



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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

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School of Bio and Chemical Engineering

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. Ma

Employability

Entrepreneurship

Skill Development

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-100 Questions of 2 marks each. Mark 200

20 Marks

Employability

Entrepreneurship

Skill Development

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, Capsule 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. Mark for

20 Marks

 Employability  Entrepreneurship  Skill Development

80 Marks

 - Employability

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

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.

S24BLH21	BIOSENSORS AND MEASUREMENTS	L	T	P	EL	Credits	Total Marks
		3	0	2	0	4	100

COURSE OBJECTIVE

- To provide the basics of measurements, knowledge on the principle and operation of different medical transducers.
- To introduce the application of sensors and transducers in the physiological parameter measuring system.

UNIT 1 MEASUREMENT SYSTEM

9 Hrs.

Measurement System – Functional elements of an instrumentation system - Static and Dynamic Characteristics - Errors in Measurements and their statistical analysis – Calibration - Primary and secondary standards. Sensor for Motion and Position Measurement, GPS, INS, Doppler, SONAR.

UNIT 2 PASSIVE AND ACTIVE TRANSDUCERS

9 Hrs.

Classification of transducers and characteristics for selection of transducers - Resistive Transducers-Strain Gauge, Capacitive transducer - various arrangements, Capacitor microphone, Capacitive pressure sensor, Proximity sensor. Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics. Piezoelectric active transducer.

UNIT 3 BIO POTENTIAL ELECTRODES AND CHEMICAL SENSORS

9 Hrs.

Electrodes Electrolyte Interface, Half-Cell Potential, Polarization, Polarizable and Non-Polarizable, Electrodes, Reference Electrode, Hydrogen Electrode, Electrode Skin-Interface and Motion Artifact. Surface Electrodes. Oxygen electrodes, CO₂ electrodes, enzyme electrode, construction, ISFET for glucose, urea etc. fiber optic sensors.

UNIT 4 SMART AND BIOSENSORS

9 Hrs.

Biological Sensors: Study of various corpuscles like Pacinian, functions and modelling, sensors for smell, sound, vision, osmolality and taste. Biosensors: Introduction, Advantages and limitations, various components of Biosensors, Biocatalysts based biosensors, bio-affinity based biosensors & microorganisms-based biosensors, Types of membranes used in biosensor constructions, Electronic Nose. SMART SENSORS. Introduction to Smart Sensors and Semiconductor sensors, MEMS.

UNIT 5 DISPLAY AND RECORDING DEVICES

9 Hrs.

Digital Display System and Indicators: Classification of display devices, DOT Matrix display, Digital voltmeter, Multimeter, Digital storage oscilloscope, LCD monitor, Recorders: Graphic recorders, strip chart recorders, Galvanometer type recorders and self-balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders.

Max.15 Hrs.

PRACTICE EXERCISE

1. Characteristics of Temperature Transducers.
2. Characteristics of Optical Transducer.
3. Characteristics of LVDT and Potentiometer Transducer
4. Characteristics of Strain Gauge.
5. Dead weight measurement
6. Study of Characteristics of Hall effect Transducer using Arduino.
7. Measurement of pulse and body temperature using Arduino

Max.60 Hrs

COURSE OUTCOMES

- CO1** - Understand the calibration procedure for the basic instruments involved in physiological parameter measurement.
- CO2** - Identify the characteristics of various transducers and classify transducers.
- CO3** - Attain adequate knowledge about the various sensors and measuring instruments used for measurement and detection of physical quantities.
- CO4** - Demonstrate the concepts, types, working and practical applications of important biosensors.
- CO5** - Apply the suitable design criteria for developing a medical sensor for a particular application.
- CO6** - Employ Multimeter, CRO and different types of recorders for appropriate measurement.

TEXT BOOK / REFERENCE BOOK

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai Sons, 2014
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw Hill, 2011.
3. John G. Webster, Medical Instrumentation Application and Design, 4th Edition, Wiley India Pvt. Ltd., New Delhi, 2015.
4. Richard S.C. Cobbold, Transducers for Biomedical Measurements: Principles and Applications, John Wiley & Sons, 2004.
5. Nandini K. Jog, Electronics in Medicine and Biomedical Instrumentation, PHI, 2nd Edition 2013.

6. Harry N, Norton, Biomedical sensors – Fundamentals and Application, 2001.
7. Tatsuo Togawa, Toshiyo Tamma and P. Ake Öberg, Biomedical Transducers and Instruments, 2018. Pillai S.O., Solid state Physics, New age International Publishers, 7th Edition.

