ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.E. BIOMEDICAL ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- To prepare the graduates for pursuing research or gaining employment in a bioengineering or related profession
- To enhance the skills of graduates to design a variety of electronic or computer based devices and software for applications including biomedical instrumentation, medical imaging, physiological measurement and biomedical signal processing.
- To enrich the graduates to make positive contributions in biomedical industries and/or other sectors.
- To facilitate the graduates to exhibit leadership skills, make decisions with societal and ethical responsibilities, function and communicate effectively in multidisciplinary settings.

PROGRAMME OBJECTIVES:

PO1 An ability to apply knowledge of mathematics, science, and engineering to solve problems at the interface of engineering and biology.

PO2 An ability to design and conduct experiments, as well as to analyze and interpret data from living systems; addressing the problems associated with the interaction between living and non-living materials and systems.

PO3 An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO4 An ability to function on multidisciplinary and diverse teams and provide leadership.

PO5 An ability to identify, formulate, and solve biomedical engineering problems.

PO6 An understanding of professional and ethical responsibility.

PO7 An ability to communicate effectively: by oral, written and graphic modes.

PO8 The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

PO9 A recognition of the need for and an ability to engage in life-long learning.

PO10 An exhibiting a knowledge of contemporary.

PO11 An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

PO12 An understanding of biology and physiology as related to biomedical engineering needs

PROGRAM SPECIFIC OBJECTIVES (PSOs)

PSO1: To acquire and understand the basic skill sets required for Biomedical Engineering.

PSO2: To Implement the techniques and tools of Bio Medical Engineering to address the needs of technology in healthcare domain.

PSO3: To address the problems associated with the interaction between living and non-living materials and systems.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES:

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	x	x	x		x			x		x	x	
II	x	x			x	x	x		x	x		
III		x	x	x			x	x		x	x	x
IV				x		x		x			x	

M.E. BIOMEDICAL ENGINEERING
SEMESTER COURSE WISE PO MAPPING

		SUBJECTS	PROGRAMME OUTCOMES											
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I YEAR	SEMESTER I	Applied Mathematics for Medical Engineers	x			x								
		Human Anatomy and Physiology		x		x	x		x		x	x	x	x
		Bio Signal Processing		x	x							x		x
		Biomedical Sensors and Instrumentation		x		x	x	x		x	x	x	x	x
		Medical Imaging Systems		x		x	x	x	x	x		x	x	x
		Professional Elective I												
		Principles of Genetic Analysis		x			x		x		x	x		x
		Physics in Medicine			x	x		x	x		x	x	x	
		Bio Materials		x	x							x		x
		Bio Statistics	x			x						x	x	
		Medical Equipment Calibration and Maintenance			x		x	x				x	x	x
		Clinical Instrumentation Laboratory		x	x	x		x		x	x	x	x	X
		Applied Medical Image Processing	x			x				x			x	
		Diagnostic and Therapeutic Equipments		x		x	x					x	x	x
		Biomechanics		x	x	x			x					
		Medical Ethics and Standards		x	x			x			x			
		Professional Elective II												
		Brain Computer Interface	x	x		x		x				x		
		Tissue Engineering		x	x		x			x		x		
		Tele Health Technology	x	x			x		x					x

	Nano Technology and Applications	x	x	x		x		x		x			
	Pattern Recognition Techniques and its Applications	x	x		x				x			x	x
	Professional Elective IIII												
	Hospital Planning, Organization and Management			x			x		x				
	Finance Management in Hospitals			x			x		x				
	Human Resource Management in Hospitals	x					x		x				
	Health Policy and Equipment Management			x			x		x				
	Hospital Architecture	x		x			x		x			x	x
	Biosignal and Image Processing Lab	x		x	x						x	x	x
	Rehabilitation Engineering	x	x	x			x		x		x	x	
	Professional Elective IV												
	Computer Based Medical Instrumentation			x		x		x				x	x
	Bio MEMS			x	x		x	x		x			
	Finite Element Methods for Bio Mechanical Analysis	x	x			x		x				x	x
	Biomedical Optics			x	x	x						x	x
	Advanced Neural Computing.		x	x		x						x	
	Professional Elective V												
	Hospital Waste Management			x	x		x		x	x			
	Quality Assurance and Safety in Hospitals				x	x		x				x	x
	Physiological Modeling			x	x				x			x	x
	Wavelet Transforms and its Applications		x	x	x							x	

		Wearable Devices and Technologies		x	x		x	x		x		x	x	
		Hospital / Biomedical Industry Training		x	x				x				x	
		Project Work Phase I	x		x	x	x		x		x	x	x	x
		Project Work Phase – II	x		x	x	x		x		x	x	x	x

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M.E. BIOMEDICAL ENGINEERING
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CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5157	Applied Mathematics for Medical Engineers	FC	4	4	0	0	4
2.	BM5151	Human Anatomy and Physiology	PC	3	3	0	0	3
3.	BM5191	Bio Signal Processing	PC	3	3	0	0	3
4.	BM5101	Biomedical Sensors and Instrumentation	PC	3	3	0	0	3
5.	BM5102	Medical Imaging Systems	PC	3	3	0	0	3
6.		Professional Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	BM5111	Clinical Instrumentation Laboratory	PC	4	0	0	4	2
			TOTAL	**23**	**19**	**0**	**4**	**21**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM5291	Applied Medical Image Processing	PC	3	3	0	0	3
2.	BM5201	Diagnostic And Therapeutic Equipments	PC	3	3	0	0	3
3.	BM5202	Biomechanics	PC	3	3	0	0	3
4.	MX5091	Medical Ethics and Standards	PC	3	3	0	0	3
5.		Professional Elective II	PE	3	3	0	0	3
6.		Professional Elective III	PE	3	3	0	0	3
PRACTICALS								
7.	BM5211	Biosignal and Image Processing Lab	PC	4	0	0	4	2
			TOTAL	**22**	**18**	**0**	**4**	**20**

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BM5391	Rehabilitation Engineering	PC	3	3	0	0	3
2.		Professional Elective IV	PE	3	3	0	0	3
3.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
4.	BM5361	Hospital / Biomedical Industry Training	EEC	4	0	0	4	2
5.	BM5311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**25**	**9**	**0**	**16**	**17**

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	BM5411	Project Work Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5157	Applied Mathematics for Medical Engineers	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5151	Human Anatomy and Physiology	PC	3	3	0	0	3
2.	BM5191	Bio Signal Processing	PC	3	3	0	0	3
3.	BM5101	Biomedical Sensors and Instrumentation	PC	3	3	0	0	3
4.	BM5102	Medical Imaging Systems	PC	3	3	0	0	3
5.	BM5111	Clinical Instrumentation Laboratory	PC	4	0	0	4	2
6.	BM5291	Applied Medical Image Processing	PC	3	3	0	0	3
7.	BM5201	Diagnostic and Therapeutic Equipments	PC	3	3	0	0	3
8.	BM5202	Biomechanics	PC	3	3	0	0	3
9.	MX5091	Medical Ethics and Standards	PC	3	3	0	0	3
10	BM5211	Biosignal and Image Processing Lab	PC	4	0	0	4	2
11	BM5391	Rehabilitation Engineering	PC	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5361	Hospital / Biomedical Industry Training	EEC	4	0	0	4	2
2.	BM5311	Project Work Phase – I	EEC	12	0	0	12	6
3.	BM5411	Project Work Phase – II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)*
SEMESTER I
ELECTIVE I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5071	Principles of Genetic Analysis	PE	3	3	0	0	3
2.	BM5001	Physics in Medicine	PE	3	3	0	0	3
3.	BM5072	Bio Materials	PE	3	3	0	0	3
4.	BM5091	Bio Statistics	PE	3	3	0	0	3
5.	BM5002	Ultra Sound Principles and Applications in Medicine	PE	3	3	0	0	3

SEMESTER II
ELECTIVE II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5092	Brain Computer Interface	PE	3	3	0	0	3
2.	BM5093	Tissue Engineering	PE	3	3	0	0	3
3.	MX5094	Tele Health Technology	PE	3	3	0	0	3
4.	BM5073	Nano Technology and Applications	PE	3	3	0	0	3
5.	MX5071	Pattern Recognition Techniques and its Applications	PE	3	3	0	0	3

SEMESTER II
ELECTIVE III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5003	Hospital Planning, Organization and Management	PE	3	3	0	0	3
2.	BM5004	Finance Management in Hospital	PE	3	3	0	0	3
3.	BM5005	Human Resource Management in Hospitals	PE	3	3	0	0	3
4.	BM5006	Hospital Architecture	PE	3	3	0	0	3
5.	BM5007	Health Policy and Equipment Management	PE	3	3	0	0	3

SEMESTER III
ELECTIVE IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MX5093	Computer Based Medical Instrumentation	PE	3	3	0	0	3
2.	MX5092	Bio MEMS	PE	3	3	0	0	3
3.	BM5008	Finite Element Methods for Bio Mechanical Analysis	PE	3	3	0	0	3
4.	BM5094	Biomedical Optics	PE	3	3	0	0	3
5.	MX5072	Advanced Neural Computing.	PE	3	3	0	0	3

SEMESTER III
ELECTIVE V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BM5009	Hospital Waste Management	PE	3	3	0	0	3
2.	BM5074	Quality Assurance and Safety in Hospitals	PE	3	3	0	0	3
3.	MX5073	Physiological Modeling	PE	3	3	0	0	3
4.	CU5093	Wavelet Transforms and Its Applications	PE	3	3	0	0	3
5.	BM5075	Wearable Devices and Technologies	PE	3	3	0	0	3

MA5157 APPLIED MATHEMATICS FOR MEDICAL ENGINEERS L T P C
4 0 0 4

OBJECTIVES:

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for the students in various engineering discipline. This course also will help the students to identify, formulate, abstract, and solve problems using mathematical tools from a variety of mathematical areas, including linear algebra, numerical solution of linear equations and differential equations, approximation of functions in terms of polynomials using interpolation, numerical differentiation and integration, linear programming and queueing models.

