CURRICULUM AND SYLLABUS (R2015)
CHOICE BASED CREDIT SYSTEM

M.TECH MEDICAL NANOTECHNOLODY
FULL TIME
I TO IV SEMESTERS

SEMESTER I

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
			THEORY				
1	PC	MN8101	Biomedical Sensors and Instrumentation	3	0	0	3
2	PC	MN8102	Diagnostic and Therapeutic Equipments	3	0	0	3
3	PC	MN8103	Medical Imaging Systems	3	0	0	3
4	PC	MA8163	Advanced Applied Mathematics	3	1	0	4
5	PC	MD8152	Anatomy and Physiology	3	0	0	3
6	PE		Professional Elective I	3	0	0	3
			PRACTICAL				
7	PC	MN8111	Clinical Instrumentation Laboratory	0	0	4	2
			TOTAL	18	1	4	21

SEMESTER II

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
1	PC	MN8252	Bio Mechanics	3	0	0	3
2	PC	MN 8253	Rehabilitation Engineering	3	0	0	3
3	PE		Professional Elective II	3	0	0	3
4	PE		Professional Elective III	3	0	0	3
5	PE		Professional Elective IV	3	0	0	3
6	PE		Professional Elective V	3	0	0	3
7	PC	MN8211	Hospital Information System Laboratory	0	0	4	2
			TOTAL	18	0	4	20

SEMESTER III

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
			THEORY				
1	PE		Professional Elective VI	3	0	0	3
2	PE		Professional ElectiveVII	3	0	0	3
3	OE		Open ElectiveVIII	3	0	0	3
			PRACTICAL				
4	PR	MN8311	Project Work (phase I) Summer Training Pre-requisite	0	0	12	6
			TOTAL	9	0	12	15

SEMESTER IV

SL. NO	Category	COURSE CODE	COURSE TITLE	L	T	P	C
			PRACTICAL				
1	PR	MN8411	Project Work (phase II)	0	0	24	12
			TOTAL	0	0	24	12

OVERALL CREDITS   : 68

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		
1	**Professional Core (PC)**	18	8	-	-	26	38.23
2	**Professional Elective (PE)**	3	12	3		18	26.47
3	**Open Electives (OE)**	-	-	3	-	3	4.37
4	**Project Work, Seminar, Internship, Term Paper, etc. (PR)**	-	-	6	12	19	27.53
	Total Credit	21	20	15	12	68	100%
	Total Contact Hour	28	26	21	24	99	

LIST OF ELECTIVES

SUB.CODE	SUBJECT NAME	L	T	P	C
PROFESSIONAL ELECTIVE (PE) - I					
MN8001	Bio Statistics	3	0	0	3
MN8002	Finance Management in Hospital	3	0	0	3
MN8003	Finite Element Analysis For Biomedical Engineering	3	0	0	3
PROFESSIONAL ELECTIVE (PE) –II					
MN8004	Health Informatics	3	0	0	3
MN8005	Health Policy and Equipment Management	3	0	0	3
MN8006	Hospital Architecture	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - III					
MN8007	Hospital Planning, Organization and	3	0	0	3
MN8008	Hospital Waste Management	3	0	0	3
MN8009	Human Resource Management in Hospital	3	0	0	3
PROFESSIONAL ELECTIVE (PE) - IV					
MN8010	Physics in Medicine	3	0	0	3
MN8011	Quality Assurance and Safety in Hospitals	3	0	0	3
MN8012	Signal Processing and Image processing	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – V					
MN8071	Bio Materials	3	0	0	3
MD8071	Advanced Neural Computing	3	0	0	3
MD8072	Advanced Neural Engineering	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – VI					
MD8073	Bio MEMS	3	0	0	3
MD8074	Computer Based Medical Instrumentation	3	0	0	3
MD8075	Medical Ethics and Standards	3	0	0	3
PROFESSIONAL ELECTIVE (PE) – VII					
MD8076	Medical Optics	3	0	0	3
MD8077	Nanomedicine Principles and Applications	3	0	0	3
MD8078	Pattern Recognition Techniques and Applications	3	0	0	3

SUB.CODE	SUBJECT NAME	L	T	P	C
OPEN ELECTIVE(OE) –I					
MD8079	Physiological Modeling	3	0	0	3
MD8080	Principles of Genetic Analysis	3	0	0	3
MD8081	Tele Health Technology	3	0	0	3

MN8101	**BIOMEDICAL SENSORS AND INSTRUMENTATION**	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic BioSensor (B.Tech)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To study the basic characteristics of measurement system.
- To study the different types of transducers, electrodes and signal conditioning circuits.
- To study the techniques used for measurement of various non electrical physiological parameters.
- To know the different types of display and recording devices.

COURSE OUTCOMES (COs)

CO1	Students will get the clear domain knowledge about various measurement systems.
CO2	Students will be able to develop measurement systems by selecting different types of sensors, electrodes, signal conditioning circuits for acquiring and recording various physiological parameters.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	COs	Programme Outcomes (POs)										
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M	H			H			M			
2	CO2				M								L
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
			√										
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   TRANSDUCERS   9
Characteristics- Static, Dynamic, Errors in the measurements, Classification of transducers - Resistive, Capacitive, Inductive, Photoelectric, piezoelectric and mechanoelectronics.

UNIT II   ELECTRODES & AMPLIFIERS   9
Half cell potential, Reference electrodes, polarization effects, Polarisable and nonpolarisable electrodes, Micro electrodes, Equivalent Circuits, Signal Conditioning circuits- Characteristics of Amplifiers , Differential Amplifiers, Filters, Bridge circuits, A/D Converters.

UNIT III   CHEMICAL AND OPTICAL TRANSDUCERS   9
PH, PO2, PCO2, HCO3 electrodes, Ion sensor, Anion and Cation sensor, Liquid and solid ion exchange membrane electrode, Enzyme electrode, Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors, PPG sensors.

UNIT IV   NON ELECTRICAL PARAMETERS MEASUREMENTS   9
Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements-

Direct, Indirect, Blood flow Measurements – Invitro, Invivo, Gas flow measurements.

UNIT V   RECORDERS AND DISPLAY   9
Types of recorders, Ink jet, heated stylus, Photographic recorder, Multicolor dot scanners, CRO, storage type, long persistence, digital scope, magnetic tape recorders.

TOTAL: 45 PERIODS

REFERENCES:
1. Rangan C.S., Sarma G.R., and Mani V.S.V., Instrumentation devices and system, Tata McGraw hill Publishing Company limited, New Delhi, 1983.
2. John G.Webster, Medical Instrumentation, Application and Design, Third Edition, John willey and sons,1999.
3. Jacob Kline., Handbook of Bio Medical Engineering, Academic press Inc., Sandiego, 1988.
4. J.B.Gupta, A course in electronic and electrical measurement and instrumentation, S.K.Kataria& Sons, 1999.
5. Tatsuo Togawa, Toshiyo Tamura, P.Ake Oberg, Biomedical Transducers and Instruments,CRC Press, New York, 1997.
6. Joseph J.Carr and John M Brown, Introduction To Biomedical Equipment Technology, 4/E,pearson education India.2001.

MN8102	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Biomedical Instrumention				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To know the various biopotential recordings so as to enable students to record various biosignals.
- To know the various functional blocks present is cardiac care units so that the students can handle these equipments with care and safety.
- To develop an understanding of the physiotherapy and diathermy equipment so that the student can learn to operate.

COURSE OUTCOMES (COs)

CO1	Develop measurement systems by selecting different types of, electrodes, signal conditioning circuits for acquiring and recording various biopotential.
CO2	Describe and explain specific parts in Cardiac care units. Describe important working mechanisms of assist devices.
CO3	Get clear domain knowledge about various types of Medical stimulators, and recently developed equipments
CO4	Develop measurement systems by selecting different types of, electrodes, signal conditioning circuits for acquiring and recording various biopotential.
CO5	Describe and explain specific parts in Cardiac care units. Describe important working mechanisms of assist devices.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	COs	Programme Outcomes (POs)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO01	M	L	H	L	M	M	M	M				
	CO02	M	L	H	L	M	M	M	M				
	CO03	M	L	H	L	M	M	M	M				
	CO04	M	L	H	L	M	M	M	M				
	CO05	M	L	H	L	M	M	M	M				

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   BIO POTENTIAL RECORDING
9

ECG, EEG, EMG, PCG, EOG, lead system and recording methods, typical waveform, frequency spectrum, abnormal waveforms. Evoked response.

UNIT II   CARDIAC CARE UNITS   9

Pace makers - different types, batteries for pace makers.DC defibrillators, asynchronous and synchronous types, patient monitoring system, principles of bio telemetry.

UNIT III   DIATHERMY AND STIMULATOR   9

Physiological effects of HF radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvani, Faradic stimulators,Interferential therapy, Electrical safety-Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser

UNIT IV   ASSIST DEVICES   9

Heart lung machine-Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process. Hemodialyser-Indication and Principle of Hemodialysis, Membrane, Dialyasate, Different types of hemodialysers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type. Respiratory aids- Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters.

UNIT V   RECENT TRENDS   9

Principles and application of thermography, Detection circuits, Principles of cryogenic Technique and application, principles of Fiber optics cables, Endoscopy, Laparoscopy, principles of Lithotripsy.