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 with internal choice, each carrying 16 marks

80 Marks

 - Employability

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

SBMB1101	CELL BIOLOGY AND MICROBIOLOGY	L	T	P	EL	Credits	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- To introduce extensive knowledge in cell structure, functions, cell signaling pathways and transfer across membranes in cell
- To enable students to learn about the principles of Microbiology to emphasize structure and biochemical aspects of various microorganisms
- To understand the basic principles of microscopy and sample preparation

UNIT 1 CELL STRUCTURE AND TRANSPORT ACROSS CELL MEMBRANE 9 Hrs.

Structure and functions of Eukaryotic cell, Plasma Membrane models and chemical composition, Permeases, Passive and active transports, Transport through cell membrane, Sodium - potassium pumps, co- transport, symport, antiport, Endocytosis and Exocytosis.

UNIT 2 CELL RECEPTORS AND CELL SIGNALING 9 Hrs.

Membrane bound receptors, Cytosolic and Nuclear receptors, autocrine, paracrine and endocrine signaling, signal amplification, CAMP and G-protein role in signal transduction, role of IP3, DAG and calcium in cell signaling.

UNIT 3 CELL DIVISION AND DNA REPLICATION 9 Hrs.

Cell cycle – interphase, cell cycle check points, cell cycle regulations, Cell division - Mitosis & Meiosis cell division, difference between mitosis and Meiosis cell division, DNA replication- Conservative, Semi - Conservative, & Dispersive models of DNA replication

UNIT 4 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL GROWTH 9 Hrs.

History, overview and scope of microbiology, contributions of Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner, and Fleming. Structure of bacteria; (nucleoid, plasmid, ribosomes, cell wall, flagella), morphology, reproduction of bacteria. Microbial growth types of media, growth curve and pure culture, Enumeration of microorganisms -Pour plate, Spread plate, and Streak plate, preservation of pure culture.

UNIT 5 MICROSCOPY AND STAINING TECHNIQUES 9 Hrs.

Microscope - compound microscope, phase contrast microscope, fluorescent microscope, electron microscope - Transmission electron microscope, scanning electron microscope. Sterilization and disinfection methods, Staining techniques- simple staining, Gram's staining, acid fast staining, capsule and spore staining.

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- C01** - Understanding the principles of cell structure and transport across the cell membrane.
- C02** - Demonstrate the role of various cell receptors and the signaling between the cells.
- C03** - Learning the process of cell division and recognize the importance of chromosome.
- C04** - Understands the scope of microbiology, structure of microbes and their microbial growth.
- C05** - Demonstrates the morphology of microbes using various microscopes and staining techniques.
- C06** - Outline the problem encountered to stain the microbes and mechanism of staining reaction.

TEXT BOOK / REFERENCE BOOK

1. Thomas D. Poolard, Williams C. Earnshaw, Graham T. Johnson, Cellbiology, 3rd edition, 2017, Elsevier
2. C.B.Powar, Cell Biology, New Edition, Publisher : Himalaya Publishing House (1 January 2010) ISBN-10 9350246694 , India.
3. Pelczar, Jr E.C. S Chan and noel R.Krieg, Microbiology, 5th edition Tata McGraw Hill 2006.
4. Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton, Prescott's Microbiology, 8th Edition, McGraw Hill Higher Education, 2008.
5. Tortora, Funke, and Case's Microbiology, An Introduction 13th Edition, Publisher: Pearson, ISBN-10: 0134605187, January 8, 2018

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 with internal choice, each carrying 16 marks

80 Marks

SBMA3014	MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE FOR HEALTHCARE APPLICATION	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To understand the concepts of Machine Learning
- To get introduced to Artificial Intelligence techniques
- To apply ML in healthcare data

UNIT- I INTRODUCTION TO MACHINE LEARNING

9 Hrs

Machine Learning–Applications - Types of Machine Learning – Training, Testing, - Machine Learning process – Variance – Bias - Training Error – Testing Error - Overfitting – Underfitting – Gradient Descent – Accuracy – Precision – Recall – Confusion Matrix.

UNIT- II NEURAL NETWORKS

9 Hrs

Structure of a brain - Artificial Neural Network – Perceptron – Activation function – Sigmoid – Relu – Tanh - Multilayer perceptron – Feed forward propagation – Backpropagation - Training process in neural network-Introduction to Adaptive resonance theory and Self-organizing map.

