

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.E. BIOMEDICAL ENGINEERING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

- I. Train the students to possess good scientific and engineering knowledge in the field of biomedical engineering.
- II. To understand the principles and recent trends in physiological measurements, diagnosis and therapy procedures followed in hospital.
- III. To introduce the concepts of hospital architecture, planning and organization.
- IV. To impart knowledge on the management of equipments, finance, human resource and waste related to hospital.
- V. Ability to practice engineering in biological, medical and health care system related fields and excel as biomedical professionals in hospitals.

PROGRAMME OUTCOMES (POs):

On successful completion of the programme, graduates will demonstrate an ability to

1. Apply principles of mathematics, biology, human physiology and engineering in the field of biomedical applications.
2. Design and conduct experiments for biomedical data acquisition, analysis and interpretation
3. To understand and apply computational techniques for applications in biomedical engineering.
4. Identify, formulate and solve problems related to biomedical engineering.
5. Understand the professional and ethical responsibilities.
6. Communicate effectively and work in multi-disciplinary groups.
7. Design hospital architecture and gain experience in procurement, monitoring, quality maintenance and management of equipments in hospital.
8. Understand the impact of biomedical engineering solutions in global, economic, environmental and social context.
9. Effectively utilize health care standards, policies and calibration methods in hospitals.
10. Pursue research in the field of Biomedical Engineering.

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
I	✓	✓			✓	✓				
II		✓	✓	✓	✓			✓	✓	✓
III							✓	✓	✓	
IV						✓	✓	✓	✓	
V					✓	✓	✓	✓		✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	
YEAR 1	SEM 1	Advanced Applied Mathematics	✓										
		Human Anatomy and Physiology	✓										
		Biomedical Sensors and Instrumentation		✓	✓	✓							✓
		Diagnostic and Therapeutic Equipment			✓	✓						✓	
		Medical Imaging Systems					✓				✓	✓	
		Professional Elective I											
		Clinical Instrumentation Lab		✓	✓	✓							✓
	SEM 2	Bio Mechanics		✓					✓		✓		✓
		Rehabilitation Engineering		✓		✓					✓		✓
		Clinical sciences	✓						✓				
		Professional Elective II											

		Professional Elective III										
		Professional Elective IV										
		Hospital Information System Lab		✓	✓				✓	✓	✓	✓
YEAR 2	SEM 3	Professional Elective VI										
		Professional Elective VII										
		Professional Elective VIII										
		Hospital Training				✓				✓	✓	
		Technical Seminar and Report Writing										
		Project Work (Phase I)		✓			✓	✓		✓	✓	✓
	SEM 4	Project Work (Phase II)		✓			✓	✓		✓	✓	✓

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SEMESTER - I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7152	Advanced Applied Mathematics	FC	4	4	0	0	4
2.	MD7151	Human Anatomy and Physiology	PC	3	3	0	0	3
3.	BO7101	Biomedical Sensors and Instrumentation	PC	3	3	0	0	3
4.	BO7102	Diagnostic and Therapeutic Equipments	PC	3	3	0	0	3
5.	BO7103	Medical Imaging Systems	PC	3	3	0	0	3
6.		Elective I	PE	3	3	0	0	3
PRACTICALS								
7.	BO7111	Clinical Instrumentation Laboratory	PC	4	0	0	4	2
TOTAL				23	19	0	4	21

II SEMESTER

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BO7251	Bio Mechanics	PC	3	3	0	0	3
2.	BO7202	Rehabilitation Engineering	PC	3	3	0	0	3
3.	BO7201	Clinical Sciences	PC	3	3	0	0	3
4.		Elective II	PE	3	3	0	0	3
5.		Elective III	PE	3	3	0	0	3
6.		Elective IV	PE	3	3	0	0	3
PRACTICALS								
7.	BO7211	Hospital Information System Laboratory	PC	4	0	0	4	2
8.	BO7212	Technical Seminar and Report Writing	EEC	2	0	0	2	1
TOTAL				24	18	0	6	21