                                                        TOTAL: 45 PERIODS

REFERENCES:
1. Albert M Cook and Webster J G – Therapeutic medical devices Prentice Hall Nee York 1982
2. Heinz Kresse – Handbook of Electro medicine. John Wiely& Sons – Chrchester – 1985
3. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999
4. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
5. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
6. Joseph J Carr and John M Brown – Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001.
7. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata McGraw Hill publication , New Delhi 2nd edition 2003
8. John Denis Enderle, Joseph D. Bronzino, Susan M. Blanchard, 'Introduction to Biomedical Engineering:'Academic Press, 2005 , 2nd Edition ISBN 0122386620, 9780122386626

MN8103	MEDICAL IMAGING SYSTEMS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Digital Image Processing (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body. To study the imaging of soft tissues using ultrasound technique

COURSE OUTCOMES (COs)

CO1	Students will get the clear domain knowledge about the various Medical Imaging techniques.
CO2	Students will be able to understand the various diagnostic applications of the medical imaging techniques.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

	Cos	Programme Outcomes (Pos)											
1		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H			M	H		M			M		M
2	CO2			M									
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
			√										
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   PRINCIPLES OF RADIOGRAPHIC EQUIPMENT   8

X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy- construction of image Intensifier tubes, angiographic setup, mammography, digital radiology, DSA.

UNIT II   COMPUTED TOMOGRAPHY   10

Need for sectional images, Principles of sectional scanning, CT detectors, Methods of reconstruction, Iterative, Back projection, convolution and Back-Projection. Artifacts, Principle of 3D imaging

UNIT III   RADIO ISOTOPIC IMAGING   9

Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipments, Radio nuclides for imaging, Gamma ray camera, scanners, Positron Emission tomography, SPECT,PET/CT.

UNIT IV   ULTRASONIC SYSTEMS   9

Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principles and theory of image generation.

UNIT V   MAGNETIC RESONANCE IMAGING   9

NMR, Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI Instrumentation, Functional MRI.

TOTAL: 45 PERIODS

REFERENCES:
1. D.N.Chesney and M.O.Chesney Radio graphic imaging, CBS Publications, New Delhi, 1987.
2. Peggy, W., Roger D.Ferimarch, MRI for Technologists, McGraw Hill, New York, 1995.
3. Steve Webb, The Physics of Medical Imaging, Taylor & Francis, New York.1988.
4. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from picture to proton ,Cambridge University press, New York 2006.
5. Jerry L.Prince and JnathanM.Links," Medical Imaging Signals and Systems"- Pearson Education Inc. 2006

MA8163	ADVANCED APPLIED MATHEMATICS	L	T	P	C
	Total Contact Hours: 60	3	1	0	4
	Prerequisite: Basic Knowledge in Mathematics				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To encourage students to develop a working knowledge of the central ideas of linear algebra;
- To study and understand the concepts of probability and random variable of the various functions;
- understand the notion of a Markov chain, and how simple ideas of conditional probability and matrices can be used to give a thorough and effective account of discrete-time Markov chains;
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- Introduce the Fourier Transform as an extension of Fourier techniques on periodic functions and to solve partial differential equations;

COURSE OUTCOMES (COs)

CO1	On successful completion of this course, all students will have developed knowledge and understanding in the fields of linear algebra, probability, stochastic process, linear programming problem and fourier transform.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

		Programme Outcomes (Pos)										
1	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)		
				√								
4	Approval	41st - 42nd Meetings of Academic Council										

UNIT I   LINEAR ALGEBRA
                    9+3

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II   ONE DIMENSIONAL RANDOM VARIABLES   9+3

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable.

UNIT III   RANDOM PROCESSES   9+3

Classification – Auto correlation - Cross correlation - Stationary random process –   Markov process –- Markov chain - Poisson process – Gaussian process.

UNIT IV   LINEAR PROGRAMMING   9+3

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

**UNIT V   FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL
                 EQUATIONS   9+3**

Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poison's equations.

TOTAL: 45+15=60 PERIODS

TEXT BOOKS:

1. Bronson, R.Matrix Operation, Schaum's outline series, McGrawHill, Newyork (1989).
2. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, Academic Press, (An imprint of Elsevier), 2010.
3. Taha H.A. "Operations Research : An introduction" Ninth Edition, Pearson Education, Asia, New Delhi 2012.
4. SankaraRao, K. "Introduction to partial differential equations" Prentice Hall of India, pvt, Ltd, New Delhi, 1997.

REFERENCES:

1. Andrews,L.C. and Philips.R.L. "Mathematical Techniques for engineering and scientists", Printice Hall of India,2006.
2. O'Neil P.V. "Advanced Engineering Mathematics", (Thomson Asia Pvt Ltd, Singapore) 2007, cengage learning India private limited.

MD8152	ANATOMY AND PHYSIOLOGY	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Anatomy and Physiology (B.Tech)				
	Course Designed by : Bio-Medical Engineering Bio-Medical Engineering				

OBJECTIVES

- To understand basics of Human Anatomy and Physiology.
- To study the organs and systems involved in body functions.
- To apply this knowledge into biomedical engineering field.

COURSE OUTCOMES (COs)

CO1	Describe and explain specific parts and key terms applied in anatomy and physiology Describe important physiological mechanisms involved in cell, tissue, and organ
CO2	Understand organisation and functions of each organs and systems in human body
CO3	Describe and explain specific parts and key terms applied in anatomy and physiology Describe important physiological mechanisms involved in cell, tissue, and organ

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

	COs	Programme Outcomes (Pos)											
1		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H			M	H		M			M		M
	CO2			M									
2	CO3	M			H						M		
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
				√									
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   INTRODUCTION OF HUMAN BODY   8

Organization of human body, tissue and cavities – Anatomical planes, positions and sections - Cell: Structure and organelles structure – Functions of Each components in the cell. Cell membrane Transport, Resting membrane potential and ionic basis of potentials, Recording of Action potentials, - Homeostasis

UNIT II   BUILDING BLOCKS OF HUMAN BODY   8

Skeletal System: Bones, types and functions - Axial and Appendicular Skeleton. Joints: Definition, Types and functions. Cartilage: An overview - types and functions. Muscular System: Types of Muscle - Skeletal Muscle structure - Action potential and functions - Skin and Appendages.

UNIT III   RESPIRATION, NUTRITION AND EXCRETORY SYSTEM   10

GI Tract: Organization of GI tract – Mouth, Pharynx, Esophagus, Stomach, Small Intestine and Large Intestine - Accessory Organs: Salivary glands, Liver, Pancreas, Gall bladder, Teeth and Tongue. Ingestion, Digestion and Absorption – Factors regulating Movements and Digestion in GI tracts. Respiratory System: The Nose, Pharynx, Larynx, Trachea, Primary Bronchi, Lungs – Mechanism of Breathing – Respiratory Volumes, Measurements and Artificial Respiration. Urinary System: Structure of Kidney, Nephron, Ureter and Urinary bladder. Urine formation and Micturition reflex.

UNIT IV CARDIOVASCULAR AND ENDOCRINE SYSTEM   9

Cardiovascular System: Blood vessel, Types and internal structure - Cardiac Muscle: Structureand Action potential – Structure and Components of Heart - Conducting System of Heart – Heart Sounds – Blood Pressure – Regulation of Blood Pressure and Measurements. Endocrine Hormone – General Action – Second Messenger – Anterior and Posterior Pituitary Gland Hormones.

UNIT V   NERVOUS SYSTEM AND SPECIAL SENSES   10

Organization of Nervous system: Structure, Types and Properties of   Action potential Neurons -   of
Neuron - Neuroglial Cells – Central Nervous System and Peripheral Nervous System organization
– Brain, Lobes and Cortical Areas – Spinal cord arrangement and Plexus formation. Autonomic Nervous System: Divisions and control on each system - Reflex Mechanism. Special Senses: Structure of Eye and Ear - Errors of refraction and Correction. Conduction pathway of vision and Hearing.

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TOTAL: 45
PERIODS
</div>

REFERENCES:
1. Anatomy & Physiology, Gary A.Thibodeau, Kevin T.Patton – 7th Edition, Mosby Publisher 2009.
2. The Human Body, Gillian Pocock& Christopher D.Richards, Oxford University Press, 2009.
3. Guyton 'Text book of Medical Physiology – WB Jaunder company Philadelphia - 10 edition 2002
4. Ranganathan T S,Text Book of human Anatomy S. Chand and company New Delhi – 1994.

MN8111		**CLINICAL INSTRUMENTATION LABORATORY**	L	T	P	C
		Total Contact Hours: 60	0	0	4	2
		Prerequisite: Basic Knowledge to handle Instruments				
		Course Designed by : Bio-Medical Engineering Bio-Medical Engineering				

OBJECTIVES
- To study the various aspects of bio signals and amplifiers
- To understand the performance of surgical diathermy.
- To study practically the concepts of audiometer

COURSE OUTCOMES (COs)

CO1	Students will get the clear practical knowledge about the various basic amplifiers and their characteristics.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

		Programme Outcomes (POs)											
1	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)		
				√									
4	Approval	41st - 42nd Meetings of Academic Council											

LIST OF EXPERIMENTS
1. Operational Amplifier-various amplifier configurations
2. Study of Timer circuit
3. Study of FSK modulation and demodulation
4. Design and testing of Bio-Amplifiers
5. Recording of Electromyogram.
6. Study of ECG machine.
7. Study of EEG machine
8. Study of Patient monitoring system and biotelemetry
9. Bio-chemical measurements
10. Performance and testing of surgical diathermy unit using diathermy analyzer
11. Plotting of human auditory response using audiometer.
12. Study of Multi parameter simulator.

MN8252	BIO MECHANICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Biomechanics (B.Tech/B.E Level)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To get the clear understanding of application of mechanics in medicine.
- To study the properties of blood , bone and soft tissues like articular cartilage tendons and ligaments ,
- To gain necessary knowledge about accident and injuries.

COURSE OUTCOMES (COs)

CO1	The study of mechanical properties of biological tissues and the properties of blood give us a wide understanding about its structure and when it undergo wear and when it fails so many precautions can be given by ourselves to elders.
CO2	The knowledge gained will be helpful in doing research in properties of hard tissues like bones and to generate a mathematical mode of bone structure etc.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M	H			H			M			
	CO2					M							L

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   INTRODUCTION   9
Introduction to bio-mechanics, relation between mechanics and Medicine, Newton's laws, stress, strain, shear rate, viscosity, visco elasticity, non Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues. biofluid mechanics.

