



SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited "A" Grade by NAAC | 12B Status by UGC | Approved by AICTE

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SCHOOL OF BIO & CHEMICAL ENGINEERING

DEPARTMENT OF BIOMEDICAL ENGINEERING



CRITERION 1.1.3 2019 Regulations

**PROGRAMME: M. TECH
MEDICALINSTRUMENTATION**

SBM5103	ADVANCED BIOMEDICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To provide the student with an advanced understanding of biomedical instrumentation, from signal acquisition through to process control.
- To understand the fundamental principles and working of the biomedical instruments.
- To learn about the safety measures while working on medical equipments.

UNIT 1 BIOMEDICAL SIGNALS & ELECTRODES 9 Hrs.

Sources of biomedical signals, Basic medical instrumentation system, Origin of bioelectric signals - ECG, EEG, EMG. Electrodes for ECG, EEG, EMG, Medical surface electrodes and problems, MEMS. Electrocardiograph-block diagram, ECG leads, Types of ECG Recorders, Faults and troubleshooting, Phonocardiograph-origin of heart sounds, microphones and amplifiers for PCG, Operating Rooms

UNIT 2 ASSISTIVE DEVICES CARDIAC SYSTEM AND MONITORS 9 Hrs.

Implantable Medical Devices, Cardiac Pacemakers, Heart lung machine. Different types of Oxygenators, Pumps, Monitoring Process. Hemodialyser- Principle of Hemodialysis, Membranes, Dialysate, Different types of hemodialysers, Wearable Artificial Kidney, Defibrillators, Implantable defibrillators, Functional electrical stimulator (FES)

UNIT 3 RADIOLOGICAL, SURGICAL SCOPY AND DIATHERMY EQUIPMENTS 9 Hrs.

Digital radiography, Digital Fluoroscopy, Mammography, Angiography, Bone densitometry, Endoscopy, Laparoscopy Bronchoscopy, Gastroscopy, Physiological effects of HF radiation, Depth of Penetration, Short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Cryosurgery

UNIT 4 ULTRASONIC AND NEONATAL INSTRUMENTS 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. Infusion Pumps. Baby incubator, Phototherapy, Radiant warmer - Working principle, block diagram, description, and function of basic blocks, Fetal Monitoring System

UNIT 5 TELEMEDICINE AND SAFETY MEASUREMENTS 9 Hrs.

Fundamentals of Telemedicine, Block diagram of Telemedicine, Scope & Benefits and Limitation of Telemedicine. Applications -Teleradiography, Telecardiology, Telesurgery. Electric shock hazards – Gross shock, Effects on human body, Micro and macro electric shock, Leakage current and types, Safety techniques, Testing of Biomedical Equipments.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Characterize the sources of biomedical signals and their application in biomedical recorders
- CO2 - Apply the knowledge acquired to design a pacemaker and defibrillator
- CO3 - Describe about diathermy devices used for surgery and physiotherapy
- CO4 - Discuss about the instruments associated with ultrasonic technique and neonatal care
- CO5 - Explores the application of telehealth to modalities of medicine
- CO6 - Design various therapeutic devices based on the applications learned

TEXT / REFERENCE BOOKS

1. Joseph J Carr and John M Brown - Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001.
2. R.Ananda Natarajan, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 2016.
3. Webster J.G Medical Instrumentation application and design - John Wiley and sons New York 4th edition 2005.
4. Khandpur R.S Hand Book of Biomedical Instrumentation - Tata McGraw Hill publication, New Delhi 2nd edition 2014.

SBM5104	ADVANCED MEDICAL IMAGE PROCESSING	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- The objective of this course is to provide students with an overview of the computational and mathematical methods in medical image processing.
- The course covers all the main sources of medical imaging data.
- We will study many of the current methods used to enhance and extract useful information from medical images. A variety of radiological diagnostic scenarios will be used as examples to motivate the methods.

UNIT 1 IMAGE FUNDAMENTALS AND PREPROCESSING 9 Hrs.

Image perception, MTF of the visual system, Image fidelity criteria, Image model, Image sampling and quantization - two dimensional sampling theory, Image quantization, Image transforms-2D-DFT, Image enhancement - point operation, Histogram modeling, spatial operations.

UNIT 2 BASICS OF MEDICAL IMAGE SOURCES 9Hrs.