III SEMESTER

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Elective V	PE	3	3	0	0	3
2.		Elective VI	PE	3	3	0	0	3
3.		Elective VII	PE	3	3	0	0	3
PRACTICALS								
4.	BO7311	Hospital Training	EEC	4	0	0	4	2
5.	BO7312	Project Work Phase I	EEC	12	0	0	12	6
TOTAL				25	9	0	16	17

IV SEMESTER

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	BO7411	Project Work Phase II	EEC	24	0	0	24	12
TOTAL				24	0	0	24	12

TOTAL NO. OF CREDITS: 71

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SEMESTER - I

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7152	Advanced Applied Mathematics	FC	4	4	0	0	4
2.	BO7101	Biomedical Sensors and Instrumentation	PC	3	3	0	0	3
3.	MD7151	Human Anatomy and Physiology	PC	3	3	0	0	3
TOTAL				10	10	0	0	10

II SEMESTER

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BO7251	Bio Mechanics	PC	3	3	0	0	3
2.	BO7202	Rehabilitation Engineering	PC	3	3	0	0	3
3.	BO7201	Clinical sciences	PC	3	3	0	0	3
TOTAL				9	9	0	0	9

III SEMESTER

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	BO7102	Diagnostic and Therapeutic Equipments	PC	3	3	0	0	3
2.	BO7103	Medical Imaging Systems	PC	3	3	0	0	3.
3.		Elective I	PE	3	3	0	0	3
PRACTICALS								
4.	BO7111	Clinical Instrumentation Laboratory	PC	4	0	0	4	2
TOTAL				13	9	0	4	11

IV SEMESTER

SL.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Elective II	PE	3	3	0	0	3
2.		Elective III	PE		3	0	0	3
3.		Elective IV	PE	3	3	0	0	3
PRACTICALS								
4.	BO7211	Technical Seminar and Report Writing	EEC	2	0	0	2	1
5.	BO7212	Hospital Information System Laboratory	PC	4	0	0	4	2
TOTAL				15	9	0	6	12

V SEMESTER

SL.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Elective V	PE	3	3	0	0	3
2.		Elective VI	PE	3	3	0	0	3
3.		Elective VII	PE	3	3	0	0	3
PRACTICALS								
4.	BO7312	Project Work Phase I	EEC	12	0	0	12	6
TOTAL				21	9	0	12	15

VI SEMESTER

SL.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	BO7311	Hospital Training	EEC	4	0	0	4	2
2.	BO7411	Project Work Phase II	EEC	24	0	0	24	12
TOTAL				24	0	0	28	14

TOTAL NO. OF CREDITS:71

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Advanced Applied Mathematics	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Biomedical Sensors and Instrumentation	PC	3	3	0	0	3
2.		Diagnostic and Therapeutic Equipments	PC	3	3	0	0	3
3.		Medical Imaging Systems	PC	3	3	0	0	3
4.		Human Anatomy and Physiology	PC	3	3	0	0	3
5.		Bio Mechanics	PC	3	3	0	0	3
6.		Rehabilitation Aids	PC	3	3	0	0	3
7.		Clinical sciences	PC	3	3	0	0	3
8.		Clinical Instrumentation Laboratory	PC	3	0	0	4	2
9.		Hospital Information System Laboratory	PC	3	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	BO7001	Bio Statistics	PE	3	3	0	0	3
2.	BO7002	Finance Management in Hospital	PE	3	3	0	0	3
3.	BO7003	Finite Element Analysis For Biomedical Engineering	PE	3	3	0	0	3
4.	BO7004	Health Informatics	PE	3	3	0	0	3
5.	BO7005	Health Policy and Equipment Management	PE	3	3	0	0	3
6.	BO7006	Hospital Architecture	PE	3	3	0	0	3
7.	BO7007	Hospital Planning, Organization and Management	PE	3	3	0	0	3
8.	BO7008	Hospital Waste Management	PE	3	3	0	0	3
9.	BO7009	Human Resource Management in Hospital	PE	3	3	0	0	3
10.	BO7010	Physics in Medicine	PE	3	3	0	0	3
11.	BO7011	Quality Assurance and Safety in Hospitals	PE	3	3	0	0	3
12.	BO7012	Signal Processing and Image processing Techniques Applied to Biological Systems	PE	3	3	0	0	3
13.	BO7071	Bio Materials	PE	3	3	0	0	3
14.	MD7071	Advanced Neural Computing	PE	3	3	0	0	3
15.	MD7072	Advanced Neural Engineering	PE	3	3	0	0	3
16.	MD7073	Bio MEMS	PE	3	3	0	0	3
17.	MD7074	Computer Based Medical Instrumentation	PE	3	3	0	0	3
18.	MD7075	Medical Ethics and Standards	PE	3	3	0	0	3
19.	MD7076	Medical Optics	PE	3	3	0	0	3
20.	MD7077	Nanomedicine Principles and Applications	PE	3	3	0	0	3

