ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

M.E. BIOMEDICAL ENGINEERING

REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF BIOMEDICAL ENGINEERING

CURRICULA FOR I TO IV SEMESTER AND SYLLABI FOR I SEMESTER

(Applicable to the Students admitted from the Academic Year 2025-2026)

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
2.	BO3105	Human Anatomy and Physiology	PCC	3	0	0	3	3
3.	BO3102	Diagnostic and Therapeutic Equipment	PCC	3	0	0	3	3
4.	BO3106	Medical Imaging Systems and Radio Therapy	PCC	3	0	0	3	3
5.	BO3107	Biosignal Processing	PCC	3	0	4	7	5
6.	BO3201	Hospital Administration and Equipment Management	PCC	3	0	0	3	3
PRACTICALS								
7.	BO3112	Advanced Biomedical Instrumentation Laboratory	PCC	0	0	4	4	2
			TOTAL	**17**	**1**	**8**	**26**	**22**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Medical Image Processing	PCC	3	0	4	7	5
2.		Medical Embedded Syst1ems	PCC	3	0	4	7	5
3.		Rehabilitation Engineering and Assistive Technology	PCC	3	0	0	3	3
4.		Professional Elective I	PEC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	0	3	3
			TOTAL	**15**	**0**	**8**	**23**	**19**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Professional Elective III	PEC	3	0	0	3	3
2.		Professional Elective IV	PEC	3	0	0	3	3
3.		Professional Elective V	PEC	3	0	0	3	3
PRACTICALS								
4.		Hospital Training (4 weeks Training)	EEC	0	0	0	0	2
5.		Project Work I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**12**	**21**	**17**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.		Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

PROFESSIONAL ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.		Medical Informatics	PEC	3	0	0	3	3
2.		Wavelet Transforms and its Applications	PEC	3	0	0	3	3
3.		Human Assist Devices	PEC	3	0	0	3	3
4.		Neural Networks and Deep Learning	PEC	3	0	0	3	3
5.		Advances in Electronics Applied to Hospital Engineering	PEC	3	0	0	3	3
6.		Brain Control Interface	PEC	3	0	0	3	3
7.		Medical Device Regulations and Standards	PEC	3	0	0	3	3
8.		Ultrasound Principles and Applications in Medicine	PEC	3	0	0	3	3
9.		Medical Device Design and Development	PEC	3	0	0	3	3
10.		IoMT Architecture and Applications	PEC	3	0	0	3	3
11.		Machine Learning Techniques	PEC	3	0	0	3	3
12.		Bio MEMS and its Applications	PEC	3	0	0	3	3
13.		Telehealth Technology	PEC	3	0	0	3	3

14.		Wearable Body Area Networks	PEC	3	0	0	3	3
15.		Microfluidic Devices for Biomedical Applications	PEC	3	0	0	3	3
16.		Medical Data Analytics	PEC	3	0	0	3	3
17.		Physiological Systems Modeling and Simulation	PEC	3	0	0	3	3
18.		Medical Robotics and Automation	PEC	3	0	0	3	3
19.		Biomechanics and its Applications	PEC	3	0	0	3	3
20.		Principles of Biostatistics	PEC	3	0	0	3	3
21.		Biomaterials	PEC	3	0	0	3	3
22.		Finance Management in Hospitals	PEC	3	0	0	3	3
23.		Physics in Medicine	PEC	3	0	0	3	3
24.		Photonics in Medicine	PEC	3	0	0	3	3
25.		Cognitive Function Analysis	PEC	3	0	0	3	3
26.		Principles of Genetic Analysis	PEC	3	0	0	3	3
27.		Tissue Engineering	PEC	3	0	0	3	3
28.		Finite Element Analysis for Biomedical Engineering	PEC	3	0	0	3	3
29.		Hospital Planning, Organization and Management	PEC	3	0	0	3	3
30.		Biomedical Waste Management and Control	PEC	3	0	0	3	3
31.		Human Resources Management in Health Care	PEC	3	0	0	3	3
32.		Nanomedicine Principles and Applications	PEC	3	0	0	3	3
33.		Nanotoxicology	PEC	3	0	0	3	3
34.		Neuroscience and Neural Engineering	PEC	3	0	0	3	3
35.		Quality Assurance and Safety in Hospitals	PEC	3	0	0	3	3
36.		Biomechanics of Human Movement and Wearable Robotic Systems	PEC	3	0	0	3	3

