission ISI Correlative coding. Optimum SNR matched filter detection. Digital modulation, coherent binary modulation techniques, non coherent binary modulation.

TEXTBOOK:

1. Taub and Schilling, „Principles of Communication“, Tata McGraw Hill Publication, 1990.
2. Joseph Ediminister and Mahmood Nahri, “Electric Circuits”, Third Edition, Tata McGraw Hill, New Delhi, 1999.

REFERENCE:

1. John D. Krauss, “Electromagnetics”, McGraw Hill, 1999.
2. <http://www.nptel.ac.in/courses/117106090/>

BBM405	BIOSENSORS AND TRANSDUCERS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic knowledge of electronic devices and sensors				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
1. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.					
2. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.					
3. Know the different display and recording devices.					
COURSE OUTCOMES (COs)					
CO1	Describe the purpose and methods of measurements				
CO2	Explain different display and recording devices for various applications.				
CO3	Know the principle of transduction, classifications and the characteristics of different transducers and study its biomedical applications				
CO4	Remember and understand the concepts, types, working and practical applications of important biosensors.				
CO5	Know some of the commonly used biomedical transducers				
CO6	To learn the different types of transducers and its applications				

UNIT - I SCIENCE OF MEASUREMENT 9

Units and Standards - calibration methods - statics calibration - classification of errors, error analysis - statistical methods - odds and uncertainty.

UNIT - II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics - accuracy, precision, sensitivity, linearity etc - mathematical model of transducers - zero first - order and second - order transducers - response to impulse step, ramp and sinusoidal inputs.

UNIT - III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of resistance potentiometers, strain gauges, resistance thermometers, thermistors, hot-wire anemometer, piezoresistive sensors and humidity sensors.

UNIT - IV BIOSENSORS - PHYSIOLOGICAL RECEPTORS - J RECEPTORS 9

Chemo receptors, Baroreceptors, Touch receptors, Biosensors - Working Principle and Types, Applications.

UNIT - V OTHER TRANSDUCERS 9

Piezoelectric transducers, magnetostrictive transducer, IC sensor digital transducers - smart sensor - fibre optic transducers.

TEXT BOOKS:

1. Doebelin. E. O, Measurement Systems, McGraw Hill Book Co. 1998
2. Renganathan S, Transducer Engineering, Allied Publishers, Chennai, 2000.

REFERENCE:

1. <http://www.scribd.com/doc/178415581/Transducer-Engineering-Dr-s-Renganathan#scribd>

BBM4L1	BIOSENSORS AND TRANSDUCERS LAB		L	T	P	C
	Total Contact Hours - 45		0	0	3	2
	Prerequisite – Basic knowledge of electronic devices and sensors					
	Course Designed by – Department of Biomedical Engineering.					
OBJECTIVES						
4. Understand the purpose of measurement, the methods of measurements, errors associated with measurements.						
5. Know the principle of transduction, classifications and the characteristics of different transducers and study its Biomedical applications.						
6. Know the different display and recording devices.						
COURSE OUTCOMES (COs)						
CO1	Design the purpose and methods of measurements					
CO2	Design different Strain Gauge characteristics. for various applications.					
CO3	Learn and Design Hall Effect transducer					
CO4	Design Ramp response characteristic of filled in system thermometer.					
CO5	Know Load cell characteristics					
CO6	To learn the Characteristics of LVDT.					

LIST OF EXPERIMENTS:

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Strain Gauge characteristics.
3. Load cell characteristics.
4. Photoelectric tachometer.
5. Hall Effect transducer.
6. Characteristics of LVDT.
7. Characteristics of LDR, thermistor and thermocouple.
8. Ramp response characteristic of filled in system thermometer.
9. Step response characteristics of RTD and thermocouple.

BBT4L2	BIOCHEMISRTY LAB		L	T	P	C
	Total Contact Hours - 45		0	0	3	2
	Prerequisite – Basic Biology					
	Course Designed by – Department of Biomedical Engineering.					
OBJECTIVES						
3. Introduced to the basics of biochemistry, i.e, synthesis and carbohydrates, lipids etc						
4. Familiarized with the Classification, structure and properties of carbohydrates, Lipids, Protein and Enzyme						
COURSE OUTCOMES (COs)						
CO1	Qualitative analysis .					
CO2	Estimation of different methods					
CO3	Isolation of Starch					
CO4	Estimation of DNA					
CO5	Abnormal Urine analysis					
CO6	Estimation of Creatinine by Jafe’s method.					

LIST OF EXPERIMENTS:

1. Qualitative analysis of Glucose.
2. Qualitative analysis of Fructose.
3. Qualitative analysis of Maltose.
4. Qualitative analysis of Sucrose.
5. Qualitative analysis of Lactose.
6. Estimation of Glucose by Benedict’s Method.
7. Estimation of Glucose by Lowry’s Method.
8. Estimation of Protein by Biuret’s Method.
9. Estimation of DNA by Diphenyl amine method.
10. Estimation of Glucose present in Urine Sample.
11. Isolation of Starch from Potato.
12. Estimation of Amino acid by Ninhydrin method.
13. Estimation of Creatinine by Jafe’s method.
14. Abnormal Urine analysis (Glucose, Protein, Acetone, etc.).

BBM501	LINEAR AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basics of electronic circuits				
	Course Designed by – Department of E & I				
OBJECTIVES					
To study the application of analog ICs in the designing circuit.					
To study the applications of these Digital ICs.					
To understand the basic of the Digital systems.					
To study the design of the various functional circuits using these ICs.					
COURSE OUTCOMES (COs)					
CO1	Basics of number systems, conversion and filters				
CO2	Basics of Logic gates and Boolean algebra				
CO3	Full adder and Half adder and its implementation using ICs				
CO4	Different types of ICs and sequential circuits				
CO5	Details about RAM, ROM, EPROM and types of memories				
CO6	To understand the basic of the Digital systems.				

Unit 1: NUMBER SYSTEMS, CODES AND OPERATIONAL AMPLIFIERS 9

Number systems-Decimal, binary, Octal, Hexadecimal, conversion from one to another, complement arithmetic. Codes – Gray code, Excess-3 code, alphanumeric code. Error detection and correction. Characteristics of ideal op amp, Virtual Short, differential amplifier, offset currents and voltages, Slew rate, 741 IC Specifications, inverting and non-inverting amplifiers, differential dc amplifier, bridge amplifier, integrator, differentiator, active low pass, high pass and band pass active filters, precision diode and clamp, half wave rectifier, average detector, peak detector, log – antilog amplifiers, monostable and triangular wave generators.

UNIT II: BOOLEAN ALGEBRA AND LOGIC GATES 9

Basic theorems and properties of Boolean Algebra-De Morgan's Theorem, simplification using Boolean algebra, sum of product and product of sum, Karnaugh map. Tabulation methods, Logic gates – Truth tables, Realization of Boolean functions using Gates, Universal Gates. Logic gates- AND, OR, NOT, NAND, NOR, EX-OR GATES. Universal property of NAND AND NOR gates.

UNIT III: COMBINATIONAL CIRCUITS 9

Basic adder – half adder, full adder, comparator, decoder, encoder, multiplexer, demultiplexer, Parity generator or checker. Boolean Expression Implementation using these IC's.

UNIT IV: SEQUENTIAL CIRCUITS 9

Flip-flop – SR, JK, T, D, Master-slave flip-flop, shift registers, ripple counter, Excitation Tables, Design of counters using Excitation tables, synchronous counters and Asynchronous Counters,

7490, 74161 Counter IC specifications, Ring and Johnson Counters, Shift Register and IC Specifications

UNIT V: MEMORY AND STORAGE

9

Basics of semiconductor memory, RAM-static and dynamic, ROM-EEPROM, special types of memories.

TEXT BOOKS

1. Roy Choudhury and ShailJain, *Linear Integrated circuits* , Wiley Eastern Ltd., 1995.
2. Coughlin & Driscull, *Operational Amplifiers & Linear Integrated Circuits* , 6th ed., Prentice Hall Of India, 2003.

REFERENCE BOOKS

1. Gayakwad A.R. , *Op-Amp and Linear Integrated circuits* ,4th ed. Prentice Hall of India, 2003.
2. Sergio Franco,, *Design with Operational Amplifier and Analog Integrated Circuits* , McGraw Hill, 1997.
3. <http://nptel.ac.in/video.php?subjectId=108106069>

BEI502	DIGITAL SIGNAL PROCESSING	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Basics of electronics and C++ programming				
	Course Designed by – Department of E & I				
OBJECTIVES					
1. To learn discrete Fourier transform and its properties					
2. To know the characteristics of IIR and FIR filters learn the design of infinite and finite impulse					
3. response filters for filtering undesired signals					
4. To understand Finite word length effects					
5. To study the concept of Multi-rate and adaptive filters					
COURSE OUTCOMES (COs)					
CO1	Apply DFT for the analysis of Digital Signals & Systems				
CO2	Design IIR and FIR Filters				
CO3	Characterize finite word length effect on filters				
CO4	Design the Multi-Rate Filters				
CO5	Apply Adaptive Filters to equalization				
CO6	To learn the mathematical way of designing the filters				

UNIT-1 DISCRETE TIME SIGNALS AND SYSTEMS

9+3

Periodic and Pulse signals-eg."s for sequences-Pulse,Step,Impulse,Ramp,Sine and exponential-Differential equations-Linear time invariant-Stability,casuality-DT systems-Time domain analysis.

UNIT-2 DISCRETE TIME SYSTEMS - Z TRANSFORM

9+3

Z transform and its properties-Convolution, Inverse.Z transform-Discrete Fourier series Properties-Sampling the Z transform-Discrete Fourier transform-Properties for frequency domain analysis-Linear Convolution using discrete Fourier transform-Overlap save method.

UNIT-3 FREQUENCY ANALYSIS OF SIGNALS - FAST FOURIER TRANSFORMS

9+3

Introduction to Radix to FFT"s-decimation in the FFT Algorithm-Decimation in frequency FFT Algorithm-Computing inverse DFT using FFT-mixed radix FFT algorithm, Periodogram Techniques.

UNIT-4 IIR FILTER DESIGN

9+3

Classification-Reliability constraints-IIR design-Butterworth and Chebyshev Filters, Bilinear Transform Method-Impulse Invariant Method-Step Invariance Method.

UNIT-5 FIR FILTER DESIGN**9+3**

FIR design-Fourier Series Method –Window function Method, triangular window, rectangular window, Hamming window, Hanning window functions, Kaiser window. Applications of Signal Processing in Biomedical Engineering.

TEXTBOOKS:

1. Openheim.A.V & Shaefer.R.S. “ Discrete Time Signal Processing “ Prentice Hall , N.J , 1980.
2. Proakis .J.G & Manolakis.D.G “ Introduction to Digital Signal Processing “ Maxwell Mc.Williams International Edition London 1989.

REFERENCES :

1. Antonla.A “Digital Filter Analysis and Design”, TataMcGraw Hill publishing Co., NewDelhi, 1998.\
2. Stranneby “Digital Signal Processing & Applications” CBS Publishers. Chennai 2006
3. Biomedical Digital Signal Processing by Tompkins.
4. <http://www.ece.wisc.edu/~cobb/courses/431Notes.pdf>

BBM503	BIOMEDICAL INSTRUMENTATION II	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Biomedical instrumentation- 1				
	Course Designed by – Department of Biomedical engineering				
OBJECTIVES					
The student should be made to:					
1. Gather basic knowledge about measurements of parameters related to respiratory system					
2. Learn measurement techniques of sensory responses					
3. Understand different types and uses of diathermy units.					
4. Know ultrasound imaging technique and its use in diagnosis					
5. Know the importance of patient safety against electrical hazard					
COURSE OUTCOMES (COs)					
CO1	Explain about measurements of parameters related to respiratory system				
CO2	Describe the measurement techniques of sensory responses				
CO3	Analyze different types and uses of diathermy units				
CO4	Discuss ultrasound imaging techniques and its usefulness in diagnosis				
CO5	Outline the importance of patient safety against electrical hazard				
CO6	Know the instrumentation for various biomedical systems				

UNIT-I HEART LUNG MACHINE 9+3

Condition to be satisfied by the H/L system, different type of Oxygenators, pumps- Blood handling system.

UNIT-II CARDIAC ASSIST DEVICES 9+3

Synchronous counter pulsation, right ventricular bypass pump, left ventricular bypass pump, Intra aortic balloon pumping and veno arterial pumping.