21.	MD7078	Pattern Recognition Techniques and Applications	PE	3	3	0	0	3
22.	MD7079	Physiological Systems Modeling And Simulation	PE	3	3	0	0	3
23.	MD7080	Principles of Genetic Analysis	PE	3	3	0	0	3
24.	MD7081	Tele Health Technology	PE	3	3	0	0	3
25.	MD7082	Tissue Engineering	PE	3	3	0	0	3
26.	MD7083	Ultrasound Principles and Applications in Medicine	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Technical Seminar and Report Writing	EEC	2	0	0	2	1
2.		Hospital Training	EEC	4	0	0	4	2
3.		Project Work (Phase I)	EEC	12	0	0	12	6
4.		Project Work (Phase II)	EEC	24	0	0	24	12

OBJECTIVES:

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

UNIT I LINEAR ALGEBRA**9+3**

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

UNIT II ONE DIMENSIONAL RANDOM VARIABLES**9+3**

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

UNIT III RANDOM PROCESSES**9+3**

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

UNIT IV LINEAR PROGRAMMING**9+3**

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

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

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

TOTAL: 45+15=60 PERIODS**OUTCOME:**

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

TEXT BOOKS:

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

REFERENCES:

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

MD7151**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.
- To apply this knowledge into biomedical engineering field.

UNIT I INTRODUCTION**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 MUSCULOSKELETAL SYSTEM**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 Glands-Hormone – General Action – Second Messenger – Anterior and Posterior Pituitary Gland Hormones.

UNIT V RECORDERS AND DISPLAY**9**

Types of recorders, Ink jet, heated stylus, Photographic recorder, Multicolor dot scanners, CRO, storage type, long persistence, digital scope, magnetic tape recorders.

TOTAL: 45 PERIODS**OUTCOMES:**

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

REFERENCES:

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

BO7102**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 in 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, Dialysate, 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. Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 3rd edition 1999
4. Jacobson B and Webster J G Medical and Clinical Engineering – Prentice Hall of India New Delhi 1999
5. Leslie Cromwell , Fred J.Weibell and Erich A.Pfeiffer - Biomedical Instrumentation Prentice Hall New Delhi 2000
6. Joseph J Carr and John M Brown – Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001.
7. Khandpur R.S Hand Book of Biomedical Instrumentation – Tata McGraw Hill publication , New Delhi 2nd edition 2003
8. John Denis Enderle, Joseph D. Bronzino, Susan M. Blanchard, 'Introduction to Biomedical Engineering:'Academic Press, 2005 , 2nd Edition ISBN 0122386620, 9780122386626

BO7103 MEDICAL IMAGING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To Study the Production of X-rays and its applications 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 EQUIPMENT 8

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

UNIT II	COMPUTED TOMOGRAPHY	10
Need for sectional images, Principles of sectional scanning, CT detectors, Methods of reconstruction, Iterative, Back projection, convolution and Back-Projection. Artifacts, Principle of 3D imaging		
UNIT III	RADIO ISOTOPIC IMAGING	9
Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipments, Radio nuclides for imaging, Gamma ray camera, scanners, Positron Emission tomography, SPECT,PET/CT.		
UNIT IV	ULTRASONIC SYSTEMS	9
Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principles and theory of image generation.		
UNIT V	MAGNETIC RESONANCE IMAGING	9
NMR, Principles of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI Instrumentation, Functional MRI.		