UNIT- III SUPERVISED AND UNSUPERVISED LEARNING

9 Hrs

Supervised Learning- Regression - Linear Models for Regression – Classification – Logistic Regression - Classification Models - KNN Classification – Naïve Bayes Classification – Decision Tree Classification – Support Vector Machine – Ensemble Learning – Random Forest-Clustering - k-means clustering.

UNIT-IV INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM-SOLVING AGENT

9 Hrs

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem-Solving Approach to Typical AI Problems- Introduction to Knowledge Representation and Reasoning- Introduction to Decision Theory.

UNIT-V HEALTH CARE APPLICATIONS

9 Hrs

Case Studies and use cases- Disease Personalized medicine- patient monitoring- Robotic surgery- Precision medicine- Medical Imaging Diagnosis Signal Classification -Oncology research- Bio Predictive Analysis- Simple programs for classification of biosignals.

COURSE OUTCOMES

45 Hrs

- On completion of the course, students will be able to
- CO1: Understand the basics of Machine Learning
 - CO2: Acquire knowledge of training data using Neural Networks
 - CO3: Analyze the Supervised Learning and Unsupervised learning methods
 - CO4: Explore the principles of Artificial Intelligence
 - CO5: Explore techniques for analyzing and classifying medical data.
 - CO6: Design an algorithm for anomaly detection using a machine-learning algorithm

TEXTBOOK / REFERENCE BOOK

1. Burkov, Andriy, —The Hundred-page Machine Learning Book, 2019.
2. Theobald, Oliver., — Machine Learning for Absolute Beginners: A Plain English IntroductionII, Scatterplot Press, 2017. .
3. Maini, Vishal, and Sabri, Samer. Machine Learning For Humans: Introduction to Machine Learning with Python. Romania, Alanna Maldonado, 2023
4. Stephen Lucci and Danny Kopec," Artificial Intelligence in the 21st Century, Second Edition, Mercury Learning and Information, 2015.
5. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Second Edition, Cambridge University Press, 2017. Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017

 - Skill Development

S24BPB71	VR AND AR IN BIOMEDICAL APPLICATIONS	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To understand virtual reality, and augmented reality and use them to build Biomedical engineering applications.
- To know the intricacies of these platforms to develop PDA applications with better optimality

UNIT- I INTRODUCTION

9 Hrs

Introduction to AR and VR. Difference between AR and VR. The three I 's of virtual reality-Components of AR and VR technology - Input Devices:(Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers navigation and manipulation interfaces and gesture interfaces. Output Devices: Graphics displays-sound displays

UNIT-II VR DEVELOPMENT PROCESS AND CONTENT CREATION CONSIDERATIONS FOR VR

9 Hrs

Geometric modeling-kinematics modeling-physical modeling, behavior modeling, model Management. Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system-cyber sickness effects of exposures to virtual reality environment

UNIT-III STEREOSCOPIC VISION & HAPTIC RENDERING

9 Hrs

The human optical system, Depth cues, Stereopsis, Retinal disparity, Haptic sense, Haptic devices, Haptic rendering and parallax algorithms, Stereo pairs Synthesis, and Stereo images pipelines.

UNIT-IV SOFTWARES FOR AR AND VR

9 Hrs

AR software, Camera parameters and calibration, AR based on markers, and AR Toolkit. JS-pros and cons-building blocks (WebVR, WebGL), Three.js, device orientation events) frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatialaudio-Assessinghumanparameters-devicedevelopmentanddrivers-DesignHaptics.

UNIT-V APPLICATIONS

9 Hrs

Medical applications-military applications-robotics applications-Advanced Realtime Tracking of other applications-games, movies, simulations, therapy

COURSE OUTCOMES

45 Hrs

- On completion of the course, students will be able to
- CO1-Understands the system or process to meet given specifications with realistic engineering constraints
 - CO2-Identify problem statements and function as a member of an engineering design team.
 - CO3-Examine the Stereoscopic vision and haptic rendering
 - CO4-Explore the various software used for the development of AR and VR
 - CO5-Apply the concepts of AR and VR to medical and industrial applications
 - CO6-Design various medical applications based on augmented reality.