Semester I

RM3151 RESEARCH METHODOLOGY AND IPR L T P C
2 1 0 3

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9

Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem

CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data

CO3: Explain the process of data analysis; interpret and present the result in suitable form CO4: Explain about Intellectual property rights, types and procedures

CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.
4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

BO3105 HUMAN ANATOMY AND PHYSIOLOGY L T P C
3 0 0 3

UNIT I BASIC ORGANIZATION OF HUMAN BODY 8

Human Body organization: Cell, Tissue, Organs and Systems. Body Cavities, Membranes and Coverings. Anatomical positions, planes and sections. Homeostasis and maintenance for homeostasis. Cell: cell wall structure, organelles and functions of each component. Transport mechanisms in the cell. Tissue: Types, modifications and functions of tissue.

UNIT II MUSCULOSKELETAL SYSTEM 8

Skeletal System: Bone, Types of bone, structure, bone cells, functions of bone. Axial skeleton- skull, sinuses, Fontanelles, vertebral column characteristics of typical vertebra, different parts of vertebral column (parts only), features of vertebral column, movements and functions of vertebral column, sternum, ribs, shoulder girdle and upper limb, pelvic girdle and lower limb Bones: types and functions - Axial and Appendicular Skeleton. Types of joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radioulnar joint, wrist joint, Hip joint, Knee joint, ankle joint. Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage Muscular System: Types of Muscle

- Skeletal Muscle, cardiac muscle and smooth muscle structure and functions.

UNIT III RESPIRATORY, GASTROINTESTINAL AND URINARY SYSTEM 10

Gastrointestinal System: Organs of the digestive system – mouth, tongue, teeth, pharynx, esophagus, stomach, gastric juice and functions of stomach, small intestine-structure, chemical digestion in small intestine, large intestine – structure, functions of the large intestine. Accessory organs of GI tract: Salivary glands, Pancreas and Liver. Respiratory System: Upper Respiratory tract - Lower respiratory tract. Respiration – muscles of respiration, cycle of respiration, variables affecting respiration, lung volumes and capacity Urinary System: Structure of Kidney, Nephron, Ureter and Urinary bladder. Urine formation and Micturition reflex- Homeostasis and blood pressure regulation by urinary system.

UNIT IV CARDIOVASCULAR, LYMPHATIC 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 ofHeart – Heart Sounds – Blood Pressure. Lymphatic System: Lymphatic vessel – Lymph fluid – Lymph nodes - Endocrine System: Hormones – Anterior and Posterior Pituitary Gland Hormones.

UNIT V NERVOUS SYSTEM AND SPECIAL SENSES 10

Organization of Nervous system: Structure, Types and Properties of Neurons - Neuroglial Cells – Central Nervous System and Peripheral Nervous System organization – Brain, Lobes and Cortical Areas – Spinal cord – Spinal tract and Spinal nerve formation - Autonomic Nervous System: Divisions and control on each system - Reflex Mechanism. Special Senses: Structure of Eye and Ear. Skin and Appendages.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course the student will be able to:

CO1 Describe internal environment of human body and explain the fundamental concept of homeostasis.

CO2 Explain the structure and functioning of various types of tissues.

CO3 Describe the structure of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system.

CO4 Demonstrate and analyze various physiological parameters in normal and abnormal conditions.

CO5 Explain the functioning of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system.

REFERENCES:

1. Ross & Wilson's, Anne Waugh and Allison Grant, "Anatomy and Physiology in Health and Illness", Churchill Livingstone Publications, 14th Edition, 2022.
2. Sujit K. Chaudhuri, "Concise Medical Physiology", New Central Book Agency Pvt. Ltd, 5th Edition, 2016.
3. K. Sembulingam and Prema Sembulingam, "Essentials of Medical Physiology", 8th Edition, Jaypee Publications, 2019.
4. Lauralee Sherwood, "Human Physiology: From Cells to Systems", 9th Edition, Thomson India Edition, 2015.
5. Gillian Pocock, Christopher D. Richards, "The Human Body An introduction forBiomedical and Health Sciences", Oxford University Press, USA, 1st Edition, 2009.
6. Gillian Pocock & Christopher D. Richards, "The Human Body", Oxford University Press, 2009.
7. Guyton, "Text book of Medical Physiology", WB Jaunder company Philadelphia, 10th edition 2020.