UNIT II   MECHANICS OF CIRCULATION   9
Flow properties of blood, effect of shear rate, hematocrit, temperature and protein Content of blood, rheology of blood and micro vessels, dynamics of circulatory system, turbulence flow around prosthetic heart valves.

UNIT III   MECHANICS APPLIED TO ORTHOPAEDICS   9
Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, and analysis of force in orthopedic implants.

UNIT IV   MECHANISM OF BIOLOGICAL SYSTEMS   9

Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism

UNIT V   BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION   9

Experimental and Analytical method of analysis, Clinical evaluation, Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Y.C.Fung, Biomechanics: Mechanical properties in living tissues, Springer Verlag, New York 1981.
2. Susan J.Hall, Basics Bio Mechanics 5th Edition, McGraw-Hill Publishing Co,Newyork, 2007.
3. Subratapal ,Text book of Biomechanics, Viva education private limited, 2009.
4. C.R Ethier and C.A.Simmons , Biomechanics from cells to organisms, Cambridge university press,2007.
5. D.Dawson and Right, Introduction to Bio-mechanics of joints and joint replacement, Mechanical Engineering publications Ltd. 1989.
6. Jacob clime, Head book of Bio Medical Engineering, Academic Press in, Sandiego, 1988.

MN8253		**REHABILITATION ENGINEERING**	L	T	P	C
		Total Contact Hours: 45	3	0	0	3
		Prerequisite: Knowledge in Rehabilitation Engineering (B.Tech/B.E)				
		Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To develop an understanding of the various rehabilitation aid principle and its working.
- To give various information about rehabilitation medicine and Advocacy.

COURSE OUTCOMES (COs)

CO1		By the end of this course the student will be able to design rehabilitation aid and apply them with confidence, to help the challenged people.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1		Programme Outcomes (POs)											
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H		H			H			M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
			√			
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   PROSTHETIC AND ORTHOTIC DEVICES   9

Hand and arm replacement, different types of models for externally powered limb prosthetics, Lower limb, Upper limb orthotics, and material for prosthetic and orthotic devices, mobility aids.

UNIT II   AUDITORY AND SPEECH ASSIST DEVICES   9

Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer.

UNIT III   VISUAL AIDS   9

Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, Text voice converter, screen readers.

UNIT IV   MEDICAL STIMULATOR   9

Muscle and nerve stimulator, Location for Stimulation, Functional Electrical Stimulation, Sensory Assist Devices, Design issues.

UNIT V   REHABILITATION MEDICINE AND ADVOCACY   9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

<div align="right">TOTAL: 45 PERIODS</div>

REFERENCES:

1. Rory A Cooper, An Introduction to Rehabilitation Engineering, CRC press,2006
2. Joseph D.Bronzino,The Biomedical Engineering Handbook,Third Edition: Three Volume Set,CRC Press,2006
3. Levine.S.N.Editor, Advances in Bio Medical Engineering and Medical Physics, Inter University Publication, New York 1968.
4. Albert M.Cook and Webster J.G, Therapeutic Medical devices, Prentice Hall Inc., NewJersy, 1982.
5. Reswick.J, What is Rehabilitation Engineering, Annual review of Rehabilitation-volume2, Springer-Verlag, New York 1982.

MN8211	HOSPITAL INFORMATION SYSTEM LABORATORY	L	T	P	C
	Total Contact Hours: 60	0	0	4	2
	Prerequisite: Knowledge in Hospital Management (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To study about the basics of Java programming, web designing and to develop a hospital information system.
- To study about signal and image processing applications using MATLAB

COURSE OUTCOMES (COs)

CO1	Students gain the programme based knowledge to design a hospital information system

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H		H			H			M			

Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
		√			

Approval	41st - 42nd Meetings of Academic Council

LIST OF EXPERIMENTS

1. HTML, XHTML, XML programming
2. Java Script programming
3. Development of front end and back end applications for hospital information system
4. Development of Web postal for medical applications
5. Study of medical standards-HL7,DICOM,LOINC,Medical data formats
6. Processing of BioSignals using Mat Lab
7. Image processing techniques using Mat Lab
8. Study of Data acquisition systems

TOTAL: 60 PERIODS

MN8001	**BIO-STATISTICS**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in Numerical Maths (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To introduce strengths and limitations of measures of central tendency and measures of variability. Classify common statistical tests and tools.
- Distinguish between p-values and confidence intervals as measures of statistical significance. Interpret commonly used regression analysis.

COURSE OUTCOMES (COs)

CO1	The student is able to understand the techniques used in statistical & regression analysis.
CO2	the student is able to compare the various parameters used in statistical significance

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

						Programme Outcomes (POs)						
1	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)		
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   INTRODUCTION   9
Introduction to probability, likelihood & odds, distribution variability.

UNIT II   STATISTICAL PARAMETERS   6
Statistical parameters p-values, computation and level chi square test and distribution.

UNIT III   REGRESSION ANALYSIS   6
Regression, correction use of regression, multiple regression.

UNIT IV   INTERPRETING DATA   12
Interpreting life tables clinical trails, epidemical reading and interpreting of epidemical studies, application in community health.

UNIT V   META ANALYSIS   12
META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis

                                                           TOTAL: 45 PERIODS

REFERENCE:

1. Joseph A. Ingelfinger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware Biostatistics in Clinical Medicine (third edition), Singapore, 1994.

MN8002	**FINANCE MANAGEMENT IN HOSPITALS**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Hospital Management (B.Tech)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- The objective of this subject is to expose the students to decision making by corporate board in the areas of finance function.
- To provide an understanding of the basic principles and processes involved in the accounting system of a hospital.

COURSE OUTCOMES (COs)	
CO1	The students is equipped with concepts, technical and analytical tools for optimal management of financial resources.
CO2	Also the course helps to develop skills in analyzing accounting statements for decision-making in a hospital setting and practice the preparation of final accounts

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

	COs	Programme Outcomes (Pos)											
1		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	M	H			H			M			
2	CO2					M							L
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   INTRODUCTION   4
Finance Function – Meaning – Definition - scope of finance function- Executive functions & Incidental functions - Scope and goal of Financial Management in Hospitals – Profit maximization & Wealth maximization.

UNIT II   ACCOUNTING TECHNIQUES   10
Types of Accounting, Hospital accounting - Financial book Keeping, Book keeping obligations. Accounting Concepts & Conventions – Final Accounts :Trading – Profit & Loss Accounts - Balance Sheet.
UNIT III   COSTING IN HOSPITALS
        10
Nature & Scope of Cost Accounting – Cost analysis & Classification - Cost Calculation, significance of internal billing in Hospital -Necessary for internal & external controlling cost, cost unit calculation.

UNIT IVMANAGEMENT ACCOUNTING   11
Budgeting & Budgetary control – Cost – Volume – Profit analysis.

UNIT V   FINANCING DECISIONS
10

Cost of capital & Capital Structure – Sources of Short term finance: Management of Working Capital –Sources of Long term finance: share capital, debentures - corporate debit capacity.

TOTAL: 45 PERIODS

REFERENCES:
1. James C. Vanhorne, Fundamentals of Financial Management, Prentice Hall of India Pvt. Ltd., New Delhi, 8th Edition, 1993.
2. James C.Vanhorne, Financial Management and Policy, Prentice Hall of India Pvt. Ltd., New Delhi, 9th Edition, 1995.
3. Prasannachandra, Financial Management, Tata McGraw Hill Publishing Co. Ltd., New Delhi, First Revised edition
4. Financial Management IM PandeyVikas Publishing Co. 1999.

MN8003	FINITE ELEMENT ANALYSIS FOR BIOMEDICAL ENGINEERING	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic knowledge of control System (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To introduce the basic concepts of finite element analysis
- To study about the application to Field Problems in Bio mechanics
- To gain ideas about the materials used in the field of biomedical engineering

COURSE OUTCOMES (COs)

CO1	At the end of this course the students would have developed a thorough understanding of the basic principles of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving problems in Bio-mechanical Engineering

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

		Programme Outcomes (POs)											
1	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1			H									
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)			Project/ Term Paper Seminar/ Internship (PR)		
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   GENERAL INTRODUCTION   10

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems – Variational Formulation of Boundary Value Problems – Ritz Technique –Natural and Essential Boundary conditions - Basic concepts of the Finite Element Method. One Dimensional Second Order Equations – Discretization – element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors - Assembly of Matrices - solution of problems from solid and bio mechanics- Structural, stress, and strain analysis of the human body and/or artifical implants,

UNIT II   BEAM ELEMENTS AND SCALAR PROBLEM IN 2D   9

Fourth Order Beam Equation –Transverse deflections - Natural frequencies of beams and Longitudinal vibration. Second Order 2D Equations involving Scalar Variable – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems in Bio mechanics - Quadrilateral elements

UNIT III   APPLICATIONS TO FIELD PROBLEMS   9

Higher Order Elements. Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One, two and three dimensions – Serendipity elements – Numerical

integration and application to plane stress problems transformation in ^{,and} coordinates-Jacobian of transformation-order of convergence- numerical integration –example problems-shape functions in natural coordinates- rectangular elements- Lagrange family- Serendipity family-rectangular prisms- tetrahedral elements

UNIT IVISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS   8

Introduction to elasticity equations – stress strain relations – plane problems of elasticity – element equations Plane stress, plane strain and axisymmetric problems – stress-strain-time or constitutive equations for soft connective tissue components Modelling and force analysis of musculoskeletal systems– Stress calculations - Plate and shell elements – Introduction to flow problems- solution of problems in fluid mechanics- numerical examples -plates and shells

UNIT V   NON-LINEAR ANALYSIS   9

Introduction to Non-linear problems - some solution methods- computational procedure- simple material nonlinearity, stress stiffening, contact interfaces- problems of gaps and contact- geometric non-linearity- modeling considerations- Impact analysis. Mechanical properties of biological and commonly used biomedical engineering materials -. Critical reviews of finite element analysis in biomechanical research.