Medical images obtained with ionizing radiation: Medical imaging modalities, Images from x-rays, Images from γ -rays, Dose and risk. Medical images obtained with non-ionizing radiation: Ultrasound imaging, Magnetic resonance imaging, Picture archiving and communication systems (PACS).

UNIT 3 MEDICAL IMAGE ANALYSIS AND CLASSIFICATION 9Hrs.

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

UNIT 4 IMAGE REPRESENTATION, RECONSTRUCTION, RECOGNITION 9Hrs.

Representation - Chain Code - Polygonal approximation, signature, boundary segments - Boundary descriptors-Shape number-Fourier Descriptor, moments-Regional Descriptors-Topological feature, Texture - Patterns and Pattern classes - Projection geometry- Fourier Slice theorem- Back projection-Algebraic reconstruction, Recognition based on matching.

UNIT 5 MEDICAL APPLICATIONS OF IMAGING 9Hrs.

Computer-aided diagnosis in mammography, Tumor imaging and treatment, Angiography, Bone strength and osteoporosis, Tortuosity.

Max. 45 Hours

COURSE OUTCOMES

The student will be able to

CO1: Describe the digital image fundamentals and the effect of image enhancement techniques on images

CO2: Discuss about the medical images obtained with ionizing radiation and non-ionizing radiation

CO3: Outline the image segmentation procedure and the various feature extraction techniques for image analysis

CO4: Explain and compute features useful for image representation and recognition

CO5: Illustrate the computer aided diagnosis in medical applications

CO6: Predict the qualitative performance of advanced imaging techniques

TEXT / REFERENCE BOOKS

- Atam P. Dhawan, Medical Image Analysis, Wiley Interscience Publication, NJ, USA 2003.
- Geoff Dougherty, Digital Image Processing for Medical Applications, Cambridge University Press, 2009.
- R.C. Gonzalez and R.E. Woods, Digital Image Processing, Fourth Edition, Pearson Education, 2018.
- Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education, Indian Reprint 2017.
- Malay K. Pakhira, Digital Image Processing and Pattern Recognition, First Edition, PHI Learning Pvt. Ltd, 2011

SBM5105	COMPUTER BASED MEDICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- With widespread use and required hardware components for designing of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.
- It attempts to render a broad classification of converters for the biomedical instruments.
- It provides knowledge of the principle of operation and design and the background knowledge of all the hardware such as amplifiers, filters, converters and interfacing components for designing biomedical instruments and specific applications of biomedical engineering.

UNIT 1 INTRODUCTION

9 Hrs.

Generalized Instrumentation system - Feature of personal computer - **PC based Instrumentation system** - Principle of signal conditioning - Operational Amplifier - instrumentation amplifier - Bridge circuits - Half and Full Bridge Circuit, Filters - Noise reduction techniques.

UNIT 2 PRINCIPLE OF DATA ACQUISITION

9 Hrs.

Sampling concepts - DAC - Weighted Resistor Network, R-2R Ladder Network, ADC - Successive Approximation ADC - Counting type, Successive approximation, parallel comparator, Data acquisition system - Analog Input, Analog Output.

UNIT 3 HARDWARE ORGANIZATION OF PC

9 Hrs.

Motherboard components - Microprocessor, memory, Chipset Chips, Interrupts, DMA Channel, System Control Chip, Peripheral Control Chip - Peripherals, Features of ISA and PCI buses.

UNIT 4 COMPUTERISED DATA ACQUISITION

9 Hrs.

Overview of GPIB - System and Implementation, commands - primary command, secondary commands, device specific commands, expanding GPIB, Sharing GPIB, SCPI - Generalized Instrument Model.

UNIT 5 DATA ACQUISITION USING SERIAL INTERFACE

9 Hrs.

Serial Communication - Features and Formats, Interface standard - RS232, RS-422, RS-485, PC, serial port UART, Microcontroller serial interface - USB System and USB Transfer.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the knowledge of basic operation of biomedical instruments materials and understand its working principle.
- CO2 - Analyse the characteristics of various medical instruments.
- CO3 - Classify and analyse the various converters for medical instruments.
- CO4 - Illustrate the qualitative knowledge of interfacing components for designing biomedical instruments.
- CO5 - Become Aware of the latest technological application in biomedical engineering.
- CO6 - Apply the knowledge of basic hardware and understand application processes.