UNIT-III ARTIFICIAL KIDNEY 9+3

Indication and Principle of Haemodialysis, different types of dialysis, monitoring systems, artificial kidney.

UNIT-IV PROSTHETIC AND ORTHODIC DEVICES 9+3

Hand and arm replacement- different types of models, externally powered Prosthesis feed back in orthodic system, materials for prosthetic and orthodic devices

UNIT-V RESPIRATORY AND HEARING AIDS 9+3

Intermittent positive pressure breathing apparatus, operating sequence, audiograms, types of deafness hearing aids, impedance matching -BERA Test.

TEXTBOOKS:

1. Albert-N. Cook & Webster. J. G. Therapeutical medical devices, Prentice hall INC, New Jersey, 1982.

REFERENCES:

1. Khanpur, R.S., Handbook of Bio medical instruments and measurements, Tata Mc-Graw Hill, 1987.
2. Scott / Mathur "Textbook of Biomedical Instrumentation" CBS Publishers. Chennai 2007.
3. <http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html>

UNIT 5**IMPLANTATION BIOMATERIAL****9**

Bioceramics, types – bioactive, restorable, non-resorbable. Stoichiometry and Ca/P ratio of various forms calcium phosphates, bioceramic coatings on metallic implants and bone bonding reactions on implantation. Hydroxyapatite –properties and applications. Bone cements and bio glasses. Dental implants- materials, types and designs.

TEXTBOOKS :

1. Joon Bu Park, Roderic S, Lakes, “Biomaterials”, Springer-Verlag, New York Inc., 2010.
2. Ratner A, and S.Hoffman, B. D. “Biomaterials Science: An Introduction to Materials in Medicine”, Academic Press; 3 edition, November 8, 2012.

REFERENCES:

1. “Biomaterials”, Sujata V Bhat., Narosa Publishing House, New Delhi, 2002.
2. A.F. Von Recum, “Handbook of Biomaterials Evaluation - Scientific, Technical and Clinical Testing of Implant Materials”, 2nd Edn., Taylor & Francis, Philadelphia, 1999.
3. F. Silver and C. Dillon, “ Biocompatibility: Interactions of Biological and Implantable Materials” Vol.1, VCH Publishers, New York, 1989.
4. Park. J.B. “Biomaterials: An Introduction", CBS Publishers, 2007.
5. L.L. Hench and E.C. Ethridge “Biomaterials: An Interfacial Approach”, Academic press, New York, 1982.
6. F.H. Silver, “Biomaterials, Medical Devices and Tissue Engineering: An Intergrated Approach” 1st Edn., Chapman & Hall, London, 1994.
7. Buddy Ratner *et al.*, “ Biomaterials Science – An Introduction to Materials in Medicine”, Academic Press, San Diego, 2004.
8. <http://ocw.mit.edu/courses/mechanical-engineering/2-782j-design-of-medical-devices-and-implants-spring-2006/lecture-notes/>

BBM506	PHYSIOLOGICAL CONTROL SYSTEMS	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – NIL				
	Course Designed by – Department of Biomedical engineering				
OBJECTIVES					
1. To study the concept and different mathematical techniques applied in analyzing any given system 2. To learn the analysis of given system in time domain and frequency domain 3. To study the stability analysis of the given system 4. To study the concept of physiological control system					
COURSE OUTCOMES (COs)					
CO1	Analyze the time and frequency domains of the given system using different mathematical techniques				
CO2	Learn the basics of control systems				
CO3	Time and frequency response analysis				
CO4	Bio-control system definition and modeling				
CO5	Study the model of eye, respiratory system, etc				
CO6	To learn to workout numerical problems based on control systems				

UNIT 1. CONTROL SYSTEM MODELLING

9+3

System concept, Differential Equations, Transfer functions, Modelling of electrical systems, Translational and rotational mechanical systems, Electro-mechanical systems, physiological systems, block diagram modelling, signal flow graphs.

UNIT 2. TIME RESPONSE ANALYSIS

9+3

Time domain specifications, step and Impulse response analysis of first order and second order systems, steady state errors, stability, Routh-Hurwitz criteria, **Root locus techniques, construction of root locus, stability**, dominant poles, applications of Root locus diagram.

UNIT 3. FREQUENCY RESPONSE ANALYSIS

9+3

Frequency response, Bode plot-Nyquist plots, Nyquist stability criterion, Relative stability, Gain margin, phase margin, bandwidth magnitude plots, constant circles, Nichol's chart

UNIT 4. PHYSIOLOGICAL CONTROL SYSTEMS

9+3

Introduction to physiological control systems, **modelling of human movements**, parameter estimation, linearizing

UNIT 5. STUDY OF BIOLOGICAL SYSTEMS

9+3

Human Thermal system, Neuro muscular system, Respiratory system, oculomotor system.

TEXTBOOKS:

1. Michael C K, Khoo, “Physiological Control Systems – Analysis, Simulation and Estimation”, Prentice Hall of India Private Ltd., New Delhi, 2001.
2. Joseph D, Bronzino, “The Biomedical Engineering Handbook”, CRC Press, 3rd edition, 2006

REFERENCES :

1. M.Gopal, “Control Systems”, Principles and Design, Tata McGraw-Hill, 1997.
2. Benjamin. C.Kuo, ' Automatic Control Systems', Prentice Hall of India, 1995.
3. Manfredlyner and John H.Milsum, Bio Medical engineering system, McGraw-Hill and Co., New York, 1970.
4. <http://www.eee.metu.edu.tr/~ngencer/ee518/Lecture%20Notes/2013/Chapter%201/Chapter%201.pdf>

BBM5L1	BIOMEDICAL INSTRUMENTATION LAB	L	T	P	C
	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Biomedical instrumentation- 1				
	Course Designed by – Department of Biomedical engineering				
OBJECTIVES					
The student should be made to:					
• Gather basic knowledge about measurements of parameters related to respiratory system • Learn measurement techniques of sensory responses • Understand different types and uses of diathermy units. • Know ultrasound imaging technique and its use in diagnosis • Know the importance of patient safety against electrical hazard					
COURSE OUTCOMES (COs)					
CO1	Design ECG recording and Analysis.				
CO2	Study of ESU				
CO3	Analyze different types and uses of diathermy units				
CO4	Design of Blood Pressure Measurement System				
CO5	Outline the importance of patient safety against electrical hazard				
CO6	Study about Electrical safety measurements.				

LIST OF EXPERIMENTS:

1. ECG recording and Analysis.
2. EEG recording and analysis.
3. Respiratory Analysis.
4. Blood Pressure Measurement System.
5. Nerve Conduction Study.
6. Digital Heart Monitor.
7. EOG system
8. Study of ESU – cutting and coagulation modes
9. pH Measurement and conductivity test.
10. Spectrophotometer.
11. Flame photometer.
12. ELIZA.
13. Plotting of human auditory response using audiometer
14. Analysis of bio signals using FFT Spectrum Analyser
15. Ultra Sound Dopplers.
16. Defibrillators and Pacemakers (Demo)
17. Ventilators and Humidifiers
18. Nebuliser
19. Pacemaker(Demo)
20. Physiotherapy equipment - Digi laser, Indsonic, Indotherm – 500W
21. Electrical safety measurements.
22. Mini project.

BBM5L2	LINEAR AND DIGITAL INTEGRATED CIRCUITS	L	T	P	C
	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Basics of electronic circuits				
	Course Designed by – Department of E & I				
OBJECTIVES					
To study the application of analog and digital ICs in the designing circuit.					
COURSE OUTCOMES (COs)					
CO1	Design of number systems, conversion and filters				
CO2	Basics of Logic gates and Boolean algebra				
CO3	Design Full adder and Half adder and its implementation using ICs				
CO4	Design the Different types Operational amplifier				
CO5	Details about RAM, ROM, EPROM and types of memories				
CO6	To understand the basic of the Digital systems.				

LIST OF EXPERIMENTS:

1. Inverting, non-inverting amplifier and comparator
2. Active filter – first order LPF and HPF
3. Schmitt trigger using IC741
4. Instrumentation amplifier using IC741
5. Wein bridge oscillator
6. Multivibrator using IC555 Timer
7. Study of logic gates, Half adder and Full adder
8. Encoder and BCD to 7 segment decoder
9. Multiplexer and demultiplexer using digital ICs
10. Universal shift register using flipflops
11. Design of mod-N counter
12. Study of operational amplifier IC 741.
13. Characteristics of operational amplifier IC 741.
14. Inverting and non inverting mode of operation.
15. Operational amplifier as summer and subtractor.
16. Operational amplifier as integrator and differentiator.
17. Active high pass filter(second order)
18. Active low pass filter(second order)
19. Narrow band pass filter.
20. RC phase shift oscillator.
21. Comparator.
22. Squaring circuit.
23. Halfwave rectifier.
24. Current to voltage converter.
25. Voltage to current converter

BBM601	RADIOLOGICAL EQUIPMENT		L	T	P	C
	Total Contact Hours - 60		4	0	0	4
	Prerequisite – Biomedical instrumentation – 1&2					
	Course Designed by – Department of Biomedical engineering					
OBJECTIVES						
The aim of the courses to show the introduction to radiological equipments.						
COURSE OUTCOMES (COs)						
CO1	Have a fundamental knowledge of basic physics of medical imaging					
CO2	Acquire knowledge about treatment planning.					
CO3	Have fundamental knowledge on effects of radiotherapy.					
CO4	Have knowledge about devices used in radiotherapy.					
CO5	Understand advanced applications of radiology.					
CO6	To understand the fundamentals of X Ray imaging and principles					

UNIT I - RADIOTHERAPY PHYSICS & PRE-TREATMENT IMAGING (9+3 hours)

Atoms, nuclei and radioactivity- Radiation interactions with matter- Radiation measurement and detection- Imaging with X-ray, MRI and ultrasound-Imaging with radio nuclides- Therapy with unsealed radio nuclides-**Radiotherapy beam production**

UNIT II - RADIATION TREATMENT PLANNING (9+3 hours)

Immobilization, localization and verification techniques- Principles and practice of radiation treatment planning- Brachytherapy-Networking, data and image handling and computing in radiotherapy- Quality management in radiotherapy.

UNIT III - RADIOTHERAPY EFFECTS (9+3 hours)

Epidemiology of cancer-screening- Biological and pathological introduction- Molecular, cellular and tissue effects of radiotherapy- **Principles and management of patients with cancer-** Chemotherapy and hormones- Skin and lip cancer-head and neck cancer.

UNIT IV - RADIOTHERAPY ASSISTING DEVICES (9+3 hours)

Features of conventional simulator and modern simulator – Immobilization equipment for head, neck, pelvic and extremities

UNIT V - ADVANCED APPLICATIONS (9+3 hours)

Cobalt units, Gamma knife, Linear accelerators, helical tomotherapy, Ancillary equipment – Superficial and ortho voltage equipment

TEXTBOOKS

1. Symonds, Deehan, Meredith & Mills Walter and Miller, “*Textbook of Radiotherapy: Radiation Physics, Therapy and Oncology*”, Churchill Livingstone, Seventh Edition, 2012.
2. Pam Cherry, Angela Duxbury, “*Practical Radiotherapy-Physics and Equipment*”, John Wiley & Sons, Second Edition, 2009

REFERENCES

1. Todd Powliki, Peter Dunscombe B, Arno J, Mundt, Pierre Scalliet, “*Quality and safety in radiotherapy*”, CRC Press, First Edition, 2010
2. Subramania Jayaraman, Lawrence Lanzl H, “*Clinical Radiotherapy Physics*”, CRC Press, Second Edition, 1996
3. <http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1564webNew-74666420.pdf>

BSS601	VALUE EDUCATION AND PROFESSIONAL ETHICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basics of management and bio-ethics				
	Course Designed by – Dept of Management Studies				
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, 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 know the case study with needs the understanding of medical ethics				

UNIT I : PHILOSOPHY OF LIFE AND INDIVIDUAL QUALITIES

9

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

UNIT II : SOCIAL VALUES (INDIVIDUAL AND SOCIAL WELFARE)

9

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

UNIT III: MIND CULTURE & TENDING PERSONAL HEALTH

9

Mind Culture - Life and Mind - Bio - magnetism, Universal Magnetism (God –Realization and Self Realization) - Genetic Centre – Thought Action – Short term Memory – Expansiveness – Thought – Waves, 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: ENGINEERING AS SOCIAL EXPERIMENTATION AND ENGINEERS'S RESPONSIBILITIES FOR SAFETY

9

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

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

9

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

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

TEXT BOOKS:

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

REFERENCE:

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

BBM603	PATHOLOGY AND MICROBIOLOGY		L	T	P	C
	Total Contact Hours - 45		3	0	0	3
	Prerequisite – Basic biology					
	Course Designed by – Dept of Biomedical engineering					
OBJECTIVES						
- To learn about the cell structure and its disorders - To gain knowledge about the fundamental structure of virus, bacteria and its causes						
COURSE OUTCOMES (COs)						
CO1	Have a Fundamental Knowledge about the cell and concepts of tumor.					
CO2	Have to learn about the fluid present in the body and hemodynamic derangement					
CO3	Have a fundamental knowledge of real time imaging with basic hardware architecture, algorithms and transform techniques					
CO4	Have knowledge about basic concepts of infection and immunity of the human body					
CO5	Acquire the fundamental knowledge of structure of Bacteria, virus and its causes.					
CO6	To know the uses of various microbiology based techniques					

UNIT-I NORMAL CELL STRUCTURE 9

Introduction. Cell Degeneration and Regeneration- apoptosis, Neoplasia, Classification- Difference between benign and malignant- Etiology of tumors-Spread of tumors.