UNIT I VECTOR SPACE AND LINEAR TRANSFORMATION 12

Vector spaces – Subspaces – Linear spans – Linear independence and linear dependence – Basis and dimension – Linear transformation - Null space and range – Dimension theorem (no proof) – Matrix representation of linear transformation.

UNIT II NUMERICAL LINEAR ALGEBRA, INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Gauss elimination method - Gauss Jordan method – Jacobi, Gauss- Seidel iterative methods – Lagrange's and Newton's divided difference interpolation - Newton's forward and backward difference interpolation – Numerical differentiation by finite differences – Trapezoidal, Simpson's 1/3 and Gaussian quadrature formula.

UNIT III NUMERICAL SOLUTION OF ORDINANRY DIFFERENTIAL EQUATIONS 12

Numerical solution of first order ordinary differential equations by Taylor's series method – Euler's method - Fourth order Runge - Kutta method – Multistep methods : Adam's - Bash forth, Milne's predictor corrector methods - Finite difference methods for two point boundary value problems.

UNIT IV LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Big M method - Two phase method - Transportation problems - Assignment models.

UNIT V QUEUEING MODELS 12

Poisson Process – Markovian queues – Single and multi server models – Little's formula - Machine interference model – Steady state analysis – Self service queue.

TOTAL : 60 PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following topics:

- Compute basic objects associated with vector spaces and linear transformation.
- Solve an algebraic or transcendental equation, linear system of equations using an appropriate numerical method.
- Construction of an approximate polynomial using interpolation methods, finding of the derivatives and evaluation of integrals numerically.
- Numerical solution of ordinary differential equations using single and multistep methods.
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical knowledge, methodologies and modern computational tools.

REFERENCES :

1. Burden R. and Faires, J.D. “Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2. Friedberg, A.H., Insel, A.J. and Spence, L., “Linear Algebra”, Prentice Hall of India, New Delhi, 2004.
3. Gerald, C.F, and Wheatly, P.O., “Applied Numerical Analysis”, Pearson Education, New Delhi, 2002.
4. Jain, M.K, Iyengar, S.R.K, and Jain, R.K., “Numerical Methods for Scientific and Engineering Computation”, New Age International Publishers, New Delhi, 2003.
5. Kumaresan, S., “Linear Algebra – A Geometric Approach”, Prentice Hall of India, New Delhi, 2000.
6. Taha H.A., “Operations Research: An introduction”, 9th Edition, Pearson Education Asia, New Delhi, 2016.

BM5151 HUMAN ANATOMY AND PHYSIOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand basics of Human Anatomy and Physiology.
- To study the organs and systems involved in body functions.

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: Structure and 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 Neurons - Action potential 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.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Qualitatively and quantitatively describe each system of the human body covered in this course: integumentary, skeletal, muscular, nervous, sensory, and endocrine and the components of these systems on the organ and cellular level.
- Apply this knowledge into biomedical engineering field.
- Integrate a basic knowledge of chemistry and biochemistry with human physiology

REFERENCES:

1. Elaine.N.Marieb, "Essential of Human Anatomy and Physiology", Eleventh Edition, Pearson Education, New Delhi, 2015.
2. Gary A.Thibodeau, Kevin T.Patton, "Anatomy & Physiology", 8th Edition, Mosby Publisher 2012.
3. Gibson.J., “Modern Physiology & Anatomy for Nurses”, Blackwell SC Publishing 1981.
4. Gillian Pocock& Christopher D.Richards, "The Human Body", Oxford University Press, 2009.
5. Guyton „Text book of Medical Physiology – WB Jaunder company Philadelphia - 13th edition 2015.
6. Tobin C.E., “Basic Human Anatomy”, McGraw – Hill Publishing Co., Ltd., Delhi 1997.

BM5191	BIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES

- It provides a solid foundation in advanced biomedical signaling and imaging systems including up-to-date coverage of commercially relevant topics.
- It focuses on biomedical signals, processing the signals, and validate the methods and results for optimization of clinical applications
- To introduce techniques for automated classification and decision making to aid diagnosis

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG and HRV signals, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise cancelling in ECG, improved adaptive filtering in FECG, EEG and other applications in Bio signals, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats and other biomedical applications

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Carry out multivariate component analysis.
- Explain biosignal classification

REFERENCES:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Emmanuel C. Ifeachor, Barrie W.Jervis, second edition „Digital Signal processing- A Practical Approach‟ Pearson education Ltd., 2002
3. P.Ramesh Babu, “Digital Signal Processing”, Sixth Edition, Scitech publications, Chennai, 2014.
4. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000
5. Rangaraj M. Rangayyan, 2nd edition „Biomedical Signal Analysis-A case study approach‟, Wiley- Interscience/IEEE Press, 2015.
6. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.

BM5101 BIOMEDICAL SENSORS AND INSTRUMENTATION L T P C
3 0 0 3

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.

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, Multicolour dot scanners, CRO, storage type, long persistence, digital scope, magnetic tape recorders.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Explain non electrical parameters measurements
- Identify and utilize the type of recorders and display
- Identify and Select chemical and optical transducers

REFERENCES:

1. John G.Webster, Medical Instrumentation, Application and Design, fourth Edition, John willeyand sons, 2009.
2. Joseph J.Carr and John M Brown, Introduction to Biomedical Equipment Technology, 4/E, Pearson education India.2001.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2007.
4. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
5. Rangan C.S., Sarma G.R., and Mani V.S.V., Instrumentation devices and system, Tata McGraw hill Publishing Company limited, New Delhi, 1983.
6. Tatsuo Togawa, Toshiyo Tamura, P.Ake Oberg, Biomedical Transducers and Instruments, CRC Press, New York, second edition.

BM5102 MEDICAL IMAGING SYSTEMS L T P C

3 0 0 3

OBJECTIVES:

- To study the production of x-rays and its application to different medical Imaging techniques.
- 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

UNIT I PRINCIPLES OF RADIOGRAPHIC EQUIPMENTS 8

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

UNIT II COMPUTER AIDED TOMOGRAPHY 10

Need for sectional images, Principles of sectional scanning, Method of convolution and Back Propagation, Methods of reconstruction, Artifacts, Principle of 3D imaging

UNIT III RADIO ISOTOPIC IMAGING 9

Radiation detectors, Radio isotopic imaging equipment’s, scanners, Principle of semiconductor detectors, Gamma ray camera, Positron Emission tomography SPECT.

UNIT IV ULTRASONIC SYSTEMS 9

Wave propagation and interaction in Biological tissues, Acoustic radiation, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Principle of image generation.

UNIT V MAGNETIC RESONANCE IMAGING 9

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

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Explain computer aided tomography
- Discuss ultrasonic systems
- Outline magnetic resonance imaging

REFERENCES:

1. D.N.Chesney and M.O.Chesney Radio graphic imaging, CBS Publications, New Delhi, 1987.
2. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Grave and Martin R.Prince MRI from Picture to proton, Cambridge University press, second edition, New York 2007.
3. Frederick W Kremkau “Diagnostic Ultrasound Principles & Instruments”, Saunders Elsevier, 2005.
4. Jerry L Prince & Jonathan M Links, “Medical Imaging Signals and Systems”, Pearson Prentice Hall, 2006.
5. Jerry L.Prince and Jnathan M.Links,” Medical Imaging Signals and Systems”- Pearson Education Inc. 2014.
6. Peggy, W., Roger D.Ferimarch, MRI for Technologists, Mc Graw Hill, New York, second edition, 2000.