TOTAL :45 PERIODS

TEXT BOOKS:
1. Seshu. P. "Textbook of Finite Element Analysis" Prentice Hall of India, 2003.
2. J.N. Reddy, " Finite Element Method" Tata McGraw Hill, 2003.
3. S.S. Rao, "The Finite Element Method in Engineering "Butter worth heinemann, 2001.
4, Reddy, J.N, "An Introduction to the Finite element Method", McGraw – Hill, 1985.

MN8004	HEALTH INFORMATICS	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Knowledge on Hospital Healthcare (B.Tech)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To enable the students to gain knowledge in various aspects of informatics related to health and the techniques to apply these in proper health care delivery

COURSE OUTCOMES (COs)

CO1	The student understands the various aspects of informatics applied in health industry so that quality of health care is improved.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	COs	Programme Outcomes (POs)

1	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
3	Category	\multicolumn{2}{l|}{Professional Mathematics (PM)}	\multicolumn{2}{l|}{Professional Core (PC)}	\multicolumn{2}{l|}{Professional Elective (PE)}	\multicolumn{2}{l|}{Open Elective (OE)}	\multicolumn{3}{l|}{Project/ Term Paper Seminar/ Internship (PR)}
						√						
4	Approval	41st - 42nd Meetings of Academic Council

UNIT I   HEALTH INFORMATICS   9

Historical highlights and Evolution, Hospital Information System – its characteristics and functional online and offline modules, Health Informatics, Bioinformatics, Medical Informatics, Clinical Informatics, Nursing Informatics, Public Health Informatics, e – health services, Evidence Based Medicine, Bioethics, Virtual Hospital

UNIT II   ELECTRONICS PATIENT RECORDS AND STANDARDS   9

Electronic Patient Record, Medical data formats, – Medical Standards   HL7 – DICOM - – IRMA - LOINC - PACS - Medical Standards for Vocabulary - ICD 10, DRGs, MeSH, UMLS, SNOMED - Healthcare Standards - JCAHO, HIPAA

UNIT III   BIOINFORMATICS AND TECHNOLOGIES   9

Bio-information technologies, Semantic web and Bioinformatics, Genome projects - Education and Training - Nano technology in Healthcare - Nanomedicine, Nanopharma, CNT based Nano sensor, BioCom chip, Medical Nanorobo - Virtual Reality and Multimedia Applications in Medicine

UNIT IV   JAVA PROGRAMMING   9

Design and Development of Hospital Information Systems – Developing front-end, back-end and Client – Server interface programs in Java Environment – SQL

UNIT V   INTERNET AND WEB   9

Medical Networks - Java script programming - Web Design and programming - Design of Web portal services in medicine.

TOTAL: 45 PERIODS

REFERENCES:

1. RamachandraLele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
3. Mohan Bansal M S, Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. Yi-Ping Phoebe, Bioinformatics Technologies, Springer International, New Delhi, 2007.
5. OrpitaBosu, Bioinformatics – Databases, Tools and Algorithms, Oxford University Press, 2007.
6. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
7. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
9. AtulKhate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008
10. Lukas K Baehler, Bioinformatics – Basics, Applications in Biological Sciences and Medicine, Taylor & Francis, London, 2005. Deitel, "Java How to Program", Pearson Education / PHI, 2006

MN8005	HEALTH POLICY AND EQUIPMENT MANAGEMENT	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Knowledge in Hospital Management (B.Tech)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To expose the students for planning and operation of hospitals in a detailed manner which will include all facts of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.
- To introduce the equipment maintenance management skills and how to protect equipment from electromagnetic interferences.

COURSE OUTCOMES (COs)

CO1	Understanding the various health policies
CO2	Planning activities at health care centres.
CO3	Equipment installation ,service & calibration needs

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs	Programme Outcomes (POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H		H			H			M			
	CO2					M							L
2	CO3	M		M									
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   HEALTH SYSTEM   9
Health organization of the country, the state and cities, health financial system, teaching cum research hospitals, General Hospital, PHC reference system.

UNIT II   NATIONAL HEALTH POLICY   9
Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

UNIT III   EQUIPMENT MAINTENANCE MANAGEMENT   9
Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of equipment and operating instructions.Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT IV   LOGISTIC SUPPORT & RELIABILITY   9
Maintenance equipment and Tools, failure analysis, spare parts and maintenance

materials.Reliability fundamentals.

UNIT V   EMI TO HOSPITAL EQUIPMENTS   9
Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

TOTAL: 45 PERIODS

REFERENCES:
1. Antony Kelly, `Maintenance Planning & control' Butterworth, London 1984.
2. Hans Pleiffveradammann (ed) `Hospital Engineering in developing countries, GTZ report Eschborn, 1986.
3. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

MN8006	**HOSPITAL ARCHITECTURE**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in Hospital Management				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To expose the students to planning and operation of hospitals in a detailed manner which will include all facets of hospital planning activities covering every department that is involved both in clinical care as well as supportive services.

COURSE OUTCOMES (COs)

CO1	The student will be able to follow the newest findings in the area of hospital planning, health consultancy, hospital waste and implement the perspectives in constructing hospital standards

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H			H			M			
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   INTRODUCTION TO HEALTH CARE SYSTEM   9

International and National level policy framework for healthcare facilities – Types of healthcare facilities based on public and private ownership, bed size and type of health care services based on outpatient ,inpatient and diagnostic care - Organizational, function and structure of the hospital.

UNIT II   HOSPITAL PLANNING   9

Principles of planning, regionalization, hospital planning team, planning process, size of the hospital, site selection, hospital architect, architect report, equipping a hospital, interiors & graphics, construction & commissioning, planning for preventing injuries, electrical safety.

UNIT III PLANNING & DESIGNING OF DIFFERENT SERVICES IN HOSPITALS 9

Planning and designing of administrative services, medical and ancillary services, nursing services, supportive services, public areas and staff services, hospital services

UNIT IV   STANDARDS AND NORMS FOR HOSPITALS   9

Design and construction standards for the hospitals namely BIS –India and JCAHO, AIA and NHS
– general guidelines and standard for out-patient area, in-patient area and diagnostic area in the hospitals. Voluntary & Mandatory standards, General standards, Mechanical standards, Electrical Standards, Standard for centralized medical gas system, Standards for biomedical

waste.

UNIT V   FACILITIES FOR SUPPORTIVE SERVICES   9
Transport, Information system, Communication, Food services, Mortuary, Heating
Ventilation and Air Conditioning, Medical gases, House Keeping, Laundry.

TOTAL : 45 PERIODS

REFERENCES:
1. G.Kunders."Hospitals- Facilities Planning & Management", Tata Mcgraw - Hill education-2004.
2. S.K.Gupta, S.kant, R.Chandrashekhar, S.Satpathy. "Modern trends in planning and designing of hospitals: Principles and practice", Jaypee Brothers-Medical publishers, New Delhi, 2007.
3. Sa Tabish." Hospital and Nursing Homes planning, Organisation and Management", ", Jaypee Brothers-Medical publishers, New Delhi, 2003
4. Purnima Sharma, Sangeet Sharma, NerendraMalhotra, JaideepMalhotra. "Step by Step Hospital Designing and Planning", 2nd Edition, Jaypee Brothers-Medical publishers, New Delhi, 2010.

MN8007	**HOSPITAL PLANNING, ORGANIZATION AND MANAGEMENT**	L	T	P	C
	Total Contact Hours: 45	3	0	0	3
	Prerequisite: Basic Knowledge in hospital management (B.Tech)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- With an objective of imbibing a professional approach amongst students towards hospital management.
- The subject encompasses management principles, staffing and marketing processes, discussing their significance and role in effective and efficient management of health care organizations.
  .

COURSE OUTCOMES (COs)

CO1	The student acquires knowledge of the principles and practices essential for managing a hospital organization

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H			M	H		M			M		M
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   FORMS OF ORGANISATION   8
Sole proprietorship, Partnership, Company-public and private sector enterprises, Principles of management, Evolution of management.

UNIT II   PRINCIPLE OF HOSPITAL MANAGEMENT: 10
Importance of management and Hospital, Management control systems. Forecasting techniques decision-making process

UNIT III   STAFFING   6
Staffing pattern in hospitals, Selection, Recruiting process, Training of staff, Organizational structures, Career development

UNIT IV   MARKETING AND MANAGEMENT   10
Basic concepts marketing, Principles of social marketing, Social marketing in health sector, Consumer behavior and research health, Advertising in Health Sector, Relevance of e-marketing of Health care services

UNIT V   COMPUTER IN HOSPITAL   11

System Development life cycle, Reasons to use computers in hospital, main categories of information systems in hospitals

TOTAL :45 PERIODS

REFERENCES:
1. Goyal R.C., Human Resource Management in Hospital, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. Nauhria R.N. and RajnishPrakash, Management & systems, New Delhi Wheeler publishing, 1995.
3. Koontz, Essentials of Management, McGraw Hill, 1995.

MN8008		HOSPITAL WASTE MANAGEMENT	L	T	P	C
		Total Contact Hours:45	3	0	0	3
		Prerequisite: knowledge on Hospital Management (B.Tech)				
		Course Designed by : Bio-Medical Engineering				

OBJECTIVES

- To understand the significance of infections, biomedical waste and its proper disposal. To teach the students about the controls applied to waste management.