UNIT-II FLUID AND HAEMODYNAMIC DELANGEMENT 9

Edema, Shock, Hemorrhage- Thrombus- Embolism- Disseminated intravascular coagulation- Hematological disorders- Bleeding disorders- **Leukemia lymphoma**

UNIT-III INFECTION AND IMMUNITY 9

Normal Flora of the body- Host and Parasite relationship- Types of immunity-Innate and adaptive immunity- Important Bacterial, Viral, **Protozoan and Helminthic Diseases.**

UNIT-IV MICROORGANISMS 9

Structure of Bacteria and Virus – Methods of Isolation of Bacteria viz Streak Plate, Pour plate and Spread plate methods, viral cell- Growth and cultivation of bacteria. Microscopy- Light microscopy- Dark field microscopy- Phase contrast microscopy- Electron microscopy.

UNIT-V STRAINING TECHNIQUES 9

Identification of disease producing organism simple, gram, AFB stain, fluorescent techniques, Ag-Ab techniques like Double diffusion, electro immune diffusion and agglutination techniques.

Text Book:

1. Pillai / Qadry “Biochemistry and Clinical Pathology” CBS Publishers. Chennai. 2008.
2. Sharma “Biochemical Engineering, Biochemistry, Biotechnology & Microbiology” CBS Publishers. Chennai 2007

3. Jain P.C “Microbiology & Biotechnology for Sustainable Development” CBS Publishers. Chennai 2004.
4. Paul “Soil Microbiology, Ecology & Biochemistry” CBS Publishers. Chennai 2009.
5. <https://www.vidyarthiplus.com/vp/Thread-BM2252-Pathology-And-Microbiology-Lecture-Notes#.Vu06XuJ97IU>

BBM605	BIO SIGNAL PROCESSING	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – Basics of signals and systems				
	Course Designed by – Dept of Biomedical engineering				
OBJECTIVES					
The aim of the courses to show the introduction to biomedical signal, data acquiring system, Filtering and event detection in the biomedical signals.					
COURSE OUTCOMES (COs)					
CO1	Have a fundamental knowledge of biomedical signal.				
CO2	Acquire knowledge about the filtering the biomedical signal.				
CO3	Have fundamental knowledge event detection, ECG, EEG, EMG and the detection of waveform				
CO4	Have knowledge about Biosignal processing using Fourier transformation.				
CO5	Acquire the skills Pattern classification and diagnostic Decision.				
CO6	To learn the various filtering techniques for biosignals				

Unit – 1	INTRODUCTION TO BIOMEDICAL SIGNALS	9+3
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The nature of biomedical signals, Examples of Biomedical signals-The action potential, The Electroneurogram(ENG), The Electromyogram (EMG), The Electro Cardiogram (ECG), Event related potentials (ERPs), The Electroencephalogram (EGG), The Phonocardiogram (PCG), The speech signal.

Unit-2	FILTERING FOR REMOVAL OF ARTIFACTS	9+3
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Time-domain Filters-synchronized averaging. Moving Average Filters, Derivative-based operators to remove low frequency artifacts. Frequency-domain filters-Removal of High Frequency noise; Butterworth, Low pass filters. Removal of low frequency noise; Butterworth, high pass filters. Removal of periodic artifacts: Notch and comb Filters.

Unit-3	EVENT DETECTION	9+3
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Detection of Events and waves: Derivative-based methods for QRS detection, The Pan-Topkins algorithm for QRS detection. Correlation Analysis of EEG channels: Detection of EEG rhythms, Template matching for EEG spike and- Wave detection. Cross Spectral Techniques-Coherence analysis of EEG channels. The matched Filters- **Detection of EEG spike and wave Complexes.** Homomorphic Filtering-Generalized linear filtering, Homomorphic deconvolution.

Unit 4 **ANALYSIS OF NON STATIONARY SIGNALS** **9+3**

Time variant system-characterization of non stationary signals and dynamic systems. Fixed Segmentation- The short time Fourier transforms. Adaptive segmentation-Spectral error measure, ACF distance. Application- Adaptive segmentation of EEG signals, Time Varying analysis of Heart –rate Variability.

Unit-5 PATTERN CLASSIFICATION AND DIAGNOSTIC DECISION 9+3

Pattern classification: supervised pattern classification-Discriminate and decision functions, distance functions. Unsupervised Pattern classification: cluster seeking methods. Logistic Regression analysis. Neural networks.

TEXT BOOKS

1. John G. Proakis and Dimitris G. Manolakis, *Digital Signal Processing, Algorithms and Applications*, PHI of India Ltd., New Delhi, 3rd Edition, 2000.
2. Rangaraj. M. Rangayyan, *Biomedical signal processing*, IEEE Press, 2003.

REFERENCES

1. Sanjit K. Mitra, „Digital Signal Processing“, A Computer Based Approach, Tata McGraw-Hill, New Delhi, 1998.
- <http://ocw.mit.edu/courses/health-sciences-and-technology/hst-582j-biomedical-signal-and-image-processing-spring-2007/lecture-notes/>

BBM6L1	BIO SIGNAL PROCESSING LAB	L	T	P	C
	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Basics of signals and systems				
	Course Designed by – Dept of Biomedical engineering				
OBJECTIVES					
To gain the practical knowledge about the various bio signals and its characteristics					
COURSE OUTCOMES (COs)					
CO1	To represent the basic discrete time signals and analyze it				
CO2	To design the IIR and FIR filter				
CO3	To analyze various types of bio signals and study its characteristics				

LIST OF EXPERIMENTS

1. Generation of signals- Discrete and continuous.
2. Representation of time-series; computation of convolution.
3. Response of a difference equation to initial conditions; stability.
4. DFT computation.
5. Computational experiments with digital filtering.
6. Sampling and waveform generation.
7. FIR and IIR filters implementation.
8. Simulation of Biosignals and Analysis of ECG signals, EEG signals and EMG signals.
9. Properties of Fourier transform – zeros, FFT Discrete Fourier transform
10. Properties of Fourier transform- FFT SHIFT, IFFT SHIFT

BBM6L2	PATHOLOGY AND MICROBIOLOGY	L	T	P	C
	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Basic biology				
	Course Designed by – Dept of Biomedical engineering				
OBJECTIVES					
- To learn about the cell structure and its disorders - To gain knowledge about the fundamental structure of virus, bacteria and its causes					
COURSE OUTCOMES (COs)					
CO1	Have a Fundamental Knowledge about the cell and concepts of tumor.				
CO2	Have to learn about the fluid present in the body and hemodynamic derangement				
CO3	Have a fundamental knowledge of real time imaging with basic hardware architecture, algorithms and transform techniques				
CO4	Have knowledge about basic concepts of infection and immunity of the human body				
CO5	Acquire the fundamental knowledge of structure of Bacteria, virus and its causes.				
CO6	To know the uses of various microbiology based techniques				

LIST OF EXPERIMENTS:

- Haemoglobin Estimation-Lyanmeth Haemoglobin method.
- Peripheral smear study (i) Morphology.
(ii) Different count,
(iii) Total count.
- Cross matching of Blood-ABO blood grouping.
- Cytopathic effect.
- Study on inclusion bodies.
- Antigen-Antibody reaction Immuno electrophoresis.
- Simple staining.
- Gram staining.
- Acid-fast staining.
- IMVIC test.
- Oxidase-Citrate.
- Hydrogen sulphide test.
- Cutting section and staining.

BBM701	DIGITAL AND MEDICAL IMAGE PROCESSING	L	T	P	C
	Total Contact Hours - 60	4	0	0	4
	Prerequisite – basic of signal processing and Matlab				
	Course Designed by – Department of Biomedical Engineering				
OBJECTIVES					
The aim of the courses to show how to extract, model, and analyze information from medical data and application in order to help diagnosis , treatment and monitoring of diseases through computer sciences.					
COURSE OUTCOMES (COs)					
CO1	Have a Fundamental Knowledge of digital image processing with Fourier transforms				
CO2	Acquire knowledge about the image sampling, Modeling and quantization				
CO03	Have a fundamental knowledge of image enhancement, its process and types of filters used in image processing				
CO04	Have knowledge about image analysis, classification and reconstruction of act and MRI images				
CO05	Acquire the skills in the transmission of biological images.				
CO06	To learn image analysis using MATLAB				

UNIT-I DIGITAL IMAGE FUNDAMENTAL 9+3

Elements of digital image processing systems, Elements of Visual perception, Image formation model, Image sampling and quantization, aliasing, zooming and shrinking of digital images. Monochrome Vision Model, Colour Vision Model. Image transforms –Discrete Fourier transform, Properties of Fourier transform, Fast Fourier transform and inverse fast Fourier transform

UNIT-II IMAGE FUNDAMENTALS 9+3

Image sampling and quantization, Matrix and Singular Value representation of discrete images. Image pre-processing, point operation, Histogram modeling, spatial operations, transform operations.

UNIT-III IMAGE ENHANCEMENT 9+3

Enhancement by point processing –Simple intensity transformation –Histogram processing – Image subtraction –Image averaging. Spatial filtering –Smoothing filters, sharpening filters. Enhancements in frequency domain-Low pass filtering –High pass filtering.

UNIT-IV IMAGE ANALYSIS, CLASSIFICATION AND RECONSTRUCTION OF ACT AND MRI IMAGES 9+3

Image analysis, Spatial feature extraction, edge detection, Image segmentation. Image reconstruction from projections, Random transform, filter back projection algorithm, reconstruction of CT images, Imaging methods in MF images, fourier reconstruction of MRI.

UNIT-V TRANSMISSION OF MEDICAL IMAGES 9+3

Medical Image, data compression of transmission, transform coding, pixel Coding, predictive coding, Interference coding.

TEXT BOOK:

1. Kavyan Najarian and Robert Splerstor "Biomedical Signals and Image Processing", CRC – Taylor and Franciscn, New York, 1991.
2. John L. Semmlow, "Biosignal and Biomedical Image Processing Matlab Based applications" Marcel Dekker Inc., New York, 2004.

REFERENCES:

1. <http://www.cs.uu.nl/docs/vakken/iby/reader/readerINFOIBV.pdf>

BBM703	HEALTH, HOSPITAL AND EQUIPMENT MANAGEMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basics knowledge on equipment and management				
	Course Designed by – Department of Biomedical Engineering				
OBJECTIVES					
To learn about the health, hospital and equipment management.					
COURSE OUTCOMES (COs)					
CO1	Have Knowledge about the health organization of the country.				
CO2	Have a well-founded knowledge hospital organization and management				
CO3	Have a fundamental knowledge of regulatory requirement and health care codes				
CO4	Have a skills about the equipment maintenance management				
CO5	Acquire the skills Function, role of Clinical Engineer.				
CO6	To know the structure of the hospital management				

UNIT-I HEALTH SYSTEM 9

Health organization of the country, the state, the cities and the region, Health Financing System, Organisation of Technical Section.