CO-PO MAPPING:

COURSE OUTCOMES	PROGRAMME OUTCOMES					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1			3			
CO2		1	3			
CO3		1	3			
CO4	3	1	3		1	
CO5	3	1	3		1	
Avg	3	1	3		1	

BO3102 DIAGNOSTIC AND THERAPEUTIC EQUIPMENT L T P C
3 0 0 3

UNIT I BIO POTENTIAL RECORDING 9

Origin of Bio Potential-Half-cell potential, Electrodes-types of electrodes, Signal Conditioning circuits- Characteristics of Amplifiers, Differential Amplifiers, Filters, Isolation Amplifier, Design concepts. ECG, EEG, EMG, PCG, EOG, lead system and recording methods, typical waveform, frequency spectrum, abnormal waveforms. Evoked response.

UNIT II MEASUREMENT OF NON ELECTRICAL PARAMETER 9

Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements Direct, Indirect. Blood flow Measurements – In vitro, In vivo, Gas flow measurements. Lung volume measurement – Spirometer.

UNIT III CARDIAC CARE UNITS 9

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

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- Types of Ventilators – Pressure, Volume, and Time controlled.

UNIT V DIATHERMY, STIMULATOR AND PATIENT SAFETY 9

Diathermy-Physiological effects of high frequency radiation, Depth of Penetration, short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Hazards and safety procedures. **Medical Stimulators** – Intensity Duration Curve, Current waveforms - Galvanic, Faradic, surged faradic, exponential, biphasic, TENS, Interferential therapy. **Electrical Safety**-Leakage current, Micro and macro electric shock, GFI units, Earthing Scheme, Electrical safety Analyser.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course the student will be able to:

CO1 Design and analyze the bioamplifiers.
CO2 Measure vital and non-electrical parameters.
CO3 Design and demonstrate the pacemaker and defibrillator.
CO4 Demonstrate the function of assist devices.
CO5 Design stimulators and test the electrical safety of medical equipment in the hospital environment.

REFERENCES:

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology”, Pearson Education, 4th Edition, 2014.
2. John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and Sons, New York, 4th Edition, 2009.
3. Myer Kutz, “Biomedical Engineering & Design Handbook: Volume 2”, McGraw-Hill Publisher, 2nd Edition, 2009.
4. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, John Wiley and Sons, 3rd Edition, Reprint 2008.
5. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Pearson Education India; 2nd Edition, 2015.
6. Antony Y.K.Chan, "Biomedical Device technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.

CO-PO MAPPING:

COURSE OUTCOMES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1		1	3	3		
CO2			3			
CO3		1	3	3		
CO4			3			
CO5		1	3			
Avg		1	3	3		

BO3106 MEDICAL IMAGING SYSTEMS AND RADIO THERAPY L T P C
3 0 0 3

UNIT I X-RAY PROJECTION RADIOGRAPHY AND TOMOGRAPHY 10

Physics of Radiography. X-ray Tube- Principle and production of X-rays, Line Focus Principle, Anode Heel effect, X-ray Machine- filter, collimator, Bucky Diaphragm, Cassette, film. Digital Radiography. mammography, dental X- ray. Fluoroscopic Technique- Image Intensifiers, Angiography- Cine Angiography, Digital Subtraction Angiography. Computed Tomography - Principles of tomography, CT Generations, Gantry, Detectors, Slip rings, CT Numbers, Imaging Artifacts, Spiral CT, Ultra-fast CT Scanners, 3D Imaging. Image reconstruction techniques- back projection, Fourier slice Theorem and iterative method. Case studies on recent development in CT.

