



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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

www.sathyabama.ac.in

School of Bio and Chemical

Department of Biomedical Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

B.Tech. – Biomedical Engineering

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SBMA1403	BIOFLUIDS AND BIOMECHANICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To appreciate the role of physiological fluid mechanics in Biomedical Engineering and build an appreciation for the applications of engineering in biology and medicine.
- To apply different mathematical models to describe the behavior of non-Newtonian viscous fluids such as blood.

UNIT 1 BIOMECHANICS

9 Hrs.

Biomechanics- Definition and perspective, Fundamental Mechanical Concepts- Kinetics and Kinematics, Newton's Laws, Mechanical Properties -Stress, Strain, Elasticity, Shear, Tension, Compression, Plastic Deformation, Creep, and Fatigue. Mechanical testing of biomaterials-UTM- Basic Engineering mechanics, Force - Resolution of forces.

UNIT 2 FLUID MECHANICS

9 Hrs.

Viscosity-Definition, properties. Types of fluids- Newtonian fluid, Non- Newtonian fluid, Types of fluid flow. Hagen-Poiseuille's equation. Viscoelasticity-Viscoelastic Models, Vascular tree, Flow properties of Blood, Physical, Chemical and Rheological properties of blood, Apparent and Relative and viscosity, Fahraeus-Lindqvist Effect.

UNIT 3 HUMAN LOCOMOTION

9 Hrs.

Anthropometric Characteristics of human body. Types of motion in humans, Gait analysis. Goniometry. Accelerometer, Foot Pressure Measurements – Pedobarograph, Podiascan - Force platform. Mechanics of foot.

UNIT 4 HARD AND SOFT TISSUE MECHANICS

9 Hrs.

Biomechanics of upper extremities-Elbow, Shoulder. Biomechanics of lower extremities-Hip and Knee.-Tissue Mechanics- Mechanical Properties of Tissues, Biological materials, Properties of Cortical, Cancellous Bone. Soft Tissue properties Mechanical testing of Soft tissue.

UNIT 5 KINESIOLOGY OF SPORTS

9 Hrs.

Application of biomechanics to neuromuscular fitness, gymnastics, Application of aerodynamics in sports, hydrodynamics in swimming. Analysis of throw and push patterns. Sports Medicine.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Understands the principles of mechanics to the analysis of biological systems

CO2 - Remembers the engineering features of complex problems involving living

systems CO3 - Interrelates the appropriate problem-solving approach for biomechanical investigations

CO4 - Analyses and interpret raw data, e.g. motion analysis outputs and experimental flow

fields CO5 - Describes how mechanics plays a role in basic physiological processes in the

human body CO6 - Employs kinematic and kinetic principles to describe human

locomotion

TEXT / REFERENCE BOOKS

1. Susan J Hall, Basic Biomechanics, Mc Graw Hill, 5th Edition, 2006.
2. Fung, Y.G., Biomechanics, Springer-verlag, New York Inc., 2008.
3. Joseph Bronzino, Hand book of Biomedical Engineering, Springer, 2nd Edition, 2000.
4. Joseph Hamill and Kathleen M. Knutzen, Biomechanical Basis of Human Movement, Lippincott Williams & Wilkins, 3rd Edition, 2008, Philadelphia.
5. Duane Knudson, Fundamental of Biomechanics, Kluwer Academic/Plenum publishers, 2nd Edition, 2007, Chico, California.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

MaxMarks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

- Employability

SBMA1404	RADIO IMAGING AND THERAPEUTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- ☐ To provide the knowledge about the specialty of medicine in radiation therapy.
- ☐ To make the student understand about the application of imaging technology and effects of radiation.

UNIT 1 ELEMENTS OF RADIATION

9 Hrs.

Radioactive elements and Radioisotopes in medicine, Radioactivity, General properties of alpha, beta and gamma rays -Laws of radioactivity, Radioactive decay - alpha decay, beta decay, positron decay, decay energy and half-life. Radiation units-Roentgen, Rad - rem - sievert. Radiation sources - Natural and artificial radioactive sources.

UNIT 2 RADIATION GENERATORS

9 Hrs

Particle Accelerators- Cyclotron, Klystron, Magnetron, Cascade generator, Van De Graff generator X ray films, X ray film processing, X Ray cassettes, Intensifying screens-New phosphor technology, photostimulable phosphor imaging. collimators, grids - bucky grids, Body section radiography, Xeroradiography

UNIT 3 RADIO DIAGNOSIS

9 Hrs.

Fluoroscopy – Digital Fluoroscopy. Angiography, Cine Angiography, Digital subtraction Angiography. Mammography and Dental x-ray unit. Digital radiography, Angiography, Image intensifier, PET, SPECT,

UNIT 4 RADIOTHERAPY

9 Hrs.

COBALT-60, Linac, Gamma camera, Nuclear scintigraphy, Brachytherapy, Cyber Knife, Gamma knife, Intraoperative radiotherapy

UNIT 5 RADIATION SAFETY MEASURES

9 Hrs.

Radiation Protection, Protective barrier-primary& secondary, Equivalent Dose, Biological effects of radiation, Somatic & genetic effects of radiation-LD 50/30, Effect of radiation on skin, blood forming organs, Personnel and area monitoring systems, Radiation measuring devices -dosimeter, survey meter.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Understanding the elements of radiation and radioactive decay involved in radiation therapy.

CO2 - Illustrate the working principle of radiation generators with the processing of X ray machine and its application.

CO3 - Understanding the technique of fluoroscopy and various radio diagnosis techniques.

CO4 - Demonstrate the applications of radiotherapy.

CO5 - Attain the adequate knowledge about radiation measurements and effect of radiation on body.

CO6 - Outline the methods of radiation safety.

TEXT / REFERENCE BOOKS

1. Thomas S. Curry, III, James E. Dowdey, Robert C. Murry J R., Christensen The Physics of Diagnostic Radiology Lea &

Febiger, 6th Edition 2008.

2. Faiz M.Khan, The Physics of Radiation Therapy, 4th Edition, 2009.

3. Gopal,B.Saha , Physics & Radiology of nuclear medicine, Springer 2nd Edition, 2006.

4. Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw Hill Publishing Company Ltd., New Delhi and revised edition, 2007.

5. Thayalan K., Basic Radiological Physics, Jaypee Brothers Medical Publishers Pvt. Ltd., Revised Edition, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA1502	BIOMATERIALS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The course provides an intriguing insight in chemistry, engineering, biology and medicine that has a significant impact on biomaterials.
- It highlights the way in which modern biology and medicine is inextricably linked to scientific discipline and helping us to understand the complex world of biomaterials.

UNIT 1 INTRODUCTION AND METALS

9 Hrs.

Biomaterials - Overview, Classification of biomaterials, Interfacial Phenomena and tissue response to biomaterials, Metals and alloys for orthopedic implants-Stainless steel, Cobalt chromium alloy, Titanium and its alloys, Precious metal alloys, Other metal alloys. Dental implants - Endosseous Tooth Implants, materials, types and designs.

UNIT 2 POLYMERS AND APPLICATIONS

9 Hrs.

Polymers in biomedical use, biodegradable polymers, microorganisms in polymeric implants, Polymer Sterilization, Deterioration of polymers, Polyethylene, Poly Vinyl Chloride, Hydrogels, silicone rubber.

UNIT 3 BIOCERAMICS AND COMPOSITES

9 Hrs.

Bioceramics, types - bioactive resorbable, non - resorbable, bioceramic coatings on metallic implants and bone bonding reactions on implantation. Hydroxyapatite - properties and applications. Composites - Types and Applications, Bioglass.

UNIT 4 REPLACEMENT AND FIXATION DEVICES

9 Hrs.

Bioelectric effect, Wolff's Law, Types of orthopedic fixation devices-pins, screws and plates, Intra Medullary and spinal nails. Interface Problems with artificial joints and various fixation methods, hard tissue replacements - total hip and knee joint replacements. Soft Tissue replacements- Sutures -Tapes, Staples, Adhesives. Maxillofacial Implants.

UNIT 5 OPHTHALMOLOGY

9 Hrs

Ophthalmology- Introduction, Contact lenses, Eye shields, Viscoelastic solutions, Vitreous implants, Acrylate adhesives, Scleral buckling materials for retinal detachment, artificial tears. Corrosion, Biocompatibility and Hemocompatibility, Biological Tests. Material surface characterization, 3D characterization.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Identify different types of biomaterials used for various applications.
- CO2 - Understand the hard tissue replacement and soft tissue replacement for various fixations.
- CO3 - Recognize various polymers, ceramics and composite used as biomaterials for organ replacement.
- CO4 - Acquire knowledge about how to rectify eye defect using various biomaterials.
- CO5 - Apply suitable methods to test Biocompatibility and Hemocompatibility of biomaterials.
- CO6 - Implement various characterization methods to identify biomaterials.

TEXT / REFERENCE BOOKS

1. Sujata V.Bhat, Biomaterials, Narosa Publishing House, New Delhi, 2002.
2. Rolando Barbucci, Integrated Biomaterials Science, Plenum Publishers, New York, 2002.
3. Von Recum A.F., Handbook of Biomaterials Evaluation-Scientific, Technical and Clinical Testing of Implant Materials, 1998.
4. Joseph D Bronzino, The Biomedical Engineering Hand Book, Vol.11, CRC Press, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA1503	DIAGNOSTIC INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain in depth knowledge about instruments employed for disease diagnosis.
- To provide complete exposure of various recording mechanism and to understand the basic principles and working of biomedical instruments.