UNIT-II HOSPITAL ORGANISATION AND MANAGEMENT 9

Management of Hospital Organization. Nursing section Medical Sector, Central Services, Technical Department, **Definition and Practice of Management by Objective**, Transactional Analysis Human relation in Hospital. Importance to Team Work, Legal aspect in Hospital Management

UNIT-III REGULATORY REQUIREMENT AND HEALTH CARE CODES 9

FDA Regulation, **joint commission of Accreditation for Hospitals**, National Fire Protection Association Standard, IRPC.

UNIT-IV EQUIPMENT MAINTENANCE MANAGEMENT 9

Organizing Maintenance Operations, Paperwork Control, Maintenance Job, Planning Maintenance Work Measurement and Standards, Preventive Maintenance, Maintenance Budgeting and Foirecating, Maintenance Training, Contract Mainframe.

UNIT-V TRAINED TECHNICAL PERSONNEL 9

Function of Clinical Engineer, Role to be performed in Hospital, Man power Market, Professional Registration, Structure in Hospital.

TEXTBOOKS:

1. Kunders G D, “Biomechanics: Hospitals, facilities planning and management”, Tata Mcgraw Hill, 2008.
2. Sakharkar B M, “Principles of hospital administration and planning”, Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.

REFERENCES:

1. Cesar A. Caceres and Albert Zara, The Practice of Clinical Engineering. Academic Press, 1977.
2. Webster, J. G. and Albert M. Cook, Clinical Engineering Principles and Practices, Prentice Hall Inc. Englewood Cliffs, 1979.
3. Antony Kelly, Maintenance planning and control, Butterworths London, 1984.
4. Hans Pfeiff Vera Dammann (Ed.) Hospital Engineering In Developing Countries, Z report Eschborn, 1986.
5. Jacob Kline, Handbook of Bio Medical Engineering, Academic Press. San Diego 1988.
6. R.C.Goyal. Handbook of Hospital Personal Management. Prentice Hall of India. 1993.
7. <http://www.scribd.com/doc/18278414/Hospital-management#scribd>

BBM7L1	IMAGE PROCESSING LAB	L	T	P	C
	Total Contact Hours - 45	0	0	3	2
	Prerequisite – Basic of signal processing and Matlab				
	Course Designed by – Department of Biomedical Engineering				
OBJECTIVES					
To learn about the health, hospital and equipment management.					
COURSE OUTCOMES (COs)					
CO1	To understand the fundamentals of digital image and its properties				
CO2	To enhance the medical images by applying various filters				
CO3	To segment the region of interest using various image processing algorithms				

LIST OF EXPERIMENTS:

1. Implement (a) Edge Detection (b) Line Detection
2. Implement a function in MATLAB for image segmentation.
3. Implement a function in MATLAB for Image Restoration
4. Display an image and its histogram
5. Image arithmetic operations – Addition, Subtraction, Multiplication and Division of 2 images.
6. Gray level transformation – Log transformation, Power law transformation and Histogram equalization.
7. Spatial Filters-Salt and pepper noise, speckle noise, Average Filter and Gaussian Filter
8. Properties of Fourier transform – zeros, FFT Discrete Fourier transform, Two dimensional Discrete Fourier transform.
9. Properties of Fourier transform- FFT SHIFT, IFFT SHIFT
10. Display an image and its histogram

BBM504	MEDICAL PHYSICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basics of physics				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
• To Study effects of sound and light in human body • To study effects of radiation in matter and how isotopes are produced					
COURSE OUTCOMES (COs)					
CO1	To learn about Ultrasound fundamentals.				
CO2	To know about Natural radioactivity, type of radiation and their applications.				
CO3	To get knowledge of Interaction of charged particles with matter.				
CO4	To learn about Major components of cardiovascular system.				
CO5	To learn about Photoelectric effect, Acute Radiation Effects.				
CO6	To gain knowledge on physics behind medical imaging				

UNIT I - ELECTROMAGNETIC SPECTRUM AND ITS MEDICAL APPLICATION 9

Light - Physics of light, Intensity of light, limits of Vision and color vision Sound – Physics of sound , Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) – Interaction of Ultrasound with Materials-Reflection and Refraction – Absorption and Scattering Non- ionizing Electromagnetic Radiation Tissue as a leaky dielectric – Relaxation Processes – Overview of non – ionizing radiation effects -Low Frequency Effect – Higher frequency effect.

UNIT II RADIOACTIVE DECAY

9

Radioactive Decay – Spontaneous Emission – Isometric Transition - Gamma ray emission, alpha, beta, positron decay, electron capture Principles of Nuclear Physics – Natural radioactivity, Decay series, Half life period, type of radiation and their applications. Production of radionuclides – Cyclotron produced Radionuclide - Reactor produced Radionuclide – fission and electron Capture reaction, Radionuclide Generator – Milking Process - Linear accelerator , Radionuclide used in Medicine and technology.

UNIT III - INTERACTION OF RADIATION WITH MATTER

9

Interaction of charged particles with matter – Specific ionization , linear energy Transfer Range, Bremsstrahlung , Annihilation Interaction of Gamma radiations with matter – Photoelectric effect, Compton Scattering , pair Production, Attenuation of Gamma Radiation, Interaction of neutron with matter

UNIT IV - PHYSICS OF CARDIOPULMONARY SYSTEM

9

The Airways, - blood and lung interaction – measurement of lung volume – pressure air flow volume relations of lungs – physics of alveoli – the breathing mechanism – Major components of cardiovascular system – O₂ and CO₂ exchange in the capillary system – Physical activity of heart – transmural pressure – Bernolli's principles applied to cardiovascular system - Blood flow – laminar and turbulent

UNIT V - RADIATION EFFECTS

9

Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous system syndrome - Gastro-intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation - Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

TEXT BOOKS

1. B.H Brown , PV Law ford, R H Small wood , D R Hose , D C Barber , “Medical Physics and Biomedical Engineering”, CRC Press, 1999.
2. Gopal B.Saha “Physics and Radiobiology of Nuclear Medicine” Springer, 3rd ed, 2006

REFERENCES:

1. John R. Cameron and James G. Skofronick, “Medical Physics”, John–Wiley & Sons, 978.
2. RF Farr and PJ Allisy –Roberts, “Physics for Medical Imaging” Saunders, 1997.
3. P.Uma Devi, A. Nagarathnam, B S Satish Rao, “Introduction to Radiation Biology” B.I Churchill Livingstone pvt ltd, 2000.
4. S.Webb, “The Physics of Medical Imaging”, Taylor and Francis, 1988.
5. https://www.iop.org/education/teacher/resources/teaching-medical-physics/page_54690.html

BBM502	BIOFLUID AND BIOMECHANICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic knowledge of human joint movement				
	Course Designed by – Department of Biomedical engineering.				
OBJECTIVES					
To provide the students:					
1. An understanding on the physiology and anatomy of studied systems,					
2. A capability to analyze cardiac, respiratory, soft tissue and orthopedic mechanics					
COURSE OUTCOMES (COs)					
CO1	The fundamental concepts and definitions related to Biomechanics				
CO2	Discuss on Cardiovascular and pulmonary system in human body				
CO3	Explain blood properties, especially the anatomy and physiology of blood vessels.				
CO4	Explain the laws concerning bio-fluid mechanics				
CO5	Various mechanical properties of tissues, bone, ligaments and cartilage				
CO6	To learn the applications of Biofluids and biomechanics				

UNIT-I BIOMECHANICS

9

Newton's law, Stress, Strain, Hookes-law, Elasticity, Shear, Tension, Compression, Bone – Cancellous and cortical bone, structure, Mechanical Properties and mechanical testing of bone, UTM, creep and Fatigue.

UNIT II BIOFLUID MECHANICS

9

Viscosity, Newtonian fluid, Non-Newtonian fluid, Viscoelastic, Vascular tree, Flow properties of Blood, Physical, Chemical and Rheological properties of blood, Apparent and Relative and Viscosity, Problems associated with extra corporeal blood flow

UNIT-III RESPIRATORY AND CARDIAC MECHANICS

9

Alveoli mechanics, PV curve of lung, Breathing Mechanism, Airway resistance, Physics of Lung Diseases. Cardio vascular system, Mechanical properties of blood vessels – arteries, arterioles, capillaries, veins, blood flow: laminar and turbulent.

UNIT IV SOFT TISSUE MECHANICS

9

Tissue Mechanics-Mechanical Properties of Tissues, Biological materials, Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons, Mechanical testing of Soft tissue.

UNIT V ORTHOPAEDIC MECHANICS

9

Mechanical properties of cartilage, diffusion properties of articular cartilage, kinetics and kinematics of joints, lubrication of joints analysis of force in orthopaedic implants. Biomechanics of Elbow Shoulder hip and Knee.

TEXTBOOKS:

1. Fung Y C, Biomechanics: “Mechanical Properties of Living Tissues”, Springer, 2nd edition, 1993.
2. Susan J Hall, “basic biomechanics”, Tata Mcgraw hill, 4th edition, 2004.

REFERENCES:

1. Y.C.Fung, “Biomechanics: Mechanical properties of living tissues”, Springer, verlag, New York, 1981.
2. D.Dawson & Right, “Introduction to bio-mechanics of joints and joint replacement”, Mechanical Engineering Publication Ltd, 1989.
3. Jacob Kline, “Handbook of biomedical engineering”, Academic press Inc., Sandiego, 1988.
4. Basic Biomechanics by Susan J Hall
5. Jay D Humphrey and Sherry L. Delange, “An Introduction to Biomechanics” Springer
6. Donald R Pieterse and Joseph Bronzino “ Biomechanics – principles and applications” CRC Press, 2008.
7. <http://www.maths.gla.ac.uk/~xl/Arasu-biofluid.pdf>

BBM056	BIOPROCESS TECHNOLOGY		L	T	P	C
	Total Contact Hours - 45		3	0	0	3
	Prerequisite – Basic knowledge on clinical chemistry					
	Course Designed by – Department of Biomedical Engineering.					
OBJECTIVES						
To introduce Bioprocess Technology and Enzyme based actions in Medical Applications.						
COURSE OUTCOMES (COs)						
CO1	To learn about basic principle of bioprocess					
CO2	To learn about Bioreactor design. Batch, fed batch and continuous cultivation					
CO3	To learn about Growth rate parameters					
CO4	To learn about Kinetics and thermodynamics of enzyme-catalyzed reactions, techniques of enzyme immobilisation,					
CO5	To learn about Methods of on-line and off-line biomass estimation					
CO6	To learn about computer-based data acquisition, monitoring and control-LABVIEW Software.					

UNIT I INTRODUCTION OF BIOPROCESS TECHNOLOGY 9

Introduction to bioprocess technology, Screening, preservation and improvement of industrially important microorganisms, Raw material and media formulation for fermentation process, Influence of environmental factors on growth and product formation.

UNIT II BIOREACTORS 9

Bioreactor design. Batch, fed batch and continuous cultivation. Solid state cultivation. Sterilization of media reactor and air. Agitation and aeration and mass transfer of oxygen. Inoculum development, addition and sampling.

UNIT III GROWTH RATE ANALYSIS 9

Growth rate parameters : Specific growth rate, doubling time, validity of exponential growth law, growth yield, metabolic quotient, Effect of substrate concentration, Monod Kinetics, Determination of K_s , Definition of lag period.

UNIT IV ENZYME TECHNOLOGY 9

Kinetics and thermodynamics of enzyme-catalyzed reactions, techniques of enzyme immobilisation, basic design and configuration of immobilised enzyme reactors, applications of immobilised enzyme technology.

UNIT V BIOPROCESS ESTIMATIONS 9

Methods of on-line and off-line biomass estimation; Flow injection analysis for measurement of substrates. Product and other metabolites; State and parameter estimation techniques for biochemical processes; Computer-based data acquisition, monitoring and control-LABVIEW Software.

Reference Books :

1. Principles of Fermentation Technology : Whitekar & Stanbury
2. Industrial Microbiology – Casida
3. Shule and Kargi, " Bioprocess Engineering ", Prentice Hall, 1992.
4. <http://www.slideshare.net/yongkangbirdnest/lecture-5-bioprocess-technology-operation-mode-and-scale>

BBM083	TROUBLESHOOTING OF MEDICALINSTRUMENTS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3

Prerequisite – Basic knowledge of circuit analysis & electronic devices	
Course Designed by – Department of Biomedical engineering.	
OBJECTIVES	
To provide the knowledge of planning ,designing and safety management in hospital services.	
COURSE OUTCOMES (COs)	
CO1	To learn about hospital planning and design .
CO2	To know about Radiology and imaging services .
CO3	To get knowledge of to Engineering department.
CO4	To learn about Admitting department .
CO5	To learn about the Importance of infection control .
CO6	To learn about the overview of department based services

UNIT I - PLANNING AND ORGANIZATION OF THE HOSPITALS 9

Roles of hospital in healthcare-hospital planning and design-outpatient servicesthe nursing unit-intensive care unit-nursing services-effective hospital management-directing and leading-controlling – financial management.