BM5111 CLINICAL INSTRUMENTATION LABORATORY L T P C
0 0 4 2

OBJECTIVES:

To enable the students to know about the measurements and recording of Bioelectric and Bio Chemical Signals. To study the different preamplifiers used for amplifying the Bio Signals

LIST OF EXPERIMENTS

1. Operational Amplifier-various amplifier configurations
2. Study of Timer circuit, Study of FSK modulation and demodulation
3. Design and testing of Bio-Amplifiers
4. Record and analyze the ECG signal
5. Record and analyze the EMG signal.
6. Record and analyze the EEG signal.
7. Audiometer
8. Recording of various physiological parameters using patient monitoring system and telemetry units
9. Study and analysis of functioning and safety aspects of surgical diathermy
10. Bio-chemical measurements
11. Respiration rate measurement using spirometer
12. Blood count measurement using blood cell count meter
13. Blood pH measurement using pH meter

TOTAL: 60 PERIODS

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

BM5291 APPLIED MEDICAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To develop computational methods and algorithms to analyze and quantify biomedical data
- To understand the fundamentals of medical image processing techniques.

UNIT I IMAGE FUNDAMENTALS 9

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization – two dimensional sampling theory, Image quantization, Optimum mean square quantizer, Image transforms – DFT, DCT, KLT, SVD.

UNIT II IMAGE ENHANCEMENT AND RESTORATION 9

Histogram equalization and specification techniques, Noise distributions, Spatial averaging, Directional Smoothing, Median, Geometric mean, Harmonic mean, Contra harmonic mean filters, Homomorphic filtering, Color image enhancement. Image Restoration - degradation model, Unconstrained and constrained restoration, Inverse filtering- Wiener filtering

UNIT III MEDICAL IMAGE REPRESENTATION 9

Pixels and voxels – algebraic image operations - gray scale and color representation- depth-color and look up tables - image file formats- DICOM- other formats- Analyze 7.5, NifTI and Interfile, Image quality and the signal to noise ratio

UNIT IV MEDICAL IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and image classification – Statistical, Rule based, Neural Network approaches

UNIT V IMAGE REGISTRATIONS AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will be able to apply image processing concepts for medical images.
- Will be able to analyze Morphology, Segmentation techniques and implement these in images.
- Enables quantitative analysis and visualization of medical images of numerous modalities such as PET, MRI, CT, or microscopy

REFERENCES:

1. Atam P.Dhawan, “Medical Image Analysis”, Wiley Interscience Publication, NJ, USA 2003.
2. Anil. K. Jain, “Fundamentals of Digital Image Processing”, Pearson education, Indian Reprint 2003.
3. John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications” Marcel Dekker Inc.,New York,2004
4. Kavyan Najarian and Robert Splerstor, “Biomedical signals and Image processing”,CRC – Taylor and Francis,New York,2006
5. Milan Sonka et al, “IMAGE PROCESSING, ANALYSIS AND MACHINE VISION”, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
6. R.C.Gonzalez and R.E.Woods, “Digital Image Processing”, Second Edition, Pearson Education, 2002.
7. Wolfgang Birkfellner, “Applied Medical Image Processing – A Basic course”, CRC Press, 2011.

BM5201 DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS L T P C
3 0 0 3

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.

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

OUTCOMES:

By successfully completing this course, students will be able to:

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

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

BM5202 BIOMECHANICS L T P C
3 0 0 3

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.
- Introduction to basic structural analysis of medical implants

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. Steps in analyzing a biomechanical problem – Graphical methods – contact forces – resolution of forces

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 MECHANICAL PROPERTIES OF BONES 9

Bone structure & composition mechanical properties of bone, cortical and cancellous bones - Electrical properties of bone, fracture mechanism and crack propagation in bones, fracture fixators, repairing of bones. Pseudo elasticity, nonlinear stress-strain relationship, viscoelasticity, structure, function and mechanical properties of skin, ligaments and tendons. Head Injury tolerance, rotational injury, spine injury – Accident reconstruction, Analysis of impact, skid analysis – Damage analysis

UNIT IV MECHANICS OF THE JOINTS 9

Skeletal joints, skeletal muscles, basic considerations, basic assumption and limitations, forces and stresses in human joints, mechanics of the elbow, shoulder, spinal column, hip, knee and ankle. Structure of the Tibio femoral joint, patello femoral joint, knee joint motion – flexion, extension, rotation, Arthro-kinematics, stabilization and its contributors, positioning of the knee joints, locking/unlocking mechanism, Q- angle. Human locomotion, gait analysis and goniometry, Ergonomics, Foot Pressure measurements – Pedobarograph, Force platform, mechanics of foot. Total Hip Prosthesis: requirements, different types of components, Stress analysis & instrumentation, Knee Prosthesis.

UNIT V DESIGN OF MEDICAL IMPLANTS USING SOFTWARE 9

Importance of medical Devices, World Scenario, Design process & factors, Micro Engineering, Prototyping, Software based design of implants – MIMICS, CAD/CAM, Material Analysis, Finite Element Analysis in Orthopaedic Biomechanics – Introduction - Methology for the finite element analysis of biomechanical systems - How to generate finite-element-models of the implant-bone-compound - Application of the finite-element-method for preclinical analysis of an endo-prosthetic implant - Application to the behaviour of hip prostheses - Application to the lumbar spine - Application to splints for hand therapy

TOTAL : 45 PERIODS

OUTCOMES:

The study of mechanical properties of biological tissues and the properties of blood give us awide understanding about its structure and when it undergoes wear and when it fails so manyprecautions can be given by ourselves to elders. Introduction to FEM and its medicalapplications. Human body boundary conditions for implants design and analysis. The knowledge gained will be helpful in doingresearch in properties of hard tissues like bones and to generate a mathematical mode of bonestructure etc.

REFERENCES:

1. A Z Tohen and C T Thomas, Manual of Mechanical Orthopaedics
2. C.R Ethier and C.A.Simmons , Biomechanics from cells to organisms, Cambridge university press,2007
3. D.Dawson&V.Wright, Introduction to Biomechanics of joints and joint replacement
4. David Moratal, Finite Element Analysis, ISBN 978-953-307-123-7, 698 pages, Publisher: Sciyo, published August 17, 2010
5. D N Ghista, Biomechanics of Medical Devices, Macel Dekker, 1982
6. D.N. Ghista and Roaf, Orthopaedic Mechanics, Academic Press
7. Subratapal ,Text book of Biomechanics, Viva education private limited, 2009.
8. Susan J. Hall, Basics Bio Mechanics 7th Edition, McGraw-Hill Publishing Co, Newyork, 2007.
9. V.C. Mow and W. C. Hayes, Basic Orthopedic Biomechanics, Lippincott, RavenPublishers
10. Y. C. Fung, Biomechanics: Mechanical properties in living tissues, second Edition, Springer Verlag, New York, 1993

MX5091 MEDICAL ETHICS AND STANDARDS L T P C
3 0 0 3

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.

UNIT I INTRODUCTION TO MEDICAL ETHICS 8

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code 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

Accrediation- JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards -Indian Perspective.

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

OUTCOMES:

Upon completion of this course the student should be able to demonstrate a measurable increase in their knowledge, skills and abilities related to:

- Legal and professional guidelines for the health professions
- Public duties and consent
- Guidelines to obtain medical standards in hospitals

REFERENCES:

1. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press Canada 2009.
2. Bioethics--An Introduction for the biosciences‖, 2nd edition 2008, Ben Mepham, Oxford.
3. Domiel A Vallero -Biomedical Ethics for Engineers‖, Elsevier Pub.1st edition, 2007
4. Joint Commission Accreditation Standards for Hospitals ,2nd edition 2003
5. NilsHoppe and JoseMiola - Medical law and Medical Ethics - Cambridge University Press-2014
6. Physical Environment Online: A Guide to The Joint Commission‘s Safety Standards is published by HCPro, Inc. 2010
7. Robert M Veatch‖ Basics of Bio Ethics‖, Second Edition. Prentice- Hall,Inc 2003

BM5211 BIO SIGNAL AND IMAGE PROCESSING LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To study the various aspects of analysis of bio-signals and medical images.
- To develop algorithms for denoising, power spectral density and classification of bio signals.
- To develop image processing algorithms for segmentation, feature extraction and classification.