TOTAL: 45 PERIODS

OUTCOMES:

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

REFERENCES:

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

BO 7111	CLINICAL INSTRUMENTATION LABORATORY	L T P C
		0 0 4 2

OBJECTIVES:

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

LIST OF EXPERIMENTS

1. Operational Amplifier-various amplifier configurations
2. Respiratory analysis using spirometer
3. Design and testing of Bio-Amplifiers
4. Recording of Electromyogram.
5. Study of ECG machine.
6. Study of EEG machine
7. Study of Patient monitoring system and biotelemetry
8. Bio-chemical measurements
9. Performance and testing of surgical diathermy unit using diathermy analyzer
10. Plotting of human auditory response using audiometer.

- 11. Study of Multi parameter simulator
- 12. Electrical safety testing of medical equipment.

TOTAL: 60 PERIODS

OUTCOME:

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

BO7251

BIO MECHANICS

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.

UNIT I INTRODUCTION

9

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

UNIT II MECHANICS OF CIRCULATION

9

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

UNIT III MECHANICS APPLIED TO ORTHOPAEDICS

9

Orthopedic biomechanics, mechanical properties of bones, stress induced bone growth, kinematics and kinetics of joints, lubrication of joints, and analysis of force in orthopedic implants.

UNIT IV MECHANISM OF BIOLOGICAL SYSTEMS

9

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

UNIT V BIO MECHANICAL ASPECT OF ACCIDENT INVESTIGATION

9

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

TOTAL: 45 PERIODS

OUTCOME:

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

REFERENCES:

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

BO7202**REHABILITATION ENGINEERING****L T P C
3 0 0 3****OBJECTIVES:**

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

UNIT I PROSTHETIC AND ORTHOTIC DEVICES 9

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

UNIT II AUDITORY AND SPEECH ASSIST DEVICES 9

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

UNIT III VISUAL AIDS 9

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

UNIT IV MEDICAL STIMULATOR 9

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

UNIT V REHABILITATION MEDICINE AND ADVOCACY 9

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

TOTAL: 45 PERIODS**OUTCOMES:**

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

REFERENCES:

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

OBJECTIVES:

- To focus on the underlying concepts and mechanism in basic science.
- To enhance student's knowledge and critical thinking about the development of drugs based on basic biological science and medicine.
- To improve students skills in knowing the strategies of drug development for human diseases from basic to application level.
- To provide an underlying cause of the health issues that pose unique challenges in society.

UNIT I PRINCIPLES OF BIOCHEMISTRY 9

Physical, structural and functional properties of carbohydrates, lipids, nucleic acids and proteins. Metabolic pathways and disorders of carbohydrates, lipids and proteins. Clinical analysis of major metabolites.

UNIT II INTRODUCTION OF IMMUNOLOGY 9

Development of the immune system, cellular and molecular mechanisms of immune recognition, effector response against pathogens. Innate immunity and adaptive immune responses. Immunological memory and vaccines. Human diseases including allergy, autoimmunity, cancer, immunodeficiency and HIV.

UNIT III BIOANALYTICAL TECHNIQUES 9

Principle, instrumentation and applications of electrophoresis, spectrophotometry, fluorimetry and NMR studies in medical sciences. Clinical enzymology- isoenzymes and their significance in diagnosis, enzyme pattern in health and diseased conditions, techniques in screening isoenzymes. Biosensors and its types, RIA and ELISA, biological hazards, safety measurements in handling isotopes and disposal of labelled compounds and dosimetry.