UNIT II - CLINICAL AND ADMINISTRATIVE SERVICES 9

Radiology and imaging services-laboratory services-operation theatre suite- pharmacy-central sterile supply department- hospital infection- materials management-evaluation of hospital services.

UNIT III - DESIGNING OF HOSPITAL SERVICES 9

Engineering department - maintenance management- clinical engineering- electrical system- air conditioning system- water supply and sanitary system- centralized medical gas system-communication system- solid waste management and transportation.

UNIT IV - DESIGNING SUPPORT SERVICES AND SAFETY MANAGEMENT 9

Admitting department- medical records department- food service department laundry and linen service-housekeeping- volunteer department- safety in hospital fire safety- Alarm system-disaster management.

UNIT V - HOSPITAL INFECTION CONTROL 9

Importance of infection control-hand hygiene-aseptic techniques-isolation precautions-disinfection and sterilization-clinical laboratory standards to infection control-health care workers safety.

TEXTBOOKS

1. Kunders G D, “Biomechanics: Hospitals, facilities planning and management”, Tata Mcgraw Hill, 2008.
2. Sakharkar B M, “Principles of hospital administration and planning”, Jaypee Brothers Medical Publishers Pvt Limited, 2nd edition, 2009.

REFERENCES

1. Sanjiv Singh, Sakthikumar Gupta, Sunil Kant, "Hospital infection control guidelines, principles and practice", Jaypee Brothers Medical Publishers Pvt Limited, First edition, 2012.
2. <https://www.ems1.com/ems-products/medical/equipment/services/articles/1109754-How-to-troubleshoot-any-medical-device/>

BBM055	TELEMEDICINE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – biomedical instrumentation				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
• To introduce telemedicine advancements in telemedicine .Benefits of telemedicine , Functional Block of a telemedicine system,Tele healthcare and E-medicine. • To study Communication infrastructure for telemedicine LAN and WAN technology Satellite communication Mobile hand held devices and mobile communication Internet technology and telemedicine using World Wide Web Video and audio conferencing. • Introduction to Network Configuration , circuit and packet switching. • Introduction Archives Electronic Documentation Business aspects Common Access to Biological Resources and Information (CABRI) Database indexing and search terms Nucleic and genome databases Molecular data base and servers. • To learn Ethical and legal issues of Telemedicine - Confidentiality and the law - Patient rights and consent - Access to medical Records.					
COURSE OUTCOMES (COs)					
CO1	To learn about the telemedicine				
CO2	Study about the communication and networking system in telemedicine				
CO3	Have a knowledge about the standards of telemedicine and encryption				
CO4	To get knowledge about uses of telemedicine				
CO5	Aware about laws of telemedicine				
CO6	To learn Ethical and legal issues of Telemedicine - Confidentiality and the law - Patient rights and consent - Access to medical Records.				

UNIT I FUNDAMENTALS OF TELEMEDICINE

9

History and advancements in telemedicine - Benefits of telemedicine – Functional Block of a telemedicine system - Tele-healthcare and E-medicine - Use of computers in distance mode of healthcare delivery - Familiarizing with technology of telemedicine – scanner, electro stethoscope - data reception equipment - Scope for telemedicine - Cyber laws related to telemedicine - Telemedicine access to health care services - Limitations of telemedicine.

UNIT II COMMUNICATION SYSTEMS AND NETWORKS IN TELEMEDICINE

9

Communication infrastructure for telemedicine - LAN and WAN technology - Satellite communication - Mobile hand held devices and mobile communication - Internet technology and telemedicine using World Wide Web - Video and audio conferencing - Types of information - Audio, Video, Still images, Text and data, fax - Types of communication and network - PSTN, POTS, ANT, ISDN, Internet, Wireless communication - GSM satellite, and Microwave – Signal Modulation techniques - Data compression and transfer - Capturing Medical Signals - Types of antennas depending on requirements, Integration and operational issues - System integration, store –and - forward operation, Real-time Telemedicine – Remote Sensing.

UNIT III DATA EXCHANGE, MANAGEMENT, SECURITY AND STANDARDS IN TELEMEDICINE 9

Network Configuration - circuit and packet switching - H. 320 series (Video phone based ISBN) - T. 120, H.324 (Video phone based PSTN) - Encryption - Cryptography - Mechanisms of encryption - phases of Encryption - Protocols - TCP/IP, ISO-OSI Standard - DICOM, HL7 - Medical information storage and management for telemedicine - Patient information medical history - Test reports, medical images diagnosis and treatment - Hospital information - Doctors, paramedics, facilities available - **Pharmaceutical information – Information Security and confidentiality of medical records and access control**

UNIT IV APPLICATIONS OF TELEMEDICINE 9

Introduction - Archives - Electronic Documentation - Business aspects - Common Access to Biological Resources and Information (CABRI) - Database indexing and search terms - Nucleic and genome databases - Molecular data base and servers - Array express - Gateway to archives - Sequential retrieval system - Protein Identification Resource(PIR) - Telemedicine in Neuroscience - Telecardiology – Teledermatology - Teleneurology - Teleophthalmology – Telepathology – Teleoncology - Telepediatrics – Telepharmacy – Telepsychiatry and mental health – Teleradiology – Telesurgery – Veterinary – Other specialties

UNIT V ETHICAL ASPECTS AND CASE STUDIES IN TELEMEDICINE 9

Ethical and legal issues of Telemedicine - Confidentiality and the law - Patient rights and consent - Access to medical Records - Consent treatment - Jurisdictional Issues - Intellectual property rights - Telemedicine technology and Health care delivery for rural population - Use of telemedicine technology for clinical diagnostic study - Conceptual frame work on home telemedicine.

TEXT BOOKS

1. Olga (EDT) Ferrer – Roca, M.Sosa (EDT) Iudicissa Hand book of Telemedicine IOS press 2002.
2. A.C. Norris, Essentials of Telemedicine and Telecare John Sons & Ltd, 2002.
3. Marilyn J. Field, “A Guide to Assessing Telecommunications in Health Care”, NATIONAL ACADEMY PRESS, 1996.
4. Bashshur, R. L., Sanders, J. H and Shannon, G. W., “Telemedicine: Theory and Practice”, Volume 27, Number 2, Springer Netherlands, 1999,

REFERENCES

1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471 53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199 413-3), 2002.
4. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
5. Bommel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

<https://peqbfzn.files.wordpress.com/2015/07/telemedicine-lecture-notes-pdf.pdf>

BBM058	CLINICAL ENGINEERING			L	T	P	C
	Total Contact Hours - 45			3	0	0	3
	Prerequisite – Basic knowledge of planning and designing of hospital services						
	Course Designed by – Department of Biomedical Engineering.						
OBJECTIVES							
To introduce Clinical Engineering-Management, Quality Assurance and Risk Factors.							
COURSE OUTCOMES (COs)							
CO1	To learn basic of clinical engineering						
CO2	Study about the assessments and risk factors of medical technology						
CO3	Have a knowledge about quality of improvement ant tem work						
CO4	To learn about the standards for clinical engineering and regulators agencies						
CO5	To get knowledge about the uses of virtual instruments in health care						
CO6	To understand the differences between the role of a clinical and biomedical engineer						

UNIT – 1 CLINICAL ENGINEERING 9

Definition, Evolution of Clinical Engineering – interactions of a clinical engineer, Hospital Organization and the Role of Clinical Engineering, Clinical Engineering Programs

UNIT -2 MANAGEMENT AND ASSESSMENT OF MEDICAL TECHNOLOGY AND RISK FACTORS 9

The Health Care Delivery System, Strategic Technology Planning, Technology Assessment, Equipment Assets Management. Risk Management – **Strategies, Risk Management: Application**

UNIT -3 QUALITY OF IMPROVEMENT AND TEAM BUILDING 9

Deming's 14 Points, Zero Defects, TQM (Total Quality Management) and Tools Used for Quality Improvement, Standard Database, Measurement Indicators.

UNIT -4 STANDARDS 9

Standards Regulatory and Assessment Agencies, Standards for clinical Engineers, Regulatory Agencies, Technology Assessment Agencies

UNIT -5 APPLICATIONS OF VIRTUAL INSTRUMENTS IN HEALTH CARE 9

Application with Examples, Trending, Relationships, and Interactive Alarms, **Data Modeling, 0 Medical Equipment Risk Criteria**, Peer Performance Reviews

REFERENCES

1. Handbook of Biomedical Engineering-Joseph Bronzino, 2000
2. Principles of Biomedical Engineering-Joseph Bronzino
3. <http://ocw.mit.edu/courses/health-sciences-and-technology/hst-590-biomedical-engineering-seminar-series-developing-professional-skills-fall-2006/lecture-notes/>

BMM084	REAL TIME PROCESSOR AND BIOMEMS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – DSP and microprocessor				
	Course Designed by – Department of Biomedical engineering.				
OBJECTIVES					
To learn about the Digital Signal Processing and BIOMEMS in the real time.					
COURSE OUTCOMES (COs)					
CO1	To learn about Architecture of TMS 320C54XX .				
CO2	To know about applications of PSoC.				
CO3	To get knowledge of Nonlinear Image Processing Algorithms.				
CO4	To learn about Working principle of Microsystems.				
CO5	To learn about the Importance Drug delivery.				
CO6	To learn the different MEMS technologies and its techniques				

UNIT-I INTRODUCTION TO DIGITAL SIGNAL PROCESSING DEVICES 9

Architecture of TMS 320C54XX Digital Signal Processor-18. Addressing Modes and Instruction sets of TMS 320C54XX DSP-19. TMS 320VC5416 Assembly Language Programming-. Interfacing and Real Time C Programming with TMS 320C54XX- TMS 320C6713 Floating Point Processor Architecture and Real Time C Programming

UNIT-II PROGRAMMABLE EMBEDDED SYSTEM-ON-CHIP (PSOC) PROCESSOR 9

Architecture- Designer- Developing tools- biomedical applications

UNIT-III INTRODUCTION TO REAL-TIME IMAGING 9

Basic Hardware Architecture.-Linear Image Processing Algorithms-Compression by Matrix Transforms-Nonlinear Image Processing Algorithms-Parallel Architectures-Programming Languages-Optimization Techniques

UNIT IV MEMS AND MICROSYSTEMS 9

Working principle of Microsystems, materials for MEMS and Microsystems, micromachining, System modeling and properties of materials

UNIT V BIOMEMS 9

Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip.

REFERENCES

1. Udayashankara, V. ,Real time digital signal processing : fundamentals, algorithms and implementation using tms processor,phi 2007.
2. Technical Reference Manuals,Cyprus Semiconductors,USA 2008
3. Edward R. Dougherty, Phillip A. Laplante ,Introduction to Real-Time Imaging ISBN: 978-0-8194-1789-3,February 1995, Wiley-IEEE Press.

4. Tai Ran Hsu , “ MEMS and Microsystems design and manufacture”, Tata McGraw Hill Publishing Company, New Delhi, 2002.
5. <https://nanohub.org/resources/992/download/2005.02.07-Bashir1.pdf>

BBM704	MODELLING OF PHYSIOLOGICAL SYSTEMS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Physiological control systems				
	Course Designed by – Department of Biomedical Engineering				
OBJECTIVES					
To design the physiological systems					
COURSE OUTCOMES (COs)					
CO1	Have Knowledge about the physiological process in the biological system.				
CO2	Have a skills to modeling of human thermal regulatory system				
CO3	Have a fundamental basis for respiratory system				
CO4	Have a skills to design the Ultra Filtration system				
CO5	To design the Model of body dynamics				
CO6	To understand the mechanical designing of bone				

UNIT I CONTROL SYSTEM MODELLING

9

Physiological processes and principles of their control flow, gas exchange Ultra filtration, biochemical reactions, pneumatic transport, digestion, Energy utilization and waste disposal, linear and nonlinear control systems, principles of open loop and feedback systems techniques for system Response characterization.

