



**Dr. M.G.R.**  
EDUCATIONAL AND RESEARCH INSTITUTE  
**UNIVERSITY**  
(Declared U/S 3 of the UGE Act 1956)



*c. B. Palaniswami*

REGISTRAR  
Dr. M.G.R.

EDUCATIONAL AND RESEARCH INSTITUTE  
(Deemed to be University)  
Periyar E.V.R. High Road,  
Maduravoyal, Chennai 600 095

**DEPARTMENT OF BIOMEDICAL INSTRUMENTATION**

**CURRICULUM AND SYLLABUS**

**2017 REGULATION - Electives**

**Elective 1**

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BBI17E01	Troubleshooting of Bio-Medical Equipments	3	3	0/0	0/0	Ty
BBI17E02	Rehabilitation Engineering	3	3	0/0	0/0	Ty
BBI17E03	Human Assist Devices	3	3	0/0	0/0	Ty

**Elective 2**

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BBI17E04	Laser and Ultrasonic Application in Medicine	3	3	0/0	0/0	Ty
BBI17E05	Computer based Medical Instrumentation	3	3	0/0	0/0	Ty
BBI17E06	Biomedical MEMS and Nano Technology	3	3	0/0	0/0	Ty

**Elective 3**

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BBI17E07	Radiological Equipments	3	3	0/0	0/0	Ty
BBI17E08	Biological Effects of Radiation	3	3	0/0	0/0	Ty
BBI17E09	Computer in Medicine	3	3	0/0	0/0	Ty

**Elective 4**

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BBI17E10	Medical Informatics	3	3	0/0	0/0	Ty
BBI17E11	Fibre Optic and Laser Instruments	3	3	0/0	0/0	Ty
BBI17E12	Diagnostic and Therapeutic Equipments I	3	3	0/0	0/0	Ty

**Elective 5**

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BBI17E13	Recent Advances Applied to Hospital Engineering	3	3	0/0	0/0	Ty
BBI17E14	Diagnostic and Therapeutic Equipments II	3	3	0/0	0/0	Ty
BBI17E15	System Theory Applied to Biomedical Engineering	3	3	0/0	0/0	Ty

<b>Subject Code:</b> BBI17E01	<b>Subject Name : TROUBLESHOOTING OF BIO-MEDICAL EQUIPMENTS</b>							<b>T / L/ ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P/ R</b>	<b>C</b>
Prerequisite:							T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To provide adequate technical information on operating principles of medical instruments</li> <li>➤ To attain mastery in fault detection and corrective measures.</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Understands the information on operating principles of medical instruments											
CO2	Capable in finding fault detection and corrective measures.											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	H	L	M	H	M	L	M	H
CO2	M	H	M	L	M	H	M	L	M	M	H	M
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		L		H		M		H			
CO2	H		M		L		M		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

**TROUBLESHOOTING OF BIO-MEDICAL EQUIPMENTS**

**UNIT I BASIC OF TROUBLESHOOTING PROCEDURES**

**9 Hrs**

Troubleshooting Process and Fault finding Aids, Troubleshooting Techniques, Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and Correction Action to repair the Equipment.

**UNIT II TESTING OF DEVICES**

**9 Hrs**

testing procedure OF resistors, capacitors and inductors, causes of failure for electronic components, testing procedure of special diodes, bipolar transistors, field effect transistor (FET), and thyristor.

**UNIT III FAULT DIAGNOSIS IN CIRCUITS**

**9 Hrs**

Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

**UNIT IV BIOMEDICAL EQUIPMENT I TROUBLESHOOTING**

**9 Hrs**

Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anaesthesia machine, Autoclaves and sterilizers, Endoscope

**UNIT V BIOMEDICAL EQUIPMENT II TROUBLESHOOTING**

**9 Hrs**

Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators, Oxygen cylinders and flow meters, Pulse Oximeter, Sphygmomanometers, Suction Machine, X-Ray Machine Troubleshooting.

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair and Maintenance", Tata McGraw-Hill, Second Edition 2009.
2. Dan Tomal and Neal Widmer, "Electronic Troubleshooting", McGraw Hill, 3rd Edition 2004.

**Reference Books:**

1. Nicholas Cram and Selby Holder, "Basic Electronic Troubleshooting for Biomedical Technicians", TSTC Publishing, 2nd Edition 2010
2. World Health Organisation, "Maintenance and Repair of Laboratory, Diagnostic imaging and Hospital Equipment", Geneva, 1994.
3. Ian R, McClelland, "X-ray Equipment maintenance and repairs workbook for Radiographers and Radiological Technologists", World Health Organisation, Geneva, 2004.
4. Ministry of Health and Family Welfare, "Medical Equipment Maintenance Manual- A first line maintenance guide for end users", New Delhi, October 2010.
5. Joseph.J, Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation and Servicing of Radiographic Equipment", Charles C Thomas Publisher Ltd, 2nd Edition 2005.

<b>Subject Code:</b> BBI17E02	<b>Subject Name : REHABILITATION ENGINEERING</b>						<b>T / L/ ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P/ R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To study basics of Rehabilitation Engineering</li> <li>➤ To learn the design of Wheel Chairs</li> <li>➤ To gain knowledge of the recent developments in the field of rehabilitation engineering.</li> <li>➤ To understand various assistive technology for vision and hearing</li> <li>➤ To study various orthotic and prosthetic devices</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Understands the basics of Rehabilitation Engineering											
CO2	Capable to design Wheel Chairs											
CO3	Understands the recent developments in the field of rehabilitation engineering											
CO4	Acquires various assistive technology for vision and hearing											
CO5	Analysis various orthotic and prosthetic devices											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	M	H	L	M	H	L	M	H	H	H
CO2	H	M	H	M	L	M	H	L	M	H	L	M
CO3	H	M	H	M	L	M	H	H	M	H	L	M
CO4	L	H	M	L	H	M	H	L	L	H	M	H
CO5	M	H	L	H	M	L	H	L	M	H	L	M
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	M		L		H		M		H			
CO3	H		L		M		H		L			
CO4	L		M		M		L		M			
CO5	H		M		L		H		M			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