LIST OF EXPERIMENTS:

1. Design of FIR filter using MATLAB and DSP kit
2. Design of IIR filter using MATLAB and DSP kit
3. Analysis of ECG signal - Removal of artifacts like power line interference, baseline, electrode movement, wandering etc. and study of abnormalities in ECG pattern - using LABVIEW / MATLAB
4. Analysis of EEG Signal-Extraction of rhythms (delta, theta, alpha, beta and gamma waves), calculate Power spectral density in each rhythms using LABVIEW / MATLAB
5. Analysis of EMG Signal - Removal of artifacts like power line interference, baseline, electrode movementand calculate the muscle force using LABVIEW / MATLAB
6. Histogram Equalization, Non-linear filtering and edge detection for CT images.
7. Apply 2 D DFT, DCT and DWT transform for medical images (X – ray/CT/MRI).
8. Medical Image segmentation using watershed transform
9. Feature extraction and classification for medical image
10. Apply Image compression techniques for medical image.
11. Human Joint angle measurements using standard Goniometer
12. Human Joint angle measurements using electronic Goniometer
13. Performing Finite element loading analysis of knee joint in the following joint state
    - o Full extension
    - o Flexion (90 Degree flexion)
    - o Squatting (40-50-degree flexion)

TOTAL:60 PERIODS

OUTCOMES:

- Ability to analyze any biosignal and to classify the abnormalities.
- Apply the techniques of medical image analysis to develop Computer aided detection systems.

BM5391 REHABILITATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To develop an understanding of the various rehabilitation aids so as to enable the student to design and apply them with confidence, to help the challenged people.

UNIT I INTRODUCTION TO REHABILITATION 9

Definition, Concept of Rehabilitation: Types of Physical Impairments**,** Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles**,** Engineering Concepts in Sensory & Motor rehabilitation.

UNIT II ORTHOTICS & PROSTHETICS IN REHABILITATION 9

Types of orthosis-FO,AFO,KAFO,HKAFO and prosthesis ,Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses, Prosthetic Hand, Advance and automated prosthetics and orthosis, Externally powered and Controlled orthotics & prosthetics, -FES system, Restoration of Hand function, Restoration of standing and walking.

UNIT III MOBILITY AIDS 9

Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Polarized Ultrasonic Travel aids, Materials used for wheel chairs, Type of Wheel Chairs, design of wheel Chair, Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches.

UNIT IV AUDITORY AND SPEECH ASSIST DEVICES 9

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

UNIT V SENSORY AUGMENTATION AND SUBSTITUTIONS 9

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired

TOTAL:45 PERIODS

OUTCOME:

The student will have the knowledge about various rehabilitation aids available and the issues associated with the use of these aids

REFERENCES:

1. Joseph D.Bronzino,The Biomedical Engineering Handbook,Third Edition: Three Volume Set,CRC Press,2006
2. MacLachlan M. and Gallagher P. Enabling Technologies – Body Image and Body Function, Churchill Livingstone, 2004.
3. Mann W.C. (ed). Smart Technology for Aging, Disability, and Independence – The State of The Science, Wiley, New Jersey, 2005.
4. Muzumdar A. Powered Upper Limb Prostheses – Control, Implementation and Clinical Application. Springer, 2004.
5. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor & Francics ,CRC press,2006

BM5071 PRINCIPLES OF GENETIC ANALYSIS L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamental principles of genetics and to describe the experiments used to establish them.
- To develop skills in applying these principles to solve genetic problems and demonstrate how genetic analysis can be used to investigate aspects of biology.

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 modified organisms.

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 DNA microarray, scientific & medical benefits of this project.

UNIT V IMPACT OF GENETIC VARIATION 9

Population Genetics, Quantitative Genetics, Evolution Genetics.

OUTCOMES:

- Interpret different forms of inheritance patterns and identify them in genetic data
- Acquire in depth knowledge in evolutionary analysis of genetic sequence
- Interpret and critically evaluate the outcomes of statistical analysis associated with the research project
- 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

REFERENCES:

1. Anthony J.F. Griffiths, Susan R. Wessler, Sean B. Carroll, John Doebley, Introduction to Genetics Analysis‖, – W.H Freeman & company, New York 11th Edition - 2015.
2. Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten —Molecular Biotechnology, Principles and application of Recombinant DNA 4th Edition ASM Press, 2010.
3. Karp, Gerald - Cell and Molecular Biology. Concepts and Experiments, 7th Edition, John Wiley Sons, 2013.
4. Tom Strachan, Andrew P Read —Human molecular Genetics‖ 4th Edition, Garland Publishing – 2010
5. Watson. J. etal, — Molecular Biology of the Gene —, 7th Edition, Pearson Publication, 2014.
6. Weaver. R.F. — Molecular Biology — 5th Edition, McGraw – Hill, 2011.

BM5001 **PHYSICS IN MEDICINE** **L T P C**
3 0 0 3

OBJECTIVE:
To develop an understanding of physics involved in various imaging modalities and the effect of radiation on human body.

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 decay- electron capture - internal conversion - nuclear isomerism- Natural radioactivity, 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.

UNIT II PHYSICS OF INFRARED, MICROWAVE AND RADIO FREQUENCY 9
Production and properties - interaction mechanism of RF and microwaves 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—thermographic equipments—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

OUTCOMES:
- The students analyse the physics behind radiation used in medical techniques and acquires indepth knowledge about optics & ultrasound along with their effects of radiation

REFERENCES:

1. Branski.S and Cherski.P, Biological effects of microwave, Hutchinson&ROSS Inc.Stondsburg 1980.
2. Catherine Westbrook, Carolyn Kaut Roth with John Talbot, MRI in Practice, 4th Edition, 2011, Wiley-Blackwell
3. Eric .J.Hall, and Amato .J.Giaccia, Radiobiology for radiologist', Lippincott Williams and Wilkins, 6th edition, 2006.
4. Glasserr .O,Medical Physics Vol.1, 2,3 year Book Publisher Inc. Chicago, 1980
5. Haim Azhari, Basics of Biomedical Ultrasound for Engineers, Wiley-IEEE Press, 2010.
6. Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, John M. Boone, The essential Physics for Medical Imaging, 2011, Wolters Kluwer Health.
7. Moseley, Non-ionizing Radiation: Microwaves, Ultraviolet and Laser Radiation 'AdamHilgar Brustol 1998.
8. Rudy E. Sabbagha., Diagnostic Ultrasound applied to Obstetrics and Gynecology, 2nd sub Edition, Lippincott Williams & Wilkins,1987.
9. Simon R. Cherry, James A. Sorenson, and Michael E. Phelps, Physics in Nuclear Medicine, Elsevier, 4th Edition, 2012.
10. Sorenson James A, Physics in Nuclear Medicine', W.B. Saunders Company, 1987.
11. Suzanne Amador Kane, Nancy Donaldson, Boris Gelman, Introduction to Physics in Modern Medicine, Second Edition, 2009, CRC Press.

BM5072 BIO MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To introduce concepts of materials, surface and tissue placement in biomaterial functions
- To understand diverse elements controlling biological responses to materials
- To provide contemporary biomaterial principles

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 Biomimetic Materials, Composites. Material preparation, chemical composition, Properties, uses in medicine and biosciences and failure mechanisms.

UNIT III STERLIZATION OF BIOMATERIALS 7

Sterilization techniques: – process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gassterilization.

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 thromobogenicity, ISO 10993- standard for assessment of biocompatibility.

UNIT V HARD AND SOFT REPLACEMENT 10

Cardiac Implants, Orthopedic Implants, Neuromuscular Implants, Transcutaneous Implants, Intraocular lenses.

TOTAL : 45 PERIODS

OUTCOMES:

The student will be able to

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

REFERENCES:

1. Andrew F.VonRacum, Handbook Of Biomaterials Evaluation: Scientific, Technical And Clinical Testing Of Implant Materials, Second Edition, CRC Press, 1998
2. Buddy D.Ratner,Allan S .Hoffman, Frederick J. Schoen, Jack E. Lemons, Biomaterial Science; An Introduction to Materials in Medicine, 3rd Edition, Elsevier Academic Press,2013
3. J.H.U.Brown (Ed), Advances in Biomedical Engineering, Academic Press 1975.
4. JytteBrender. Handbook of Evaluation Methods for Health Informatics, Elsevier Academic Press: Burlington, MA, 2006.
5. Joseph D. Bronzino and Donald R. Peterson, The Biomedical Engineering Handbook", fourth edition, CRC Press Taylor & Francis, 2015.
6. Jacob Cline, Hand Book of Biomedical Engineering, Academic Press in Sandiego, 1988.
7. Jonathan Black, Biological Performance of Materials- Fundamentals of bio compatibility, 4th Edition, CRC Press 2005.
8. Larry L. Hench and Julian R.Jones, Biomaterials, Artificial organs and Tissue Engineering, CRC Press, 2005.

BM5091 BIO STATISTICS L T P C

3 0 0 3

OBJECTIVES:

- To introduce strengths and limitations of measures of central tendency and measures of variability.
- To classify common statistical tests and tools.
- To distinguish between p-values and confidence intervals as measures of statistical significance.
- To interpret commonly used regression analysis.
- To evaluate commonly used statistical and epidemiologic measures.

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

OUTCOMES:

- The student is able to explain the techniques used in statistical & regression analysis. Also the student is able to compare the various parameters used in statistical significance.