UNIT II MODELING OF CONTROL SYSTEM

9

Modeling of human thermal regulatory system o. Parameters involved, control system model etc. biochemistry of digestion, types of heat loss from body, models of heat transfer between subsystems of human body like skin core, etc. and systems like within body, body environment etc.

UNIT III HUMAN SYSTEMS

9

Respiratory system: Modeling oxygen uptake by RBC and pulmonary capillaries, mass balancing by lungs, gas transport mechanism of lungs, oxygen and carbon dioxide transport in blood and tissues.

UNIT IV HUMAN EXCRETION

9

Ultra Filtration system Transport through cells and tubules, diffusion, factated diffusion and active transports, methods, of waste removal, counter current model of urine formation in nephron, moellir Henle's loop.

UNIT V PHYSIOLOGICAL CONTROL SYSTEM

9

Modeling body dynamics: Principles of mechanical modeling of bone, tissues etc.modeling stress were propagation in bones, hills, model of muscle mechanisms Current trends : Pharmacokinetic modeling with illustrated example like drug diffusion, computer aided modeling etc.

TEXT BOOKS:

1. Advanced Methods of Physiological System Modeling by V.Z. Marmarelis
2. Applied mathematical model in Human Physiology, by Johnny T. Ottesen, Mette S. Olufsen, Jesper K.Larsen

REFERENCE BOOKS:

1. Physiological basis of Ventilatory Support, By John. J. Marini, Arthur S. Slutsky
2. Pharmacokinetic and Pharmacodynamic Data Analysis: Concepts and Applications, By Daniel (Weiner, Johan Gabrielsson).
3. <http://physiology.arizona.edu/people/secomb/472-572lecturenotes09>

BBM051	TISSUE ENGINEERING AND ARTIFICIAL ORGANS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Biomaterials and artificial organs				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
To learn about the basic mechanics of Tissue Engineering, model of artificial organs and it process.					
COURSE OUTCOMES (COs)					
CO1	To learn about Tissue Development, objectives of Tissue engineering				
CO2	To learn about Cell growth and differentiation, Cell and tissue mechanism, cell adhesion				
CO3	To learn about Cell delivery and recirculation, Delivery molecular agents in tissue engineering				
CO4	To learn about tissue replacements				
CO5	To learn about				
CO6	To learn the practical applications in tissue engineering				

UNIT I FUNDAMENTAL OF TISSUE ENGINEERING 9

Tissue Exchange and Tissue Development, objectives of Tissue engineering, Element of Tissue development.

UNIT II CELLULAR STUDIES 9

Cell growth and differentiation, Cell and tissue mechanism, cell adhesion, cell migration, cell aggregation and tissue equivalent.

UNIT III TISSUE BARRIERS TO MOLECULAR AND CELLULAR TRANSPORT 9

Cell delivery and recirculation, Delivery molecular agents in tissue engineering, control releaser agents in time and space.

UNIT IV TISSUE REPLACEMENT IMPLANTS 9

Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, joint replacements.

UNIT V ARTIFICIAL ORGANS 9

Artificial Heart, Prosthetic Cardiac Valves, Limb prosthesis, Externally Powered limb Prosthesis, Dental Implants.

REFERENCES:

1. PARK J.B., “Biomaterials Science and Engineering”, Plenum Press, 1984.
2. W Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue — Oxford University Press Inc New York 2004.
3. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York 2004.
4. <http://www.sciencedirect.com/science/book/9781855737372>

BBM701	MEDICAL INFORMATICS			L	T	P	C
	Total Contact Hours - 45			3	0	0	3
	Prerequisite – Fundamentals of Computer programming						
	Course Designed by – Department of Biomedical engineering.						
OBJECTIVES							
To learn about the historical information of hospitality and recent trends in the Hospital information system.							
COURSE OUTCOMES (COs)							
CO1	To study about Historical Highlights of health care information system						
CO2	To learn about Motherboard and its logic-Memory and I/O interfacing/memory						
CO3	To learn about Concept of HIS its position in hospital-introduction						
CO4	To learn about Visual Basic Principles and Programming-Design						
CO5	To study about Integration of inter and intra hospital information system						
CO6	To learn the importance of hospital information system						

UNIT-I BIOMEDICAL INFORMATION SYSTEM 9

Historical Highlights of health care information system-Biomedical information system-problems and pitfalls-History and evolution of Electronic resources, Multimedia components.

UNIT-II OVERVIEW OF COMPUTER HARDWARE 9

Motherboard and its logic-Memory and I/O interfacing/memory and input output mapping-I/O peripherals and Add-on cards.

UNIT- III HOSPITAL INFORMATION SYSTEM 9

Concept of HIS its position in hospital-introduction of a computerized HIS Automation of medical record-cost and Benefits of HIS-Modems and Networking in Hospitals.

UNIT-IV VISUAL PROGRAMMING AND MULTIMEDIA INFORMATION 9

Visual Basic Principles and Programming-Design, Production and Testing of Multimedia based HIS.

UNIT-5 INTEGRATED MEDICAL INFORMATION SYSTEM 9

Integration of inter and intra hospital information system. Role of expert systems-web based Multimedia information system-Video-conferencing-PowerPoint Presentation.

Text book:

1. R.D.Lele „Computer in Medicine” Tata McGraw Hill, Newyork, 1999.

References:

1. S.K.Chauhan “PC Organisation”, S.K.Kataria and Sons, Delhi 2000.
2. Harold Sackam “Bio Medical Information Technology”, Academic Press, Newyork.
3. <http://www.springer.com/series/684>

BEI010	VLSI DESIGN			L	T	P	C
	Total Contact Hours - 45			3	0	0	3
	Prerequisite – Basic knowledge on design						
	Course Designed by – Dept. of E&I						
OBJECTIVES							
To introduce NMOS, PMOS, CMOS devices and their characteristics. Design principles, design layout rules, construction of multiplexers							
COURSE OUTCOMES (COs)							
CO1	To introduce about NMOS, PMOS, CMOS devices characteristics,						
CO2	To learn about CMOS inverter design principles, design layout rules						
CO3	To study about Combinational logic and sequential logic circuits						
CO4	To learn about Design concepts- design tools, simulators						
CO5	To study about VHDL model for combinational networks						
CO6	To be thorough with the fundamentals of VLSI design						

UNIT-1: BASIC DEVICE CHARACTERISTICS

9

NMOS, PMOS, CMOS devices characteristics, linear saturating modes, bulk effect capacitances, device models for simulation CMOS device fabrication principles.

UNIT-2: BASIC CIRCUITS FOR DIGITAL SYSTEMS

9

CMOS inverter design principles, design layout rules, construction of multiplexers, transmission gates, latches, flip flops, timing and fan out considerations.

UNIT-3 : BUILDING BLOCKS OF DIGITAL SYSTEMS

9

Combinational logic and sequential logic circuits. Data path circuits. Adder multiplier architecture and accumulators.

UNIT-4: DIGITAL DESIGN USING VHDL

9

Design concepts- design tools, simulators, introduction to VHDL- sequential and concurrent descriptions- signal port and variable statements- case and other sequential statements- compilation and simulation of VHDL code- VHDL functions- procedures - packages and libraries- introduction to verilog and brief comparison with VHDL

UNIT-5 : FPGA DESIGN

9

VHDL model for combinational networks- routing procedures in FPGA and CPLD programming, methods for FPGA and CPLD- simulation and synthesis issues- FPGA architecture - FPGA design flow for logic gates, ALU, multiplexer, flip flop, counter.

TEXT BOOK

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

REFERENCES

1. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.
2. Intellectual Property Today : Volume 8, No. 5, May 2001, [www.iptoday.com].
3. https://www.wto.org/english/tratop_e/trips_e/intel1_e.html

BEI011	MICROCONTROLLER BASED SYSTEM DESIGN			L	T	P	C
	Total Contact Hours - 45			3	0	0	3
	Prerequisite – Microprocessor and its applications						
	Course Designed by – Department of Biomedical engineering.						
OBJECTIVES							
1. To introduce microcontroller, the role of microcontrollers .Types and selection,its application and examples.							
2. To study the microcontroller resources and Family members, bus widths program and data memory parallel ports. D/A and A/D convertors, reset circuitry, watchdog timers, power down considerations							
3. To study Interrupt structures programmable timers, real time clock, latency, interrupt, density and interval constraints.							
4. To study CPU register- structure- addressing modes- instruction sets- assembly languages- assemblers.							
5. To study Queues, tables and strings, program organisation, microcontroller expansion methods, I/O hardware alternatives, development tools, RTOS.							
COURSE OUTCOMES (COs)							
CO1	To learn about the role of microcontrollers						
CO2	Study about the microcontroller resources						
CO3	Have a knowledge about real time control						
CO4	To learn about the programming and framework for 8051 and PC16F877						
CO5	To get knowledge about the software building blocks						
CO6	To learn about the applications of microcontroller in diagnosis						

UNIT 1: THE ROLE OF MICROCONTROLLERS

9

Types and selection- application example

UNIT 2 : MICROCONTROLLER RESOURCES

9

Family members, bus widths program and data memory parallel ports. D/A and A/D convertors, reset circuitry, watchdog timers, power down considerations.

UNIT 3 : REAL TIME CONTROL

9

Interrupt structures programmable timers, real time clock, latency, interrupt, density and interval constraints.

UNIT 4 : PROGRAMMING FRAMEWORK FOR 8051 AND PC16F877

9

CPU register- structure- addressing modes- instruction sets- assembly languages- assemblers.

UNIT 5 : SOFTWARE BUILDING BLOCKS

9

Queues, tables and strings, program organisation, microcontroller expansion methods, I/O hardware alternatives, development tools, RTOS, motorola MC68HC11 and intel 8051.

Textbooks:

1. S Ghoshal, "Microprocessor Based System Design", MacMillan Publisher, 1996.
https://engineering.purdue.edu/ece362/Refs/prelim_text_copyright_2001_dgm.pdf

BBM060	MEDICAL IMAGING TECHNIQUES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Digital image processing				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
To study about medical image techniques, NMR, mathematical process.					
COURSE OUTCOMES (COs)					
CO1	To learn about the different modes of medical records				
CO2	Study about the radioisotopic images				
CO3	Have a knowledge about nuclear magnetic resonance imaging				
CO4	To learn about the image formation and image processing				
CO5	To get knowledge about the computer requirements for image system				
CO6	To understand the theorems formulated on CT images				

UNIT I DIFFERENT MODES OF MEDICAL RECORDING

Quality assurance and image improvement in diagnostic radiology with X-Rays, specific Quality assurance tests for X-rays, need for sectional images, principles of sectional images recording, computer tomography with different trajectories.

UNIT II RADIOISOTOPIC IMAGES

9

Radio isotopic imaging equipments, radiation detectors, radionuclide for imaging, static and dynamic planar scintillography.

UNIT III NUCLEAR MAGNETIC RESONANCE IMAGING

9

Development of NMR, relaxation processes and their measurements, MRI-Image acquisition and reconstruction, MRI safety.

UNIT IV MATHEMATICS OF IMAGE FORMATION AND IMAGE PROCESSING

9

Concept of object and image, general image processing problem, discrete fourier representation and models for imaging, image restoration, image sampling, perception of moving images.

UNIT V COMPUTER REQUIREMENT FOR IMAGING SYSTEM

9

Single / multi user system, transferring of images, processing speed, display of medical images, 3-D image display and its clinical applications.

TEXT BOOK

Steve Webb, “The physics of medical imaging”, Adam Hilger, Bristol, England, Philadelphia, USA, 1988.

REFERENCES:

1. <http://ocw.mit.edu/courses/nuclear-engineering/22-058-principles-of-medical-imaging-fall-2002/lecture-notes/>

BBM057	ROBOTICS AND NANOTECHNOLOGY	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Biomedical engineering.				
OBJECTIVES					
To introduce about basic principle of robotics and nanotechnology					
COURSE OUTCOMES (COs)					
CO1	To study about Definition and origin of robotics				
CO2	To learn about Hydraulic, pneumatic and electric drives determination				
CO3	To introduce about Construction of manipulators – manipulator dynamics				
CO4	To learn about basic concepts of Nano science and technology				
CO5	To study about material processing by Sol – Gel method				
CO6	To know the applications of nanotechnology in various medical fields				

UNIT – I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov’s laws of robotics – dynamic stabilization of robots.