**REHABILITATION ENGINEERING**

**UNIT I REHABILITATION TECHNOLOGY**

**9 Hrs**

Selection, design or manufacturing of augmentive or assistive devices appropriate for individual with disability

**UNIT II REHABILITATION SCIENCE**

**9 Hrs**

Knowledge about the basic and clinical research about the variation in the physiological functioning and anatomical structure

**UNIT III REHABILITATION ADVOCACY**

**9 Hrs**

Legal aspect helps the handicapped people in choosing the devices, the provisions available to them in this regard.

**UNIT IV REHABILITATION MEDICINE**

**9 Hrs**

Physiological aspects of functional recovery, neurological and physhological aspects, rehabilitation therapies training to restore vision auditory and speech

**UNIT V REHABILITATION ENGINEERING**

**9 Hrs**

Introduction to Rehabilitation Engineering - PHAATE model - Clinical practice of rehabilitation Engineering - Low technology tools - Service delivery – Universal design - Design based on human ability - Standards for assistive technology - Test for best design

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Reswick.J.What is Rehabilitation Engineering?, Annual Review of rehabilitation – volume 2  
springer – verlag, New York, 1982.

**Reference Books:**

1. Robinson.C.J, Rehabilitation Engineering Handbook of electrical engineering, CRC Press,  
Bocaraton, 1993.

<b>Subject Code:</b> BBI17E03	<b>Subject Name : HUMAN ASSIST DEVICES</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Study the Heart Lung Machines and Artificial Heart</li> <li>➤ To gain knowledge of Cardiac Assist Devices</li> <li>➤ To learn about Artificial Kidney</li> <li>➤ To gain knowledge of Prosthetic And Orthodic Devices</li> <li>➤ To Study the Respiratory Aids and Hearing Aids</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Understands the Heart Lung Machines and Artificial Heart											
CO2	Capable to analyze Cardiac Assist Devices											
CO3	Understands the concept of Artificial Kidney											
CO4	Understands the concept of Prosthetic And Orthodic Devices											
CO5	Acquires knowledge on Respiratory Aids and Hearing Aids											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	H	M	L	H	M	L	M	H
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	H
CO4	H	L	M	H	M	H	L	M	H	H	L	M
CO5	L	M	H	L	L	M	H	M	L	H	M	H
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H		M		L		M		H			
CO2	M		L		M		H		L			
CO3	L		L		H		M		H			
CO4	M		H		L		M		H			
CO5	M		H		L		M		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												

**HUMAN ASSIST DEVICES**

**UNIT I HEART LUNG MACHINES AND ARTIFICIAL HEART**

**9 Hrs**

Condition to be satisfied by the H/L System - Different types of Oxygenerators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Mock test setup for assessing its Functions

**UNIT II CARDIAC ASSIST DEVICES**

**9 Hrs**

Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortica Venous Pumping, Prosthetic Vardio Valves, Principles and problem, Biomaterials for implantable purposes, its characteristics and testing

**UNIT III ARTIFICIAL KIDNEY**

**9 Hrs**

Indication and Principles of hemodialysis, Membrane, Dialysate, Different Types of hemodialysers, Monitoring systems, Wearable Artificial Kidney, Implanting Type

**UNIT IV PROSTHETIC AND ORTHODIC DEVICES**

**9 Hrs**

Hand and Arm Replacement – Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthotic system, Functional Electrical Stimulation, Sensory Assist Devices, Materials for Prosthetic and orthotic devices

**UNIT V RESPIRATORY AIDS AND HEARING AIDS**

**9 Hrs**

Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters- Audiograms, Types of Deafness Conductive and Nervous, Hearing Aids, Construction and Functional Characteristics.

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Leving S.N.(Ed.), Advances in Bio Medical Engineering and Medical physics. Volumes I, II and IV, Inter University Publications, New York, 1968.
2. Kolff W.J., Artificial Organs, John Wiley and Sons, New York 1979.

**Reference Books:**

1. Andreas, F.Von racum, Hand book of bio material evaluation, Mc-Millan publishers, 1980.
2. Albert M. Cook and Webster J.G., Therapeutic Medical Devices, Prentice Hall Inc., New Jersey, 1982.

<b>Subject Code:</b> BBI17E04	<b>Subject Name : LASER AND ULTRASONIC APPLICATION IN MEDICINE</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Gain Knowledge Of Laser</li> <li>➤ To Study About Ultrasonics</li> <li>➤ To Learn About Ultrasonic Scanners</li> <li>➤ To Study About High Energy Ultrasonics</li> <li>➤ To Gain Knowledge Of Holographic Application In Medicine</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires Knowledge Of Laser											
CO2	Graduate acquires knowledge on Ultrasonics											
CO3	Capable to analyze Ultrasonic Scanners											
CO4	Understands High Energy Ultrasonics											
CO5	Acquires knowledge on Holographic Application In Medicine											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	M	H	M	L	H	M	L	M
CO2	H	M	L	M	H	L	M	L	H	M	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	H
CO5	M	L	H	H	M	L	H	M	L	M	H	M
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	M		L		H		M		L			
CO3	H		M		L		M		H			
CO4	M		H		L		M		H			
CO5	L		M		H		M		L			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												



**LASER AND ULTRASONIC APPLICATION IN MEDICINE**

**UNIT I LASER**

**9 Hrs**

Principles of Laser action, different types and of lasers and its operation, Applications of Laser in Biology, Dentistry, Ophthalmology, Dermatology, Medicine, Surgery, Interferometer Applications, Fluorescence studies in cancer Diagnosis, Laser in Genetic Engineering, Low power applications in Medicine.