UNIT 1 INTRODUCTION AND GENERAL PURPOSE EQUIPMENT

9 Hrs.

Basic Measurement system, Types of Biomedical equipment,, Basic Audiometer – Bekesy audiometer, Pure tone & speech, Conventional hearing aids, BERA Test, Basic Spirometry. Auto Refractometer, Keratometer, Retinoscope, Tonometers.

UNIT 2 BIOMEDICAL RECORDER

9 Hrs.

ECG-Lead configuration-Instrumentation set-up - effects of artifacts. IECG, EEG-10-20 Electrodes configuration - Instrumentation - recording of Evoked potentials, EMG - Measurement of nerve conduction velocity. ERG, EOG, EGG, PCG, TMT and Holter Monitors.

UNIT 3 IMAGING EQUIPMENTS

9 Hrs.

X-Ray machine, CT - Scanning system, processing unit, viewing part & storage unit. MRI - The magnet, RF transmitter system, Gradient system, imager system, Advantages. Ultrasonic imaging systems - A Scan, B Scan, TM Mode Scan, Echocardiography, Biomedical Applications Thermographic Equipment.

UNIT 4 FLOW METERS & PSYCOPHYSIOLOGICAL SYSTEMS

9 Hrs.

Flow meters and CO Measurement, Electromagnetic flow meters, Ultrasonic Blood flow meters, Laser Doppler Blood flow meters,, Indicator Dilution method, Dye dilution method, Thermal dilution method. Polygraph GSR Measurement, Sensory and motor measurement, Plethysmography.

UNIT 5 PATIENT MONITORING SYSTEMS

9 Hrs.

BP measurement - Direct and indirect method, pulse rate analysis, temperature measurement, Respiration Rate, Apnoea Monitors, Central monitoring system. Endoscopy, Capusule Endoscopy, Laparoscopy, Oximetry, Foetal monitors, Cardiotocograph.

Max. 45 Hrs.

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 - Understand and discuss about the various image acquisition machines.
- CO3 - Compare the different flowmeters and dilution methods and discuss about sensory instrumentation.
- CO4 - Discuss about the instruments associated with patient monitoring and its need in health care.
- CO5 - Analyze the performance of instruments related to hearing and vision.
- CO6 - Apply the knowledge acquired to design diverse diagnostic equipment.

TEXT / REFERENCE BOOKS

1. Khandpur R.S., Hand Book of Biomedical instrumentation, Tata McGraw Hill Publication, 2014.
2. John G. Webster, Medical Instrumentation, John Wiley & Sons, 2007.
3. Cromwell, Biomedical Instrumentation & Measurements Prentice Hall of India Private Limited, 2011.
4. Carr & Brown, Introduction to Biomedical Equipment Technology, 2001.
5. Ananda Natarajan R., Biomedical Instrumentation & Measurements, PHI Publication, 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA1601	THERAPEUTIC INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gather adequate knowledge about treatment of various physiological ailments.
- To understand the fundamental principles and working of the biomedical instruments involved in the therapy.

UNIT 1 INSTRUMENTS FOR CARDIOLOGY

9 Hrs.

Cardiac Pacemakers – Evolution of pacemakers, Need for Cardiac Pacemaker - External Pacemakers - implantable Pacemakers - Recent Developments in Pacemakers, Pacemaker analyzer. Cardiac Ablation Catheter, Cardiac Defibrillators -Need for a Defibrillator - DC Defibrillator – Automatic Implantable Defibrillators(AID) - Pacer-cardioverter - defibrillator analysers, LVAD.

UNIT 2 DIATHERMY AND ELECTROTHERAPY EQUIPMENT

9 Hrs.

Surgical diathermy machine – Principle – Working Hazards and safety aspects in ESU. High frequency heat therapy - Short wave Diathermy - Microwave diathermy - Ultrasonic diathermy - TENS – Interferential Current Therapy - Bladder Stimulators - DBS.

UNIT 3 EXTRACORPOREAL UNITS

9 Hrs

Haemodialysis Machines - Artificial Kidney - Dialyzers - Membranes , Peritoneal Dialysis -Portable Kidney machines. Lithotripters – First and modern lithotripter systems - Extracorporeal Shockwave Therapy, Heart Lung Machine – Oxygenators-Pumps.

UNIT 4 PULMONARY ASSIST INSTRUMENTS

9 Hrs.

Anesthesia Machine –Components - Electronics in Anesthesia machine. Ventilators – Types and classification- Modern microprocessor based ventilators, HF Ventilators, Humidifiers - Nebulizers and Aspirators

UNIT 5 DRUG DELIVERY AND NEONATAL SYSTEMS

9 Hrs.

Infusion Pumps- Components- Implantable infusion pumps -Insulin Pumps- Syringe Pumps. Incubators-Radiant Warmer – Phototherapy Units.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Apply the knowledge acquired to design a pacemaker and defibrillator
- CO2 - Describe about diathermy devices used for surgery and physiotherapy.
- CO3 - Assist perfusionists during dialysis and surgeries.
- CO4 - Compare the ventilator working mechanism in anesthesia machines.
- CO5 - Suggest instruments for drug delivery and neonatal care.
- CO6 - Design various therapeutic devices based on the applications learned.

TEXT / REFERENCE BOOKS

1. Khandpur R.S., Handbook of biomedical Instrumentation, Tata McGraw Hill Publication company Ltd, New Delhi, 2014.
2. Joseph J. Carr, John Michael Brown, Introduction to Biomedical Equipment Technology, 4th Edition, Pearson Education, 2012.
3. John G. Webster, Biomedical Instrumentation, Wiley Publications, 2007.
4. Geddes L.A. and L.E.Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA1603	MEDICAL IMAGE PROCESSING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To acquire knowledge about the various medical imaging techniques.
- To understand the fundamental principle and working of the medical imaging systems involved in the diagnosis of health care.

UNIT 1 IMAGE FUNDAMENTALS

9 Hrs.

Introduction - Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Zooming and Shrinking of digital images - Relationships between pixels - color models

UNIT 2 IMAGE ENHANCEMENT

9 Hrs.

Enhancement by point processing - Gray level transformations - Histogram processing - Image subtraction - Image averaging. Basics of Spatial Filtering - Smoothing and Sharpening Spatial Filtering, Enhancements in Frequency Domain - low pass filtering - High pass filtering. 2D DFT and their properties.

UNIT 3 IMAGE RESTORATION

9 Hrs.

Model Image Restoration - degradation model, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT 4 IMAGE SEGMENTATION

9 Hrs.

Edge and Line Detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT 5 IMAGE COMPRESSION AND RECOGNITION

9 Hrs.

Fundamentals, Image compression models, Huffman, Run Length Encoding, Arithmetic coding, Lossless Predictive Coding and Lossy Predictive Coding, Boundary representation, Boundary descriptors - Fourier Descriptor, Regional Descriptors – Topological feature, Texture, Patterns and Pattern classes - Recognition based on matching.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understands the fundamental concepts of digital image processing
- CO2 - Demonstrates the suitable technique for accomplishing image preprocessing task
- CO3 - Explains the restoration process and filtering techniques
- CO4 - Illustrate the steps involved in segmentation process
- CO5 - Analyze the performance of image compression and recognition methods
- CO6 - Assess the impact of digital image processing for medical application

TEXT / REFERENCE BOOKS

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2010.
2. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using Matlab", 3rd Edition Tata McGraw Hill Pvt. Ltd., 2011.
3. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
4. William K. Pratt, "Introduction to Digital Image Processing", CRC Press, 2013.
5. Jayaraman, "Digital Image Processing", Tata McGraw Hill Education, 2011.
6. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", 1st Edition, PHI Learning Pvt. Ltd., 2011.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

MaxMarks:100

Exam Duration: 3 Hrs

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA3001	MEDICAL EQUIPMENT MAINTENANCE AND TROUBLESHOOTING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand and learn the troubleshooting of instruments used for diagnosis and therapy.
- Learn how to maintain the overall working of equipment.

UNIT 1 INTRODUCTION

9 Hrs.

Testing of electrical equipments: AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating - Testing of circuit breakers – Transformer testing- Earthing – Earth wires - Earthing of appliances – contactor, relay testing–CT and PT, Panel wiring- Megger-Testing equipments and instruments.

UNIT 2 TESTING AND TROUBLESHOOTING

9 Hrs.

Testing of electronic components: Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse.

UNIT 3 TESTING OF MEDICAL EQUIPMENT

9 Hrs.

Testing of surgical Equipment: Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

UNIT 4 TROUBLESHOOTING OF MEDICAL EQUIPMENT

9 Hrs.

Troubleshooting of equipments: X-ray machines, Troubleshooting of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, and quality and safety standards.

UNIT 5 MAINTENANCE MANAGEMENT

9 Hrs.

Life cycle management of medical equipment: Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle. Case study.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Identify major reasons for equipment failure.
- CO2 - Compare general testing and troubleshooting of equipment.
- CO3 - Understand testing of OT instruments
- CO4 - Discuss about the troubleshooting of medical equipment and safety standards.
- CO5 - Analyze the management issues pertaining to medical instruments.
- CO6 - Apply the tools in design, testing and developing medical equipment

TEXT / REFERENCE BOOKS

1. Shakti Chatterjee, Aubert Miller, "Biomedical Equipment Repair", Cengage Learning Technology & Engineering, 2010.
2. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment", McGrawHill Professional, 2013.
3. Rao S, "Testing, Commissioning, Operation and Maintenance of Electrical Equipment", Khanna Publishers, New Delhi, 2014.
4. Francis Hegarty, John Amore, "Health care technology management – A systematic approach", CRC Press, USA, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

 - Employability

SBMA3010	TELEHEALTH TECHNOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enable the student to understand the scope and benefits of telemedicine using communication networks and their protocols.
- To learn about new healthcare needs through the applications of telemedicine.