COURSE OUTCOMES (COs)

CO1	Awareness of environmental hazards
CO2	Challenges against the infectious diseases To create litter free zone around hospitals
CO3	New & efficient methods in disposing the hospital waste
CO4	Awareness of environmental hazards

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M				H					M

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I INTRODUCTION 9

The Medical Waste Stream, Types of waste - Waste management elements – Categories of Bio-medical waste- Regulatory Requirements.

UNIT II PRINCIPLES OF STERILIZATION 9

Disease Transmission - Disinfection methods – Sterilization - steam sterilizing (Auto claving) - Microwave (Non-burn treatment technology).

UNIT III DISPOSAL OF WASTE 9

Disposal methods - Incinerator - Hazardous waste, radioactive waste, liquid waste destruction - landfill.

UNIT IV   CONTROLS APPLIED TO WASTE MANAGEMENT   9
Air pollution and Emission control, Instrumentation and monitoring, Crematories

UNIT V   ENVIRONMENTAL SAFETY, RISKS & PUBLIC ISSUES.   9
Risk management in hospitals - Environment issues in hospitals - Risk analysis
                                                                TOTAL : 45 PERIODS

REFERENCES:
1. C.R.BRUNNER, Medical Waste Disposable Handbook, Incentrated, Consultant in Corporated, Virginia, 2000.
2. C.R.BRUNNER, Incentrated Consultant in CorporatedIncentration System Hand Book, Virginia

MN8009	HUMAN RESOURCES MANAGEMENT IN HOSPITAL		L	T	P	C
	Total Contact Hours:45		3	0	0	3
	Prerequisite: Basic knowledge in Hospital management (B.Tech)					
	Course Designed by : Bio-Medical Engineering					

OBJECTIVES
- This subject acquaints the students with major functions of HRM aligned with the business strategy.
- The subject encompasses the concept of best fit employee, training & executive development, sustaining employee interest and performance appraisal

COURSE OUTCOMES (COs)

CO1	Upon the completion of this course, the student is well acquainted with the knowledge about the significance and role in effective and efficient management of human resources in health care organizations .

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   PERSPECTIVES OF HUMAN RESOURCE MANAGEMENT   9

Evolution of Human Resource Management - Importance of Human factor, Objectives of Human resource Management - Human Resource Policies - Need for HRD/HRM in Healthcare Organisation - Computer Applications In Human Resource Management.

UNIT II   THE CONCEPT OF BEST FIT EMPLOYEE   9

Organisational Job Design - job description - job analysis - job rotation-job evaluation- Man-power planning- Importance of Human Resource Planning, Forecasting of Human Resource Requirements - Selection procedures - test, Validation, Interviews, Recruitment, Medical Examination.

UNIT III   TRAINING & EXECUTIVE DEVELOPMENT   9

Types of Training methods and their benefits - Executive development Programme - common practices - Benefits, self-development - knowledge Management.

UNIT IV   SUSTAINING EMPLOYEE INTEREST   9

Wage and Salary Administration – concept of incentives and its operational implications – Participative decision making – Concept of Collective Bargaining – Compensation plans –

Rewards – Motivation – Theories of motivation - Grievances and redressal methods.

UNIT V   PERFORMANCE APPRAISAL   9

Importance of Performance Appraisal - Methods of Performance Evaluation, - Traditional methods – Modern methods – Feedback – Promotion – Demotion – transfer. Implications of jobs change. The control process, Methods and Requirements of Effective control system.

TOTAL : 45 PERIODS

REFERENCES:

1. R.C.Goyal, Human Resource Management in Hospitals, Prentice Hall of India, 2000.
2. Mamoria C.B. and MamoriaS.Personnel Management, Himalaya Publishing Company, 1997.
3. Decenzo and Robbins, Human Resource Management, Wiley & Sons, Singapore, 1999.

MN8010	**PHYSICS IN MEDICINE**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge in medical Physics (B.Tech)				
	Course Designed by : Biomedical				

OBJECTIVES
- To develop an understanding of physics involved in various imaging modalities and the effect of radiation on human body

COURSE OUTCOMES (COs)

CO1	The students understands the physics behind radiation used in medical techniques and acquires in-depth knowledge about optics & ultrasound along with their effects of radiation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	M		M			H			M			H
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT I   PRINCIPLES OF NUCLEAR PHYSICS   9

Traditional definition of atom, periodic system of elements, mechanical properties of atom, emission of light and its frequencies . Electromagnetic spectra, Laws of equilibrium - Theory of
            - electron capture - internal conversion - nuclear isomerism- Natural radioactivity,
decay   Decay
series, type of radiation and their applications, , accelerator principles; reactor and cyclotron produced isotopes - fission products- artificially produced isotopes and its application   - Radionuclides used in Medicine and technology.

PHYSICS OF INFRARED , MICROWAVE AND RADIO
UNIT II   FREQUENCY   9

Production and properties - interaction mechanism of RF and mirocwaves with biological systems: Thermal and non-thermal effects on whole body, lens and cardiovascular systems - tissue characterization and Hyperthermia and other applications. Biomagnetism - Effects – applications-Infrared   detectors—thermographicequipments—quantitative   medical thermography— pyroelectric video camera—applications of thermography.

UNIT III   LASER PHYSICS AND PHOTOMEDICINE   9

Characteristics of laser radiation , Laser speckle, biological effects, laser safety management Synthesis of vitamin D in early and late cutaneous effects, Phototherapy, photo hemotherapy, exposure level, hazards and maximum permissible exposures. Optical characteristics of biomolecules from the point of spectroscopy – principles of UV – Visible absorption – IR and FTIR absorption – Raman and Fluorescence spectroscopy – application with regard to

characterization of biomolecules – blood oxygen, glucose measurements, monitoring drug concentration, cancer

UNIT IV   DIAGNOSTIC ULTRASOUND   9

Ultrasonic waves – generation and detection of ultrasound –Beam characteristics—attenuation of ultrasound –specific acoustic impedance—reflection at body interfaces---Coupling medium ---
interaction ultrasound with tissues-—deleterious effects of Ultrasound- Safety levels of Ultrasound- real time scanners image clarity---Resolution ---axial and lateral resolution ----Artifacts---Pulse echo imaging ----Obsterics abdominal investigations- Echo cardiograph (UCG) – The Doppler Effect-Doppler Shift---continuous wave Doppler system ---Pulsed wave Doppler systems---duplex scanning-display devices for ultrasonic imaging

UNIT V   RADIOBIOLOGICAL EFFECT OF RADIATION   9

Target theory, single hit and multi target theory, cellular effects of radiation, DNA damage, chromosomal damage, Somatic effect : Radio sensitivity protocol of different tissues in human ,LD 50/30 effect, Genetic effect: Threshold of linear dose effect, relationship factors affecting frequency of radiation induced mutation, biological effect of microwave, Rf wave and UV radiation.

TOTAL: 45 PERIODS

REFERENCES:
1. Moselley 'Non ionizing Radiation' Adam HilgarBrustol 1998
2. Branski.S and Cherski.P 'Biological effects ofmicrowave ' Hutchinson & ROSS Inc.Stondsburg 1980
3. Glasserr .O.Medical Physics Vol.1, 2,3 year Book Publisher Inc Chicago, 1980
4. Eric .J.Hall, and Amato .J.Giaccia , 'Radiobiology for radiologist' , Lippincott Williams and Wilkins.,2006
5. Sorenson James A, 'Physics in Nuclear Medicine', W.B. Saunder's Company, 1987.
6. Diagnostic Ultrasound applied to OBG-Sabbahaga-Maryland -1980
7. Basic Ultrasound-Hylton B Meire and Pat Farrant-John Wiley & Sons –NY-1994.
8. MRI in Practice-Catherine Westbrrok
9. The essential Physics for Medical Imaging – Jerrold T Bushberg

MN8011	QUALITY ASSURANCE AND SAFETY IN HOSPITALS	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Hospital safety (B.Tech/B.E)
Course Designed by : Bio-Medical Engineering

OBJECTIVES
- To provide basic knowledge on the concept of Healthcare Quality management towards continuous improvement of patient care .
- To make the students aware of the role of biomedical engineer in hospitals, especially in the management of electrical supply, maintenance of electrical safety.

COURSE OUTCOMES (COs)

CO1	The purpose of this course is to help students to develop knowledge and insight into the procedures used in quality control and assurance activities as well as safety measures to be followed in hospitals.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H	H	M			H			M			M
3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)			
						√							
4	Approval	41st - 42nd Meetings of Academic Council											

UNIT ISTANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS   9
Define Quality- Need for Standarization& Quality Management, TQM in Health care organization-Quality assurance methods ,QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments

UNIT II   REGULATORY REQUIREMENT FOR HEALTH CARE   9
FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

UNIT III   HOSPITAL SAFETY   9
Security & Safety of Hospital -Property, Staff & Patients, Radiation safety, Safety precautions, hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety, Disposal of Biological waste.

UNIT IV   ELECTRICAL & FIRE SAFETY   9
Sources of shocks, macro & micro shocks -Hazards, monitoring and interrupting the Operation from leakage current- Elements of fire, causes of fire , Action to be taken in case of fire in a Hospital.

UNIT V   ASSESSING QUALITY HEALTH CARE   9

Patient Safety Organization- Governmental & Independent, Measuring Quality care – Evaluation of hospital services – six sigma way, Quality Assurance in Hospitals Sop's – Patient Orientation for Total Patient Satisfaction. 5S techniques

TOTAL :45 PERIODS

REFERENCES:

1. Cesar A. Cacere& Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.
2. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979.
3. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd.
4. K.ShridharaBhat, Quality Management, Himalaya Publishing House.
5. Karen Parsley, Karen Parsley Philomena Corrigan" Quality improvement in Healthcare, 2nd edition ,Nelson Thrones Pub, 2002
6. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012

Joseph F Dyro "Clinical Engineering Handbook" Elsevier Publishers, 2004

MN8012	**SIGNAL PROCESSING AND IMAGE PROCESSING TECHNIQUES APPLIED TO BIOLOGICAL SYSTEMS**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: knowledge in signal and image processing (B.Tech/B.E)				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To introduce the basics of signal processing and its application to biological systems.
- To make the students to understand the fundamentals of image processing and its applications

COURSE OUTCOMES (COs)

CO1	Widen rational design approaches to biomaterials engineering
CO2	Identify significant gap required to overcome challenges and further development
CO3	Develop critical analyses of biomaterials through proposal writing and review.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
2		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   INTRODUCTION   10
Definition of biomaterials, mechanical properties, surface chemistry of materials, surface modification, Tissue Reaction, Wound Kinetics, Bio Compatibility.