**UNIT II ULTRASONICS**

**9 Hrs**

Different Modes of Display, A, B, C, scanning Techniques, Absorption in biological Tissues, Measurement of Ultrasonic Energy, Construction of Ultrasonic probe, Ultrasonic Imaging in Abdomen, Breast, Heart, Chest, Eye, Kidney, Skull, Pulsatile Motion, Pregnant and non-Pregnant uterus.

**UNIT III ULTRASONIC SCANNERS**

**9 Hrs**

Real Time Echo, 2-D Scanners, Colour Doppler

**UNIT IV HIGH ENERGY ULTRASONICS**

**9 Hrs**

Effects due to High energy ultrasonics applications in Surgery, Cell destruction, Cleaners

**UNIT V HOLOGRAPHIC APPLICATION IN MEDICINE**

**9 Hrs**

Wave front Recording and Reconstruction, Recording Media, Image forming application, Motion Induced Contrast, correlation filtering, Holograms using Ultrasonic signals and Hologram using Lasers.

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Leon Goldman, M.D., and R. Jamies Rockwell, Jr. Lasers in medicine Gordon and breach, science publishers Inc., New York, 1971
2. Brown Y.H.V. and Dickson J.F. (Eds), Advances in Bio – Medical Engineering Volume II and V, Academic press, London, 1972
3. Georg W. Stroke, Kock W.E., Ultrasonic Imaging and Holography, plenum press, New York, 1974

**Reference Books:**

1. Mertellucci S. Sand Chester A.N. Laser Photo biology and photo medicine, plenum press, New York, 1989.
2. Wolbarsht M.L., Laser Application in Medicine and Biology, Plenum press, New York, 1989

<b>Subject Code:</b> BB117E05	<b>Subject Name : COMPUTER BASED MEDICAL INSTRUMENTATION</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Gain Knowledge On Introduction Of Computer Based Medical Instrumentation</li> <li>➤ To Study About The Microcontrollers</li> <li>➤ To Learn About The System Design</li> <li>➤ To Gain Knowledge On Computers In Patient Monitoring</li> <li>➤ To Study About Medical Equipments System</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires Knowledge On Introduction Of Computer Based Medical Instrumentation											
CO2	Capable to analyze the concept of Microcontrollers											
CO3	Capable to analyze System Design											
CO4	Capable to acquire Knowledge On Computers In Patient Monitoring											
CO5	Acquires Knowledge on Medical Equipments System											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	M	H	L	M	H	L	M	H
CO2	H	M	L	M	H	L	M	H	L	M	H	M
CO3	H	M	L	M	H	L	M	H	L	M	H	L
CO4	L	M	L	M	L	H	M	L	M	H	L	M
CO5	L	M	H	L	M	M	L	M	L	H	L	M
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	H		M		L		M		H			
CO3	L		M		H		L		M			
CO4	M		H		L		M		H			
CO5	M		L		H		L		M			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												

**COMPUTER BASED MEDICAL INSTRUMENTATION**

**UNIT I INTRODUCTION**

**9 Hrs**

8086 Architecture – system connections and timing – Instruction set and assembly language programming. Macro assemblers – BIOS and DOS Services – memory and I/O interfacing – Advanced Intel 32 bit processors.

**UNIT II MICROCONTROLLERS**

**9 Hrs**

Introduction – 8051 architecture and programming, micro controller based medical systems – TMS 320 series – architecture and programming – applications in bio-signal processing – IDE51 – C Cross Assemblers.

**UNIT III SYSTEM DESIGN**

**9 Hrs**

Multichannel computerized ECG, EMG and EEG data acquisition –storage, analysis and retrieval techniques – Medical image acquisitions through video –card – storage and retrieval techniques – Moderns and computer networking in the hospital.

**UNIT IV COMPUTERS IN PATIENT MONITORING**

**9 Hrs**

Physiological monitoring – automated intensive care units – computerized arrhythmia monitoring – information flow in a clinical lab – computerized concepts – interfacing to HIS.

**UNIT V MEDICAL EQUIPMENTS SYSTEM**

**9 Hrs**

Microprocessor based medical system – pulmonary instrumentation – anesthesia machine –EEG system – microprocessor based blood pressure monitor – prosthetic systems – bio- chemical measuring systems and micro processor based medical devices – Radiological Information system.

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Kenneth J. Ayala, the 8051 Micro Controller – Architecture Programming And Applications, Second Edition, Penram International, 1996.

**Reference Books:**

1. Douglas V. Hall, Microprocessors and Interfacing: Programming and hardware, Mcgrase Hill, Singapore, 1999.

<b>Subject Code:</b> BBI17E06	<b>Subject Name : BIOMEDICAL MEMS AND NANOTECHNOLOGY</b>						<b>T / L/ ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P/ R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To understand the working principle of MEMS and Microsystems</li> <li>➤ To understand the working of MOEMS Technology</li> <li>➤ To understand the concepts of BioMEMS and its application in healthcare</li> <li>➤ To give an insight to the DNA based BioMEMS</li> <li>➤ To study about the biomedical Nanotechnology and its application in research domain</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	understands the working principle of MEMS and Microsystems											
CO2	understands the working of MOEMS Technology											
CO3	understands the concepts of BioMEMS and its application in healthcare											
CO4	Acquires knowledge on the DNA based BioMEMS											
CO5	Acquires knowledge on the biomedical Nanotechnology and its application in research domain											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	L	M	H	L	M	H	L	M	H
CO2	H	H	H	L	L	M	H	M	H	L	M	H
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	L	M	H	L	M	H	L	M	H	L	M	H
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs / PSOs	PSO1		PSO2			PSO3		PSO4		PSO5		
CO1	M		L			H		L		M		
CO2	M		H			L		M		H		
CO3	H		H			H		M		L		
CO4	M		H			L		M		H		
CO5	L		M			M		L		M		
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												