UNIT IV REGENERATIVE MEDICINE 9

Introduction to regeneration in different tissues, role of biomolecules in tissue regeneration, stem cells and its types, isolation procedures and applications of stem cells. Biomaterials- types, biocompatibility, characterisation, fabrication, modification and applications of biomaterials in different tissues.

UNIT V NANOSCIENCE AND NANOTECHNOLOGY 9

Introduction to nanoscience and nanotechnology, Preparation, modification and characterization methods. Nanoparticles as carriers in drug delivery- design, manufacture and physicochemical properties. Diagnostic applications- targeted drug and gene delivery, bone treatment, nanoparticles for oral vaccination and skin diseases. Use of materials in diagnostic and therapeutic applications and its future directions.

TOTAL PERIODS: 45 PERIODS**OUTCOMES:**

- The students know the basic components and architecture of the immune system.
- Acquire the underlying knowledge in the molecular mechanism of disease development.
- Able to design the molecular targets of new drugs for various diseases.

TEXT BOOKS:

1. Fundamentals of Biochemistry, Donald Voet, Akif Uzman, Judith G. Voet, Charlotte W. Pratt, John Wiley and Sons, New York, 2008
2. Practical Biochemistry- Principles and Techniques- Keith Wilson and John Walker.
3. Nano: The Essentials: Understanding Nanoscience and Nanotechnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
4. Immunology, J. Kuby, 5th edition, W.H. Freeman and Company, New York, 2003
5. An introduction to Materials in medicine: BD Ratner, AS Hoffmann, FJ Schoen, JE Lemmons, Academic Press 1996.

BO7211

HOSPITAL INFORMATION SYSTEM LABORATORY

L T P C
0 0 4 2

OBJECTIVES:

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

LIST OF EXPERIMENTS:

1. HTML, XHTML, XML programming
2. Java Script programming for hospital information system
3. Study of medical standards-HL7,DICOM,LOINC,Medical data formats
4. Processing of BioSignals
5. Medical image analysis techniques.
6. Study of Data acquisition systems
7. Spectrometric analysis of blood parameter
8. Histological image analysis by image processing
9. Identification of pathogens by image processing
10. Design of protein and docking with ligand
11. Phylogenetic tree construction and primer designing

TOTAL: 60 PERIODS

OUTCOME:

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

BO7001

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.
- Classify common statistical tests and tools.
- Distinguish between p-values and confidence intervals as measures of statistical significance.
- Interpret commonly used regression analysis.
- 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**OUTCOME:**

- 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.

REFERENCE:

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

BO7002**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. James C. Vanhorne, Fundamentals of Financial Management, Prentice Hall of India Pvt. Ltd., New Delhi, 8th Edition, 1993.
2. James C. Vanhorne, Financial Management and Policy, Prentice Hall of India Pvt. Ltd., New Delhi, 9th Edition, 1995.
3. Prasannachandra, Financial Management, Tata McGraw Hill Publishing Co. Ltd., New Delhi, First Revised edition
4. Financial Management IM Pandey Vikas Publishing Co. 1999.

BO7003**FINITE ELEMENT ANALYSIS FOR BIOMEDICAL
ENGINEERING****L T P C
3 0 0 3****OBJECTIVES:**

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

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 and coordinates-Jacobian of transformation-order of convergence- numerical integration – example problems-shape functions in natural coordinates- rectangular elements- Lagrange family- Serendipity family- rectangular prisms- tetrahedral elements

UNIT 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

OUTCOME:

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

REFERENCES:

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

BO7005**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. Hans Pleiff veradamann (ed) `Hospital Engineering in developing countries, GTZ report Eschborn, 1986.
3. R.C.Goyal `Human Resource Management in Hospitals' Prentice Hall of India, New Delhi, 2000.