UNIT 1 INTRODUCTION

9 Hrs.

Fundamentals of Telemedicine, Block diagram of Telemedicine, History of telemedicine: Main phases of Telemedicine, Pre electronic Telemedicine, Electronic Telemedicine, Tele-healthcare and E-medicine, Telemedicine access to health care services, Scope & Benefits and Limitation of Telemedicine.

UNIT 2 COMMUNICATION AND NETWORK

9 Hrs.

Types of information: Audio, Video, Data, Fax, Still Image. Types of Communication and Networks: Overview of PSTN, POTS, ISDN, ATM, Videoconferencing, Wireless Communication – RF, GSM Satellite and Microwave, CDPD, Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www)-Video and audio conferencing

UNIT 3 DATA EXCHANGE AND NETWORK SECURITY

9 Hrs.

Basic concepts of internet, Network Configuration, Circuit and Packet Switching, H.320 series, h.324 Protocols: TCP/IP, Standards for DICOM, Security: Encryption – DES, RSA, and Cryptography.

UNIT 4 ETHICAL AND LEGAL ASPECTS AND CASE STUDIES

9 Hrs.

Confidentiality and law, Patient Right and consent, Access to medical Records, Consent treatment, jurisdictional issues, Intellectual Property Rights, Telemedicine technology and Health care delivery for rural population - Use of telemedicine technology for clinical diagnostic study - Conceptual frame work on home telemedicine

UNIT 5 APPLICATIONS OF TELEMEDICINE

9 Hrs.

Teleradiography – Basic parts of a Teleradiography System, Telepathology, Telecytology, Telecardiology, Telehome – Care Home based Applications, Teleoncology, Telesurgery, Telepsychiatry, Teledermatology, Telepediatrics, Telepharmacy.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understands the basics of telemedicine and its application in healthcare.
- CO2 - Classify the various standards and protocols related to telemedicine.
- CO3 - Discuss about protocols and security for transfer of tele medicine data.
- CO4 - Understand and apply the ethical and legal issues in telemedicine.
- CO5 - Explores the application of telehealth to modalities of medicine.
- CO6 - Compares the telehealth technologies for future challenges arising in our community.

TEXT / REFERENCE BOOKS

- 1 Olga , Ferrer – Roca, M. Sosa, Marcelo C, Handbook of Telemedicine, IOS press 2002.
- 2 Ling Guan, Multimedia image and video processing, CRC Press, 2000.
- 3 Thorsten M Buzug, Heinz Handels, Dietrich Holz, Telemedicine: Medicine and communication, Springer Verlag 2001.
- 4 Douglas V Goldstein, E Healthcare: Harness the power of internet, e – commerce and e – care, Jones and Barlett Publishers. 2000.
- 5 Norris A.C., Essentials of Telemedicine and Telecare, John Wiley & Sons, 2002.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

 - Employability

SBMA3011	REHABILITATION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To develop assistive devices, prosthetics and orthotics for the disabled.
- To provide the basic concept so that the students can implement their knowledge for developing innovative and effective rehabilitation and assistive technologies.

UNIT 1 INTRODUCTION TO REHABILITATION

9 Hrs.

Introduction, Concepts of rehabilitation engineering, Principles of Rehabilitation Engineering - Key Engineering Principles - Key Ergonomic Principles, Principles of Assistive Technology Assessment, Rehabilitation Team.

UNIT 2 ORTHOTICS & ORTHOPROSTHETICS

9 Hrs.

Orthopedic prosthetics and orthotics in Rehabilitation Fundamentals, Applications: Computer Aided Engineering in customized component design. Intelligent prosthetic knee and hand. A self-aligning orthotic knee joint. FES System: Restoration of hand function; restoration of standing and walking. Body Powered Prosthetics, Hybrid Assistive systems (HAS) Active prostheses. Active Above knee Prosthesis. Myoelectric hand and arm prostheses. Orthotics - FO, AFO, TLSO, LSO

UNIT 3 WHEELED MOBILITY

9 Hrs.

History and Categories of Wheelchairs. Wheelchair Structure and Component Design. Ergonomics of wheel chair propulsion. Power Wheelchair Electrical System. Personal transportation. Tricycles, Lift mechanism in ambulance

UNIT 4 SENSORY AUGMENTATION AND SUBSTITUTION

9 Hrs.

Visual System: Visual augmentation. Tactual vision substitution. Auditory vision substitution: Auditory System: Auditory augmentation. Cochlear implants. Visual auditory substitution. Tactual auditory substitution. Tactual system: Tactual augmentation. Tactual substitution. Alternative and Augmentative communication, User Interface: Outputs: Acceleration Techniques, HAAT model.

UNIT 5 ADVANCED APPLICATIONS IN REHABILITATION ENGINEERING

9 Hrs.

Computer - assisted lip reading, Brain - computer interface, Haptic devices for rehabilitation, Robotic Rehabilitation, Visual Aids, Hearing Aids, Writing Aids Electronic Travel Applications (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Nottingham Obstacle Sensor, Polarized Ultrasonic Travel Aid.

Max. 45 Hs.

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

- CO1 - Apply the various principles involved in rehabilitation.
- CO2 - Support rehab engineers in designing orthotic and prosthetic devices.
- CO3 - Compare the types of wheelchairs and assist disabled persons.
- CO4 - Discover new augmentation and substitution devices for visual and hearing impaired.
- CO5 - Assess the merits of support aids designed for the disabled.
- CO6 - Develop and design rehabilitation devices cost effectively and purposefully.

TEXT / REFERENCE BOOKS

1. Bronzino J.D., The Biomedical Engineering Hand Book, Volume 1, Academic Press, 2000.
2. Textbook of rehabilitation, Sunder, Jaypee Publications, 2010.
3. Handbook of Physical Medicine & Rehabilitation, W.B.Saunders Publication, 2003.
4. Marion A. Hersh, "Assistive Technology for Visually Impaired and Blind People", CRC Press, 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

- Employability

SBMA3012	MEDICAL ROBOTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To expose the students to the field of medical (surgical and oncology) robotics.
- To understand the design aspects of medical robots.

UNIT 1 INTRODUCTION

9 Hrs

Definition and origin of robotics, Different types of robotics, various generations of robots, Asimov's law's of robotics. Degrees of freedom – dynamic stabilization of robots Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics

UNIT 2 SENSORS AND TRACKING

9 Hrs

Localization And Tracking - Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems - Hybrid systems, Basic control concepts -impedance, admittance

UNIT 3 SURGERY AND IMAGING

9 Hrs

Minimally Invasive Surgery (MIS), Human-machine interfaces, Robot design concepts, Video images in MIS, Augmented reality Image-Guided Interventions, Robot compatibility with medical imagers(e.g., MRI, US, X-ray, CT), Image segmentation and modeling, Tracking devices, Surgical navigation, Calibration

UNIT 4 APPLICATIONS

9 Hrs

Applications in Biomedical Engineering – Bio Engineering Biologically Inspired Robots, Neural Engineering, Application in Rehabilitation – Interactive Therapy, Bionic Arm, Clinical and Surgical – Gynaecology, Orthopaedics, Neurosurgery. Physically assistive robotics, Socially assistive robotics, Rehabilitation robotics

UNIT 5 CASE STUDIES

9 Hrs

Cardiac, abdominal, and urologic procedures with tele-operated robots, Robotic catheters for heart electrophysiology, Orthopedic surgery with cooperative robots, Prostate interventions with manual "robots" Mobile robots in the body, Instrument-tissue interaction modeling

Max 45 Hours

Course Outcomes:\

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

CO1: Describe the types of medical robots and the concepts of navigation and motion replication.

CO2: Discuss about the sensors used for localization and tracking

CO3: Summarize the applications of surgical robotics

CO4: Classify the types of assistive robots

CO5: Apply robotics to healthcare field.

CO6: Analyze the design characteristics, methodology and technological choices for medical robots.

TEXT / REFERENCE BOOKS

- 1 Thomas Bräunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, Third Edition, Springer-Verlag Berlin Heidelberg, 2008.
2. Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.
3. Daniel Faust, "Medical Robots", Rosen Publishers, 2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 questions of 2 marks each - No choice

PART B : 2 questions from each unit of internal choice; each carrying 16 marks

Exam Duration : 3 Hrs.

20 Marks

80 Marks

SBMA3013	Wearable Systems for Healthcare	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Objectives:

1. To impart the importance of smart sensors, sensor interface standards for wearable device applications
2. Identify the need for development of wearable devices and its implications on various sectors.
3. Comprehend the design and development of various wearable bioelectrode and physiological activity monitoring devices for use in healthcare applications.

Unit 1 Sensors for wearable systems

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Radiant thermal sensor, Wearable motion sensors, Wearable biochemical Sensors, Wearable gas sensors.

Unit 2 Signal Processing and Energy Harvesting

Wearability issues -physical shape and placement of sensor, technical challenges – sensor design, signal acquisition, lightweight signal processing, Rejection of irrelevant information, Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests.

Unit 3 Scope of Wearable Devices

Role of Wearables, Attributes of Wearables, The Meta Wearables – Textiles and clothing, Social Aspects: Interpretation of Aesthetics, Adoption of Innovation, On-Body Interaction; Wearables: Challenges and Opportunities, Future and Research Roadmap.

Unit 4 Wireless Health Systems

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.

Unit 5 Wearable Devices for Healthcare

Wearable ECG devices, Wearable EEG devices, Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement – wearable surface electrodes, Smart textile for neurological rehabilitation system (NRS), Wearable Blood Pressure (BP) Measurement: Cuff-Based Sphygmomanometer, Cuffless Blood Pressure Monitor, Wearable sensors for Body Temperature: Intermittent and Continuous temperature monitoring.