UNIT II EMISSION IMAGING 8

Radioactivity- Radioactivity decay law, Alpha, Beta, Gamma Emission, Radiotracers, different types of Radiation Detectors- Gas-filled, Scintillation and Semiconductor detectors. Planar Scintigraphy- Collimators, Scintillation Crystal, Photomultiplier Tubes, Positioning Logic, Pulse Height Analyzer, Gating Circuit, Image Capture. PET and SPECT- Principle and Instrumentation, Combined PET/CT Systems.

UNIT III MAGNETIC RESONANCE IMAGING 9

Principle of MRI- Precession, NMR, Longitudinal and transverse magnetization, Relaxation processes and their measurements, Spin echo, Pulse sequencing. MR image acquisition, Imaging parameters- TE, TR and image contrast, Slice selection, frequency encoding and phase encoding, MRI instrumentation- Magnets, gradient coils, Radio Frequency coils and shim coils. Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

UNIT IV ULTRASOUND IMAGING AND THERMOGRAPHY 9

Wave propagation and interaction in biological tissues, Acoustic radiation fields, Reflection and Refraction at Plane Interfaces, Transmission and Reflection Coefficient, Attenuation, Scattering, Doppler effect, continuous and pulsed excitation, Transducers and imaging systems, Scanning methods, Imaging Modes-A, B & M, Principles and theory of image generation. Thermography- Principle, detectors and applications. Case studies on 3D, 4D ultrasound imaging.

UNIT VEFFECTS AND THERAPEUTIC APPLICATIONS OF RADIATION 9

Biological effects of Radiation- DNA, Cellular, tissue, organ and Whole-body level. Radiation Therapy- Linear accelerator, Stereotactic radiosurgery, IGRT, IMRT, Cyberknife, Tele gamma Machine, Brachytherapy, Proton beam therapy. Radiation Dosimetry- Exposure, Dose, Kerma, Absorbed, Equivalent and Effective dose. Automatic Treatment Planning, ICRP regulation, Allowed Levels, Protection Methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of this course the student will be able to:

CO1 Describe the physics of various medical imaging techniques. **CO2** Demonstrate the Instrumentation of different imaging techniques **CO3** Understand and apply the image reconstruction concepts.

CO4 Explain the principle of different Radiation therapy equipment and radiation detectors.

CO5 Discuss the effects of radiation, radiation safety and the principle of Radio therapy Techniques.

CO6 Discuss the recent developments in medical imaging technology

REFERENCES:

1. Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt, John M. Boone, “The Essential Physics of Medical Imaging”, Lippincott Williams and Wilkins; Third Edition, 2012.
2. Jerry L. Prince and Jonathan M. Links, “Medical Imaging Signals and Systems”, Pearson Education Inc. 2014.
3. D.N. Chesney and M.O. Chesney, “Radio graphic imaging”, CBS Publications, New Delhi, 1987.
4. Alexander, Kalender and Linke, “Computed Tomography: Assessment Criteria, Ct System Technology, Clinical Applications”, John Wiley, Chichster, 1986.
5. Steve Webb, “The Physics of Medical Imaging”, Adam Hilger, Philadelpia,1988.
6. Donald Graham, Paul Cloke, Martin Vosper, “Principles of Radiological physics”, Churchill Livingston, 6th Edition, 2011.
7. Donald W. Mc Robbice, Elizabeth A. Moore, Martin J. Grave and Martin R. Prince, “MRI from picture to proton”, 2nd Edition, Cambridge University press, New York 2006.

CO-PO MAPPING:

COURSE OUTCOMES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3			
CO2			3			
CO3			3	1		
CO4			3			
CO5			3			1
CO6		1	3			
Avg		1	3	1		1

BO3107 BIOSIGNAL PROCESSING L T P C
3 0 4 5

UNIT I SIGNAL, SYSTEM AND SPECTRUM 9

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

UNIT II TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

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

UNIT III ADAPTIVE FILTERING AND WAVELET DETECTION 9

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

UNIT IV BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition, Statistical signal classification, linear discriminant function, direct feature selection and ordering, Backpropagation neural network based classification. Applicationin Normal versus Ectopic ECG beats and other Biomedical applications. Case studies on Biosignal classification.