UNIT II   MATERIALS IN MEDICAL DEVICES   10
Metals, Ceramics, Polymers and Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III   STERLIZATION OF BIOMATERIALS   7
                                                                                     steam sterilization,
Sterilization techniques: – process and mechanism of action of   radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide   and plasma gas sterilization
.

UNIT IV   TESTING OF MATERIALS   8
Testing with Tissue Culture – in vitro and in vivo assessment of biocompatibility, Testing with Soft Tissues and testing at non Thrombogenic surface – blood compatibility and thrombobogenicity.

UNIT V   HARD AND SOFT REPLACEMENT   10

Cardiac Implants, Orthopedic Implants, Neuro Muscular Implants, Transcutaneous Implants, Intraocular lenses.

TOTAL: 45 PERIODS

REFERENCES:
1. J.H.U.Brown (Ed), Advances in Bio Medical Engineering, Academic Press 1975.
2. Andrew F.VonRacum, Hand Book of Bio Medical Evaluation, Mc-Millan Publishers, 1980.
3. Jacob Cline, Hand Book of Bio Medical Engineering, Academic Press in Sandiego, 1988.
4. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.
5. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering, 2005.
6. Buddy D.Ratner,Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine,2nd Edition, Elsevier Academic Press,San Diego,2004.

MD8071		**ADVANCED NEURAL COMPUTING**		L	T	P	C
		Total Contact Hours:45		3	0	0	3
		Prerequisite: basic in neural network (B.Tech/B.E)					
		Course Designed by : Biomedical Engineering					

OBJECTIVES

- The course will teach a variety of contemporary approaches to neural networks and introduce the theory underlying these approaches. The approaches to be covered will include such things as biological and statistical foundations of neural networks, Perception, MLPs, RBFN,SVM and competitive learning. Additionally, a brief introduction to optimization techniques using Genetic algorithm and its applications will be given.

COURSE OUTCOMES (COs)

CO1	Upon completion of this course student gains knowledge about various neural networks that can be used for biomedical signal analysis and Medical image analysis. Also about the genetic algorithms as well as techniques used in its implementation

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1		Programme Outcomes (Pos)										
	(	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2		M		M			H			M			H

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   INTRODUCTION TO ARTIFICIAL NEURAL SYSTEMS   8

Biological Neurons and their Artificial models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer Perceptron Classifiers.

UNIT II   BPN AND BAM   9

Back Propagation Network, Generalised Delta Rule, BPN Application, Associative Memory Definition, BAM, Hopfield Memory, Simulated Annealing-Boltzmann Machine.

UNIT III   OTHER NETWORKS   10

Counter Propagation Network, Feature Mapping, Self Organising Feature Maps, Adaptive Resonance Theory (ART) Network Descriptions.

UNIT IV   GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES   8

The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic

Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling, GA applications

UNIT V   ADVANCES AND APPLICATIONS   10
Support Vector Machines, R B F Network, Neocognitron. Evolving neural networks using GA, Applications of ANN in biomedical signal analysis and Medical image analysis

TOTAL: 45 PERIODS

REFERENCES:
1. Philip D.Wasermann, Advanced Methods in neural Computing, Van NostrandReinhold,NewYork 1993.
2. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison - Wesley USA,1997.
3. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998..
4. Simon Haykins, Neural Networks, Prentice Hall international lnc, 1999.
5. James A Freeman and David M. Skapura, Neural Networks, Addison - Wesley, India 1999.

MD8072		ADVANCED NEURAL ENGINEERING			L	T	P	C
		Total Contact Hours:45			3	0	0	3
		Prerequisite: basic in neural network (B.Tech/B.E)						
		Course Designed by : Biomedical Enginnering						

OBJECTIVES

- Neural engineering and rehabilitation research applies neuroscience and engineering methods to analyze central and peripheral nervous system function and to design clinical solutions to neurological disorders or injury.
- To study the basics of Nervous system
- To understand the development and arrangement of neural tissue To study the neuronal disorders and injuries
- To study the repairing and reconstruction mechanism of nervous system.

COURSE OUTCOMES (COs)

CO1	Through this course of study application of basic science and engineering techniques, neural engineers can develop methods to record from and exert control over the nervous system and associated organ systems.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

		Programme Outcomes (Pos)										
1		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2		M		M			H			M			H

3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)
						√				
4	Approval	41st - 42nd Meetings of Academic Council								

UNIT I   BASICS OF NERVE   9

Development of Nervous system – Neurotrophic Factors, Extracellular Matrix components in Nervous system development – Neuron & Glial cells Structure, Classifications and Functions – Myelination – Neurotransmitter; types & functions – Action potential   - Transport of impulse and materials in neurons – NMJ - Neural control of movement – Sensory Feedback Mechanism.

UNIT II   BRAIN, BRAIN STEM AND SPINAL CORD   9

Brain: Lobes - Cortical Areas – Brain Circuits – Memory – Sleep - Brains Stem: Structure and Control areas – Cerebellum - dyslexia. Spinal cord: Structure and Functions. Concepts of Nuclei, Ganglia and tracts - Reticular formation – Plexus formation – Visual, Auditory & Olfactory Pathway.Neurophysiology and neural control of genitourinary function.

UNIT III   NEURON TRACING   9

Physiology of Nerve conduction - Visualization of nervous system – Synaptic transmission and cellular signaling of Neurons - Electrical activity of the brain and recording of brain

waves - Cortical mapping - Voltage sensitive dyes - Fluorescent tracing of neural tissue. Synchronization and control of neural activity in-vivo and in-vitro - Spinal neural circuits – Neural cell markers.

UNIT IV   NERVE INJURY AND DISORDERS   9

Blood Brain Barrier - Neurological dysfunctions - Neuro degeneration – Demyelination – Neuronal injury - Neural plasticity- Wallerian degeneration – Drugs acting on CNS and their Pharmacokinetics. Alzheimer's, Parkinson's and Prion diseases. Sleep Disorder – Schizophrenia

UNIT V   NEURAL ENGINEERING   9

Regeneration of the Nervous system - Axon guidance -   Retinal regeneration - Neuron & Neuroglial culture - Nerve graft: Neural Tissue Engineering –Peripheral Nerve Reconstruction - Drug Delivery system in CNS. Cognitive & neurobehavioral rehabilitation.

TOTAL :45 PERIODS

REFERENCES :
1. Mathews G.G. Neurobiology, 2nd Edition, Blackwell Science, UK, 2000.
2. Textbook of Neuroanatomy, Malcom Carpenter, Mc.Grawhill Edition.
3. Park J.B."Biomaterials Science and Engineering", Plenum Press, 1984.
4. W. Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue –- Oxford University Press inc New York, 2004.

MD8073	BIO MEMS			L	T	P	C
	Total Contact Hours:45			3	0	0	3
	Prerequisite: Knowledge in Biomems (B.Tech)						
	Course Designed by : Bio-Medical Engineering						

OBJECTIVES
- Different types of sensors and actuators and their principles of operation at the micro scale level.
- Application of MEMS in different field of medicine.

COURSE OUTCOMES (COs)

CO1	Understand the operation of different types of sensors and actuators at microscale level
CO2	Understand the design issues at microscale level
CO3	Choose the material for any application
CO4	Apply the concepts to the design of different types of microsystems

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1 2	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
	CO1	H	H	M			H			M			M
	CO2				H			H			M	H	
	CO3		M			M	H			M			
	CO4			M					H				M

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   MEMS MATERIALS AND FABRICATION   9

Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining-photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA

UNIT II   MECHANICAL AND THERMAL SENSORS AND ACTUATORS   9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS
9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor. Case study: Design of electrostatic actuator

UNIT IV   MICROFLUIDIC SYSTEMS   9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale.Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers , Case study: Design of elecrophoreticmicrocapillary network system.

APPLICATIONS OF MEMS IN
UNIT V   MEDICINE   9
CAD for MEMs, Biological MEMS materials, polymer
based   gas sensor, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, Drug delivery- Types of reservoirs, Case study: Design of BP sensor.

TOTAL: 45 PERIODS

REFERENCES:
1. Chang Liu,' Foundations of MEMS', Pearson Education International, New Jersey, USA, 2006
2. NitaigourPremchandMahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
4. Wanjun Wang, Stephen A.Soper, "BioMEMs: Technologies and applications", CRC Press, New York, 2007
5. Marc J. Madou ' Fundamentals of Microfabrication: the science of miniaturization', CRC Press, 2002
6. NadimMaluf, Kirt Williams. "An introduction to Microelectromechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004
7. Ellis Meng , "Biomedical Microsystems", CRC Press,Boca Raton, FL, 2011.
8. Victor.C.Yang,That.T.Ngo."Biosensors and their applications", Springer, 2006.

MD8074	COMPUTER BASED MEDICAL INSTRUMENTATION	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in medical instrumentation (B.Tech/B.E)				
	Course Designed by : Electronic				

OBJECTIVES

- To teach PC hardware and its related interfacing
- To give a complete overview of 80186, 80286, 80386 and 80486 microprocessors.
- To understand the basics of computerized data acquisition and programming.
- To enrich the students knowledge with biometrics and network security.