Course Outcomes:

1. Discuss and analyse the usage of various biochemical and gas sensors as wearable devices.
2. Identify the technical challenges for signal processing and Energy Harvesting.
3. Describe the scope of the wearable devices and its design constraints for measuring physical and biological signals.
4. Design and develop various wearable device for detection of physiological body signals, blood pressure and body temperature for use in healthcare applications.
5. Acquaint the usage of wearable devices as assistive devices, diagnostic devices and other modern applications.
6. Able to design and perform experiments on the sensors and develop the projects based on the customer needs.

References:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.
3. Toshiyo Tamura and Wenxi Chen, "Seamless Healthcare Monitoring", Springer 2018
4. Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 10 questions of 2 marks each - No choice

PART B : 2 questions from each unit of internal choice; each carrying 16 marks

Exam Duration : 3 Hrs.

20 Marks

80 Marks

SBAA4004	VENTURE CREATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

Course Learning Objectives:

1. To develop an entrepreneurial mindset, understand the concept of entrepreneurship and identify personal strengths and weaknesses
2. To understand the design thinking process and apply design thinking to real-world problems
3. To identify problems and opportunities and develop ideas for new ventures by assessing market potential
4. To develop a value proposition, business model canvas, build MVP to create sustainable differentiation for the venture with a well-structured business plan, unit economics, go-to-market strategies and funding plan for managing business growth
5. To build an idea pitch and deliver it with confidence to potential stakeholders

Course Contents

Unit	Unit title	Descriptors
Unit 1	Introduction to Entrepreneurship	Defining Entrepreneurship, evolution the concept & Emerging Trends in Entrepreneurship (Domain specific), Understanding the unique opportunities
		Why be an Entrepreneur?
		Entrepreneurship in Indian Scenario & Its role in economic development
		Success stories of Entrepreneur (Domain specific)
		Entrepreneurial style assessment tool
		Developing the Entrepreneurial mindset- Attributes & skills, recognizing your sweet spot for starting up
		Principles of Effectuation
		Myths about Entrepreneurship
		Types of Entrepreneurs
		Entrepreneur vs Intrapreneur
		Role of Entrepreneurial Teams
Unit 2	Design Thinking & Opportunity Discovery	Introduction to Design Thinking for startups
		Design Thinking principles & process
		Define the problem using Design thinking principles and validate Problem
		Generation of ideas, Idea generation techniques and evaluating creative ideas
		Identify problem worth solving
		Sharpen your Problem Pitch
Unit 3	Customer, Markets and creating a sustainable differentiation	Differentiate between a customer and a consumer
		Who is your customer and what is your segment
		Customer Job, Pains, and Gains using Value proposition Canvas
		Build solution using Value Proposition Canvas
		Market Estimation-TAM,SAM,SOM
		Competitive analysis
		Minimum viable product – what is MVP: Build - Measure - Learn, differentiate between solution Demo & MVP
		How to validate MVP- Achieve a Product – Market fit
Unit 4	Business Model,	Introduction to Business model, Business plan

	Business Planning and Go to Market strategies	Lean approach 9 block lean canvas model
		Financial feasibility: Costs, revenue streams, Pricing, Financial Projections, Key Financial Metrics using financial template, Managing growth & targeting scale, Unit economics
		Selecting the Right Channel
		Introduction to Digital Marketing and tools
		Branding strategy
Unit 5	Funding strategy	Sources of funds: Debt & Equity
		Map the Start-up Lifecycle to Funding Options
		Build an Investor ready pitch deck

Assessment

Assessment	Internal evaluation	External examination
Weightages	50%	50%

Internal Assessment CAE1,2

External Assessment

Component 1	Component 2	
Milestone 1 & 2	Milestone 3 & 4	Pitch presentation
20 marks	20 marks	10 marks

Note :

- Internal evaluation will be based on Milestone deck submission in the LMS NextGen Platform provided by Wadhwani Foundation and presentation.
- The students form venture teams and work with their venture idea. This practice venture will converge to a Milestone, a pitch deck presentation created by students in the templates provided as part of the Ignite program.

External Examination

- Written examination for 50 marks on the Ignite program content.

Teaching Learning Process (Pedagogy)

The program is driven by facilitator with top-notch curated material, real life examples and case studies, access to experts and mentors, masterclasses and expert webinars. The Ignite program is hosted in the LMS NextGen Platform provided by Wadhwani Foundation. The program helps students to build practice ventures with the help of milestone deck to gain global jury certification. Students successfully completing the course will get an opportunity to get their milestone deck evaluated by team of global jury. On qualifying the global jury based on rubric assessment the student venture team gains a global jury certification from Wadhwani Foundation.

Course Learning Outcome:

Upon completion of the course, students will be able

- To define entrepreneurship and explain emerging trends in entrepreneurship
- To identify and evaluate business opportunities and assess market potential
- To conduct customer discovery, market research, build a lean canvas, develop a business plan and marketing strategies
- To identify sources of funding and develop a funding strategy, understand basic legal requirement for starting and running a business
- To build an idea pitch and deliver it with confidence to various stakeholders

References

- Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2017). Entrepreneurship (10th ed.). McGraw-Hill Education.

2. Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Crown Business.
3. Blank, S. G., & Dorf, B. (2012). *The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company*. K&S Ranch.
4. Roy, R. (2017). *Indian Entrepreneurship: Theory and Practice*. New Delhi: Oxford University Press.
5. Chandan, J. S., & Rana, S. S. (2019). *Entrepreneurship Development and Management*. New Delhi: McGraw Hill Education.
6. Sinek, S. (2011). *Start with Why: How Great Leaders Inspire Everyone to Take Action*. Portfolio.
7. Choudhary, R., & Mehta, N. (2019). *From Zero to One: How to Build a Successful Startup in India*. Notion Press.
8. Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. John Wiley & Sons.
9. Mitra, P., & Banerjee, A. (2019). *Startup Minds: The Entrepreneur's Journey from Idea to Success*. SAGE Publications India.
10. Thiel, P. (2014). *Zero to One: Notes on Startups, or How to Build the Future*. Crown Business.
11. Zappos, T. (2010). *Delivering Happiness: A Path to Profits, Passion, and Purpose*. Business Plus.

SBMA1102	PRINCIPLES OF BIOMEDICAL ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand the basics of biomedical engineering in healthcare.
- To gain knowledge in the various fields of biomedical engineering.

UNIT 1 INTRODUCTION

9 Hrs.

Evolution of modern health care system, Engineering in modern medicine, Role of Biomedical Engineering, Roles played by Biomedical Engineers, Professional status of Biomedical Engineering, History of Biomedical Devices

UNIT 2 BIOLOGY AND ENGINEERING

9 Hrs.

Characteristics of human anatomy and physiology related to biomedical devices, Engineering of immunity and pathology, Communication systems in the body and its connection to biomedical engineering.

UNIT 3 ELECTRONICS AND MEDICINE

9 Hrs.

Medical Electronics, Basis of Bioelectric potential Bio potential electrodes, Biomedical amplifiers, Characteristics of recording systems, Computer applications in medicine, Design of electromedical equipment

UNIT 4 CLINICAL ENGINEERING

9 Hrs.

Evolution of clinical engineering, Clinical engineer Vs Biomedical engineer, Role of clinical engineers, Good clinical practice, Major functions of a clinical engineering department, Standards for clinical engineering

UNIT 5 RESEARCH IN BIOMEDICAL

9 Hrs.

Medical devices and Robotics, Biofabrication and Biomanufacturing, Biomedical Imaging, Biomolecular Science and Engineering, Musculoskeletal Biomechanics and Mechanobiology, Systems Biology, Tissue Engineering, Rehabilitation Engineering, Biomaterials and Nanotechnology, Neural Engineering- Case Studies.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Understand his/her role as a biomedical engineer.
- CO2 - Interpret the application of biology in engineering.
- CO3 - Assimilate the role of electronics in medicine.
- CO4 - Examine his/her responsibility as a clinical engineer.
- CO5 - Apply his/her knowledge to research in different areas of biomedical engineering
- CO6 - Implement the knowledge gained in understanding the concepts better in forthcoming semesters

TEXT / REFERENCE BOOKS

1. C.Raja Rao, Sujoy K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press, 2001.
2. W. Mark Saltzman, Biomedical Engineering: Bridging Medicine and Technology, Cambridge University Press, 2015.
3. Sundararajan V. Madihally, Principles of Biomedical Engineering, Artech House Publishers, 2010.
4. Azzam F.G. Taktak, Paul Ganney, David Long, Clinical Engineering: A Handbook for Clinical and Biomedical Engineers, Elsevier, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SCHA4005	INDUSTRY 4.0 FOR BIO-CHEMICAL ENGINEERS <u>PROJECT BASED LEARNING APPROACH</u>	L	T	P	C	Max. Marks
		1	0	2	2	100

COURSE OBJECTIVE:

- To demonstrate the achievement of efficient and economically viable production without being hazardous to human health and environment. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

UNIT 1: MODELLING AND SIMULATION

6 Hours

Introduction to Industry 4.0 - The Various Industrial Revolutions - Modeling Principles: Introduction, definition of modeling and simulation, different types of models, application of mathematical modeling.

Simulation: Introduction, Simulation Tools, Process Simulation Software Platforms and Applications, Trends in Process Simulation Engineering

UNIT 2: SMART INDUSTRY

6 Hours

Road to Industry 4.0 - Green manufacturing, Robotic Automation, Industrial Applications- Manufacturing, Control, Maintenance and Assembly, RFID- Type, RFID system, applications, RFID in health care, Embedded Systems - Embedded firmware, Platform software design, Wireless design, Embedded testing, modeling & automation, Hardware platform design, Device Management, Monitoring – Industrial monitoring, condition monitoring, Health monitoring.