REFERENCES:

1. Beth Dawson, Robert G. Trapp,Basic and clinical Biostatistics, McGraw Hill, 2004.
2. John C. Bailar, David C. Hoaglin, Medical Uses of Statistics, 2012, Wiley.
3. Joseph A. Ingelfinger, Frederick Mosteller, Lawrence A. Thibodeau, James H. Ware Biostatistics in Clinical Medicine (third edition), Singapore, 1994.

BM5002 ULTRASOUND PRINCIPLES AND APPLICATIONS IN MEDICINE L T P C

3 0 0 3

OBJECTIVES:

- To teach the principles of ultrasonic's and its interaction with tissue.
- Students will be able to know about the scanning techniques and real time scanners principles and application of these principles in health care settings & gain knowledge about the various applications of ultrasound in medicine.

UNIT I PRINCIPLES OF ULTRASONICS 9

Introduction, Piezo Electric Devices, The Fields of 'simple', CW excited sources, The Pulsed Acoustic field, Effects of human body on Beam Propagation, Beam formation by transducer arrays, Magnitudes of Acoustic Field variables, Displacement detectors Thermal mechanisms, Cavitation, Radiation Pressure.

UNIT II TISSUE-ULTRASOUND INTERACTION 9

Introduction, Absorption in biological tissues, Tissue-Ultrasound interaction cross sections, Theory of mechanisms for the absorption of ultrasonic longitudinal waves, Measurement of attenuation and Absorption Coefficients in tissues, Acoustic properties reflecting different levels of tissue organization, Molecular aspects of soft tissue mechanics, Structural contribution to bulk and shear acoustic properties of tissues. Relevance to tissue characterization, Ultrasound quantitation and tissue characterization

UNIT III SCANNING TECHNIQUES 9

Ultrasound transducers, Construction of ultrasonic probe, Measurement of ultrasonic energy, pulse echo imaging, Pulse echo equation, Transducer motion, Transmit steering and focusing, Beam forming and Dynamic focusing, Transmitter, Receiver, Positional information, Scan converter-Analog, Digital. Image display, Image position, Transducer output, signal processing, adjustment of controls. Scanning Techniques- Acoustic windows, Scanning motion, Transducer Selection, Scan Indexing. Basic Image Interpretation-Contour, Internal Echo pattern, Attenuation, Classification, Artifacts.

UNIT IV REAL TIME ULTRASONIC SCANNERS 9

Different modes of display-A mode, B mode, M mode, B-scan System, The Principles of Ultrasound Motion Detection, Techniques for Measuring Target Velocity, Phase Fluctuation (Doppler Methods), Envelope Fluctuation Methods, Phase Tracking Methods, Envelope Tracking Techniques, Ultrasound Imaging Systems, Considerations Specific To Color Flow Imaging, Angle Independent Velocity Motion Imaging, Tissue Elasticity & Echo Strain Imaging, Performance Criteria, Use of Contrast Media, Real Time Echo, 2-D and 3-D Scanners, Color Doppler.

UNIT V ULTRASONIC APPLICATIONS 9

Ultrasonic diagnosis in Abdomen, Breast, Thyroid, Heart, Chest, Eye, Kidney, Skull, Pregnant and Non Pregnant uterus, 3-Dimensional Ultrasonic Imaging of The Fetus, Advantages And Limitations of 3-Dimensional Ultrasound.

TOTAL: 45 PERIODS

OUTCOMES:

- In-depth knowledge about the Ultrasound imaging systems and its interaction with living systems.
- Ability to specify method of ultrasonic scanning method for imaging different organs Proficient knowledge about Real time Scanners and their applications.

REFERENCES:

1. C.R.Hill, Jeff C.Bamber, Gail Haa, Physical Principles of medical Ultrasonics; John Wiley & Sons Ltd; 2nd Edition, 2004.
2. Hassan Rivaz, Emad Boctor, Pezhman Foroughi, Richard Zellars, Gabor and Gregory Hager, "Ultrasound Elastography: A Dynamic Programming Approach", IEEE Transactions on Medical Imaging, 2008
3. James Revell, Majid Mirmehdi and Donal McNally, "Computer Vision Elastography: Speckle Adaptive Motion Estimation for Elastography using Ultrasound Sequences", IEEE Transactions on Medical Imaging, Vol.24, No.6, June 2005.
4. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata Mc Graw Hill publication , New Delhi 2nd edition 2003
5. M.A.Flower, "Webb's Physics of Medical Imaging", 2nd Edition, CRC Press ,Boca Raton, FL,2012 10. Thomas L.Szabo,"Diagnostic ultrasound imaging Inside out",Elsevier Academic Press, London,2004
6. Shirley Blackwell Cusick, Farman and Vicary, A User's Guide to Diagnostic Ultrasound; Pitman Medical Publishing Co Ltd; Kent, England. 1978.
7. Timothy J.Hall, AAPM/RSNA, "Physics Tutorial For Residents: Elasticity Imaging With Ultrasound", Radio Graphics, Vol.23, No.6, Nov-Dec 2003. (RSNA 2003)
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9. W.N.McDicken, Churchill Livingstone, Diagnostic Ultrasonics – Principles and use instruments– New York, 3rd Edition, 1991.

BM5092 BRAIN COMPUTER INTERFACE L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the signal processing methods used in BCI

UNIT I INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI: Invasive, Could Anyone Use a BCI?, Non-invasive and Partially invasive BCI- Brain signal acquisition, Signal Preprocessing, Artifacts removal

UNIT II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity –Neuronal activity in motor cortex and related areas- Electric andmagnetic fields produced by the brain- signals reflecting brain metabolic activity- Mu rhythm,Movement Related Potentials – Slow Cortical Potentials - P300 Event related potential – VisualEvoked Potential - Activity of Neural Cells - Multiple Neuro-mechanisms

UNIT III FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, Wavelets, AR, MA, ARMA models, Bandpassfiltering, Template matching, Kalman filter, PCA, Laplacian filter – Linear and Non-Linear Features

UNIT IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis –Nearest neighbours, Support Vector Machines - Regression –Learning Vector Quantization – Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

UNIT V APPLICATIONS OF BRAIN-COMPUTER INTERFACES 9

Introduction, - BCIs for Assistive Technology – BCIs for Recreation - BCIs for Cognitive Diagnostics and Augmented Cognition - Rehabilitation and Prosthetics, Functional Near-Infrared Sensing (fNIR) and Environmental Control Applications - Near Infrared Sensing Technology – The OTIS System – Basic BCI Application – Environmental Control with fNIR, Brain-Computer Interfacing and Games – Introduction - Human-Computer Interaction for BCI - BCI for Controlling and Adapting Games, Direct Neural Control of Anatomically Correct Robotic Hands, Software Tools for BCI Research - Introduction – Data Streaming – Online DataProcessing - Ethical Issues in BCI Research.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student will be able to:

- Acquire the brain signal in the format required for the specific application
- Preprocess the signal for signal enhancement
- Extract the dominant and required features
- Classify the signal for applications

REFERENCES:

1. Andrew Webb, “Statistical Pattern Recognition”, Wiley International, Second Edition, 2002.
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9. S. Coyle, T. Ward et al, “On the suitability of near infra-red systems for next generation Brain Computer interfaces”, Physiological Measurement, 25, 2004.
10. Special Issue on Brain Control Interfaces, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Vol 14, June 2006.
11. TorstenFelzer, “On the possibility of Developing a Brain Computer Interface”, Technical Report, Technical University of Darmstadt, Germany, 2001.
12. Wolpaw J. R, N.Birbaumer et al, “Brain control interface for Communication and control”, Clinical Neurophysiology, 113, 2002.
13. http:://ida.first.fhg.de/projects/bci/competition_iii

BM5093 **TISSUE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand basics of Tissue Engineering
- To understand fundamentals of cell mechanisms
- To teach the Physical & biological principles that serve as the scientific basis for understanding the interactions of biological molecules and cells with biomaterials employed for the fabrication of permanent implantable prostheses and as matrices for tissue engineering.
- To understand application of Tissue Engineering

UNIT I BASICS OF TISSUE ENGINEERING 9

Introduction to Tissue Engineering - Objectives of Tissue Engineering - Basic definitions - Structure and organization of Tissues – Development of Tissue – Tissue exchange and diffusion of simple metabolites – Tissue Equivalent - Wound Healing Process - Biocompatibility and toxicity assessment.

UNIT II FUNDAMENTALS OF CELL MECHANISMS 9

Cell adhesion, Cell migration and Cell aggregation – Cell growth and Cell cycle. Cellular Interactions: Cell – Cell and Cell – Matrix. Control of Cell migration in Tissue Engineering –Cell delivery and Recirculation – Cell Culture in vitro – 3D culture in Tissue Engineering - In vitro Organogenesis - Cell transplantation.