UNIT – II POWER SOURCES AND SENSORS 9

Hydraulic, pneumatic and electric drives determination of HP of motor and gearing ratio variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT – III MANIPULATORS, ACTUATORS AND GRIPPERS 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV NANO MATERIALS AND NANOTECHNOLOGY 9

Basic concepts of Nano science and technology – Quantum wire – Quantum well – Quantum dot – Properties and technological advantages of Nanomaterials – Carbon Nanotubes and applications

UNIT V MATERIALS PROCESSING AND CHARACTERISATION: 9

Material processing by Sol – Gel method, Chemical Vapor deposition and Physical Vapor deposition – Microwave Synthesis of materials – Principles of SEM, TEM and AFM - Fluorescence Microscopy and Imaging.

TEXT BOOK

1. Niku Saeed B, Introduction to Robotics: Analysis, System, Applications, PHI Publishers.
2. Tony Hyland, Scientific and Medical Robotics, Smart Apple Media Publishers, 2007.
3. Hari Singh Nalwa, “*Nanostructured Materials and Nanotechnology*”, Academic Press, 2002.

REFERENCES:

<https://books.google.co.in/books?id=VT8jgh81zycC&pg=PA233&lpg=PA233&dq=ROBOTICS+AND+NANOTECHNOLOGY+lecture+notes&source=bl&ots=fVFAVc80qK&sig=uKi7jtpHw1yMWDl-YeS0cjeQJcc&hl=en&sa=X&ved=0ahUKEwik2NX8gsfLAhVMvRQKHARABBwQ6AEINjAE#v=onepage&q=ROBOTICS%20AND%20NANOTECHNOLOGY%20lecture%20notes&f=false>

BBM075	VIRTUAL INSTRUMENTATION		L	T	P	C
	Total Contact Hours – 45		3	0	0	3
	Prerequisite – Medical instrumentation					
	Course Designed by – Department of Biomedical engineering.					
OBJECTIVES						
1. To introduce Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data flow techniques.						
2. To study CAN bus characteristics. Bus interface for R422 and RS485.						
3. To study Principles of PAL’s PLD’s GAL’s CPLD and their design considerations.						
4. To study Principles and design considerations of specific PROM, EPROM, SRAM, SDRAM. Dual ported memories, FIFO’s flash memories						
5. To study Multiphase clock generators, LCD display controller.						
COURSE OUTCOMES (COs)						
CO1	To learn about the review of virtual instrumentation					
CO2	Study about the programming techniques for virtual instrumentation					
CO3	Have a knowledge about basic of data acquisition					
CO4	To learn about the interfaces of common instruments					
CO5	To get knowledge about the use of analysis tools					
CO6	To study Multiphase clock generators, LCD display controller.					

UNIT-1: REVIEW OF VIRTUAL INSTRUMENTATION 9

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data flow techniques. Graphical programming in data flow, comparison with conventional programming.

UNIT-2 : VIRTUAL INSTRUMENTATION PROGRAMMING TECHNIQUES 9

VIS and subVIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT-3: DATA ACQUISITION BASICS 9

ADC, DAC, DIO, counters and timers. PC hardware structure, timing, interrupts, DMA, software and hardware installation.

UNIT-4: COMMON INSTRUMENT INTERFACES 9

Current loop, RS232C/RS485, GPIB, system buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI etc., network basics for office and industrial applications, visa and IVI, image acquisition and processing, motion control.

UNIT-5: USE OF ANALYSIS TOOLS 9

Fourier transforms, power spectrum correlation methods, windowing uttering, VI application in various fields.

TEXTBOOKS:

1. Anand M M S, Electronic Instruments and Instrumentation Technology, PHI Publishers, 2007.
2. Stephen Bennett, Emagic Logic Virtual Instruments, PC Publishing, 2003.

REFERENCES:

1. <http://ocw.njit.edu/csla/opse/opse-310/index.php>

BBM081	DIGITAL SYSTEM DESIGN	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – BioMEMS				
	Course Designed by – Department of Computer Science Engineering				
OBJECTIVES					
1. To introduce Circuit diagram of Til, CMOS, NMOS, ECL, GaAs building blocks, operating conditions, interfacing between different families.					
COURSE OUTCOMES (COs)					
CO1	To learn about Til, CMOS, NMOS, ECL etc.				
CO2	To know about Bus interface for R8422 and RS485.				
CO3	To get knowledge of Principles of PAL’s , etc.				
CO4	To learn about Admitting department .				
CO5	To learn about the Importance of LCD display controller .				
CO6	To understand the various interfacing circuits				

UNIT-1: DIGITAL LOGIC FAMILIES

9

Circuit diagram of Til, CMOS, NMOS, ECL, GaAs building blocks, operating conditions, interfacing between different families- interpreting data sheet of 74 series, CD 4000 series, ECL 10000 series- power supply considerations for digital IC.

UNIT-2: DIGITAL SYSTEM BUS CHARACTERISTICS

9

RS-232, RS-485, R8422, ISA, PCL, HC, SPI, CAN bus characteristics. Bus interface for R8422 and RS485

UNIT-3 : PROGRAMMABLE LOGIC DEVICES

9

Principles of PAL's PLD's GAL's CPLD and their design considerations

UNIT-4: DIGITAL MEMORIES

9

Principles and design considerations of specific PROM, EPROM, SRAM, SDRAM. Dual ported memories, FIFO's flash memories.

UNIT-5: DIGITAL SYSTEM DESIGN CASE STUDIES

9

Multiphase clock generators, LCD display controller, PRBS generator, watch dog timer, interfacing with SPI bus, interfacing with flash memory.

TEXTBOOKS:

1. Balakrishnan, "Digital System Design", Oxford University Press, USA 2007.
2. Mark Zwolinski, "Digital System Design with VHDL", Prentice Hall, 2003.

REFERENCES:

<http://www.ece.uic.edu/~dutt/courses/ece465/lect-notes.html>

BBM052	BIOLOGICAL EFFECTS OF RADIATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – The student should know Medical physics				
	Course Designed by – Department of Biomedical Engineering.				
OBJECTIVES					
To learn about effects of radiation in the biological system.					
COURSE OUTCOMES (COs)					
CO1	To learn about DNA and chromosomal damages.				
CO2	To know about LD50/30 effective radiation on skin,etc.				
CO3	To get knowledge of to Threshold and linear dose, gene control hereditary diseases effect of dose.				
CO4	To learn about Effects of various human organs.				
CO5	To learn about Classification of sources, measurement of different radiations.				
CO6	To know the harmful effects of radiation and how to minimize it				

UNIT – I ACTION OF RADIATION IN LIVING CELLS 9

Various theories related to radiation at cellular level. DNA and chromosomal damages.

UNIT – II SOMATIC APPLICATION OF RADIATION 9

Radio sensitivity protocols of different tissues of human. LD50/30 effective radiation on skin. Bone marrow, eye, endocrine glands, and basis of radio therapy.

UNIT – III GENETIC EFFECTS OF RADIATION 9

Threshold and linear dose, gene control hereditary diseases effect of dose.

UNIT – IV EFFECT OF MICROWAVE AND RF WITH MATTERS 9

Effects of various human organs and systems, Wavelength in tissue, non thermal interaction. Standards of protection, national, and international standards and precautions.

UNIT – V UV RADIATION 9

Classification of sources, measurement, photo medicine, UV radiation, safety visible and infrared Radiation.

REFERENCE:

1. Paul Fryer, Duncan Ward, Radiation, White Cube Publishers (2008).
2. Steve Forshier, Essential of Radiation Biology and Protection, Delmar Publishers (2008).
3. <http://www.slideshare.net/erletshage1/lecture-4-30005235>

BBA008	TOTAL QUALITY MANAGEMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic principles of Management				
	Course Designed by – Department of Management Studies				
OBJECTIVES					
To study about quality management, New management tools, , Quality auditing					
COURSE OUTCOMES (COs)					
CO1	To learn about - Need for quality ,- Basic concepts of TQM - Definition of TQM				
CO2	To learn about – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement				
CO3	To learn about The seven traditional tools of quality – New management tools				
CO4	To learn about Quality circles – Quality Function Deployment (QFD)				
CO5	To learn about _Need for ISO 9000- ISO 9000-2000 Quality System				
CO6	To learn the need for management process and stages				

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDCA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II 9

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

TEXT BOOK:

1. Dale H.Besterfield, et al., “Total Quality Management”, Pearson Education Asia,3rd Edition, Indian Reprint (2006).

REFERENCES:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S., “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2000UNIT III
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman, B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.

<http://asq.org/learn-about-quality/total-quality-management/overview/overview.html>

BBA001	PRINCIPLES OF MANAGEMENT AND ORGANIZATIONAL BEHAVIOUR	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic principles of 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 Functions				
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				

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 MANAGEMENT

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 THEORY

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 ORGANIZATION BEHAVIOR

9

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

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

UNIT V GROUP

9

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

REFERENCES:

1. and Heinz wehrich, „Essentials of Management“, McGraw Hill
3. publishing Company, Singapore International Edition, 2004.
4. Ties AF, Stoner and R. Edward Freeman, “Management” Prentice Hall of India Pvt. Ltd., New Delhi -110011, 1995.
5. Joseph I. Massie „Essentials of Management“, Prentice Hall of India Pvt. Ltd., New Delhi - 110011, 2004.
5. L.M. Prasad “Principles and Practice of Management”, Sultan Chand & Sons.2001
6. Uma Sekaran, “Organizational Behaviour”, Tata McGraw Hill, 2007.
7. <http://asq.org/learn-about-quality/total-quality-management/overview/overview.html>

BBM076	REGULATORY ASPECTS IN BIOSCIENCES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic principles of Management and science				
	Course Designed by – Department of Management Studies				
OBJECTIVES					
To learn about regulatory aspects in biosciences.					
COURSE OUTCOMES (COs)					
CO1	To learn about the food and drug administration.				
CO2	To know about Data and safety monitoring.				
CO3	To get knowledge of The Nurenberg code.				
CO4	To learn about Working principle of Microsystems.				
CO5	To learn about the Importance Drug delivery.				
CO6	To get an overview on the regulatory aspects of pharmaceutical industry				

UNIT I - INDIVIDUAL AND INSTITUTIONAL RESPONSIBILITY & REGULATION BY FDA 9

Researching a bioethical question, Individual and institutional responsibility, Institutional review boards, Role of independent institutional review boards, The regulation of drugs and biological products by the food and drug administration.

UNIT II - LEGAL ISSUES AND HEALTH POLICY 9

Data and safety monitoring, Legal issues, rules to prevent conflict of interest on human subjects, National institutes of health policy on the Inclusion of women and minorities as subjects, Role and importance of trial registries and results databases.

UNIT III - ETHICAL AND REGULATORY GUIDANCE 9

Immobilization, The Nuremberg code, Declaration of Helsinki: Ethical principles of medical research involving human subjects, The Belmont report: Ethical principles and guidelines for the protection of human subjects, The common rule, Code of federal regulations.

UNIT IV - DISTINCTION BETWEEN RESEARCH AND TREATMENT & THE ETHICS OF RANDOMIZED CLINICAL TRIALS 9

Research and Practice, Demarcating Research and Treatment: A Systematic Approach, The ethics of randomized clinical trials: Problems of the randomized clinical trial, Equipoise and the ethics of clinical research, Randomized controlled trials: Lessons from ECMO.

UNIT V - ROLE OF PLACEBOS IN CLINICAL RESEARCH & CHANGING LANDSCAPE OF HUMAN EXPERIMENTATION 9

The continuing unethical use of placebo controls, Placebo-controlled trials and the logic of clinical purpose, Active control trials in the evaluation of new treatments, The changing landscape of human experimentation.

TEXTBOOKS:

1. John I, Gallin, Frederick P, Ognibene “Principles and Practice of Clinical Research”, Academic Press, Third Edition, 2012.
2. Ezekiel J, Emanuel, Robert A Crouch, John D Arras, Jonathan D Moreno, Christine Grady, “Ethical and Regulatory Aspects of Clinical Research”, Johns Hopkins University Press, First Edition, 2003.