COURSE OUTCOMES (COs)

CO1	Exposed to PC hardware as well as various microprocessor family Hardware behind data acquisition
CO2	Scope of virtual reality in health care
CO3	Develop an insight knowledge about the biometrics and network security

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

	Cos	Programme Outcomes (Pos)											
1		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	M		M			H			M			H
	CO2			H				M			M		
	CO3		M			M	H		H	M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		

4	Approval	41st - 42nd Meetings of Academic Council

UNIT I   PC HARDWARE AND OVERVIEW   9

System Unit - Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply - BIOS – DOS interaction, POST, Functional and Architecture Block diagram of a PC, Mother Board logics - Memory and I/O map

UNIT II   PROCESSORS AND MEMORY   9

80X86 Processors - Architectures and Memory management - Overview of 80X86 based Mother boards

UNIT III   PERIPHERAL INTERFACING AND CONTROLLERS   9

Keyboard and Mouse Interfaces - Memory types - RAM - SDRAM and RDRAM, Cache

memory, ROM and its types, Flash memory, CMOS semiconductor memory - Adapter Cards - Sound Card, Modem card, Video card, Network Card - I/O slots - ISA, PCI and AGP bus slots - Ports - Serial and Parallel ports, USB, FireWire port, MIDI, SCSI, IrDA, Bluetooth – Connectors - System Bus, ISA, EISA, PCI, AGP and PCI bus - Disk controllers

COMPUTERISED DATA ACQUISITION AND
UNIT IV   PROGRAMMING   **9**
Plug-in-
data   acquisition and Control Boards,   - Data acquisition using   GPIB and Serial Interfaces and Programming in C - DSP in Medical applications

UNIT V   CAD IN MEDCAL INSTRUMENTATION   9
FPGA Design Logics - Virtual Bio- Instrumentation in LABview - Multisim Simulation with bio-amplifiers - Mixed signal SoC applications in biomedical applications

TOTAL: 45 PERIODS

REFERENCES:
1. RamachandraLele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005
8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
9. AtulKhate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008

MD8075		**MEDICAL ETHICS AND STANDARDS**	L	T	P	C
		Total Contact Hours: 45	3	0	0	3
		Prerequisite: Knowledge in Professional ethics (B.Tech/B.E)				
		Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- Achieve familiarity with some basic ethical framework& understand how these ethical frameworks can help us to think through contemporary questions in medical ethics.
- Students will be able to know about the legal and ethical principles and application of these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals

COURSE OUTCOMES (COs)

CO1	Upon completion of this course the student should be able to demonstrate a measurable increase in their knowledge, skills and abilities related to:
CO2	Legal and professional guidelines for the health professions
CO3	Public duties and consent
CO4	Guidelines to obtain medical standards in hospitals.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1		Programme Outcomes (POs)											
	COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	H		H			H			M			
	CO2					M							L
	CO3	M		M									
	CO4		L								L		

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   INTRODUCTION TO MEDICAL ETHICS   8
Definition   Medical ethics, Scope of ethics in medicine, American medical Association code of   of ethics, CMA code of ethics- Fundamental Responsibilities ,The Doctor And The Patient, The Doctor And The Profession, Professional Independence, The Doctor And Society.

UNIT II   ETHICAL THEORIES & MORAL PRINCIPLES   9
Theories-Deontology &Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Principles-Non-Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research ,Bioethical issues in Human Genetics & Reproductive Medicine.

UNIT III   HOSPITAL ACCREDITATION STANDRADS   9
Accreditation- JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards.

UNIT IV   HOSPITAL SAFETY STANDARDS   10

Life Safety Standards- Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat,
Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards-Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

UNIT V   MEDICAL EQUIPMENT SAFETY STANDARDS   9

General requirements for basic safety & essential performance of medical equipments.IEC 60601 standards- Base Standard-general requirement of electrical medical devices, Collateral Standards-EMC radiation protection &programmable medical device system, Particular Standards-type of medical device

TOTAL :45 PERIODS

REFRENCES:

1. Domiel A Vallero "Biomedical Ethics for Engineers", Elsevier Pub. 1st edition, 2007
2. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada (2009)
3. Robert M Veatch" Basics of Bio Ethics", Second Edition. Prentice- Hall, Inc 2003
4. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HCPro, Inc. 2010
5. Joint Commission Accreditation Standards for Hospitals ,2 nd edition 2003
6. Bioethics-"An Introduction for the biosciences", 2nd edition 2008, Ben Mepham, Oxford.

MD8076		MEDICAL OPTICS			L	T	P	C
	Total Contact Hours:45				3	0	0	3
	Prerequisite: Knowledge in medical physics							
	Course Designed by : Bio-Medical Engineering							

OBJECTIVES
- The objectives of this course are to: (i) provide a possibility for the student to acquire knowledge about the physical properties of light and its impact and interaction with biological tissue in terms of optical properties, instrumentation in photonics, through the use and design of appropriate optical components; (ii) understand the engineering and practical applications of optics related to diagnostics, sensing and therapeutics of the human body

COURSE OUTCOMES (COs)

CO1	Able to know the various optical properties of tissue as well as application of lasers in medical fields

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M			H			M			M

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   OPTICAL PROPERTIES OF THE TISSUES   9

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, opto-thermal interaction, fluorescence.

UNIT II   INSTRUMENTATION IN PHOTONICS   9

Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, Lasers, optical filters, solid state detectors - optical detectors - time resolved and phase resolved detectors.

UNIT III   SURGICAL APPLICATIONS OF LASERS   9

Laser in tissue welding, lasers in dermatology, lasers in ophthalmology, otolaryngology, urology.

UNIT IV   DIAGNOSTIC APPLICATIONS   9

Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM.

UNIT V   THERAPEUTIC APPLLICATIONS   9

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and

non-oncological applications of PDT - Biostimulation effect – applications.

TOTAL : 45 PERIODS

TEXT BOOKS:
1. MarkolfH.Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, 2007.
2. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and sons, Inc. Publications, 2003.

REFERENCES:
1. Tuan VoDinh, "Biomedical photonics – Handbook", CRC Press LLC, 2003.
2. Mark E. Brezinski, "Optical Coherence Tomography: Principles and Applications", Academic Press, 2006.
3. R. Splinter and B.A. Hooper, "An Introduction to BioMedical Optics", Taylor and Francis, 2007.

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MD8077	**NANOMEDICINE PRINCIPLES AND APPLICATIONS**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: Knowledge in tissue engineering				
	Course Designed by : Bio-Medical Engineering				

OBJECTIVES
- To know basic nanotechnological principles and characterization methods
- To understand the essential features of biology and nanotechnology that are converging create the new areas of bionanotechnology and nanomedicine.

COURSE OUTCOMES (COs)

CO1	The student will be able to follow the newest findings in the area of Nano medicine and implement the perspectives in own research

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	H	L	M	M M	M					

3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	
						√					
4	Approval	41st - 42nd Meetings of Academic Council									

UNIT I   INTRODUCTION OF NANOPARTICLES   9

Overview of nanotechnology from medical perceptive, different types of nanobiomaterials and nanostructure interactions. Synthesis, characterization, and properties smart nanomaterials, Surface modification ,biofunctionalization of nanomaterials. Nanocarriers(e.g. liposomes, polymer capsules, polymer nanoparticles, porous materials, nanogels, dendrimers, microemulsions, inorganic nanoparticles, carbon nanotubes, lipoproteins, solid lipid nanoparticles).

**UNIT   PROTEIN AS
II   NANOSTRUCTURES   9**

Protein based nanostructures building blocks and templates – Proteins as transducers   and amplifiers – nanobioelectronic devices and polymer nanocontainers – microbial production of inorganic nanoparticles – magnetosomes.

UNIT III   DNA AS NANOSTRUCTURES   9

DNA based nanostructures – Topographic and Electrostatic properties of DNA – Hybrid conjugates of gold nanoparticles – DNA oligomers – use of DNA molecules in nanomechanics .

UNIT IV   NANOPARTICLES IN DIAGNOSIS   9

Introduction to nanoparticles in diagnostics— nuclear imaging, optical imaging, PET, Micro PET, cardio vascular disease studies,imaging and therapy of thrombosis,emerging Ethical issues and toxicology of nanomaterials

UNIT V   NANOTHERAPEUTICS   9

Nanoparticles as carriers in drug delivery- design, manufacture and physiochemical properties, transport across biological barriers, nanotechnology in Cancer therapy, lung infectious disease, bone treatment, nano particles for oral vaccination and skin disease.

TOTAL : 45 PERIODS

REFERENCES:

1. Nanobiotechnology – Concepts, Applications and Perspectives – 2004. Edited by CM, Niemeyer , C.A. Mirkin. Wiley – VCH.
2. Nanoparticle Assemblies and Superstructures. By Nicholas A. Kotov.2006 -CRC.
3. Nano: The Essentials: T. Pradeep. McGraw – Hill education – 2007.
4. Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. 2005 - By Challa, S.S.R. Kumar, Josef Hormes, CarolaLeuschaer. Wiley – VCH.

MD8078	PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge on neural network				
	Course Designed by : Biomedical Engineering				

OBJECTIVES
- The objective of this course is to enable the students to understand the fundamentals of Pattern recognition.
- The students should learn to choose an appropriate feature, pattern classification algorithm for a pattern recognition problem, properly implement the algorithm.
- To enrich the students knowledge with fuzzy systems and its applications

COURSE OUTCOMES (COs)

CO1	Develop an idea about the fundamentals of Pattern recognition. Acquire the knowledge of fuzzy systems & its applications.
CO2	Recent advancements in life science & technology using Fuzzy techniques
CO3	Develop an idea about the fundamentals of Pattern recognition. Acquire the knowledge of fuzzy systems & its applications.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M			H			M			H
CO2				H			M			M		
CO3		M			M	H		H	M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
				√		
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   OVERVIEW OF PATTERN RECOGNITION   9

Discriminant functions- Supervised learning - Parametric estimation-Maximum Likelihood estimation - Bayesian parameter estimation – Problems with Bayes Approach. Non Parametric techniques, Perceptron Algorithm-LMSE Algorithm- -Pattern classification by distance functions - minimum distance Pattern classifier.