**BIOMEDICAL MEMS AND NANOTECHNOLOGY**

**UNIT I MEMS**

**9 Hrs**

Introduction - Typical MEMS Products - Application of Micro-system in Healthcare Industry – Working Principles of Microsystems Micro-sensors – Micro-actuation - MEMS with actuation– Micro-accelerators and Micro-fluidics - Materials for MEMS and Microsystems

**UNIT II MEMS and Microfluidics**

**9 Hrs**

Fundamental principle - Light Modulators, Beam splitter – Micro-lens, Micro-mirrors - Digital Micro-mirror Device, Light detectors - Important Consideration on Micro-scale fluid, Properties of fluid - Fluid Actuation Methods – Micro-pumps - Typical Micro-fluidic Channel, Micro-fluid Dispenser.

**UNIT III BIOMEMS**

**9 Hrs**

Introduction -Principle of Biosensor, Ampero-metric Biosensor - Micro-dialysis - BioMEMS for Clinical Monitoring - Monitoring of Glucose and Lactate with a micro-dialysis probe – Ammonia Monitoring - Electronic Nose, DNA Sensors,

**UNIT IV BIOMEMS AND DNA**

**9 Hrs**

Unique features of Nucleic Acids, Lab on the Chip, Electrophoresis, Polymerase Chain Reaction (PCR), Biochemical reaction chains for integration: Biosensors and the “lab biochip”, Typical Microarray experiment, Manufacturing of Microarrays, Synthesis on the chip, Spotting Techniques, PCR on the chip, Microchamber Chips, Micro-fluidics Chips, Emerging BioMEMS Technology.

**UNIT V BIOMEDICAL NANOTECHNOLOGY**

**9 Hrs**

Nanoparticles- Nanomaterial characterization – XRD, SAXS, TEM, SEM, Scanning Tunneling microscopy, AFM, SPM technique, Biomolecular sensing for cancer diagnostics using carbon nanotubes, Carbon nanotube biosensors, Magnetic nanoparticles for MR Imaging, Nano-devices in biomedical applications.

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Steven S, Saliterman, “Fundamentals of BioMEMS and Medical Microdevices”, International Society for Optical Engineering, First Edition 2006.
2. Nitaigour Premchand Mahalik, “MEMS”, Tata McGraw Hill, 2nd Reprint 2008
3. Wanjun Wang and Steven A.Soper , “BioMEMS- Technologies and applications”, CRC Press, First edition 2007.

**Reference Books:**

1. Tai-Ran Hsu, “MEMS and Microsystems- Design, Manufacture and Nanoscale Engineering”, John Wiley and Sons, 2nd Edition 2008.
2. Gerald A Urban, “BioMEMS”, Springer, First Edition 2006.
3. Abraham P. Lee and James L. Lee, “BioMEMS and Biomedical Nanotechnology”, Volume I, Springer, First Edition 2006.
4. Paul C.H. Li, “Introduction to Microfluids and BioMEMS: A Design and Problem-Solving Textbook”, CRC Press, First Edition 2009.
5. Hari Singh Nalwa, “Nanostructured Materials and Nanotechnology”, Academic Press, First Edition 2002.

<b>Subject Code:</b> BBI17E07	<b>Subject Name : RADIOLOGICAL EQUIPMENTS</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Gain Knowledge Of X-Rays</li> <li>➤ To Study About Radio Diagnosis</li> <li>➤ To Learn About Special Radiological Equipments</li> <li>➤ To Learn About Various Application Of Radioisotopes</li> <li>➤ To Study About Radiation Safety</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires Knowledge Of X-Rays											
CO2	Capable to analyze Radio Diagnosis											
CO3	Understands Special Radiological Equipments											
CO4	Acquires knowledge of Various Application Of Radioisotopes											
CO5	Analysis Radiation Safety											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	L	L	M	H	L	M	H	H
CO2	H	H	M	L	H	M	L	M	H	H	H	L
CO3	M	H	L	M	H	L	M	L	L	M	H	M
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	L	M	H	M	H	L	M	H	M	L	M	H
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	M		H		L		M		H			
CO3	H		L		M		H		L			
CO4	L		M		H		L		M			
CO5	M		H		M		L		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

**RADIOLOGICAL EQUIPMENTS**

<b>UNIT I X-RAYS</b>	<b>9 Hrs</b>
Principles and production of soft and hard X-rays, selection of anodes, Heel Pattern. Scattered radiation, Porter Bucky system, Cooling system.	
<b>UNIT II RADIO DIAGNOSIS</b>	<b>9 Hrs</b>
Radiography, Angiography, Fluoroscopy, Image Intensifier, Multi section radiography.	
<b>UNIT III SPECIAL RADIOLOGICAL EQUIPMENTS</b>	<b>9 Hrs</b>
Principle, Plane of Movement, Multi section Radiography, CAT. Principle of NMR, MRI	
<b>UNIT IV APPLICATION OF RADIOISOTOPES</b>	<b>9 Hrs</b>
Alpha, Beta and Gamma emission, Principle of radiation detectors, dot scanners, nuclear angiogram, Principles of Radiation therapy.	
<b>UNIT V RADIATION SAFETY</b>	<b>9 Hrs</b>
Hazardous effect of Radiation, Radiation protection Techniques, Safety Limits, Radiation Monitoring.	

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. R.S.Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1997.
2. Steve Webb, "The Physics of Medical Imaging", Adam Hilger Philadelphia 1988.