TEXT / REFERENCE BOOKS

1. Mathivanan, PC-based instrumentation: concepts and practice, Prentice Hall India Pvt Ltd., 2007
2. Michael H. Tooley, PC-based instrumentation and control, 2nd Edition, Newnes Publications, 2003
3. Patrick H. Garrett, High performance Instrumentation and Automation, CRC Press, Taylor & Francis Group, 2005.
4. Atul Khathe, Cryptography and network security, Tata McGraw Hill Publishing Company, New Delhi, 2008

SBM5106	BIO SIGNAL PROCESSING	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- This course represents the application of the main signal processing tools to the analysis of biomedical signals. It shows how clinically relevant information can be extracted from these signals.
- The processing techniques will be illustrated with examples of their application in the analysis of the electrocardiogram (ECG), electroencephalogram (EEG), evoked potentials (EP), heart rate variability (HRV) and other signals.

UNIT 1 INTRODUCTION TO BIOMEDICAL SIGNALS

9 Hrs.

Bioelectric signals- Action potential, Electro-neurogram, Electro-oculogram, Electro-encephalogram, Evoked potential, Electro-cardiogram, Electro-gastrogram, bio-impedance signals- course objectives of biomedical signal analysis, difficulties in biomedical signal analysis.

UNIT 2 REAL TIME TRANSFORMS

9 Hrs.

Convolution - Linear Convolution, Circular Convolution, Correlation - Auto Correlation, Cross Correlation, DIT & DIF Algorithms, Real Time Transforms: Discrete Cosine Transform, Walsh Transform, Hadamard Transform and Wavelet Transform.

UNIT 3 EVENT DETECTION

9 Hrs.

Detection of events and waves - Derivative based operators in QRS detection - Pan Tompkins algorithm - Correlation analysis- ACF and CCF in rhythm analysis - Cross - spectral techniques - Murmur detection - Homomorphic filtering - Matched filters - Wavelet detection - Spike and wave detection- Extraction of vocal tract response and other applications.

UNIT 4 ECG DATA REDUCTION

9 Hrs.

Direct data compression Techniques: Turning Point, AZTEC, Cortes, FAN, Transformation Compression Techniques: Karhunen-Loeve Transform, Other data compression Techniques: DPCM, Huffman coding, Data compression Techniques comparison.

UNIT 5 FILTERING

9 Hrs.

Time domain filtering- Synchronous averaging, Moving average filters, Frequency domain filters- Design of Butterworth filters- optimal filtering, Adaptive noise cancellation- LMS and RLS algorithms in adaptive filtering- Application of these techniques in removal of artifacts in bio-signals.

Max. 45 Hours

Course outcomes

After successfully completing the course students will be able to:

- CO1- Understand and model a basic biomedical system.
- CO2- Classify and Identify the concepts of Real time transforms
- CO3- Attain adequate knowledge about the event detection in ECG Signals
- CO4- Demonstrate the concepts, types, working of data reduction techniques.
- CO5- Design of different filtering Techniques.
- CO6- Developing different algorithm for the removal of artifacts in bio-signals.

TEXT / REFERENCE BOOKS

- Rangaraj M. Rangayyan, 'Biomedical Signal Analysis- A case study approach', Wiley-Interscience/IEEE Press, 2015.
- Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2006.
- Dr. P. Ramesh Babu, Digital Signal Processing Scitech Publications, Fourth Edition 2010
- D. C. Reddy, Biomedical Signal Processing- Principles and Techniques, TMH, New Delhi, 2005
- Avtar Singh and S. Srinivasan, Digital Signal Processing, Thomson Publishing 2004, Singapore.

SBMA5201	ADVANCED REHABILITATION ENGINEERING	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- This course is an introduction to a field of engineering dedicated to improving the lives of people with disabilities. Rehabilitation engineering is the application of engineering analysis and design expertise to overcome disabilities and improve quality of life.
- The relationship between engineering innovation, the engineering design process, the human-technology interface and the physical medicine and rehabilitation medical community will be explored.

UNIT1 INTRODUCTION

9 Hrs.

Introduction to Rehabilitation Engineering, Principles involved in rehabilitation engineering. Assistive Technology, Steps in patient management, Epidemiology of Rehabilitation, Health, Level of Prevention, Preventive Rehabilitation, Diagnosis of Disability and Functional Diagnosis, Medical Rehabilitation, Telerehabilitation, Vocational Rehabilitation

UNIT2 ERGONOMICS & REHABILITATION TEAM

9Hrs.