BO7006 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. S.K.Gupta, S.kant, R.Chandrashekhar, S.Satpathy. "Modern trends in planning and designing of hospitals: Principles and practice", Jaypee Brothers-Medical publishers, New Delhi, 2007.
3. Sa Tabish." Hospital and Nursing Homes planning, Organisation and Management", ", Jaypee Brothers-Medical publishers, New Delhi, 2003
4. Purnima Sharma, Sangeet Sharma, Nerendra Malhotra, Jaideep Malhotra. "Step by Step Hospital Designing and Planning", 2nd Edition, Jaypee Brothers-Medical publishers, New Delhi, 2010.

BO 7007**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. Goyal R.C., Human Resource Management in Hospital, Prentice Hall of India Pvt. Ltd., New Delhi, 2000.
2. Nauhria R.N. and Rajnish Prakash, Management & systems, New Delhi Wheeler publishing, 1995.
3. Koontz, Essentials of Management, McGraw Hill, 1995.

BO7008**HOSPITAL WASTE MANAGEMENT****L T P C****3 0 0 3****OBJECTIVES :**

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

UNIT I INTRODUCTION**9**

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

UNIT II PRINCIPLES OF STERILIZATION**9**

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

UNIT III DISPOSAL OF WASTE**9**

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

UNIT IV CONTROLS APPLIED TO WASTE MANAGEMENT**9**

Air pollution and Emission control, Instrumentation and monitoring, Crematories

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

Risk management in hospitals - Environment issues in hospitals - Risk analysis

TOTAL : 45 PERIODS**OUTCOMES:**

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

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.

BO7009

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

OUTCOME:

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

BO7010

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 ----Obstetrics 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

OUTCOME:

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

REFERENCES:

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

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

OBJECTIVES:

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

UNIT I DISCRETE – TIME SIGNALS AND SYSTEMS 9

Review of discrete – time signals and systems, DTFT, Frequency response, Analysis of LTI systems using Z transform, DFT and its properties, FFT algorithms and its applications to convolution.

UNIT II DESIGN OF INFINITE AND FINITE IMPULSE RESPONSE FILTERS 9

Analog filters – Butterworth and Chebyshev type 1. Analog transformation of prototype LPF to BPF / BSF / HPF .Transformation of analog filters into equivalent digital filters- Impulse invariant and bilinear transformation technique, Design of FIR filter using window method.

UNIT III FILTERING FOR REMOVAL OF ARTIFACTS 9

Noises- random, structured and physiological noises, Time domain filters, Frequency domain filters, Optimal filtering- wiener filter, adaptive filters- LMS adaptive filter, RLS adaptive filter, Applications.

UNIT IV IMAGE FUNDAMENTALS AND PREPROCESSING 9

Image perception, Image model, Image sampling and quantization, 2D DFT, DCT, KL and SVD transform. Image enhancement- Histogram modeling, spatial operations, Image restoration- Image degradation model, Wiener filtering

UNIT V IMAGE ANALYSIS AND OTHER APPLICATIONS 9

Image segmentation, Image representation and analysis, feature extraction, Image classification, Medical Image Fusion, Image visualization and Image compression.

TOTAL: 45 PERIODS

OUTCOME :

- The student acquire thorough knoweledge about the various image & signal processing techniques that can be applied to biomédical engineering principles.

REFERENCES:

1. A.V.Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, Indian Reprint, Pearson, 2004.
2. John G Proakis and Manolakis, “ Digital Signal Processing Principles, Algorithms and Applications”, Pearson, Fourth Edition, 2007
3. Rangaraj M. Rangayyan, ‘Biomedical Signal Analysis-A case study approach’, Wiley-Interscience/IEEE Press, 2002
4. Atam P.Dhawan, ‘Medical Image Analysis’, Wiley Interscience Publication, NJ, USA 2003.
5. Anil. K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson education, Indian Reprint 2003.
6. R.C.Gonzalez and R.E.Woods, ‘Digital Image Processing’, Second Edition, Pearson Education, 2002.
7. Kayvan Najarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC – Taylor and Francis,New York,2006.