**Reference Books:**

1. William R.Hendee, E.Russel Ritenour, "Medical Imaging Physics", Third Edition, Mosby Year Book, St. Louis, 1992.

## Department of BIOMEDICAL INSTRUMENTATION ENGINEERING

<b>Subject Code:</b> BB117E08	<b>Subject Name : BIOLOGICAL EFFECTS OF RADIATION</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P/ R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Study About Action Of Radiation On Living Cells</li> <li>➤ To Learn About Somatic Application Of Radiation</li> <li>➤ To Gain Knowledge On Genetic Effects Of Radiation</li> <li>➤ To Study About Effect Of Microwave And RF With Matters</li> <li>➤ To Gain Knowledge On UV Radiation</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Understands Action Of Radiation On Living Cells											
CO2	Capable to analyze Somatic Application Of Radiation											
CO3	Acquires Knowledge On Genetic Effects Of Radiation											
CO4	Understands Effect Of Microwave And RF With Matters											
CO5	Acquires Knowledge On UV Radiation											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	H	M	L	M	H	L	M	H
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	H	M	L	H	M	H	M	H	L	M	H	L
CO4	L	M	H	L	M	H	L	M	H	L	M	H
CO5	H	M	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	H		M		H		L		H			
CO3	L		M		H		L		M			
CO4	H		L		M		H		M			
CO5	M		L		H		L		M			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												



**BIOLOGICAL EFFECTS OF RADIATION**

**UNIT I ACTION OF RADIATION ON LIVING CELLS**

**9 Hrs**

Various theories related to radiation at cellular level, DNA and chromosomal damages, experiments on computation of various parameters related to this radiation exposure

**UNIT II SOMATIC APPLICATION OF RADIATION**

**9 Hrs**

Radiosensitivity protocols of different issues of human, LA\D 50/30 effective radiation on skin, bone marrow, eye, endocrine glands, basis of radiotherapy.

**UNIT III GENETIC EFFECTS OF RADIATION**

**9 Hrs**

Thresholds and linear dose, gene control hereditary diseases, effect of dose and I Infleneceson genetic equilibrium.

**UNIT IV EFFECT OF MICROWAVE AND RF WITH MATTERS**

**9 Hrs**

Effects on various human organs and systems, wavelength in tissues, nonthermal interaction, low frequency radiation, measurement devices used to compute the thermal effects, standards of protection, national and international standards and precautions.

**UNIT V UV RADIATION**

**9 Hrs**

Classification of sources, measurement, photo medicine, UV radiation safety Visibleand infrared radiation, combined effect of UV and IR, dose measuring instruments sed safety standards for this radiation

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Glasser.O. Medical Physics, vol I, II, III, The year book Publishers linc., Chicago, 1980.
2. Baranski.S and Cherski.P, Biological effects of microwave, Hutchison and Ross Inc., Stroudsburg, 1980.

**Reference Books:**

1. Moselly.H non-ionizing Radiation, Adam-Hilgar, Bristol, 1988

<b>Subject Code:</b> BBI17E09	<b>Subject Name :</b> COMPUTERS IN MEDICINE	<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits  
T/L/ETL : Theory/Lab/Embedded Theory and Lab

**OBJECTIVE :**

- To learn about Overview Of Computer Hardware
- To gain knowledge on System Design
- To study about Computers In Patient Monitoring
- To learn Computers In Medical Systems Modeling
- To gain knowledge on Computers In Medical Research

**COURSE OUTCOMES (COs) : ( 3- 5)**

CO1	Understands the Overview Of Computer Hardware
CO2	Gains knowledge on System Design
CO3	Acquires knowledge on Computers In Patient Monitoring
CO4	Understands Computers In Medical Systems Modeling
CO5	Acquires knowledge on Computers In Medical Research

**Mapping of Course Outcomes with Program Outcomes (POs)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	H	L	M	H	M	L	M	H
CO2	H	M	L	M	H	L	M	L	H	M	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	M	H	L	M	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	M	L	H	M	L
CO2	H	M	H	L	M
CO3	M	L	H	L	M
CO4	H	L	M	H	L
CO5	L	M	H	L	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills
					✓				

Approval	
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**COMPUTERS IN MEDICINE**

**UNIT I OVERVIEW OF COMPUTER HARDWARE PC-AT**

**9 Hrs**

8086 architecture, system connections, Instruction set and programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.

**UNIT II SYSTEM DESIGN**

**9 Hrs**

Multichannel computerised ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.

**UNIT III COMPUTERS IN PATIENT MONITORING**

**9 Hrs**

Physiological monitoring, automated ICU, computerised arrhythmia monitoring, information flow in a clinical lab, computerised concepts, interfacing to HIS

**UNIT IV COMPUTERS IN MEDICAL SYSTEMS MODELING**

**9 Hrs**

Radiotherapy, drug design, drug delivery system, physiological system modeling and simulation

**UNIT V COMPUTERS IN MEDICAL RESEARCH**

**9 Hrs**

Role of expert systems, pattern recognition techniques in medical image classification, ANN concepts

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. R.D.Lele, "Computers in Medicine", Tata McGraw-Hill, New Delhi, 1999.