UNIT III BIOMATERIALS IN TISSUE ENGINEERING 9

Definition – Biological vsNonbiological materials – Extra Cellular Matrix – Collagen, Chitin & Degradable and Nondegradable materials – Polymer, Ceramics and Metals – Cell interaction with different materials –- Scaffolds - Control releaser agents in Tissue Engineering – Cell interaction with suspension and gels – Tissue response to implants.

UNIT IV STEM CELLS IN TISSUE ENGINEERING 9

Introduction of Stem cells – Hemopoetic Stem cells - Embryonic Stem cells - Adult stem cells – Cancer Stem cells – Cord Blood cells – Induced Pluripotent Stem cells - Stem cell identification - Surface markers & FACS analysis – Differentiation, Dedifferentiation and Immortalization – Application of stem cells in tissue Engineering.

UNIT V TISSUE ENGINEERING APPLICATIONS 9

Synthetic components – Artificial organs – Joints and dental prostheses - Connective Tissue Engineering – Cardiovascular Tissue Engineering – Neural Tissue Engineering - Cell and Drug Delivery systems.

TOTAL : 45 PERIODS

OUTCOMES:

By successfully completing this course, students will be able to:

- Discuss the importance of tissue engineering in the field of biomedical engineering Explain the mechanisms involved in interaction of different materials with cells and tissues
- Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
- Apply the knowledge in creating new models in drug delivery systems using synthetic and natural scaffolds
- Explain different types of stem cells and its application in tissue engineering
- Develop new approaches to build new tissues using tissue engineering techniques

REFERENCES:

1. Gary E Wnek, Gary L Browlin – Encyclopedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York, 2nd edition, 2008.
2. R.Lanza, J.Gearhart et.al,(Eds), Essential of Stem cell Biology, Elsevier Academic Press, 2nd edition 2009.
3. Robert P. Lanza, Robert Langer and Joseph Vacanti., Principles of Tissue Engineering, 2nd Edition, Academic press, Elsevier 2013.
4. SujataV.Bhatt, Biomaterials (2nd Edition), Narosa Publishing House, 2005.
5. W. Mark Saltzman Tissue Engineering – Engineering Principles for Design of Replacement Organs and Tissue, Oxford University Press Inc. New York, 2004.

MX5094 TELEHEALTH TECHNOLOGY L T P C
3 0 0 3

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.

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, Data communications and networks, 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, Realtime Telemedicine 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 services security and interoperability., Telemedicine access to health care services– health education and self-care, Business aspects - Project planning and costing, Usage of telemedicine

TOTAL: 45 PERIODS

OUTCOMES:

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

REFERENCES:

1. Bernard Fong, A.C.M. Fong, C.K. Li, Telemedicine Technologies: Information Technologies in Medicine and Telehealth, Wiley, 2011.
2. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0).
3. Ferrer-Roca, O., Sosa-Iudicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
4. Magnuson, J.A., Fu, Jr., Paul C. (Eds.), Public Health Informatics and Information systems, ISBN 978-1-4471-4237-9, Springer, 2014
5. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002.
6. 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.
7. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7.
8. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006.
9. Teresa L. Thompson, Roxanne Parrott, Jon F. Nussbaum, TheRoutledge Handbook of Health Communication, Routledge, 2011.

BM5073 NANO TECHNOLOGY AND APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

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

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 II PROTEIN AS 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.

UNITIII 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

OUTCOMES:

The student will be able to:

- Follow the newest findings in the area of nanomedicine and implement the perspectives in own research.
- Explain nanoparticles in diagnosis
- Discuss nanotherapeutics

REFERENCES:

1. CM, Niemeyer,C.A. Mirkin., Nanobiotechnology – Concepts, Applications and Perspectives – 2004. Edited by Wiley – VCH.
2. Challa, S.S.R. Kumar, Josef Hormes, CarolaLeuschaer., Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. Wiley – VCH, 2005.
3. Harry F. Tibbals, Medical Nanotechnology and Nanomedicine, CRC Press, 2010.
4. Nicholas A. Kotov., Nanoparticle Assemblies and Superstructures, CRC, 2006.
5. T. Pradeep.,Nano: The Essentials: McGraw – Hill education – 2007.
6. VinodLabhasetwar, Diandra L. Leslie-Pelecky, Biomedical Applications of Nanotechnology, John Wiley & Sons, 2007.

MX5071 PATTERN RECOGNITION TECHNIQUES AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

- To know about Supervised and unsupervised Learning.
- To study about feature extraction and structural pattern recognition.
- To explore different classification models
- To understand Fuzzy Pattern Classifiers

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

UNIT II CLUSTERING 9

Clustering for unsupervised learning and classification – Clustering concept –Hierarchial clustering, Partitional clustering- k-means algorithm – Validity of Clusters.

UINT 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 HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE 9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

UNIT V RECENT ADVANCES AND APPLICATIONS 9

Fuzzy logic – Fuzzy Pattern Classifiers – Case Study Using Fuzzy Pattern Classifiers CAD system in breast cancer detection, ECG signal classification, Fingerprint recognition, cell cytology classification

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to classify the data and identify the patterns

- Extract discriminatory features and select the features from given data set.

REFERENCES:

1. Andrew Webb, “Stastical Pattern Recognition”, Arnold publishers, London,2002..
2. C.M.Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006
3. Earl Gose, Richard Johnsonbaugh Steve Jost, “Pattern Recognition and Image Analysis”, Prentice Hall of India Pvt Ltd., New Delhi, 1996
4. M. Narasimha Murthy and V. Susheela Devi, “Pattern Recognition”, Springer 2011.
5. Robert J.Schalkoff, “Pattern Recognition Statistical, Structural and Neural Approaches”, John Wiley & Sons Inc., New York, 1992
6. R.O.Duda, P.E.Hart and D.G.Stork, “Pattern Classification”, John Wiley, 2001
   S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press, 2008.

BM5003 HOSPITAL PLANNING, ORGANIZATION AND MANAGEMENT L T P C 3 0 0 3

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.

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

OUTCOME:

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

REFERENCES:

1. G. D. Kunders Hospitals: Facilities Planning and Management, Tata McGrawHill Education, New Delhi, 2004
2. Goyal R.C., Human Resource Management in Hospital, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
3. Nauhria R.N. and Rajnish Prakash, Management & systems, New Delhi Wheeler publishing, 1995.
4. Syed Amin Tabish, Hospitals & Nursing Homes: Planning, Organisations & Management, Jaypee Brothers Medical Publishers (P) Limited, 2003

BM5004 FINANCE MANAGEMENT IN HOSPITALS L T P C

3 0 0 3

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.

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 IV MANAGEMENT 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

OUTCOMES:

- The students is equipped with concepts, technical and analytical tools for optimal management of financial resources.
- 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

REFERENCES:

1. GR Kulkarni, P Satyashankar, Libert Anil Gomes , Financial Management for Hospital
2. IM Pandey Vikas Financial Management Publishing Co. 1999.
3. Jaypee Brothers Administration, ,Medical Publishers Pvt. Limited, 01-Jul-2009
4. James C.Vanhorne, Financial Management and Policy, Prentice Hall of India Pvt. Ltd., New Delhi, 9th Edition, 1995.
5. Michael Nowicki , The Financial Management of Hospitals and Healthcare Organizations, Health Administration Press, 2008
6. Prasannachandra, Financial Management, Tata McGraw Hill Publishing Co. Ltd., New Delhi, First Revised edition

BM5005 HUMAN RESOURCES MANAGEMENT IN HOSPITAL L T P C

3 0 0 3

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.

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

OUTCOMES:

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

REFERENCES:

1. D. K. Sharma, R. C. Goyal, Hospital administration and human resource management,PHI Learning Pvt. Ltd., 2013
2. Decenzo and Robbins, Human Resource Management, Wiley & Sons, Singapore, 1999.
3. Mamoria C.B. and Mamoria S.Personnel Management, Himalaya Publishing Company, 1997.
4. R.C.Goyal, Human Resource Management in Hospitals, Prentice Hall of India, 2000.
5. Walter J. Flynn (Author), Robert L. Mathis (Author), John H. Jackson, Healthcare Human Resource Management **,** 2006.

BM5006 HOSPITAL ARCHITECTURE L T P C

3 0 0 3

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.

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

OUTCOMES:

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.

REFERENCES:

1. G.Kunders.‖Hospitals- Facilities Planning & Management, Tata Mcgraw - Hill education-2004.
2. Purnima Sharma, Sangeet Sharma, Nerendra Malhotra, Jaideep Malhotra. ‖Step by Step Hospital Designing and Planning‖, 2nd Edition, Jaypee Brothers-Medical publishers, New Delhi, 2010.
3. 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.
4. Sa Tabish, Hospital and Nursing Homes planning, Organisation and Management, Jaypee Brothers-Medical publishers, New Delhi, 2003

BM5007 HEALTH POLICY AND EQUIPMENT MANAGEMENT L T P C
3 0 0 3

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.