UNIT II   UNSUPERVISED CLASSIFICATION   9

Clustering for unsupervised learning and classification, clustering concepts hierarchical clustering, Partitional clustering, k- means algorithm - Validity of clustering solutions.

UNIT III   FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION   9

KL Transforms - feature selection through functional approximation - Binary selection

Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.

UNIT IV   FUZZY SYSTEMS   9

Fuzzy sets and fuzzy reasoning- fuzzy matrices-fuzzy functions-decomposition – Fuzzy inference systems Mamdani and Sugeno model, Fuzzy clustering- fuzzy c- means algorithm- fuzzy control method- fuzzy decision making.

UNIT V   RECENT ADVANCES AND APPLICATIONS   9

Principle of neuro fuzzy techniques, Application of PR in image segmentation – CAD system in Breast cancer detection, ECG signal analysis, Fingerprint identification - Cell cytology classification

TOTAL : 45 PERIODS

REFERENCES:
1. Duda R.O., and Hart P.G.,Pattern Classification and scene analysis, JohnWiley, New York, 1973.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image analysis, Prentice Hall of India, New Delhi - 2007.
3. Robert J. Schalkoff , Pattern recognition: Statistical, Structural and Neural approaches,John Wiley and Sonslnc, New York, 1992.
4. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley and sons, New York, 1993.
5. Andrew Webb, Statistical Pattern Recognition, Arnold publishers, London,1999.
6. Donna L. Hudson, Maunee E. Cohan, Neural Networks & Artificial Intelligence for Biomedical Engineering, Prentice Hall of India, New Delhi - 2001.
7. Timothy Ross, Fuzzy Logic with Engineering applications,2nd Edition John Wiley and sons,West Sussex,2004.

MD8079		**PHYSIOLOGICAL MODELLING**	L	T	P	C
		Total Contact Hours:45	3	0	0	3
		Prerequisite: knowledge on physiology control system (B.Tech/B.E)				
		Course Designed by : Management				

OBJECTIVES

- To understand the fundamental engineering aspects of modelling Physiological
- To utilize concepts derived from biomedical research to aid in the design of engineering systems.
- To apply system techniques and methods to biomedical problems.

COURSE OUTCOMES (COs)

CO1	Provides an insight into and understanding of the utilization of models, system analysis and analog simulation in the field of bioengineering.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M			H			M			H

3	Category	Professional Mathematics (PM)		Professional Core (PC)		Professional Elective (PE)		Open Elective (OE)		Project/ Term Paper Seminar/ Internship (PR)	
								√			
4	Approval	41st - 42nd Meetings of Academic Council									

UNIT I   INTRODUCTION TO SYSTEM CONCEPTS   9

The Model and Analog, System Properties – Resistance and Storage, Concept of Energy Storage and Dissipation in physiological systems, Thermal System with Combined System properties, Step response of a Resistance/Compliant Systems, pulse response of a first order system.

UNIT II   TRANSFER FUNCTION   9

System as an Operator, Transfer Function of First and Second Order system, Transfer Function and Concept of Impedance – Circuits into transfer function, Circuit Analog from transfer function.

UNIT III   SYSTEM RESPONSE CHARACTERISTICS   9

Characteristics of Physiological System, Sinusoidal Analysis of Instrumentation System, Frequency Response Characteristics – Semicircular Canals, Visual Tracking System, Evaluation of Transfer Function from Frequency Response, Transient Response Characteristics – Transient input functions, Under-damped Response of physiological system – example - post synaptic aortic arch.

UNIT IV   FEEDBACK   9

Feedback and Homeostasis, Review of system stability concepts, Hypophysis – Adrenal

Feedback Control System, Thermoregulation, Pupil Control System.

UNIT V   SIMULATION OF BIOLOGICAL SYSTEMS   9
Introduction to Simulation, Simulation of Respiratory mechanics, Cardiovascular Control
System, Skeletal muscle servo mechanism, Oculomotor System, Hodgkin Huxley Model.

**   TOTAL : 45 PERIODS**

REFERENCES
1. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co, New York, 1969.
2. ManfreoClynes and John H. Milsum, Biomedical Engineering System, McGraw Hill and Co, New York, 1970.
3. Michael C.K. Khoo, "Physiological Control System" - Analysis, Simulation and Estimation"-Prentice Hall of India, New Delhi, 2001
4. Douglas S. Rigg, Control Theory and Physiological Feedback Mechanism, The William and
   Wilkins Co, Baltimore, 1970   .
5. Richard Skalak and ShuChien, Hand Book of Biomedical Engineering, McGraw Hill and Co, New York, 1987.

MD8080	**PRINCIPLES OF GENETIC ANALYSIS**	L	T	P	C
	Total Contact Hours:45	3	0	0	3
	Prerequisite: basic knowledge on genetic (B.Tech/B.E)				
	Course Designed by : Biomedical Engineering				

OBJECTIVES
- Completion of this subject is expected to enhance a student's ability to understand fundamental principles of genetics and to describe the experiments used to establish th Students will develop skills to apply these principles to solve genetic problems demonstrate how genetic analysis can be used to investigate aspects of biology

COURSE OUTCOMES (COs)

CO1	Interpret different forms of inheritance patterns and identify them in genetic data
CO2	Interpret and critically evaluate the outcomes of statistical analysis associated with the research project
CO3	Acquire in depth knowledge in evolutionary analysis of genetic sequence
CO4	Exploit relevant molecular genetic information with skill and confidence to conduct a research project involving the analysis of real molecular genetic data with minimal supervision

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

Cos	Programme Outcomes (Pos)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M		M			H			M			H
CO2			H				M			M		
CO3		M			M	H		H	M			
CO4	L								L			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   GENETIC INHERITANCE   9

Organisation of DNA, Chromosomal inheritance, Eukaryotic genomes – repetitive and non repetitive sequence, Genetic mapping - restriction cleavage ,RFLP and SNPs.

UNIT II   DNA AND PHENOTYPE   9

DNA structure and replication, DNA sequencing, amplification and hybridisation. DNA Polymorphism, RNA transcription and processing, translation and its post translation modification. Regulation of gene expression.

UNIT III   ENGINEERING OF GENES   9

Gene isolation and manipulation, mutations, repair and recombination, site directed mutagenesis,
in vivo techniques of genetic manipulation, tools for
analysing   gene expression and genetically
        organisms.
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UNIT
IV   HUMAN GENOME PROJECT   9
Human Genome Project (HGP) – an overview of the project, goals of the project, major scientific strategies & approaches used in HGP, physical mapping, gene ontology, gene annotation,
techniques in HGP – microsatellite markers, STS, EST,DNA sequencing and   microarray
DNA   ,
scientific& medical benefits of this project.

UNIT V   IMPACT OF GENETIC VARIATION   9
Population Genetics, Quantitative Genetics, Evolution Genetics.
                                                        TOTAL: 45 PERIODS
REFERENCES:
1. Watson. J. etal, " Molecular Biology of the Gene ", 5th Edition, Pearson Publication, 2004.
2. Griffiths, Wesslers, Lewontin, Bart Gel, Suzuki, Miller "Introduction to Genetics Analysis", – W.H Freeman & company, New York 8th Edition - 2005.
3. Recombinant DNA" 3rd Edition ASM Press, 2003
4. Karp, Gerald." Cell and Molecular Biology". Concepts and Experiments, 4th Edition, John Wiley Sons, 2005.
5. Weaver. R.F. " Molecular Biology " 3rd Edition, McGraw – Hill, 2005.
6. Tom Strachan, Andrew P Read "Human molecular Genetics" 3rd Edition, Garland Publishing – 2004.

MD8081		TELEHEALTH TECHNOLOGY	L	T	P	C
		Total Contact Hours:45	3	0	0	3
		Prerequisite: basic knowledge on healthcare				
		Course Designed by : Biomedical Engineering				

OBJECTIVES
- To teach the key principles for telemedicine and health.
- To enable the students with the knowledge of telemedical standards, mobile telemedicine and its applications

COURSE OUTCOMES (COs)

CO1	Technologies applied in multimedia using telemedicine
CO2	Protocols behind encryption techniques for secure transmission of data
CO3	. Applications of telehealth in healthcare

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation)   H-High, M-Medium, L-Low

1	Cos	Programme Outcomes (Pos)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	CO1	M		M			H			M			H
	CO2				H			M			M		
	CO3		M			M	H		H	M			

3	Category	Professional Mathematics (PM)	Professional Core (PC)	Professional Elective (PE)	Open Elective (OE)	Project/ Term Paper Seminar/ Internship (PR)
					√	
4	Approval	41st - 42nd Meetings of Academic Council				

UNIT I   TELEMEDICINE AND HEALTH   9

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Tele health, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine

UNIT II   TELEMEDICAL TECHNOLOGY   9

Principles of Multimedia - Text, Audio, Video,   Data communications and networks, data,   PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, 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 (www). Video and audio conferencing.Clinical data –local and centralized.

UNIT III TELEMEDICAL STANDARDS 9

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-timeTelemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV MOBILE TELEMEDICINE 9

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available.Pharmaceutical information system.

UNIT V TELEMEDICAL APPLICATIONS 9

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, telesurgery.
Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health security and interoperability., Telemedicine services access to health care services – health education and self care, Business aspects - Project planning and costing, Usage of telemedicine.

TOTAL :45 PERIODS

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. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
4. 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.
5. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
6. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)