**Reference Books:**

1. Douglas V.Hall, "Microprocessors and Interfacing : Programming and hardware", McGraw Hill, Singapore, 1999.

<b>Subject Code:</b> BBI17E10	<b>Subject Name : MEDICAL INFORMATICS</b>						<b>T / L/ ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P/ R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Gain Knowledge On Biomedical Information Technology</li> <li>➤ To Learn About Overview Of Computer Hardware</li> <li>➤ To Study About Hospitals Information Systems</li> <li>➤ To Gain Knowledge On Visual Programming And Multimedia Information Systems</li> <li>➤ To Learn About Integrated Medical Information Systems</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires Knowledge On Biomedical Information Technology											
CO2	Acquires Knowledge On Overview Of Computer Hardware											
CO3	Acquires Knowledge On Hospitals Information Systems											
CO4	Acquires Knowledge On Visual Programming And Multimedia Information Systems											
CO5	Acquires Knowledge On Integrated Medical Information Systems											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	L	L	H	M	L	M	H	L	M
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	M	H	L	M	H	L	M	H	L	M	H	L
CO5	L	M	L	H	L	M	H	L	M	H	L	M
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	H		M		L		M		H			
CO3	L		M		H		L		M			
CO4	M		L		M		H		L			
CO5	H		M		L		M		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

**MEDICAL INFORMATICS**

**UNIT I BIOMEDICAL INFORMATION TECHNOLOGY**

**9 Hrs**

Historical highlights of Healthcare Information systems – Biomedical Information systems – problems and pitfalls – History and evolution of Electric resources – Internet and Interactive Multimedia components.

**UNIT II OVERVIEW OF COMPUTER HARDWARE**

**9 Hrs**

Motherboard and its logic – memory and I/O interfacing, memory and I/O map I/O peripherals and add-on cards, RS 232-C and various IEEE standards.

**UNIT III HOSPITALS INFORMATION SYSTEMS**

**9 Hrs**

Concept of HIS and its Position on the hospital – introduction of a computerized HIS-application of HIS in project management – Automation of Medical record – hospital Inventory data protection aspects – costs and benefits of HIS – transfer of information within the hospital – Modems and computer networking in Hospitals.

**UNIT IV VISUAL PROGRAMMING AND MULTIMEDIA INFORMATION SYSTEMS**

**9 Hrs**

Visuals Basic principles and programming – Design, Production and testing of multimedia based medical information systems.

**UNIT V INTEGRATED MEDICAL INFORMATION SYSTEMS**

**9 Hrs**

Integration of Intra and Inter hospital information systems – Role of expert systems and fuzzy logic in medical information systems – Physiological system modeling and simulation – Concepts of Virtual reality, web based multimedia information systems – video conferencing.

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. S.K. Chauhan, . “PC Organisation”, S.K. Kataria and sons, Delhi.
2. Harold sackman, “Biomedical Inforamtion Technology, Academic Press, New York, 1997.

**Reference Books:**

1. Mary Beth Fecko, “Electronic Resources: Access and Issues, Bowker-saur, London, 1997.
2. R.D. Lele, “Computers in medicine”, Tata McGraw Hill, New Delhi, 1999.
3. Tay Vaughan, “Multimedia making it work”, Tata McGRaw Hill, New Yotk, 1999.
4. Mark Spenik, “Visual Basic 6, Iterative Course”, Techmedia, New Delhi, 1999.

<b>Subject Code:</b> BB117E11	<b>Subject Name : FIBRE OPTICS AND LASER INSTRUMENTS</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ Introduction to basic concepts of optical fibers and their industrial applications.</li> <li>➤ Providing adequate knowledge about Industrial application of optical fibers.</li> <li>➤ Understanding basic concepts of lasers.</li> <li>➤ Exposure to the basic knowledge about Industrial application of lasers and the Industrial application of Holography and Medical applications of lasers</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Understands basic concepts of optical fibers and their industrial applications											
CO2	Gains adequate knowledge about Industrial application of optical fibers											
CO3	Understands basic concepts of lasers.											
CO4	Understands basic knowledge about Industrial application of lasers and the Industrial application of Holography and Medical applications of lasers											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	L	M	H	L	M	H	L	M
CO2	H	M	L	M	H	L	M	H	L	M	H	L
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	M		L		H		M		L			
CO3	M		H		L		M		H			
CO4	M		H		L		M		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												

**FIBRE OPTICS AND LASER INSTRUMENTS**

**UNIT I OPTICAL FIBERS AND THEIR PROPERTIES**

**9 Hrs**

Principles of light propagation through a fiber – different types of fibers and their properties transmission characteristics of optical fiber – absorption losses – scattering losses – dispersion – optical fiber measurement – optical sources – optical detectors – LED – LD – PIN and APD

**UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS**

**9 Hrs**

Fiber optic sensors – fiber optic instrumentation system – different types of modulators – detectors – application in instrumentation – interferometric method of measurement of length – moiré fringes – measurement of pressure, temperature, current, voltage liquid level and strain – fiber optic gyroscope – polarization maintaining fibers.

**UNIT III LASER FUNDAMENTALS**

**9 Hrs**

Fundamental characteristics of lasers – three level and four level lasers – properties of laser – laser modes – resonator configuration – Q-switching and mode locking – cavity dumping – types of lasers: gas lasers, solid lasers, liquid lasers and semi conductor lasers

**UNIT IV INDUSTRIAL APPLICATION OF LASERS**

**9 Hrs**

Laser for measurement of distance, length velocity, acceleration, current, voltage and atmospheric effect – material processing – laser heating, welding melting and trimming of materials – removal and vaporization

**UNIT V HOLOGRAM AND MEDICAL APPLICATION**

**9 Hrs**

Holography – basic principle; methods; holographic interferometry and applications, holography for non – destructive testing – holographic components – medical applications of lasers; laser and tissue interaction – laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. John and Harry, Industrial lasers and their applications, McGraw-Hill, 1974
2. Senior J.M., Optical Fiber Communication Principles and Practice, Prentice Hall, 1985

**Reference Books:**

1. John F Read, Industrial applications of lasers, Academic Press, 1978
2. MonteRoss, Laser applications, McGraw-Hill, 1968
3. Keiser G., Optical Fiber Communication, McGraw-Hill, 1991
4. Jasprit Singh, Semi conductor optoelectronics, McGraw-Hill, 1995