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, Ambulataory Care.

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 IN HOSPITAL EQUIPMENTS 9

Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

TOTAL: 45 PERIODS

OUTCOMES:

The student becomes an expert in

- Explaining the various health policies
- Planning activities at health care centres.
- Equipment installation ,service & calibration needs

REFERENCES:

1. Antony Kelly, `Maintenance Planning & control' Butterworth, London 1984.
2. Binseng Wang, Medical Equipment Maintenance: Management and Oversight, Morgan & Claypool Publishers, 2012
3. Hans Pleiff veradammann (ed) `Hospital Engineering in developing countries, GTZ report Eschborn, 1986.
4. Medical Equipment Management, Keith Willson, Keith Ison, Slavik Tabakov CRC Press **,** 2013
5. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

MX5093 COMPUTER BASED MEDICAL INSTRUMENTATION L T P C
3 0 0 3

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.

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 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

UNIT III PROCESSORS AND MEMORY 9

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

UNIT IV COMPUTERISED DATA ACQUISITION AND 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 LAB view - Multisim Simulation with bio- amplifiers - Mixed signal SoC applications in biomedical application.

TOTAL :45 PERIODS

OUTCOMES:

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

REFERENCES:

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

MX5092 BIO MEMS L T P C
3 0 0 3

OBJECTIVES:

To understand

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

UNIT I MEMS AND MICROSYSTEMS 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.

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

UNIT V APPLICATION OF BIO MEMS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Understand the operation of different types of sensors and actuators at microscale level
- Understand the design issues at microscale level
- Choose the material for any application
- Apply the concepts to the design of different types of micro systems
- Apply the knowledge of CAD tools for MEMS design

REFERENCES:

1. Chang Liu, ‟ Foundations of MEMS‟, Pearson Education International, New Jersey, USA, 2006
2. Ellis Meng , —Biomedical Microsystems‖, CRC Press,Boca Raton, FL, 2011.
3. Marc J. Madou, Fundamentals of Microfabrication: the science of miniaturization ‘, CRC Press, 2002
4. NitaigourPremchandMahalik, “MEMS”, Tata McGraw Hill Publishing Company, New Delhi, 2007
5. NadimMaluf, Kirt Williams. —An introduction to Microelectromechancial Systems Engineering‖, Second Edition, Artech House Inc, MA, 2004
6. Tai Ran Hsu,“MEMS and Microsystems design and manufacture”, Tata McGraw Hill PublishingCompany, New Delhi, 2002
7. Wanjun Wang, Steven A.Soper “ BioMEMS- Technologies and applications”, CRC Press,BocaRaton,2007
8. Yang, Victor C., Ngo, That T, Biosensors and Their Applications, Springer, 2000

BM5008 FINITE ELEMENT METHODS FOR BIO MECHANICAL ANALYSIS L T P C
3 0 0 3

OBJECTIVES :

The students should be made to:

- Understand the concepts of finite element methods for biomechanical analysis
- Study beam elements and scalar problem in 2d
- Understand applications to field problems

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 artificial 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 $\xi, \eta \, and \, \zeta -$ 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 IV ISOPARAMETRIC 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

OUTCOMES:

At the end of this course, the students should be able to:

- Explain isoparametric formulation
- Discuss isoparametric elements
- Critique finite element analysis in biomechanical research

REFERENCES:

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

BM5094 BIOMEDICAL OPTICS L T P C
3 0 0 3

OBJECTIVES:

The objectives of this course are

- To 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
- To understand the engineering and practical applications of optics related to diagnostics, sensing and therapeutics of the human body.

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, Lasers in Neurosurgery, Laser Treatment of Breast Tumors, Therapeutic Applications of Lasers in Gastroenterology.

UNIT IV DIAGNOSTIC APPLICATIONS 9

Optical coherence tomography, Elastography, Fluorescence Imaging, Raman Imaging, FLIM, X-Ray Diagnostic Techniques, Speckle Correlometry, Near-Field Imaging in Biological and Biomedical Applications

UNIT V THERAPEUTIC APLLICATIONS 9

Phototherapy, Photodynamic therapy (PDT) - Principle and mechanism - Oncological and non-oncological applications of PDT - Biostimulation effect – applications.

TOTAL: 45 PERIODS

OUTCOME:

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

REFERENCES:

1. Mark E. Brezinski, —Optical Coherence Tomography: Principles and Applications‖,Academic Press, 2006.
2. Markolf H.Niemz, —Laser-Tissue Interaction Fundamentals and Applications‖, Springer, 2007.
3. Paras N. Prasad, —Introduction to Bio photonics, A. John Wiley and sons, Inc. Publications,2003.
4. R. Splinter and B.A. Hooper, —An Introduction to Bio-Medical Optics‖, Taylor and Francis,2007.
5. Tuan Vo Dinh, —Biomedical photonics – Handbook‖, CRC Press LLC, 2003.

MX5072 ADVANCED NEURAL COMPUTING L T P C
3 0 0 3

OBJECTIVES:

- To learn the theory and implementation of neural networks
- To introduce neural computing as an alternative knowledge acquisition/representation paradigm,
- To explain its basic principles and their relationship to neurobiological models,
- To describe a range of neural computing techniques and their application areas.

UNIT I BASIC CONCEPTS OF NEURAL COMPUTING 9

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 NEURAL NETWORKS 9

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

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 9

Genetic Algorithm: Fundamentals of genetic algorithm-Mathematical foundations-Genetic modeling-Survival of the fittest - crossover- Inversion and Deletion-mutation-reproduction Generational cycle-rank method-rank space method- Other derivative free optimization simulated annealing- Random search- Downhill simplex search- Applications.

UNIT V ADVANCES AND APPLICATIONS 9

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

OUTCOMES:

- Able to demonstrate an understanding of the principles of Neural Networks and a knowledge of their main areas of application;
- Ability to design, implement and analyse the behaviour of simple neural networks.
- Ability to use a neural network to solve real-world problems,

REFERENCES:

1. David Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison – Wesley USA, 1997.
2. Jang J.S.R., Sun C.T and Mizutani E, “Neuro Fuzzy and Soft Computing: A Computational Approach to Learning Machine Intelligence”, Prentice Hall, 1997.
3. James A Freeman and David M.Skapra, Neural Networks, Addison – Wesley, India 1999.
4. Melanie Mitchell, An Introduction to Genetic Algorithms: Prentice Hall of India, New Delhi 1998.
5. Philip D.Wasermann, Advanced Methods in neural Computing, Van Nostrand Reinhold, Newyork 1993.
6. Simon Haykins, Neural Networks, Prentice HallinternationalInc, 1999.

BM5009 **HOSPITAL WASTE MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

The students should be made to:

- Study the sterilization methods
- Understand the importance of disposal of waste
- Learn the controls applied to waste management

UNIT I INTRODUCTION **9**

Introduction, definition of general and hazardous health care waste and diseases, Infectious waste, genotoxic waste, waste sharps, biomedical waste categories categorization and composition of Biomedical waste

UNIT II PRINCIPLES OF STERILIZATION **9**

Disease Transmission - Disinfection methods – Sterilization - steam sterilizing (Auto claving) - Microwave (Non-burn treatment technology). Mechanical Treatment &Chemical Disinfections

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**

Environmental pollution, its causes, consequences, mitigation and remedies. Emission control, Instrumentation and monitoring, Crematories

UNIT V ENVIRONMENTAL SAFETY, RISKS & PUBLIC ISSUES. **9**

Risk management in hospitals - Environment issues in hospitals - Risk analysis Legislation, policies and law regarding environment on Health care waste management. Biomedical waste management and handling rules, 1998 and its amendment

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students should be able to:

- Explain Disposal methods
- Discuss health care waste management
- Explain environmental pollution

REFERENCES:

1. C.R.Brunner, Medical Waste Disposable Handbook, Incentrated, Consultant in Corporated, Virginia, 2000.
2. C.R.Brunner, Incentrated Consultant in Corporated Incentration System Hand Book, Virginia.

BM5074 QUALITY ASSURANCE AND SAFETY IN HOSPITALS L T P C
3 0 0 3

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.

UNIT I STANDARDIZATION 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

OUTCOMES:

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.

REFERENCES:

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd.
2. Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New Yark, 1977.
3. Joseph F Dyro "Clinical Engineering Handbook " Elsevier Publishers,2004.
4. K.Shridhara Bhat, Quality Management, Himalaya Publishing House.
5. Karen Parsley, Karen Parsley Philomena Corrigan"Quality improvement in Healthcare, 2 nd edition,Nelson Thrones Pub,2002
6. Sharon Myers "Patient Safety & Hospital Accreditation - A Model for Ensuring Success" Springer Publishers 2012
7. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentic Hall Inc., Engle wood Cliffs, New Jersy, 1979.