UNIT 3 BIG DATA ANALYTICS AS SERVICE PROVIDER

7 Hours

Technologies for enabling Industry 4.0 - Role of data, information, knowledge and collaboration in future organizations. Big Data - Background - Programming- Python and R - Git - Docker - Pipelines - DNA and RNA Sequencing - Massively parallel sequencing - Applications - Next Generation Sequencing and its future and big data analytics in healthcare - Big Data Repositories - Cloud platforms and computing for automation - Embedded systems in healthcare - Digitization the future of healthcare - medical cyber physical systems - Case study - Integration of Multi-Omics Big Data in Cardiovascular Risks and Diseases.

UNIT4 PLANT/PROCESS MANAGEMENT

6 Hours

Business issues in Industry 4.0 - Nanobiotechnology: Synthesis of different Nanostructures, Characterization of Nanostructures, Nanostructures in Diagnosis and Therapy. Tissue Engineering: Scaffolds: Natural and Artificial polymers, Scaffold fabrication, 3D Bioprinting; Bioreactors for Tissue Engineering: Effect of different Parameters, Conditions; Tissue engineering for Skin, Bone, Vasculature and Cornea; Regulatory framework in development and marketing tissue-based products.

UNIT 5 PROTOTYPING – TESTING AND COMMUNICATION

20 Hours

Applications and Case Studies - New ideas – centered design process – functional prototype - testing methods/ideas – prototyping and test beds – proof of concept – assembly – prototyping apps – addressing the complex problems.

Max.45 Hours

COURSE OUTCOMES:

- CO1. Articulate on the new age technologies in the modeling of biochemical engineering.
- CO2. Integrate different emerging technologies to evolve Smart Factories
- CO3. Deduce the components that lead to industrial digital revolution
- CO4. Ability to assess the developments in bioengineering.
- CO5. Criticize the professional and ethical issues in novel industrial technologies.
- CO6. Develop a prototype/ innovative ideas in the various fields of biochemical engineering.

- Entrepreneurship

TEXT / REFERENCE BOOKS

1. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and SMART Systems, 1st Editio, CRC Press, 2020
2. Sider W.D., Seader J. D., and Lewin D.R., Product and Process Design principles, Synthesis, Analysis and Evaluation, 2nd Edition, John Wiley and Sons, 2010.
3. Thomas Varghese & K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, Atlantic, 2012
4. Uthayan Elangovan, Smart Automation to Smart Manufacturing: Industrial Internet of Things, Momentum Pr, 1st Edition, 2019.

END SEMESTER EXAMINATION PATTERN

Max Marks: 100

PROJECT PRESENTATION

SCSA1102	FUNDAMENTALS OF PYTHON PROGRAMMING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To understand why Python is a useful scripting language for developers.
- To learn how to use lists, tuples, and dictionaries in Python programs.
- To learn how to build and package Python modules for reusability.
- To learn how to read and write files in Python.
- To learn how to use exception handling in Python applications for error handling.
- To learn how to design and program Python applications.

UNIT 1 INTRODUCTION

9 Hrs.

History of Python- Introduction to the IDLE interpreter (shell) -Expressions – Data Types - Built-in function - Conditional statements - Iterative statements- Input/output -Compound Data Types - Nested compound statements – Introduction to Object Oriented Concepts.

UNIT 2 FILES AND EXCEPTIONS HANDLING, MODULES, PACKAGES

9 Hrs.

File Operations – Iterators - Exception handling - Regular Expressions- Creating Modules-Import Statement-Introduction to PIP-Installing Packages via PIP-Using Python Packages

UNIT 3 GUI PROGRAMMING

9 Hrs.

GUI Programming in Python - Introduction to GUI library - Layout management - Events and bindings - Fonts – Colours - Canvas - Widgets (frame, label, button, check box, entry, listbox, message, radiobutton, text, spinbox).

UNIT 4 DATABASE AND NETWORK

9 Hrs.

Database (using NoSQL): Connector Module – Cursor – Statements - Exceptions in database. Network connectivity: Socket module - Client – Server – Email – URL Access

UNIT 5 CASE STUDY

9 Hrs.

Web Programming using Python, Image Processing – Facebook Analysis – Twitter Analysis.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Describe the Numbers, Math functions, Strings, List, Tuples and Dictionaries in Python.
- CO2 - Do the decision making and write functions in Python.
- CO3 - Explain how to design GUI Applications in Python and evaluate different database operations.
- CO4 - Design and develop Client Server network applications using Python.
- CO5 - Ability to design real life situational problems and think creatively about solutions of them.
- CO6 - Apply the best features of mathematics, engineering and natural sciences to program real life problems.

TEXT / REFERENCE BOOKS

1. Y. Daniel Liang, Introduction to Programming Using Python, Pearson, 2013.
2. Paul Gries, Jennifer Campbell, Jason Montojo, Practical Programming:
3. An Introduction to Computer Science Using Python 3, Pragmatic Bookshelf, 2nd Edition, 2014.
4. Magnus Lie Hetland, Beginning Python: From Novice to Professional, Apress.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA1402	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES

- This course will introduce the basic concepts and techniques for processing signals on a computer.
- By the end of the course, the student will be familiar with the most important methods in DSP, including digital filter design, transform-domain processing.

UNIT 1 INTRODUCTION TO DISCRETE TIME SIGNALS AND SYSTEMS

9 Hrs.

Representations - Classification of DT Signals & DT Systems - Concepts of Signal processing - Advantages of digital signal processing compared with analog processing - Typical applications - Analysis of DT-LTI Systems - Z- Transform and its properties - Inverse Z-Transform - Long division method - Partial fraction method - Residue or Contour integration method - Convolution method.

UNIT 2 FREQUENCY ANALYSIS OF SIGNALS

9 Hrs.

Discrete Fourier Transform and its properties - Relationship of the DFT to other transforms - General computation of DFT - convolution - Linear convolution, Circular convolution - Introduction to Fast Fourier Transform - Radix-2 FFT algorithms - Decimation in time (DIT), Decimation in Frequency (DIF) algorithms.

UNIT 3 DIGITAL FILTER DESIGNING

9 Hrs.

Introduction - Frequency selective filters - Digital versus Analog filters - Advantages & disadvantages of digital filters - Butterworth and Chebyshev Filters - Frequency Transformation in analog & Digital domain - Designing of FIR Filters - Fourier series method of designing FIR filters - Design of FIR filters using windows - Rectangular window - Hamming Window - Hanning Window functions

UNIT 4 BIOSIGNAL DETECTION AND COMPRESSION

9 Hrs.

QRS detection methods-Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms. Automated ECG analysis. Data compression techniques: Data reduction algorithms- Lossy and Lossless types, Turning Point algorithm, AZTEC, CORTES.

UNIT 5 BIOSIGNAL ANALYSIS USING WAVELETS

9 Hrs.

Wavelets in Medicine: Need for wavelets, Types of wavelets, Selection of a wavelet for an application, Decomposition and reconstruction of signals using wavelets, Denoising using wavelets, Typical medical applications.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understand the basics of discrete time signals and systems.
- CO2 - Acquire knowledge to process the signals on a computer.
- CO3 - Apply the acquired knowledge to process the biosignals on a computer.
- CO4 - Analyse the various signals using different detection and compression techniques.
- CO5 - Investigate the results of various compressed signals in their frequency domain.
- CO6 - Develop the system to analyse the real time biosignals on a personal computer.

TEXT / REFERENCE BOOKS

2. John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing - Principles, Algorithms & Applications, 4th Edition, Pearson Education / Prentice Hall, 2007.
3. Haykin. S and Van Been. B., Signals and Systems, 2nd Edition, John Wiley & Sons, 2003.
4. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India Pvt. Ltd., 2012.
5. Sanjit K. Mitra, Digital Signal Processing - A Computer Based Approach, Tata McGraw Hill, 2007.
6. Oppenheim, A.V., R.W. Schafer and J.R. Buck, Discrete Time Signal Processing, 8th Indian Reprint, Pearson, 2004.
7. Stephane Mallat, Wavelet Tour of Signal Processing: The Sparse Way, 3rd Edition, Academic Press, 2008.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

 - Skill Development

SBMA1501	FUNDAMENTALS OF MICROPROCESSOR AND MICROCONTROLLER	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The prime objective of this course is to introduce to the students the fundamentals of Microprocessor Microcontroller and Arduino.
- The students will be equipped with the basic knowledge of microprocessor, microcontroller and Arduino interfacing and their applications.

UNIT 1 INTRODUCTION TO INTEL 8085

9 Hrs.

Evolution of Microprocessor-Architecture of 8085-Instruction format-Addressing modes-Basic timing diagram of pcode fetch, memory read, memory write I/O read and I/O write-Interrupts of 8085-Software interrupts, Hardware interrupts, Priorities of interrupts 8085 based system design.

UNIT 2 INTEL 8085 INTERFACING

9 Hrs.

Interfacing devices-8255 Programmable Peripheral Interface-Architecture & various modes of operation- 8251 USART Architecture and programming features-8237, interfacing with ADC and DAC, LCD, keyboard Interface. Application: Stepper Motor Control, Temperature Control.

UNIT 3 INTRODUCTION TO 8051

9 Hrs.

Introduction to 8-bit Microcontrollers – 8051/8051, Microcontroller Architecture – Internal RAM & Internal ROM, Instruction set, Addressing Modes, Simple programs.

UNIT 4 INTERNAL PERIPHERALS OF 8051

9 Hrs.

Modes of Timer/Counter operation – Serial Port operation & Modes – Interrupt Structure of 8051 - Memory Interfacing with 8051 – I/O ports- Input and output devices interfacing with 8051.