<b>Subject Code:</b> BBI17E12	<b>Subject Name : DIAGNOSTIC and THERAPEUTIC EQUIPMENTS I</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To learn about cardiac system</li> <li>➤ To study about neurological system</li> <li>➤ To gain knowledge on skeletal muscular system</li> <li>➤ To learn about heart-lung machine</li> <li>➤ To study about respiratory measurement and ventilator</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires knowledge about cardiac system											
CO2	Graduates gains knowledge on neurological system											
CO3	Understands skeletal muscular system											
CO4	Acquires knowledge about heart-lung machine											
CO5	Graduate gains knowledge on respiratory measurement and ventilator											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	L	H	L	M	H	L	M	H
CO2	M	L	H	M	L	M	H	L	M	H	L	M
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	L	M	H	L	M	H	L	M	H	L	M	H
CO5	H	M	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	H		M		H		L		M			
CO3	L		M		L		H		M			
CO4	M		H		L		M		M			
CO5	M		H		L		M		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												



**DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS I**

**UNIT I CARDIAC SYSTEM**

**9 Hrs**

ECG, sources of ECG, normal and abnormal waveform, diagnosis interpretation, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, electrodes, synchronised and unsynchronised types

**UNIT II NEUROLOGICAL SYSTEM**

**9 Hrs**

EEG, genesis, lead system, wave characteristics, frequency bands, spontaneous and evoked response, diagnostic interpretation, epileptic discharges

**UNIT III SKELETAL MUSCULAR SYSTEM**

**9 Hrs**

Structure of muscles, sliding theory of contraction, stimulation of muscles, muscle potential generation, recording and analysis of EMG waveforms, muscle and nerve stimulation, fatigue characteristics

**UNIT IV HEART-LUNG MACHINE**

**9 Hrs**

Need for the unit, functioning of bubble, disc type and membrane type oxygenators, fingerpump, roller pump, electronic monitoring of functional parameter

**UNIT V RESPIRATORY MEASUREMENT AND VENTILATOR**

**9 Hrs**

Spirometer, Respiratory volume measurement, pneumograph, artificial respirator – IPR type, functioning

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 1998.

**Reference Books:**

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 1997.
2. Joseph J.carr and John M. Brown, “Introduction to Biomedical equipment technology”, John wiley and sons, New York, 1997.

<b>Subject Code:</b> BBI17E13	<b>Subject Name : RECENT ADVANCES APPLIED TO HOSPITAL ENGINEERING</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To learn about Standardisation Of Hospital Equipments</li> <li>➤ To gain knowledge on Clinical Engineering</li> <li>➤ To study about Networking</li> <li>➤ To gain knowledge on Fibre Optic Sensors For Measuring Physiological Parameters</li> <li>➤ To learn about Emi And Emc Applied To Hospital Equipments</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires knowledge on Standardisation Of Hospital Equipments											
CO2	Gains knowledge on Clinical Engineering											
CO3	Graduate understands Networking											
CO4	Gains knowledge on Fibre Optic Sensors For Measuring Physiological Parameters											
CO5	Acquires knowledge EMI And EMC Applied To Hospital Equipments											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	L	M	H	L	M	H	L	M
CO2	M	L	H	M	L	M	H	L	M	H	L	M
CO3	L	M	H	L	M	H	L	M	H	L	M	H
CO4	H	M	L	M	H	L	M	H	L	M	H	L
CO5	M	H	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	H		M		L		M		H			
CO2	M		H		L		M		H			
CO3	L		M		H		L		M			
CO4	M		H		L		M		H			
CO5	H		M		M		H		L			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												

**RECENT ADVANCES APPLIED TO HOSPITAL ENGINEERING**

**UNIT I STANDARDISATION OF HOSPITAL EQUIPMENTS**

**9 Hrs**

Need for standardization, classification of equipments, international standards, Experimental methods of testing standards, maintenance of standards and recalibration.

**UNIT II CLINICAL ENGINEERING**

**9 Hrs**

Hospital design, electrical, air – conditioning, sanitation, ventilation, safety regulation to be incorporated in the hospital center, management and legal aspects, latest drug delivery systems for sustained delivery of medicines.

**UNIT III NETWORKING**

**9 Hrs**

Importance of networking, LAN features, network topologies, LAN components, network operating system, basic data communication concept, application, LAN and multi-user system, planning and installing LAN in hospital set up.

**UNIT IV FIBRE OPTIC SENSORS FOR MEASURING PHYSIOLOGICAL PARAMETERS**

**9 Hrs**

Different optical sources, optical detectors, principle of fiber optic cables, single mode multi mode, step index and graded index type, sensors based on polarisation, interferometer principle, magnetic sensors, application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities, principles of smart sensors.

**UNIT V EMI AND EMC APPLIED TO HOSPITAL EQUIPMENTS**

**9 Hrs**

Principles of EMI, computation of EMI, measuring techniques to quantify the level of interference, method of suppressing and isolating this unit from interference

**Total Number of Hours: 45  
Hrs**

**Text Books:**

1. Donald R.J. White, A Handbook of electromagnetic Interference and Compatibility, Vol 4, 5, Published by Donwhite Constant – Maryland, 1972.
2. Webster J.G. and Albert M. Cook, Clinical Engineering Principles and Practices Printice Hall Inc, Englewood Cliffs, New Jersey, 1979.
3. Bernhard Keiser, Principles of Eletromagnetic Compatibility, Artech House- 3rd Edition, 1986.

**Reference Books:**

1. Eric Udd, Fiber Optic Sensors and introduction for engineers and scientists, Wiley Interscience Publication, New Delhi, 1991.
2. Bajbai, P.K. Ceramic – a novel device for sustained long term delivery of drugs Bio Ceramic Vol III,
3. Rose Heliman Institute of Technology, Terrahaute, Indian, 1992.
4. S.K. Basandia, Local Area Network, Golgotia Publishing Pvt Ltd., New Delhi, 1995.