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 STERILIZATION 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 thrombogenicity, ISO 10993- standard for assessment of biocompatibility.

UNIT V HARD AND SOFT REPLACEMENT 10

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

TOTAL: 45 PERIODS

OUTCOMES:

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

OBJECTIVES:

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

UNIT I INTRODUCTION TO ARTIFICIAL NEURAL SYSTEMS 8

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

UNIT II BPN AND BAM 9

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

UNIT III OTHER NETWORKS 10

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

UNIT IV GENETIC ALGORITHMS & IMPLEMENTATION TECHNIQUES 8

The Appeal of Evolution, Search Spaces and Fitness Landscapes, Elements of Genetic Algorithms, Data Structures, Adaptive Encoding. Selective Methods, Genetic Operators, Fitness Scaling, GA applications

UNIT V ADVANCES AND APPLICATIONS 10

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

TOTAL: 45 PERIODS

OUTCOME:

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

REFERENCES:

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

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 MATERIALS AND FABRICATION 9

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

UNIT II MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

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

UNIT III ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

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

UNIT IV MICROFLUIDIC SYSTEMS 9

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

UNIT V APPLICATIONS OF MEMS IN MEDICINE 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to specify the design issues related to different types of sensors and actuators at micro scale level
- Capability to specify the choice of the material for any application
- Capable of applying the concepts to the design of different types of micro systems with the help of CAD tools

REFERENCES:

1. Chang Liu,' Foundations of MEMS', Pearson Education International, New Jersey, USA, 2006
2. Nitaigour Premchand Mahalik, " MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007
3. Tai Ran Hsu , "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002
4. Wanjun Wang, Stephen A.Soper, "BioMEMs: Technologies and applications", CRC Press, New York, 2007

5. Marc J. Madou ' Fundamentals of Microfabrication: the science of miniaturization', CRC Press, 2002
6. Nadim Maluf, Kirt Williams. "An introduction to Microelectro mechanical Systems Engineering", Second Edition, Artech House Inc, MA, 2004
7. Ellis Meng , "Biomedical Microsystems", CRC Press, Boca Raton, FL, 2011.
8. Victor.C.Yang, That.T.Ngo."Biosensors and their applications", Springer, 2006.

MD7074

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 LABview - Multisim Simulation with bio-amplifiers - Mixed signal SoC applications in biomedical applications

TOTAL: 45 PERIODS

OUTCOME:

- 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. Ramachandra Lele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005

4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005
8. H M Dietel, Internet and World Wide Web, AB Goldberg publishers, New Delhi, 2007
9. Atul Khate, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008

MD7075

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 STANDARDS 9

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

UNIT IV HOSPITAL SAFETY STANDARDS 10

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

UNIT V MEDICAL EQUIPMENT SAFETY STANDARDS 9

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

TOTAL :45 PERIODS

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

MD7076

MEDICAL OPTICS

L T P C

3 0 0 3

OBJECTIVE:

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

UNIT I OPTICAL PROPERTIES OF THE TISSUES 9

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

UNIT II INSTRUMENTATION IN PHOTONICS 9

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

UNIT III SURGICAL APPLICATIONS OF LASERS 9

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

UNIT IV DIAGNOSTIC APPLICATIONS 9

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

UNIT V THERAPEUTIC APPLICATIONS 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

TEXT BOOKS:

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

REFERENCES:

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

MD7077**NANOMEDICINE PRINCIPLES 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 perspective, 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.

UNIT III DNA AS NANOSTRUCTURES**9**

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

UNIT IV NANOPARTICLES IN DIAGNOSIS**9**

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

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.