UNIT 5 ARDUINO UNO

9 Hrs.

Arduino – Architecture, Pin diagram, Programming Structure, Simple program to blink LED, Subroutine, 16x2 LED display, Interfacing with Arduino: LCD, Temperature Sensor, Humidity Sensor and ultrasonic sensor.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understanding architectural principle of 8085 & 8051.
- CO2 - Interpret the various peripheral devices with 8085 & 8051 microprocessor
- CO3 - Design and implement programs on 8051 microprocessor.
- CO4 - Examine various I/O devices with 8051 microcontroller
- CO5 - Apply Arduino code and how to Interface various sensors with the Arduino Board.
- CO6 - Implement the interface circuit with various sensor and I/O devices with microprocessor and microcontroller and Arduino Board.

TEXT / REFERENCE BOOKS

- Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 4th Edition, Penram International Publishing, New Delhi, 2000
- Kennith J. Ayala, 8051 Microcontroller, Thomson, 2005.
- Charles M. Gilmore, Microprocessor Principle and Application, McGraw Hill Publication, 1995.
- Nagoor Kani A., Microprocessor & Microcontroller, Tata McGraw Hill, 3rd Edition, 2012.
- Ram B., Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001.
- Michael Mc Roberts, beginning Arduino, 2nd Edition, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice each carrying 16 marks

80 Marks

- Skill Development

SBMA1504	BIOSIGNAL CONDITIONING	L	T	P	Credits	Total Marks
		3	*	0	4	100

COURSE OBJECTIVES

- To gain in depth knowledge of fundamentals of operational amplifier circuits and to study the various applications using operational amplifiers.
- To discuss filters and circuits and introduce the application of signal conditioning in biomedical field.

UNIT 1 INTRODUCTION TO OPAMP

9 Hrs.

Introduction, Signal conditioning, 741 General purpose OPAMP: ideal characteristics, offset voltages and currents. Open & Closed Loop Configuration. Inverting, Non-Inverting, Summing, Voltage Follower, Integrator, differentiators, Log & Anti-Log Amplifiers, Differential Amplifiers, CMRR.

UNIT 2 APPLICATION OF OPAMP

9 Hrs.

Comparator- Zero crossing detector, Inverting and non inverting comparator, Schmitt Trigger, Precision rectifiers- Half wave and Full wave rectifiers, Peak detectors, Monostable, Astable multivibrators, Sawtooth generator, Triangular waveform generator, Sine Wave Generators-RC Phase Shift Oscillator, Wein Bridge oscillator.

UNIT 3 FILTERS

9 Hrs.

Introduction- Analog Filters, Active Filters and Passive Filters, First order and Second order Low Pass Filters, High Pass Filters, Band Pass Filters- Narrow Band Pass, Wide band Pass Filters,, Band Reject Filters- Notch Filter, All Pass filters and higher Order filters- Design and applications.

UNIT 4 DATA CONVERTERS AND TIMERS

9 Hrs.

Sample and Hold circuit - D/A converters: Resistive divider and R-2R ladder networks, inverted R-2R DAC. A/D converters: Counting type, Successive approximation, parallel comparator. Voltage to Current Converter, 555 Timer and its applications- Astable multivibrators and Monostable Multivibrator.

UNIT 5 AMPLIFIERS AND VOLTAGE REGULATORS

9 Hrs.

Instrumentation amplifiers, Bridge Amplifiers. Bioelectric Amplifiers: - Properties desired, Isolation Amplifiers:- Battery Powered, Carrier, Optically Coupled, Current Loading, Chopper Stabilized amplifier, Input Guarding. Series op-amp regulator, fixed voltage regulator and 723 general purpose regulator.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Design and implement linear and non-linear applications of operational amplifiers. CO2 - Implement waveform generation using operational amplifier.
- CO3 - Analyze and design bio filters and isolation circuits used in signal conditioning. CO4 - Design ADC and DAC using Operational Amplifiers.
- CO5 - Describe the basic concepts of Timers and voltage regulators.
- CO6 - Recognize various bioamplifier for biosignal acquisitions using opamps.

TEXT / REFERENCE BOOKS

1. Ramakant A Gayakwad, Operational Amplifiers & Linear Integrated Circuits. Prentice Hall, 2000.
2. Joseph J. Carr & John M. Brown, Introduction to Biomedical Equipment Technology, 4th edition, Pearson Education Pvt. Ltd, 2001.
3. Roy Choudhary, Linear Integrated Circuits 2nd edition, New Age International (P) Ltd, 2004.
4. John P. Bentley, Principles of Measurement System, 3rd edition, Longman Science & Technology, 2000.
5. Robert Coughlin and Fredrer, Operational Amplifiers & Linear Integrated Circuits, Prentice Hall, 2001.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks : 100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

SBMA3007	FUZZY LOGIC AND NEURAL NETWORKS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To motivate the students gain in depth knowledge of fuzzy logic systems.
- It focuses on fundamentals of biological neurons with artificial neural networks.
- It intends to bring new ideas in Algorithm implementation in artificial neural networks.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction to Fuzzy Set Theory – Basic Concepts of Fuzzy Sets – Classical Set Vs Fuzzy Set – Properties of Fuzzy Set – Fuzzy Logic Operation on Fuzzy Sets – Fuzzy Logic Control Principles – Fuzzy Relations – Fuzzy Rules – Defuzzification.

UNIT 2 FUZZY APPLICATIONS

9 Hrs.

Logic Controller – Fuzzification Interface – Knowledge Base – Decision Making Logic – Defuzzification Interface – Application Of Fuzzy Logic To Control of Blood Pressure During Anaesthesia – Cardio Vascular Signals – Fuzzy Logic Decision By Fuzzifying Boolean Rule, Fuzzy Logic Patient Deterioration Index.

UNIT 3 INTRODUCTION TO ANN

9 Hrs.

Fundamentals of ANN – Biological Neurons And Their Artificial Models – Types of ANN – Properties – Different Learning Rules – Types of Activation Functions – Training of ANN – Perceptron Model (SingleLayer) – Training Algorithm – Problems Solving Using Learning Rules And Algorithms – Linear Separability Limitation And Its OverComings

UNIT 4 ANN NETWORKS

9 Hrs.

Back Propagation Training Algorithm – Practical Difficulties – Counter Propagation Network – Structure & Operation – Training of Kohonen and Grossberg Layer – Applications Of BPN & CPN – Statistical Method – Training Application – Boltzmann Training – Cauchy Training – Hopfield Network - Applications A/D Converter – Travelling Salesman Problem

UNIT 5 ASSOCIATIVE MEMORY AND ART

9 Hrs.

Bidirectional Associative Memory– Structure – Types – Encoding And Retrieving – Adaptive Resonance Theory– Architecture of ART1 & ART2 – Implementation – Training – Characteristics – Introduction To Optical Neural Network – Cognitron & Neocognitron . Introduction to ANFIS

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1- Recognize the Fuzzy set theory.
- CO2- Understand about Optical Neural Network.
- CO3- Implementation of FLC.
- CO4- Explain the various types Algorithms in ANN.
- CO5- Design of ANN Architecture.
- CO6- Evaluate ANN application.

TEXT / REFERENCE BOOKS

- 1.Timothy J.Ross, Fuzzy Logic with Engineering Application, 1st Edition, Tech India, 2002.
- 2.James A.Freeman & Davis Skapura, Neural Networks, Pearson Education, 2002.
- 3.Jack M..Zurada, Introduction to Artificial Neural Systems, Jaico Publishers,1997.
- 4.Philip D.Wasserman, Neural Computing Theory & Practice, Van Nostrand and Reimhold.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice

20 Marks

PART B: 2 Questions from each unit of internal choice; each carrying 16 marks

80 Marks

 - Skill Development



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School of Bio and Chemical

Department of Biomedical Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

M.Tech. – Medical Instrumentation

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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 NewYork 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–Shapenumber–FourierDescriptor, moments-RegionalDescriptors–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

- Employability

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 Khate, 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 presents 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, DFT, and FFT – 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

9 Hrs.

Ergonomics: Introduction to Ergonomics, Principles of Ergonomics, Developing an Ergonomic

Program, 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. Ergonomic

Issues Related to Posture

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 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

9 Hrs.

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

9 Hrs.

Communication 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

1. Dr. S. Sunder, Rehabilitation Medicine, Jaypee Medical Publications, 2010.
2. Joseph D. Bronzino, The Biomedical Engineering Handbook Volume-II, Second Edition, CRC Press, 2006.
3. G. Salvendy, Handbook of Human Factors and Ergonomics, Wiley, 3rd edition, 2006.
4. Kondraske, G. V., Rehabilitation Engineering, CRC Press, 2015.
5. Robinson C. J., Rehabilitation Engineering Handbook of Electrical Engineering, CRC Press, Boca Raton, 2008.
6. Susan B. O'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 applications 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 9 Hrs

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.

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

- Employability

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.

- Employability

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, Non thermal 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, 2005.
- M. Arumugam, Optical Fiber Communication and Sensors, Anuradha Agencies, 2002.
- Leon Goldman, The Biomedical Laser Technology and Clinical Applications, Springer-Verlag, 2012.
- Leon Goldman, Lasers in Medicine, Springer-Verlag, 2002

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, Polarizable and non polarizable 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:

- Reinaldo Perez, Design of Medical Electronic Device, Elsevier Science, 1st Edition.
- Norris, A.C. Essentials of Telemedicine and Telecare. Wiley (ISBN 0-471-53151-0), 2002
- Wootton, R., Craig, J., Patterson, V. (Eds.), Introduction to Telemedicine. Royal Society of Medicine Press Ltd (ISBN 1853156779), 2006

SBMA7008	COMPUTERS IN MEDICINE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- This course is an introduction to the most important technical ,clinical, and social aspects of health information technology as they relate to clinical research
- .At the conclusion of this course ,students will be familiar with core concepts in medical informatics :vocabularies, interchange standards, decision support systems;
- Understand how computers are used to manage information in healthcare and to support clinical research; Be familiar with pros and cons of using health information technology in the care setting for career research.