<b>Subject Code:</b> BBI17E14	<b>Subject Name : DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS – II</b>						<b>T / L / ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P / R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To learn about Ultrasonic Techniques For Diagnosis</li> <li>➤ To gain knowledge on Patient Monitoring And Biotelemetry</li> <li>➤ To study about Diathermy</li> <li>➤ To learn about Special Diagnostic Techniques</li> <li>➤ To gain knowledge on Patient Safety</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Acquires knowledge on Ultrasonic Techniques For Diagnosis											
CO2	Graduate understands Patient Monitoring And Biotelemetry											
CO3	Understands Diathermy											
CO4	Graduate gains knowledge on Special Diagnostic Techniques											
CO5	Understands Patient Safety											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	L	M	H	L	M	L	H	M	L	H
CO2	H	M	L	H	M	L	H	L	M	H	L	M
CO3	H	M	L	M	H	L	M	H	L	M	H	L
CO4	M	L	M	H	L	M	H	L	M	H	L	M
CO5	L	M	L	M	H	L	M	H	L	M	H	L
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs / PSOs	PSO1		PSO2			PSO3		PSO4		PSO5		
CO1	M		M			L		H		M		
CO2	H		M			L		M		H		
CO3	M		H			L		H		M		
CO4	M		H			L		M		H		
CO5	L		M			H		L		M		
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

**DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS – II**

**UNIT I ULTRASONIC TECHNIQUES FOR DIAGNOSIS**

**9 Hrs**

Basic principles of Echo technique, display techniques A, B, M modes, Echo cardiograms, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, obstetrics and gynecology.

**UNIT II PATIENT MONITORING AND BIOTELEMETRY**

**9 Hrs**

Patient monitoring system – ICU, post operative, ICCU, single channel telemetry, Multichannel telemetry, frequency allotment, radiopill - Transmission of Biosignals over telephone lines

**UNIT III DIATHERMY**

**9 Hrs**

Clinical applications of electrotherapy, short wave diathermy, ultrasonic diathermy, microwave diathermy, surgical diathermy unit, IR lamps, UV lamps

**UNIT IV SPECIAL DIAGNOSTIC TECHNIQUES**

**9 Hrs**

Principles of Cryogenic technique and application, Endoscopy, Laparoscopy, Thermography

**UNIT V PATIENT SAFETY**

**9 Hrs**

Sources of leakage current, Micro and Macro shock, monitoring circuits, earthing schemes

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 1997.

**Reference Books:**

1. John G.Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 1998.
2. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment technology”, John Wiley and sons, New York, 1997.

<b>Subject Code:</b> BBI17E15	<b>Subject Name : SYSTEM THEORY APPLIED TO BIO-MEIDCAL ENGINEERING</b>						<b>T / L/ ETL</b>	<b>L</b>	<b>T / S.Lr</b>	<b>P/ R</b>	<b>C</b>	
	Prerequisite:						T	3	0/0	0/0	3	
L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab												
<b>OBJECTIVE :</b>												
<ul style="list-style-type: none"> <li>➤ To Learn About System Concept</li> <li>➤ To Gain Knowledge On Transducer Function</li> <li>➤ To Study About Impedance Concept</li> <li>➤ To Learn About Periodic Signals, Feedback</li> <li>➤ To Gain Knowledge On Simulation Of Biological Systems</li> </ul>												
<b>COURSE OUTCOMES (COs) : ( 3- 5)</b>												
CO1	Understands System Concept											
CO2	Acquires knowledge on Transducer Function											
CO3	Graduate understands Impedance Concept											
CO4	Understands Periodic Signals, Feedback											
CO5	Simulation Of Biological Systems											
<b>Mapping of Course Outcomes with Program Outcomes (POs)</b>												
COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	M	L	H	L	M	H	L	M	H	L
CO2	M	H	L	M	H	L	M	H	L	M	H	L
CO3	M	H	L	M	H	L	M	H	L	M	H	L
CO4	M	H	L	M	L	M	H	L	M	H	L	M
CO5	M	H	L	M	H	L	M	H	L	M	H	L
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1	M		H		L		M		H			
CO2	M		H		L		M		H			
CO3	H		M		L		H		L			
CO4	L		M		H		L		M			
CO5	H		M		L		M		H			
H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low												
Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
Approval												

**SYSTEM THEORY APPLIED TO BIO-MEIDCAL ENGINEERING**

**UNIT I INTRODUCTION**

**9 Hrs**

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

**UNIT II TRANSFER FUNCTION**

**9 Hrs**

System as an Operator use of Transfer Function, bioengineering of a Coupled System, Example of Transformed Signals.

**UNIT III IMPEDANCE CONCEPT**

**9 Hrs**

Circuits for the Transfer Function with Impedance Concept Prediction of Performance.

**UNIT IV PERIODIC SIGNALS, FEEDBACK**

**9 Hrs**

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

**UNIT V SIMULATION OF BIOLOGICAL SYSTEMS**

**9 Hrs**

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

**Total Number of Hours: 45 Hrs**

**Text Books:**

1. William B. Blesser, A System Approach to Biomedicine, McGraw Hill Book Co., New York, 1969.
2. Manfred Clynes and John H. Milsum, Biomedical Engineering System, McGraw Hill and Co, New York, 1970.

**Reference Books:**

1. Douglas S. Rigg, Control Theory and Physiological Feedback Mechanism, The William and Wilkins Co., Baltimore, 1970.
2. Richard Skalak and Shu Chien, Handbook of Biomedical Engineering, McGraw Hill and Co., New York, 1987.



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