REFERENCES:

1. Michael A, Santoro, Thomas M. Gorrie, “Ethics and the Pharmaceutical Industry”, Cambridge University Press, First Edition, 2005.
2. Susan E, Lederer, “SubjectedToScience: Human Experimentation in America before the Second World War”, Johns Hopkins University Press, First Edition, 1995.
3. <http://www.ucsc-extension.edu/content/biosciences-4>

BBM801	REHABILITATION ENGINEERING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Artificial organs and allied health sciences				
	Course Designed by – Department of Biomedical engineering.				
OBJECTIVES					
To learn about the rehabilitation engineering and its process.					
COURSE OUTCOMES (COs)					
CO1	To learn about the basic of rehabilitation				
CO2	Study about the science and technology of rehabilitation engineering				
CO3	Have a knowledge about the orthopedic prosthetic and orthotics technology in rehabilitation				
CO4	To learn about the sensor rehabilitation system				
CO5	To get knowledge about the principles and uses of rehabilitation technologies				
CO6	To be equipped with the latest advancements in the applications of robotics				

UNIT 1 INTRODUCTION TO REHABILITATION: 9
Principles involved in the study of Rehabilitation Engineering, HAAT – Human Activity Assistive Technology.

UNIT 2 REHABILITATION ENGINEERING SCIENCE & TECHNOLOGY: 9
Rehabilitation engineering concepts in motor rehabilitation engineering concepts in communication disorders. Wheel chairs: Categories of Wheelchairs, Wheelchair structure and Component design, Ergonomics of Wheelchair Propulsion, Power Wheelchair Electrical Systems. Personal Transportation for the Handicap: Vehicle Selection, Lift Mechanisms, Hand Controls, Wheelchair restraint Mechanisms.

UNIT 3 ORTHOPEDIC PROSTHETICS & ORTHOTICS IN REHABILITATION TECHNOLOGY: 9
Fundamentals, Function, Structure and Cosmesis of Orthotic or Prosthetic device. Computer-Aided engineering in customized component design, Example- Intelligent prosthetic knee, hierarchically controlled Prosthetic Hand, Myoelectric hand and arm prosthesis – block diagram, signal flow diagram and functions.

UNIT 4 SENSORY REHABILITATION SYSTEMS: 9
Engineering concepts in sensory rehabilitation, Sensory Augmentation & substitution: Visual System, Auditory system, Tactual system.

UNIT 5 REHABILITATION ENGINEERING TECHNOLOGIES: PRINCIPLES OF APPLICATION: 9
Conceptual frameworks, Education and Quality Assurance, Specific Impairments and Related technologies, Future Developments – Rehabilitation Robotics, and Brain computer interface systems.

TEXT BOOK:

1. Robinson C.J Rehabilitation Engineering, Handbook of Electrical Engineering, CRC Press, Boca Raton 1993.

REFERENCE:

1. Reswick. J, What is Rehabilitation Engineering, Annual Reviews of Rehabilitaion – Volume.
 2. Springer – verlag, New York, 1982.
 3. Leon Goldman m.d.r James Rockwell. J.r. Lasers in medicine.
 4. K.Wolbarsht M. L. Laser application in Medicine and biology, Plenum Press, New York.
- <http://www.sms.hest.ethz.ch/education/lectures/RehabilitationEngineering>

BBA009	INTELLECTUAL PROPERTY RIGHTS		L	T	P	C
	Total Contact Hours - 45		3	0	0	3
	Prerequisite – Basic principles of Management					
	Course Designed by – Department of Management Studies					
OBJECTIVES						
To introduce about Intellectual property rights						
COURSE OUTCOMES (COs)						
CO1	To learn about Importance – Protection of IPR – Basic types of property					
CO2	To learn about _Protection of Geographical Indications at national and International levels					
CO3	To learn about International convention relating to Intellectual Property					
CO4	To learn about Indian Position Vs WTO and Strategies					
CO5	To learn about Case Studies on – Patents (Basumati rice, turmeric, Neem, etc.)					
CO6	Have a good knowledge about IP, copyrights and related issues					

UNIT I INVENTION AND CREATIVITY

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

UNIT II PATENTS

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

UNIT III TRADE

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

UNIT IV WTO

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

UNIT V CASE STUDIES

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

TEXT BOOK

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

REFERENCES

1. Eli Whitney, United States Patent Number : 72X, Cotton Gin, March 14, 1794.
2. Intellectual Property Today : Volume 8, No. 5, May 2001, [www.iptoday.com].
- 3.https://www.wto.org/english/tratop_e/trips_e/intel1_e.html

BBA002	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic principles of Management				
	Course Designed by – Department of Management Studies				
OBJECTIVES					
To enable the students to develop the achievement motivation and to develop entrepreneurial competency					
COURSE OUTCOMES (COs)					
CO1	To study about Qualities, nature types, traits, culture, Similarities and differences between entrepreneur and entrepreneur				
CO2	To learn about Evolution of entrepreneurs				
CO3	To introduce about Small Business				
CO4	To learn about Project finance				
CO5	To study about Setting MSMEs				
CO6	To understand the requisites of entrepreneurial development				

UNIT I ENTREPRENEURSHIP 9
 Entrepreneur - meaning - importance - Qualities, nature types, traits, culture, Similarities and differences between entrepreneur and entrepreneur. Entrepreneurship and economic development - its importance - Role of entrepreneurship - entrepreneurial - environment.

UNIT II MOTIVATION 9
 Evolution of entrepreneurs - entrepreneurial promotion: Training and developing motivation: factors - mobility of entrepreneurs - entrepreneurial change - occupational mobility - factors in mobility - Role of consultancy organizations in promoting entrepreneurs - **Forms of business for - entrepreneurs.**

UNIT III BUSINESS 9
 Small Business : Concept & Definition, Role of Small Business in the modern Indian Economy, Small entrepreneur in International business; Steps for starting a small industry, registration as SSI, Role of SIDBI; advantages and problems of SSIs; Institutional Support mechanism in India; Incentives & Facilities, Govt. Policies for SSIs

UNIT IV FINANCING AND ACCOUNTING 9
 Setting MSMEs"- location of enterprise - steps in setting - Problems of entrepreneurs - Sickness in small industries - reasons and remedies - Incentives and subsidies - Evaluating entrepreneurial performance - Rural entrepreneurship - **Women Entrepreneurship.**

UNIT V SUPPORT TO ENTREPRENEURS 9
 Project finance: Sources of finance – Institutional finance - Role of IFC, IDBI, ICICI, LIC, SFC, SIPCOT, and Commercial Bank - Appraisal of bank for loans. Institutional aids for entrepreneurship development - Role of DST, DICS, SIDCO, NSICS, IRCI, NIDC, SIDBI, SISI, SIPCOT, Entrepreneurial guidance bureau - Approaching Institutions for assistance.

REFERENCES:

1. Vasanth Desai “Dynamics of Entrepreneurial Development and Management” Himalaya Publishing House.
2. N.P.Srinivasan & G.P. Gupta “Entrepreneurial Development” Sultanchand & Sons.
3. P.Saravanelu “Entrepreneurship Development” Eskapee publications.
4. S.S.Khanka “Entrepreneurial Development” S.Chand & Company Ltd.,
5. Satish Taneja, Entrepreneur Development ; New Venture Creation.
6. https://en.wikipedia.org/wiki/Entrepreneurship_Development_Institute_of_India

BBM089	DESIGN AND DEVELOPMENT OF MEDICAL DEVICES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Advanced Biomedical Instrumentation				
	Course Designed by – Department of Biomedical Engineering				
OBJECTIVES					
To introduce Bio-Process Technology and Enzyme based actions in Medical Applications.					
COURSE OUTCOMES (COs)					
CO1	To learn about Define medical device, Classification of medical device, Medical device vs medical				
CO2	To learn about Laparoscopic instrumentation, surgical instrumentation in ophthalmology				
CO3	To learn about Patient monitoring system, ECG, EEG, Blood pressure monitor				
CO4	To learn about Pacemaker, External cardio vector defibrillator, Implantable cardio vector				
CO5	To learn about Total hip prosthesis, Joint replacement, Design of artificial pancreas				
CO6	Get familiarized with latest technologies in rehabilitation based devices				

UNIT I - INTRODUCTION TO MEDICAL DEVICE

9

Define medical device, Classification of medical device, Medical device vs medical instrumentation, Origin of bio-potential, Physiological signal, Human machine interface ,Input output and control signal, Data acquisition, Sensor, Amplification, Medical electrical stimulator.

UNIT II - MINIMALLY INVASIVE DEVICE AND TECHNIQUE

9

Laparoscopic instrumentation, surgical instrumentation in ophthalmology - Phacoemulsification: Instrument and system - Vitrorectomy: Instrument and system- **Human machine interface.**

UNIT III - SYSTEM DESCRIPTION OF DIAGNOSTIC EQUIPMENT

9

Patient monitoring system, ECG, EEG, Blood pressure monitor, Digital stethoscope, Thermometer, System description and diagram of pulse oximeter, optical fiber optics for circulatory and respiratory system measurement.

UNIT IV - SYSTEM DESCRIPTION OF THERAPEUTIC EQUIPMENT

9

Pacemaker, External cardiovector defibrillator, Implantable cardiovector defibrillator, Deep brain stimulation, Functional electrical stimulator (FES), **Hemodialysis delivery system, Mechanical ventilator.**

UNIT V - SYSTEM DESCRIPTION OF VARIOUS IMPLANT AND PROSTHESIS

8

Total hip prosthesis, Joint replacement, Design of artificial pancreas, Drug eluting stent and its engineering design - Intraocular lens implant, Cochlear implants, Heart valves.

TEXTBOOKS:

1. Gail Baura, "Medical Device Technologies: A Systems Based Overview Using Engineering", Elsevier science, 2002.
2. Martin Culjat, Rahul Singh, Hua Lee, "Medical Devices: Surgical and Image- Guided Technologies", John Wiley & Sons, Reinaldo perez, "Design of medical electronic device", Elsevier science, 2002.

3. Richard C, Fries, “Handbook of Medical Device Design”, Marcel Dekker AG, 2 nd edition 2005.

REFERENCES:

1. Anthony Y. K, Chan, “Biomedical device technology: principles and design”, Charles Thomas, 2008.
2. Theodore R, Kucklick, “The Medical Device Ramp-D Handbook”, Taylor & Francis Group LLC, 3rd edition 2013.
3. David Prutchi, Michael Norris, “Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design, construction and test of medical devices”, John Wiley & Sons, 2005
4. <https://www.cranfield.ac.uk/Courses/training/Design-Development-and-Testing-of-Medical-Devices>

Guidelines for Mini project:

To develop an ability to solve a specific Biomedical Engineering problem by identifying them, designing any hardware or software to achieve the goal.

Each student is expected to do a project and present along with the title which should be approved by the Head of the Department under the guidance of a faculty member. The improvement in the projects are been watched in every review conducted by the project coordinator under the Head of the Department. A comprehensive project report after completing the project work is written to the satisfaction of the supervisor. Based on the project work a paper should be written to be published in any appropriate journals. Project report is finally submitted at the end of the semester. The project evaluation is done based on the oral presentation and the work done by the students by the Project coordinator and Internal Guide.

OUTCOME:

On completion of the project work students will be in a position to take up any challenging practical problems and finding solution by formulation proper methodology in the field of Biomedical Engineering

BBM6P1

TERM PAPER

L T P C
0 0 4 2

Guidelines for Term Paper:

- i. Students should register for the term paper in the VII semester either in the core area or interdisciplinary area
- ii. Every student or in a group of four is expected to identify a topic with substantial literature survey and history of the topic has to be submitted at the end of the semester as a report.
- iii. The term paper report submitted by the students will be evaluated by viva-voce examination comprising of both external and internal examiners.
- iv. Students should prepare a research article based on the subject of the term paper and should submit the same for journal publication/conference presentation
- v. The students shall carry out the course under the guidance/supervision of a faculty. Each faculty can guide four students/ groups.

OBJECTIVE:

To develop an ability to solve a specific Biomedical Engineering problem by identifying them, designing any hardware or software to achieve the goal. The project done should be useful in some way to the society and which could be used in our practical life.

The students in a group of 3 to 4 are present in a project along with the title which should be approved by the Head of the Department under the guidance of a faculty member. The improvement in the projects are been watched in every review conducted by the project coordinator under the Head of the Department. A comprehensive project report after completing the project work is written to the satisfaction of the supervisor. Based on the project work a paper should be written to be published in any appropriate journals. Project report is finally submitted at the end of the semester. The project evaluation is done based on the oral presentation and the work done by the students jointly by both the internal and external examiners.

OUTCOME:

On completion of the project work students will be in a position to take up any challenging practical problems and finding solution by formulation proper methodology in the field of Biomedical Engineering.