UNIT V TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Time-scale representation, scalogram, wavelet analysis, Wavelet Denoising – Data reduction techniques, ECG data compression, ECG characterization, Feature Extraction-Wavelet packets, Multivariate component analysis-PCA, ICA. Case studies on Applications of wavelets in Biosignal.

LAB EXPERIMENTS: 60

1. Preprocessing of Bio signals.
2. QRS Detection using Pan-Tompkin's algorithm in ECG signals.
3. Heart rate variability analysis in ECG signals.
4. Development of algorithm for ECG arrhythmia detection.
5. Band separation and spectrum of EEG signals.
6. Autoregressive modelling of bio signals.
7. Feature extraction in EMG signals.
8. Noise and interference cancellation in ECG using Adaptive filters.
9. Denoising of Bio signals using wavelets.
10. Feature extraction and dimensionality reduction using PCA.

TOTAL: 45T+60P=105 PERIODS

COURSE OUTCOMES:

On completion of this course the student will be able to:

CO1 Design and evaluate digital sampling and filtering systems.

CO2 Apply frequency-domain techniques in the analysis and obtain power spectral densities for bio signals.

CO3 Analyze and perform Time series modelling and power spectral estimation for bio-signals.

CO4 Design and perform Adaptive filtering to eliminate noise and perform wavelet analysis.

CO5 Classify the bio-signals using optimal features

CO6 Apply wavelet transform techniques in the analysis of bio-signals.

REFERENCES:

1. Arnon Cohen, "Biomedical signal processing Vol 1 Time and Frequency Domain Analysis", CRC Press, 1986.
2. Arnon Cohen, "Biomedical Signal Processing Vol 2: Compression and automatic recognition",CRC Press Inc., 1986.
3. Rangaraj M. Rangayyan, "Biomedical Signal Analysis – A case study approach, Wiley, 2nd Edition, 2009.
4. Willis J. Tompkins, "Biomedical Digital Signal Processing – C Language Examples and Laboratory Experiments for the IBMR PC", Prentice Hall of India, 1998.

5. Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal processing-A Practical Approach”, Pearson education Ltd., 2nd Edition, 2002
6. Raghuveer M. Rao and Ajith S. Bopardikar, “Wavelets transform – Introduction to theoryand its applications”, Pearson Education, India 2012
7. Benjamin Griffel, John L. Semmlow, “Bio-signal and Medical Image Processing”, CRC PressInc., 3rd Edition, 2014.

CO-PO MAPPING:

COURSE OUTCOMES	PROGRAMMEOUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3	3		
CO2			3	3		
CO3	3		3	3		
CO4	3		3	3		
CO5	3	3	3	3	1	
CO6	3	3	3	3	1	
CO7	3	3	3	3	1	
Avg	3	3	3	3	1	

BO3201 HOSPITAL ADMINISTRATION AND EQUIPMENT MANAGEMENT L T P C
3 0 0 3

UNIT I HEALTHCARE SYSTEM ORGANIZATION AND MANAGEMENT 9

Healthcare organizations of the country, the State, the Cities and the Region, Health Financing System, Health services, Functions of Hospitals, Types of Hospitals, Primary Health Care, Ambulatory care. Effective Hospital Management – Planning, Organizing, Directing and Leading, Controlling and Functional Management.

UNIT II HOSPITAL ADMINISTRATION AND PLANNING 9

Outpatient, Inpatient and Nursing services; Clinical support services – Radiology and Imaging, Laboratory services, Operation Theatre suite, Pharmacy, Central Sterile Supply department; Administrative services – Medical records, Hospital Infection, Hospital utilization statistics, Material Management, Marketing of Health services and Evaluation of Hospital services; Functional Hospital Organization – Hospital linen and laundry service, Disposal of Hospital Waste, Public relations, Ethical and legal aspects, Disaster Management, Quality assurance through Record review and Medical audit;

UNIT III REGULATORY REQUIREMENT AND HEALTH CARE CODES 9

FDA Regulation, Joint Commission Accreditation for Hospitals, National Fire Protection Association Standard, IRPQ; Function of Clinical Engineer, Role to be performed in Hospital, Manpower requirement for different types of hospitals, Professional Registration, Structure in Hospital.