Ergonomics: Introduction to Ergonomics, Principles of Ergonomics, Developing an Ergonomic Program, Ergonomic Issues Related to Posture, Frequent Types of Injuries Related to Workplace Design, Occupational and Human Stress. Rehabilitation Team: The Role of Physiatrist, Occupational Therapist, Physical Therapist, Prosthetics- Orthotics, Rehabilitation nurse & Biomedical engineer. Burn injury rehabilitation.

UNIT3 ORTHOTICS AND PROSTHETICS

9 Hrs.

Orthotics, classification of orthotics, general principles of orthotics, biomechanics of orthotics, material design consideration in orthotics, different types of orthotics-spinal, cervical, thoracic, and lower limb. Iso. Fundamentals, FES systems- restoration of hand functions, restoration of standing & walking, hybrid assistive systems. Active prostheses- active above knee prostheses, myoelectric hand and arm prostheses.

UNIT4 NEURO-PROSTHETICS

9Hrs.

Sensory prosthetics-visual prosthetics-Bionic eye-retinal prosthetic-auditory prosthetics-cochlear implant- Auditory brain stem implant- bionic ear- spinal cord stimulator- Motor prosthetics-bladder control implant-sacral anterior root stimulator-prosthetics for conscious control of movements- Brain computer interface

UNIT5 COMMUNICATIONS SYSTEMS & MOBILITY AIDS

9Hrs.

Communications systems: Augmentative communication – general form of communication, types of visual aids, Hearing aids, Types of conventional hearing aid, writing aids. Mobility Aids: Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches, Wheelchairs, specialized wheelchairs.

Max. 45 Hours

Course Outcomes

On completion of the course, student will be able to

- CO1: Select the appropriate rehabilitation concept for various disabilities
- CO2: Compare the different methods of orthopedic prosthetics and orthotics for rehabilitation
- CO3: Repair and maintain powered wheel chair
- CO4: Develop and implement analytical and technical skills in orthotics and prosthetics
- CO5: analyze proper sensory augmentation and substitution
- CO6: understands the state of the art in rehabilitation engineering both in the clinical practice and in research

TEXT / REFERENCE BOOKS

- Dr. S. Sunder, Rehabilitation Medicine, Jaypee Medical Publications, 2010.
- Joseph D. Bronzino, The Biomedical Engineering Handbook Volume-II, Second Edition, CRC Press, 2006.
- G. Salvendy, Handbook of Human Factors and Ergonomics, Wiley, 3rd edition, 2006.
- Kondraske, G. V., Rehabilitation Engineering, CRC Press, 2015.
- Robinson C. J., Rehabilitation Engineering Handbook of Electrical Engineering, CRC Press, Boca Raton, 2008.
- Susan BO'Sullivan, Thomas J Schmitz, George Fulk, Physical Rehabilitation, Davis Plus, 2014.

SBM5605	BIOMATERIALS AND ARTIFICIAL ORGANS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- This course is designed to provide a general understanding of the multidisciplinary field of biomaterials.
- Current application of biomaterials will be evaluated to provide an understanding of material bulk and surface properties, degradation processes, various biological responses to the materials and the clinical context of their use.
- The general concepts of artificial organs learned in this course will further extend the understanding about the interactions at the interface of material and biological systems.

UNIT 1 INTRODUCTION

9Hrs.

Overview of Biomaterials, metallic biomaterials, Ceramic biomaterials, Polymeric biomaterials, Composite biomaterials, biodegradable polymers, Deterioration of polymers.

UNIT 2 TISSUE RESPONSE TO IMPLANTS

9Hrs.

Tissue grafts, Hard tissue replacements-Wires, pins and Screws, Joint replacements- Upper extremity and Lower extremity, Soft tissue replacements- sutures, skin and maxillofacial implants, Normal Wound healing process, Blood Compatibility

UNIT 3 CHARACTERIZATION OF OPHTHALMIC AND DENTAL MATERIALS

9 Hrs.

Corrosion of metallic implants, Contact lenses, Optical implants, Eye Shields, Artificial tears, Dental materials, types and designs, Oral implants, use of collagen in dentistry

UNIT 4 BLOOD INTERFACING IMPLANTS

9Hrs.

Neural and neuromuscular implants, Vascular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, Cardiac defibrillators, artificial kidney, Dialysis, Artificial blood.