UNIT 1 HEALTH INFORMATICS & MEDICAL STANDARDS

9 Hrs.

Introduction, Needs of computers in medicine, Historical highlights and Evolution, Hospital Information System its characteristics and functional online and offline modules ,e-healthservices, Medical Standards –HL7–DICOMPACS, Medical data formats Bioethics.

UNIT 2 MEDICAL INFORMATICS

9 Hrs.

Definitions and its six levels of interfacing, Electronic Patient Records - Biometrics, Telemedicine – Technologies and applications,Evidence Based Medicine,Virtual Reality and Multimedia applications in Medicine– Virtual Hospital

UNIT 3 BIOMEDICAL INFORMATION TECHNOLOGY

9 Hrs.

Genesis of JAVA, Data types, Operators, Control statements, Classes – Inheritance – packages and interfaces/ Oapplets,Stringhandling Applet Classes AWT and wing classes Javaapplets, Javaserve Javascript programming, Creating events, interactive forms ,frames, documents ,spreadsheet sandwindows -Client Server programming

UNIT 4 MEDICAL DATA COMPRESSION, STORAGE AND RETRIEVAL

9 Hrs.

Introduction, Picture Compression, Compression in the DICOM Standard, Data Compression for Dynamic Functiona Images,Content-Based Medical Image Retrieval: Image Retrieval by Physical Visual Features ,Geometric Spatial Filters,Combination of Semantic and Visual Features and Physiologically functional features.

UNIT 5 DATA COMMUNICATION, NETWORK INFRASTRUCTURE ANDSECURITY

9 Hrs.

Transmission and Communication Technologies, The Internet and World Wide Web, Wireless an Mobile Technologies in M-Health, Sensor Networks for Health Monitoring, Applications of Wireless Technologies in Telemedicine, Overview of Cryptographic system, Digital Watermarking, Medical Image Watermarking, Region- Based Reversible Water marking for Secure Positron Emission Tomography Image Management.