OUTCOME:**TOTAL : 45 PERIODS**

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

REFERENCES:

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

MD7078**PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS****L T P C
3 0 0 3****OBJECTIVES:**

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

UNIT I OVERVIEW OF PATTERN RECOGNITION 9

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

UNIT II UNSUPERVISED CLASSIFICATION 9

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

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms - feature selection through functional approximation - Binary selection Elements of formal grammars, syntactic description, stochastic grammars, Structural representation.

UNIT IV FUZZY SYSTEMS 9

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

UNIT V RECENT ADVANCES AND APPLICATIONS 9

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

TOTAL : 45 PERIODS**OUTCOMES:**

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

REFERENCES:

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

MD7079

PHYSIOLOGICAL SYSTEMS MODELING AND SIMULATION

**L T P C
3 0 0 3**

OBJECTIVES:

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

UNIT I INTRODUCTION TO SYSTEM CONCEPTS

9

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

UNIT II TRANSFER FUNCTION

9

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

UNIT III SYSTEM RESPONSE CHARACTERISTICS

9

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

UNIT IV FEEDBACK

9

Feedback and Homeostasis, Review of system stability concepts, Hypophysis – Adrenal Feedback Control System, Thermoregulation, Pupil Control System.

UNIT V SIMULATION OF BIOLOGICAL SYSTEMS

9

Introduction to Simulation, Simulation of Respiratory mechanics, Cardiovascular Control System, Skeletal muscle servo mechanism, Oculomotor System, Hodgkin Huxley Model.

TOTAL : 45 PERIODS

OUTCOME :

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

REFERENCES

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

MD7080**PRINCIPLES OF GENETIC ANALYSIS**

L	T	P	C
3	0	0	3

OBJECTIVE:

Completion of this subject is expected to enhance a student's ability to understand the fundamental principles of genetics and to describe the experiments used to establish them. Students will develop skills to apply 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.

TOTAL: 45 PERIODS

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. Watson. J. etal, “ Molecular Biology of the Gene “, 5th Edition, Pearson Publication, 2004.
2. Griffiths, Wesslers, Lewontin, Bart Gel, Suzuki, Miller “Introduction to Genetics Analysis”, – W.H Freeman & company, New York 8th Edition - 2005.
3. Glick, B.R and J.J Pasternak “Molecular Biotechnology”, Principles and application of Recombinant DNA” 3rd Edition ASM Press, 2003
4. Karp, Gerald.“ Cell and Molecular Biology”. Concepts and Experiments, 4th Edition, John Wiley Sons, 2005.
5. Weaver. R.F. “ Molecular Biology “ 3rd Edition, McGraw – Hill, 2005.
6. Tom Strachan, Andrew P Read “Human molecular Genetics” 3rd Edition, Garland Publishing – 2004.

MD7081**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, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentiality 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:****The student is exposed to the**

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

REFERENCES:

1. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
2. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006
3. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), Public Health Informatics and Information Systems. Springer (ISBN 0-387-95474-0), 2003
4. Ferrer-Roca, O., Sosa-Ludicissa, M. (editors), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54). (ISBN 90-5199-413-3), 2002.
5. Simpson, W. 2006. Video over IP. A practical guide to technology and applications. Focal Press (Elsevier). ISBN-10: 0-240-80557-7
6. Bemmel, J.H. van, Musen, M.A. (Eds.) (1997). Handbook of Medical Informatics. Heidelberg, Germany: Springer. (ISBN 3-540-63351-0)

MD7082**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 vs Nonbiological 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. W. Mark Saltzman Tissue Engineering – Engineering principles for design of replacement organs and tissue -- Oxford University Press inc New York, 2004.
2. Gray E Wnek, Gray L Browlin – Encyclopaedia of Biomaterials and Biomedical Engineering – Marcel Dekker Inc New York, 2004.
3. R.Lanza, J.Gearhart et.al,(Eds), Essential of Stem cell Biology, Elsevier Academic Press, 2006.
4. Sujata V.Bhatt, Biomaterials (2nd Edition), Narosa Publishing House, 2005.
5. Develop new approaches to build new tissues using tissue engineering techniques

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.

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