UNIT 5 TRANSPLANTS

9Hrs.

Overview, Immunological considerations, individual organs- kidney, liver, heart and lung, bone, cornea, Skin and hair, Pancreas, Mechanism of allograft rejection, Regeneration and ethical considerations, Immunosuppressive drugs.

Max. 45
Hours

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understand the biomaterials used for hard tissue replacement and soft tissue replacement.

CO2 - Recognize various metals, polymers, ceramics and composite used as biomaterials for organ replacement.

CO3 - Implement various characterization methods to identify biomaterials by suitable methods to test Biocompatibility and Hemocompatibility of biomaterials.

CO4 - Acquire knowledge about different types of artificial organs and their implantation.

CO5 - Implement the artificial organs to replace malfunctioning of natural organs.

CO6 - Recognize the immunological complications of organ transplantation and graft rejection.

TEXT / REFERENCE BOOKS

- JDBronzino, Biomedical Engineering handbook, CRC Press/IEEE Press, Volume 2, 2nd edition, 2000.
- RSKhandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, -2nd edition 2003
- Joon B Park, Biomaterials-An Introduction, Plenum press, New York, -2nd edition 1992.
- Sujata V Bhat, Biomaterials-Narosa Publishing House Pvt Ltd, 2nd edition, 2009

SBM5607	HOSPITAL HEALTH SYSTEMS AND MANAGEMENT	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To enable the student to develop adequate knowledge and mastery of techniques relevant to Hospital Management and hospital management discipline.
- To develop awareness of the responsibilities in Hospital Management like healthcare and operational problems at a hospital attachment.
- Formulate ideas and develop plan and to take a proactive and self-reflective role in working and to develop professional expertise.

UNIT1 PRINCIPLE OF HOSPITALMANAGEMENT

9Hrs.

Importance of management and Hospital, Management control systems. Forecasting techniques decision- making process, Hospital Administration

UNIT2 EVOLUTION OF HOSPITAL

9 Hrs.

Outpatient Department, Inpatient Service, Operation Theatre Complex, Delivery Suite, Pharmacy, Laboratory services, Radiological Department, Central Sterile supply department, and Medical records department, Material management, Hospital dietary services, Ambulance services, Medico-legal sciences.

UNIT3 HEALTH SYSTEM

9 Hrs.

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

UNIT4 HOSPITAL PLANNING

9 Hrs.

Technical consideration, size & kind of hospitals, principles of planning, selection, site of orientation, equipment plan, communication and information system, Power supply, Air-conditioning, Water supply, elevators.

UNIT5 NATIONAL HEALTH POLICY

9Hrs.

Need for evaluating a health policy, need for providing primary health care, Health education, health insurance, health legislation, inter sectoral cooperation.

Max. 45 Hours

Course Outcomes

On completion of the course, student will be able to

CO1- Evaluate the various aspects of hospital administration, forecasting and decision making techniques in the health care systems

CO2- Describe the evolution of hospital and its various departments

CO3- Analyse the health system present in India

CO4- Apply planning methodologies for construction and maintenance of the Hospitals

CO 5- Appraise various health policies that are available in India

CO6- Develop a Master plan for construction and Maintenance of a Hospital

TEXT / REFERENCE BOOKS

1. HansPleiffveradamann(ed),Hospital Engineering in developing countries, GTZ report Eschborn,2006.
2. R.C.Goyal, Human Resource Management in Hospitals, PrenticeHallofIndia, NewDelhi, 2004.
3. M.A.George, The Hospital Administrator, Jaypee Publications, 2005.
4. SanskritiSharma, Essentials for Hospital Support Services and Physical Infrastructure, Jaypee Publications, 2008.

SBM5609	FIBER OPTICS & LASER FOR BIOMEDICAL APPLICATIONS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- This course introduces fundamental physical principles of both classical and modern optics as well as principles of optical design used in the engineering of optical systems.
- Its intention is to provide a foundation of basic principles, design methodology, and practical considerations needed to design or use optical instruments in the biomedical engineering practice.

UNIT 1 INTRODUCTION

9 Hrs.

Principles of light propagation through a fiber-fiber material-construction details of optical fiber-types of fibers - Absorption losses - Scattering losses - Dispersion

UNIT 2 OPTICAL SOURCES, DETECTORS, FIBER COUPLERS & CONNECTORS 9 Hrs.