Max45Hours

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1-Identify the medical standards for hospital information system and the procedure for bioethics
CO2-Apply the knowledge of Virtual Reality and Multimedia applications in medicine
CO3-Discuss about the information technologies in biomedicalllustrate
CO4-Illustrate the technique of data compression, storage, retrieval and transmission of bioinformation
CO5- Develop Transmission and Communication Technologies for Health Monitoring
~~~~~CO6-Explores the application ofCryptographic system and Medical Image Watermarking healthcare

### TEXT / REFERENCE BOOKS

1. RamachandraLele,ComputersinMedicineProgressinMedicalInformatics,TataMcGrawHillPublishingCompany,New Delhi,2005
2. HerbertSchildt,TheCompleteReference–JAVA,TataMcGrawHillPublishingCompany,NewDelhi,2005
3. MohanBansalMS,MedicalInformatics,TataMcGrawHillPublishingCompany,NewDelhi,2005
4. DavidDaganFeng,Biomedicalinformationtechnology,AcademicPressseriesinBiomedicalEngineering2008.

 - Employability

| SBMA7009 | ROBOTICS AND ARTIFICIAL INTELLIGENCE | L | T | P | C | Total Marks |
|----------|--------------------------------------|---|---|---|---|-------------|
|          |                                      | 3 | 0 | 0 | 3 | 100         |

### COURSE OBJECTIVE

- The course covers fundamentals of robot working, programming and integration.
- To develop the student's understanding of the issues involved in trying to define and
- Simulate intelligence and to familiarize the student with specific ,well known AI methods ,algorithms and results and to provide the student additional experience in the analysis and evaluation of complicated systems.

### UNIT 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

9 Hrs.

Definition, AI versus Natural Intelligence, Defining a problem- characteristic, Search, Production Systems- characteristics ,issues in design of search programs ,heuristic search technique- hill climbing ,best first search, problem reduction

### UNIT 2 KNOWLEDGE REPRESENTATION

9 Hrs.

Representation and mapping, Knowledge Types, Knowledge representation using rules, predicate logic, symbolic reasoning under uncertainty, statistical reasoning-probability and bayes'theorem, Dempster- Shafer theory. Characteristic of AI language-PROLOG and LISP definition.

### UNIT 3 INTRODUCTION TO ROBOTICS

9 Hrs.

Classification of robots, basic robot components, manipulator end effectors, controller, accuracy precision and repeatability .Robotic vision system ,Position, velocity and acceleration sensors ,proximity and range sensors, touch and slip sensors, tactile sensors, and force and torque sensors.

### UNIT 4 ROBOT MOTION ANALYSIS

9 Hrs.

Manipulator Kinematics ,Inverse Manipulator Kinematics, Manipulator Dynamics- Newton-Euler and Lagrange formulation

### UNIT 5 ROBOT APPLICATIONS

9 Hrs.

Material transfer and machine loading /unloading, processing applications, welding and painting assembly and inspection, future robotic applications and related technologies developments.

Max. 45 Hours.

### Course Outcomes:

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

CO1- Identify and describe how human intelligence and AI works.

CO2- Summarize the learning methods adopted in AI.

CO3- Analyze the working of sensors utilized in robotics.

CO4- Prioritize on the analysis of robotic motion.

CO5- Design and evaluate functions of robots.

CO6- Demonstrate and Illustrate about functionalities of Robots and Robotics.

### TEXT / REFERENCE BOOKS

1. Mikell P. Groover, Mitehell Weiss, Roger Negaland Nicholes G. Odress. Industrial Robotics–Technology–Programming and Applications - McGraw-Hill, Latest edition.
2. Fu, Gonzalez And Lee: Robotics: Control, Sensing, Vision And Intelligence, McGraw-Hill, 1987
3. Elaine Rich And Kevin Knight, Artificial Intelligence, McGraw-Hill, 1983
4. hGeorge F. Luger, Artificial Intelligence–Structures and Strategies for Complex Problem Solving, 4 Education, 2003.
5. Russell & Norvig, second edition, Artificial Intelligence 'a Modern Approach, Pearson Education, 2003.

- Employability

| SBMA7011 | PATTERN RECOGNITION AND APPLICATIONS | L | T | P | Credits | Total Marks |
|----------|--------------------------------------|---|---|---|---------|-------------|
|          |                                      | 3 | 0 | 0 | 3       | 100         |

### COURSE OBJECTIVE

- To equip the student with basic mathematical and statistical techniques, pattern recognition algorithms commonly used in pattern recognition, and thereby to help understand, compare and contrast various pattern recognition techniques and to provide adequate background on probability theory, statistics, and optimization theory to tackle a wide spectrum of engineering problems.

#### UNIT 1 INTRODUCTION

9 Hrs.

Machine perception, an example, Pattern Recognition System, The Design Cycle, Learning and Adaptation, Architecture of Pattern recognition system,

#### UNIT 2 MAXIMUM – LIKELIHOOD AND BAYESIAN PARAMETER ESTIMATION

**Bayesian Decision Theory:** Minimum Error Rate Classification, Classifiers, Discriminant functions, and decision surfaces, Introduction to Maximum-likelihood estimation; Bayesian Estimation; Bayesian parameter estimation: Gaussian Case, general theory; Hidden Markov Models.

#### UNIT 3 UNSUPERVISED CLASSIFICATION

9 Hrs.

Clustering for unsupervised learning and classification, clustering concepts C-means algorithm- hierarchical clustering-Graph theoretic approach to pattern clustering-Validity of clustering solutions.

#### UNIT 4 FEATURE EXTRACTION

9 Hrs.

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

#### UNIT 5 INTRODUCTION TO BIOMETRICS

9 Hrs.

Identification Methods, Biometric Technologies, Automatic Identification, Fingerprint verification, Face recognition, Hand Geometry based verification, Retina Identification, DNA based identification, Smart card based authentication.

Max. 45 Hours

### COURSE OUTCOME

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

CO1: Understand basic concepts in pattern recognition

CO2: Gain knowledge about state-of-the-art algorithms used in pattern recognition research

CO3: Appraise various unsupervised classification algorithms.

CO4: Recommend techniques to extract features from visuals, images.

CO5: Infer on different methods by which biometric is utilized in day to day activities.

CO6: Apply pattern recognition techniques in practical problems.

### TEXT / REFERENCE BOOKS

- Richard O. Duda, Peter E. Hart, and David G. Stork, Pattern Classification, 2<sup>nd</sup> Edition, Wiley-Interscience, 2001.
- Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition and Image Analysis, Pearson Education, 2007.
- K. Jain, R. Bolle, S. Pankanti, Biometrics: Personal Identification in Networked Society, Kluwer Academic, 1999.

## TEXT / REFERENCE BOOKS

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

| SCCA9504 | INDUSTRY 4.0 FOR BIO ENGINEERS<br>PROJECT BASED LEARNING APPROACH | L | T | P | C | Max. Marks |
|----------|-------------------------------------------------------------------|---|---|---|---|------------|
|          |                                                                   | 1 | 0 | 2 | 2 | 100        |

#### COURSE OBJECTIVE:

- To demonstrate the achievement of efficient and economically viable production without being hazardous to human health and environment. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

#### UNIT 1: MODELLING AND SIMULATION

6 Hours

Introduction to Industry 4.0 - The Various Industrial Revolutions - Modeling Principles: Introduction, definition of modeling and simulation, different types of models, application of mathematical modeling.

Simulation: Introduction, Simulation Tools, Process Simulation Software Platforms and Applications, Trends in Process Simulation Engineering

#### UNIT 2: SMART INDUSTRY

6 Hours

Road to Industry 4.0 - Green manufacturing, Robotic Automation, Industrial Applications- Manufacturing, Control, Maintenance and Assembly, RFID- Type, RFID system, applications, RFID in health care, Embedded Systems - Embedded firmware, Platform software design, Wireless design, Embedded testing, modeling & automation, Hardware platform design, Device Management, Monitoring – Industrial monitoring, condition monitoring, Health monitoring, Sensor Technology and its applications, AI in smart manufacturing, Smart Factory logistics

#### UNIT 3 BIG DATA ANALYTICS AS SERVICE PROVIDER

7 Hours

Technologies for enabling Industry 4.0 - Role of data, information, knowledge and collaboration in future organizations. Big Data - Background - Programming- Python and R - Git - Docker - Pipelines - DNA and RNA Sequencing - Massively parallel sequencing - Applications - Next Generation Sequencing and its future and big data analytics in healthcare - Big Data Repositories - Cloud platforms and computing for automation - Embedded systems in healthcare - Digitization the future of healthcare - medical cyber-physical systems - Case study - Integration of Multi-Omics Big Data in Cardiovascular Risks and Diseases.

#### UNIT4 TISSUE ENGINEERING

6 Hours

Introduction, Methods, Materials, Material characterization; Scaffolds: Natural and Artificial polymers, Hydrogels, Bioceramics, Scaffold fabrication, Self-assembly, 3D Bioprinting: Introduction, Workflow, Imaging, 3D modeling, CAD-based design, Bioink, Techniques; Bioreactors for Tissue Engineering: Effect of different Parameters, Conditions; Tissue engineering for Skin, Bone, Vasculature and Cornea, Synthesis of different Nanostructures, Characterization of Nanostructures, Nanostructures in Diagnosis and Therapy, Organ printing. Scaffold techniques and the efficiency of gene-editing tools and their ability to fill the existing gaps in stem cell and regenerative therapies. Regulatory framework in development and marketing tissue-based products

#### UNIT 5 PROTOTYPING – TESTING AND COMMUNICATION

20 Hours

Applications and Case Studies - New ideas – centered design process – functional prototype - testing methods/ideas – prototyping and testbeds – proof of concept – assembly – prototyping apps – addressing the complex problems.

Max.45 Hours

#### COURSE OUTCOMES:

CO6. Articulate on the new age technologies in the modeling of biochemical engineering. CO7. Integrate different emerging technologies to evolve Smart Factories

CO8. Deduce the components that lead to industrial digital revolution CO9. Ability to assess the developments in bioengineering.

CO10. Criticize the professional and ethical issues in novel industrial technologies.

CO6. Develop a prototype/ innovative ideas in the various fields of biochemical engineering.

**TEXT / REFERENCE BOOKS**

5. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and SMART Systems, 1st Editio, CRC Press, 2020
6. Sider W.D., Seader J. D., and Lewin D.R., Product and Process Design principles, Synthesis, Analysis andEvaluation, 2nd Edition, John Wiley and Sons, 2010.
7. Thomas Varghese & K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis, Properties and Applications ofNanomaterials, Atlantic, 2012
8. Uthayan Elangovan, Smart Automation to Smart Manufacturing: Industrial Internet of Things, Momentum Pr, 1stEdition, 2019.

**END SEMESTER EXAMINATION PATTERN**

Max Marks: 100

**PROJECT PRESENTATION**

| SBMA7010 | NEURAL NETWORKS AND FUZZY LOGIC IN MEDICINE | L | T | P | Credits | Total Marks |
|----------|---------------------------------------------|---|---|---|---------|-------------|
|          |                                             | 3 | 0 | 0 | 3       | 100         |

### COURSE OBJECTIVE

- This program gives a comprehensive package in the area of fuzzy logic and neural network fundamental with applications ranging in the engineering field.
- This concise bioinspired course will deal with and enable the student to underlying concepts and medical applications of Self-organizing maps, Genetic algorithm, Support Vector Machines.

### UNIT 1 INTRODUCTION

9 Hrs.

Neural network learning rules– Supervised and Unsupervised Learning, single layer networks–Perceptron- Linear separability Single Layer and Multilayer Perception, Adaptive linear neuron (Adaline) and LMS algorithm - Error back propagation algorithm ,generalized deltarule.

### UNIT 2 SOM AND ART

9 Hrs.

Counter propagation network -Training of Kohonen And Grossberg Layer-feature mapping, self organizing feature maps, Adaptive Resonance theory (ART) Network- ART1 and ART 2 Architecture

### UNIT 3 GENETIC ALGORITHMS AND SVM

9 Hrs.

Evolution, search spaces and fitness landscapes ,Elements of Genetic Algorithms, Datastructures ,Adaptive Encoding.SelectiveMethods,Geneticoperators,FitnessScaling,GAapplication

### UNIT 4 FUZZY LOGIC SYSTEMS

9 Hrs.

Introduction to fuzzy set theory—membership function –basic concepts of fuzzysets–Operations on fuzzy sets and relations,classical set Vs fuzzy set–properties of fuzzyset–fuzzy logic control principles–fuzzyrelations fuzzyrules – Defuzzification

### UNIT 5 ADVANCES AND APPLICATIONS

9 Hrs.

Evolving Support Vector Machine ,Neural networks using GA ,Applications of ANN in biomedical signal analysis and medical image analysis.

Max. 45 Hours

### COURSE OUTCOMES

At the end of the course, the student will be able to,  
CO1: Comprehend the concepts of biological neurons and artificial neurons  
CO2: Analyze the different neural networks and their learning algorithms.  
CO3: Comprehend the genetic algorithms and classifiers.  
CO4: Interpret the concepts of a fuzzy logic system.  
CO5: Summarize on the applications of fuzzy in biomedical engineering  
CO6: Apply fuzzy logic and neural network to real world problems and give solutions

### TEXT / REFERENCE BOOKS

1. JamesA.Freeman&DavidM.Skapura,NeuralNetworksAlgorithms,Applications,andProgrammingTechniques,Pearson Education1991.
2. S.Haykin,NeuralNetworks:AComprehensiveFoundation,PearsonEducation(Asia)Pte.Ltd/prenticeHallofIndia,2003.
3. TimothyJ.Ross,FuzzylogicwithEngineeringApplications;McGrawHill,1997.
4. M.T.Hagan,H.B.DemuthandM.Beale,NeuralNetworkDesign,ThomsonLearning,2002.
5. BartKosko,NeuralNetworksandFuzzySystems.PrenticeHallofIndia,2005
6. GeorgeJ.KlirandBoyaun,FuzzyLogic:TheoryandApplication,PrenticeHallofIndia,2001

- Skill Development

| SBMA7012 | PHYSIOLOGICAL CONTROL SYSTEMS | L | T | P | Credits | Total Marks |
|----------|-------------------------------|---|---|---|---------|-------------|
|          |                               | 3 | 0 | 0 | 3       | 100         |

### COURSE OBJECTIVE

- The main objective of this course is to provide background knowledge on specific physiological systems nervous system, sensory systems, muscle control systems, cardiovascular systems, respiratory system, hormonal control mechanisms) and to apply control theory, system analysis, and model identification techniques to better understand the processes involved in physiological regulation.
- In this course, besides qualitative descriptions of physiological systems, we shall be dealing with the mathematical modeling and computer simulation of these models.

#### UNIT 1 INTRODUCTION

9 Hrs.

System Analysis fundamental Concepts, Physiological control systems analysis with simple example, Differentiate between Engineering and physiological control system, The science of modeling, Control system: open loop system, closed loop system, Feedback, Mathematical model of mechanical translational and mechanical rotational systems, Electrical analogous of mechanical translational and mechanical rotational system, Transfer function.

#### UNIT 2 MATHEMATICAL MODELING

9 Hrs.

Generalized System properties, Models with combinations of system elements, Linear models of Physiological Systems with Examples, Distributed –parameter versus Lumped-parameter model, Linear systems and the superposition principle.

#### UNIT 3 STATIC ANALYSIS OF PHYSIOLOGICAL SYSTEMS

9 Hrs.

Open –Loop versus Closed- Loop Systems, Determination of the Steady-State Operating Point, Regulation of Cardiac Output, Regulation of Glucose, Chemical regulation of Ventilation.

#### UNIT 4 TIME RESPONSE & FREQUENCY RESPONSE ANALYSIS OF LINEAR SYSTEM

9 Hrs.

Standard test signals, Response of First- Order & Second Order for unit step input, Bodeplot, Polarplot, Transient Response Descriptor, Frequency Response of a Model of Circulatory Control, Frequency Response of Glucose –Insulin –Regulation.

#### UNIT 5 STABILITY ANALYSIS AND IDENTIFICATION OF PHYSIOLOGICAL CONTROL SYSTEMS

9 Hrs.

Root Locus, Routh –Hurwitz Stability Criterion, Stability Analysis of Pupillary Light Reflex( Using Routh-Hurwitz Analysis), Model of Cheyne-Stokes Breathing, Identification of Physiological Control Systems: Basic Problems in Physiological Analysis, The Starling Heart-lung preparation.

Max. 45 Hours

### COURSE OUTCOME

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

- CO1: Develop an in-depth knowledge in basic tools needed for modeling physiological systems.
- CO2: Discuss on system concept and different mathematical techniques applied in analyzing any system
- CO3: Summarize on the static analysis of real time physiological systems.
- CO4: Analyze a given system in time domain and frequency domain
- CO5: Infer on the techniques of plotting the responses in both domain analysis.
- CO6: Apply all these analyses to study the biological system.