UNIT IV EQUIPMENT MAINTENANCE POLICY AND PROCURES 9

Policy and Procedure Manual – Mission, Objectives, Life Cycle of the Medical Equipment, 5S tools; Maintenance Guidelines, Procurement and Organizational Structure; Organizing Maintenance Operations, Paperwork Control, Maintenance Job Planning, Maintenance Work Measurement and Standard, Training curriculum and skillset.

UNIT V EQUIPMENT GENERAL AND TECHNICAL MAINTENANCE 9

General Management of Medical Equipment – Types and Planned Maintenance, Management Manual; Biomedical Equipment and Maintenance Program - Technical Manual, Reporting Formats, Preventive Maintenance, Maintenance Budgeting and Forecasting, Contract Maintenance. Medical Equipment Trouble shooting – Flow charts and SoPs; Handling waste and Disposal.

TOTAL=45 PERIODS

COURSE OUTCOMES:

On completion of this course the student will be able to:

CO1 Demonstrate adequate knowledge and mastery of concepts and techniques relevant to hospital management

CO2 Develop awareness of the responsibilities of hospital management

CO3 Prepare to handle the management and development issues including structure and organization

CO4 Recognize how operational problems and situations are handled and best regulatory practices are adhered

CO5 Formulate ideas, develop SoPs and participate in equipment maintenance and policy procedures

CO6 Take a proactive and self-reflective role in working and to develop professional relationship.

REFERENCES:

1. Syed Amin Tabish, “Hospital and Health Services Administration Principles and Practices”, Oxford Press New Delhi 2001.
2. G D Kunders, “ Hospitals, Facilities planning and Management”, T a t a McGraw Hill Education Private Ltd, New Delhi 2004.
3. BM Sakharkar, “Principles of Hospital Administration and Planning”, Jaypee Brothers Medical Publishers (P) Ltd, Second Edition, 2009
4. “Biomedical equipment management and maintenance program: Technical guidance document for in-house support and monitoring of public private partnerships”, Ministry of Health and Family Welfare, Government of India, New Delhi.
5. Justin Cooper and Alex Dahinten, “Medical Equipment Troubleshooting Flowchart Handbook”, Engineering World Health, Version 6, 2013.
6. “Medical Equipment Maintenance Manual”, Ministry of Health and Family Welfare, Government of India, New Delhi, 2010.

CO-PO MAPPING:

COURSE OUTCOMES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1			3		1	
CO2			3		1	
CO3			3	3	1	
CO4		3		3	1	
CO5		3		3	1	2
CO6					1	2
Avg		3	3	3	1	2

BO3112 ADVANCED BIOMEDICAL INSTRUMENTATION LABORATORY L T P C
0 0 4 2

LIST OF EXPERIMENTS

1. Design and analysis of bio amplifier using circuit simulation.
2. Design of instrumentation amplifier using Opamp and single IC
3. Design of bio amplifier for acquiring bio signals.
4. Recording of ECG in standard lead systems.
5. Recording and analysis of Electromyogram signals.
6. Recording of EEG signal.
7. Measurement of respiratory parameters using spirometer
8. Plotting of human auditory response using audiometer.
9. Performance and testing of surgical diathermy unit using diathermy analyzer.
10. Measurement of Vital parameters using patient monitoring system and biotelemetry.
11. Electrical safety testing of medical equipment.
12. Design and development of Biosensor.
13. Study of different types of muscle stimulator waveforms.
14. Study of multi parameter simulator.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of this course the student will be able to:

CO1 Design, record and analyze various bio signals.
CO2 Perform the measurement of various vital and non-electrical parameters.
CO3 Perform testing of surgical diathermy
CO4 Perform electrical safety test of medical equipment.
CO5 Identify the auditory level of humans.
CO6 Demonstrate the function of medical equipment.

CO-PO MAPPING:

COURSE OUTCOMES	PROGRAMME OUTCOMES					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	3	
CO2			3	3	3	
CO3				3		
CO4		2		3		
CO5				3		
CO6				3		
Avg	2	2	3	3	3	