Optical Sources and Detectors: Introduction, LED's, LASER diodes, Photodetectors-PIN photodiode, avalanche photo diode. Fiber Couplers and Connectors: Introduction, fiber alignment and joint loss, fiber splices, fiber connectors and fiber couplers-T-coupler, star coupler

UNIT 3 LASER CHARACTERISTICS & LASER IN BIOLOGY

9 Hrs.

Laser Characteristics: Single frequency operation, coherence of laser, spatial distribution, intensity of laser emission, polarization of laser emission, measurement of pulsed laser energy. Laser in Biology: Optical properties of tissue, Pathology of laser reaction in skin, thermal effects, laser irradiation, Nonthermal reactions of laser energy in tissue.

UNIT 4 LASER INSTRUMENTATION

9 Hrs.

Surgical instrumentation of CO₂, Ruby, Nd-YAG, He-Ne, Argon ion, Q-switched operations, continuous wave, Quasi-continuous, surgical applications of these lasers

UNIT 5 HOLOGRAM AND MEDICAL APPLICATIONS

9 Hrs.

Holography - Basic principle - Methods - Holographic interferometry and application, Holography for non-destructive testing - Holographic components - Medical applications of lasers- Dermatology, dentistry, ophthalmology.

Max. 45 Hours

Course Outcomes

On completion of the course, student will be able to

- CO1 - Explain the propagation of light and principles of optical fibers
- CO2 - Analyse various types of sources and detectors used in LASER applications
- CO3 - Understand the basic concepts of optical properties and their interaction with the tissues
- CO4 - Acquire knowledge about the various kinds of Lasers used in medicine
- CO5 - Explore the Holographic and LASER techniques for medical applications
- CO6 - Identify the use of Lasers that can be used for specific medical application

TEXT / REFERENCE BOOKS

- G. Keiser, Optical Fiber Communication, McGraw Hill, 1995.
- M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, 2002.
- Leon Goldman, The Biomedical Laser Technology and Clinical Applications, Springer-Verlag, 1981.
- Leon Goldman, Lasers in Medicine, Springer-Verlag, 1982
- Monte Ross, Laser Applications, McGraw Hill, 1971.

SBM5610	MEDICAL ELECTRONICS AND E-HEALTH	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVES

- To close the gap between theoretical concepts and realistic industry/research applications in the field of medical electronics.
- To produce graduates who understand the concept of telemedicine and advanced telecommunications technology.
- To create develop theoretical and practical knowledge which will enable them to take leading roles within the emerging field of Health Informatics.

UNIT 1 CHEMICAL AND OPTICAL TRANSDUCERS

9 Hrs.

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

UNIT 2 DIGITAL BIOPOTENTIAL AMPLIFIER

9Hrs.

Basic Parameters of Biopotential Amplifier design; Half-cell potential, Reference electrodes, polarization effects, Polarisable and non polarisable electrodes, Micro electrodes, Equivalent Circuits Simplified recording of biopotential; Low-Polarization surface electrodes; Single ended biopotential amplifiers; Ultrahigh impedance electrode buffer arrays; Pastless biopotential electrodes.

UNIT 3 SIGNAL CONDITIONING AND MEDICAL SAFETY

9Hrs.

Signal Conditioning circuits- Characteristics of Amplifiers, Differential Amplifiers, Filters, Bridge circuits, A/D Converters. Medical Safety: Electromagnetic Interference Requirements; Transient Voltage protection; Sources of Conducted and radiated interference.

UNIT 4 TELEMEDICINE AND HEALTH

9Hrs.

History and Evolution of telemedicine, Functional diagram of telemedicine system, Tele health, Global and Indian scenario, Ethical and legal aspects of Telemedicine -Confidentiality, Social and legal issues, Safety and regulatory issues, Video conferencing Real -time Telemedicine integrating doctors / Hospitals. Administration of centralized medical data, security and confidentiality of medical records and access control, Cyber laws related to telemedicine.

UNIT 5 TELERADIOLOGY, HEALTH INFORMATICS AND APPLICATIONS

9Hrs.

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. Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine access to health education and self care.

Max. 45 Hours

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1- To remember the literature in the medical electronics and e-health field

CO2- Able to understand the important technological areas used in the medical field.

CO3- To apply the literature in the e-health field.