MX5073 PHYSIOLOGICAL MODELING L T P C
3 0 0 3

OBJECTIVES:

To understand and appreciate the value and application of

- Physiological models, 2.Vital organs 3. Modeling dynamically varying physiological system 4. Methods and techniques to analyze and synthesis dynamic models 5. Develop differential equations to describe the dynamic models, simulate and visualize dynamic responses of physiological models using software.

UNIT I INTRODUCTION 9

System Concept, System Properties, Piece-Wise Linear Approximation, Electrical Analog for Compliance, Thermal Storage, Mechanical Systems, Step response of a Resistance/Compliant Systems, Pulse Response of First Order System.

UNIT II TRANSFER FUNCTION 9

System as an Operator use of Transfer Function, Bio Engineering of a Coupled System, Example of Transformed Signals and Circuits for the Transfer Function with Impedance Concept, Prediction of Performance.

UNIT III PERIODIC SIGNALS 9

Sinusoidal Functions, Sinusoidal Analysis of Instrumentation System, Evaluation of Transfer Function s from Frequency Response, Relationship between Phase Lag and Time Delay Transient Response of an Undamped Second Order system, General Description of Natural Frequency Damping, Physical Significance of Under Damped Responses.

UNIT IV FEEDBACK 9

Characterization of Physiological Feedback. Systems, Uses and Testing of System Stability.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS 9

Simulation of Skeletal muscle servomechanism, thermo Regulation, cardiovascular control System, Respiration controls, Occulo Motor System, Endocrine control system and Modeling of receptors.

L =45 TOTAL : 45 PERIODS

OUTCOMES:

The student will have knowledge in the analysis of any physiological systems through the models

REFERENCES:

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

CU5093 WAVELET TRANSFORMS AND ITS APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the fundamentals concepts of wavelet transforms.
- To study system design using Wavelets
- To learn the different wavelet families & their applications.

UNIT I INTRODUCTION TO WAVELETS 9

Introduction to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space

UNIT II MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM 9

Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III WAVELET SYSTEM DESIGN 9

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV WAVELET FAMILIES 9

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V WAVELET APPLICATIONS 9

Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids

TOTAL: 45 PERIODS

OUTCOME:

The students will be able to apprehend the detailed knowledge about the Wavelet transforms & its applications.

REFERENCES:

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, ‗Introduction to wavelets and wavelet Transform, Printice Hall 1998.
2. G.Strang and T.Nguyen, ‗Wavelet and filter banks', Wesley and Cambridge Press.
3. M.Vetterli and J. Kovacevic, ‗Wavelets and sub band coding', Prentice Hall, 1995.
4. Metin Akay, ‗Time frequency and wavelets in biomedical signal processing', Wiley-IEEE Press, October 1997.
5. P.P.Vaidyanathan, ‗Multi rate systems and filter banks', Prentice Hall 1993.
6. Raguveer m Rao & Ajith S. Bopardikar, ‗Wavelet transforms – Introduction to theory and Applications, Addison Wesley, 1998.
7. S.Mallet, ‗A Wavelet tour of signal processing', Academic Press 1998.

BM5075 WEARABLE DEVICES AND TECHNOLOGIES L T P C
3 0 0 3

OBJECTIVES:

- To understand the basic principles of Wearable Physiological Monitoring Systems
- To Study various types of wearable systems
- To Learn to design sensors/electrodes for recording various vital parameters
- To Learn to design a wearable computer & Wireless Body Area Networks

UNIT I INTRODUCTION 9

What is Wearable Systems, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Recent developments – Global and Indian Scenario, Types of Wearable Systems, Components of wearable Systems, Physiological Parameters commonly monitored in wearable applications, Smart textiles, & textiles sensors, Wearable Systems for Disaster management, Home Health care, athletes, Sleep Apnea Monitoring.

UNIT II SMART SENSORS & VITAL PARAMETERS 9

Vital parameters monitored and their significances, Bio-potential signal recordings (ECG, EEG, EMG), Dry Electrodes design and fabrication methods, Smart Sensors – textile electrodes, polymer electrodes, non-contact electrodes, MEMS and Nano Electrode Arrays, Cuff-less Blood Pressure Measurement, PPG, Galvanic Skin Response (GSR), Body Temperature Measurements, Activity Monitoring for Energy Expenditure, Respiratory parameters.

UNIT III TECHNOLOGIES USED FOR A WEARABLE DEVICE 9

Students will comprehend the functions and very basic principles of different sensors, micro-motors and communication channels that are used in wearable devices. These include accelerometers, optical sensor, GPS, various input methods, Power Requirements, Wearable Systems Packaging, Batteries and charging, Wireless Communication Technologies and Protocols, Receiver Systems (Redrafting may be needed)

UNIT IV WIRELESS BODY AREA NETOWRKS 9

Wireless Body Area Networks – Introduction, Personal Area Networks (PAN), Application in Vital Physiological Parameter monitoring, Design of Sensor & Sink Nodes, Architecture, Communication & Routing Protocols, Security, Power and Energy Harvesting, Mobile Applications based devices.

UNIT V DATA PROCESSING AND VALIDATION 9

Classification Algorithms, Data Mining and Data Fusion, Signal Processing Algorithms in wearable Applications, Issues of wearable physiological monitoring systems, Statistical Validation of Parameters, Certifications of Medical Devices and Patenting.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, students should be able to:

- Explain the basics of wearable system
- Use smart sensors to monitor vital parameters
- Design wireless body area networks
- Apply classification algorithms

REFERENCES:

1. Annalisa Bonfiglo, Danilo De Rossi, Wearable Monitoring Systems, Springer, 201+
2. A. Gieras, The proliferation of patient-worn wireless telemetry technologies within the U.S. Healthcare environment. Proc. 4th IEEE Conf. on Information Technology Applications in Biomedicine, 2003: 295–298
3. Edward Sazonov, Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elseiver, 2014.
4. Elijah Hunter, Wearable Technology, Kindle Edition 3. Guang Zhong Yang, Body Sensor Networks, Springer
5. Kate Hartman, Make: Wearable Electronics: Design, Prototype and wear your own interactive garments, Maker Media
6. Lymberis, Smart wearables for remote health monitoring, from prevention to rehabilitation: current R&D, future challenges. Proc. 4th IEEE Conf. on Information Technology Applications in Biomedicine, Birmingham, UK, 2003: 272– 275.5. J. M.Wilkinson,
7. M. Loomis, R. G. Golledge, and R. L. Klatzky, GPS-based navigation systems for the visually impaired. In: W. Barfield and T. Caudell, eds., Fundamentals of Wearable Computers and Augmented Reality, Mahwah, NJ: Laurence Erlbaum Associates, 2001.
8. M. J. Tierney, J. A. Tamada, R. O. Potts, L. Jovanovic, and S. Garg, Clinical evaluation of the GlucoWatchs biographer: a continual, non-invasive glucose monitor for patients with diabetes. Biosens. Bioelectron. 2001; 16:621–629.
9. R. M. Swift, C. S. Martin, L. Swette, A. LaConti, and N. Kackley, Studies on a wearable, electronic, transdermal alcohol sensor. *Alcohol Clin. Exp. Res*. 1992; 16(4):721–725.
10. S. Bouwstra, W. Chen, L. Feijs, S. Bambang Oetomo, “Smart jacket design for neonatal monitoring with wearable sensors”, Proceedings of Body Sensor Networks (BSN), 2009, Berkeley,USA, pp. 162 - 167.

Then the masterâ€™s in Biomedical Engineering is the programme youâ€™re looking for! This multidisciplinary programme does not exclusively train students to find â€˜merely technologicalâ€™ answers to technical questions, but calls for biomedically engineered solutions that are in balance with economical and ethical considerations, as well. Study credits.Â Consultancy in a wide range of functions, from product design to safety regulations. Notified bodies, Regulatory Affairs Managers, screening new products for a CE-mark, patent offices...Â 3. Having successfully completed programme units in higher education with a minimum of 54 ECTS-credits where English was the language of instruction. Enrolling in this programme. The Masterâ€™s in Biomedical Engineering is a two-year programme comprising 120 credits. The programme is taught entirely in English and leads to a Master of Science (MSc) degree. You can start each year in September and February. What is Biomedical Engineering? Biomedical engineers create technical solutions to medical problems by integrating scientific and engineering concepts and methodology. Technology plays an important role in prevention, diagnosis, therapy and rehabilitation. Biomedical research leads to new techniques for repairing damaged tissue, such as bone and skin.Â The programme includes an internship and culminates in a thesis based on a research project. The general curriculum is as follows: 30 credits of compulsory courses by specialization.