CO4- Analyze different eHealth applications as well as enablers and barriers for their

CO5- Explain the importance of context, health informatics standards and terminologies for the design of eHealth applications

CO6- Develop an eHealth strategies and discuss them in relation to medical electronics

TEXT/REFERENCE BOOKS:

1. Reinaldo Perez, Design of Medical Electronic Device, Elsevier Science, 1st Edition.
2. John G.Webster, Medical Instrumentation, Application and Design, Third Edition, John Willey and sons, 1999
3. Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
4. Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006

SCCA9501	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	*	2	2	100

UNIT1 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING 7 Hrs.

Establishment of smart biotechnology factory, Artificial intelligence in Bioprocess technology, Omics – Big data analysis through automation, 3D bio printing for tissue engineering. Simulation tools, RSM and Box model. Cyber physical system based telemedicine, diagnosis and therapeutics through real time biosensors. Bionanotechnology. Intellectual Property rights (IPR): Case Studies.

UNIT 2 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT 7 Hrs.

Introduction – Technological developments in Architectural, Engineering and Construction (AEC) - Building Information Modelling (BIM) using Cloud computing technology and Internet of things (IoT) – Unmanned Aerial Vehicles, sensors – Additive manufacturing in construction – Concrete 3D printing - Materials used - Lightweight and functionally graded structures - Net Zero Energy buildings, Bioswales, Biofiltration pond, Ecosan systems- Recent developments in Waste water Management, Air pollution control, waste disposal - Integration of energy, water and environmental systems for a sustainable development- Emerging Technologies: Robot Highway- Vertical farming - Intellectual Property rights: Case studies

UNIT 3 SMART MANUFACTURING 8 Hrs.

Smart factories and interconnection, Smart Manufacturing – automation systems, Additive Manufacturing, Smart grids, Micro Electro Mechanical Systems (MEMS), Stealth technology, Metal Finishing, Self propelled vehicles, e mobility, Green fuels, drones – unmanned aerial vehicles(UAVs), aerodynamics. Robotic Automation and Collaborative Robots – Augmented reality and haptics, engineering cybernetics and artificial intelligence (AI), Disruptive Technologies – Frugal Innovations –Emerging Technologies- Autonomous Robots, Swam Robot, Modular Robotics, Space craft, Intellectual Property Rights (IPR): Case Studies.

UNIT 4 SMART WORLD 8 Hrs.

Smart Sensors and IIOT, Smart grid, Hybrid renewable energy systems, Electronics in Smart city, Integration of Sensors in Robots and Artificial Intelligence, 5G Technology, Communication protocols, Human-Machine Interaction, Virtual Reality, Quantum Computing: Changing trends in transistor technology: Processor, Emerging Trends: Deep Space, Swarm Robots, Cyborg, Geofencing, Pervasive Computing, Intellectual Property Rights- Case Studies.

UNIT 5 CYBER PHYSICAL SYSTEMS 8 Hrs.

Introduction to Cyber Physical Systems (CPS), Architecture of CPS, Data science and technology for CPS, Prototypes of CPS, Emerging applications in CPS including social space, crowd sourcing, healthcare and human computer interactions, Industrial Artificial Intelligence, Deep Learning, Gamification, Networking systems for CPS applications, Wearable cyber physical systems and applications, Domain applications of CPS: Agriculture, Infrastructure, Disaster management, Energy, Transportation, Intellectual Property Rights (IPR) : Case Studies.

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

1. William D. Callister, "Materials Science and Engineering, An Introduction, John Willey and Sons Inc. Singapore, 2001.
2. V. Raghavan, "Physical Metallurgy: Principle and Practice, Prentice Hall India Pvt. Ltd, 2006.
3. Flavio Craveiro, Jose Pinto Duarte, Helena Bartolo and Paulo Jorge Bartolo, "Additive manufacturing as an enabling technology for digital construction: A perspective on Construction 4.0", Automation in Construction, Vol. 103, pp. 251-267, 2019.
3. Klaus Schwab, "Fourth Industrial Revolution", Random House USA Inc, New York, USA, 2017.
4. Oliver Grunow, "SMART FACTORY AND INDUSTRY 4.0. The current state of Application Technologies", Study lab Publications, 2016.
5. Alasdair Gilchrist, "INDUSTRY 4.0: Industrial Internet of Things", Apress, 2016.
6. Sang C. Suh, U. John Tanik, John N Carbone, Abdullah Eroglu, "Applied Cyber-Physical Systems", Springer Publications, New York, 2013.