TEXTBOOK / REFERENCE BOOK

1. C. Burdea & Philippe Coiffet, Virtual Reality Technology, Second Edition, Gregory, John Wiley & Sons, Inc., 2008
2. Jason Jerald, 2015.TheVRBook: Human-CentredDesignforVirtualReality.AssociationforComputingMachineryandMorgan& Claypool, New York, NY, USA,.2015.
3. Augmented Reality: Principles and Practice (Usability)by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
4. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media;1edition, 2015.
5. Vasanth Mohan, Creating Augmented and Virtual Realities: Theory and Practice for Next-Generation Spatial Computing, Shroff/O'Reilly, 2019

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 with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

- Skill Development

S24BPB72	AI FOR HEALTH CARE	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To develop fundamental knowledge in the area of artificial intelligence and to establish useful applications for it
- To organize and model a complex issue as a state space, then use intelligent search techniques to identify the most effective solutions
- To design and create methods for making decisions in challenging, unpredictable situations

UNIT-I INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND PROBLEM-SOLVING AGENT

9 Hrs

Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem-Solving Approach to Typical AI Problems.

UNIT-II INFORMED SEARCH ALGORITHMS

9 Hrs

Informed Search - Introduction to Heuristics – Greedy Breadth First Search, A* - Local Search Optimization Algorithms - Hill Climbing, Simulated Annealing.

UNIT-III OPTIMAL SEARCH ALGORITHMS

9 Hrs

Global optimization algorithms - Genetic Algorithms, Particle Swarm Optimization Algorithm, Ant Colony Optimization, Gravitational Search Algorithm - Games – Optimal Decisions in Games - Minimax Algorithm, Alpha-Beta Pruning Algorithm.

UNIT-IV KNOWLEDGE REPRESENTATION AND REASONING

9 Hrs

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information.

UNIT-V DECISION THEORY AND PLANNING

9 Hrs

Basics of utility theory, decision theory, sequential decision problems, decision networks, elementary game theory, Planning: planning as search, partial order planning, construction and use of planning graph.

COURSE OUTCOMES

45 Hrs

On completion of the course, students will be able to

CO1: Demonstrate a fundamental understanding of the evaluation of Artificial Intelligence (AI) and its foundations.

CO2: Elucidate the basic knowledge representation, problem-solving, and learning methods of Artificial Intelligence

CO3: Apply basic principles of AI in solutions that require problem-solving through Optimal Search Algorithms

CO4: Demonstrate working knowledge of reasoning in the presence of uncertain information and show how search algorithms are essential for problem-solving

CO5: Illustrate the importance of artificial intelligence and planning in solving real-world problems

CO6: Design applications for healthcare that use Artificial Intelligence

TEXT BOOK / REFERENCE BOOK

1. Russell S and Norvig P, Artificial Intelligence – A Modern Approach, 3rd Edition, Prentice Hall, 2015.
2. Elaine Rich, Kevin Knight, Shivashankar B Nair., "Artificial Intelligence", 3rd Edition, McGraw Hill Education, 2017.
3. Wolfgang Ertel, "Introduction to Artificial Intelligence", Second Edition, Springer, 2017.
4. Stephen Lucci and Danny Kopec, "Artificial Intelligence in the 21st Century, Second Edition, Mercury Learning and Information, 2015.
5. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Second Edition, Cambridge University Press, 2017.
6. Saroj Kaushik, "Logic & Prolog Programming", New Age International, 1st edition, 2002.

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 with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

S24BPB73	MACHINE LEARNING	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To focus on the construction and study of algorithms that can learn from data.
- To emphasize the logical, knowledge-based approach.
- To introduce students to the basic concepts and techniques of Machine Learning.
- To develop skills in using recent machine learning software for solving practical problems.
- To gain experience in doing independent study and research.

UNIT-I INTRODUCTION TO MACHINE LEARNING

9 Hrs

Machine learning - examples of machine learning applications - Learning associations - Classification -Regression - Unsupervised learning - Supervised Learning - Learning class from examples - PAC learning -Noise, model selection, and generalization - Dimension of the supervised machine learning algorithm.

UNIT-II MULTILAYER PERCEPTRONS

9 Hrs

Structure of brain - Neural networks as parallel processing - Perceptron - Multilayer perceptron - Backpropagation - Training procedures - Tuning the network size - Learning time.

UNIT-III 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, Evolving Support Vector Machine.

UNIT-IV DECISION THEORY

9 Hrs

Bayesian Decision Theory- Introduction- Classification - Discriminant function-Bayesian Networks-Association rule - Parametric Methods - Introduction - Estimation -Multivariate methods-Data Parameter estimation-Dimensionality Reduction- PCA-Linear discriminant analysis.

UNIT-V CLUSTERING & REGRESSION

9 Hrs

Clustering - Mixture densities - k-means clustering - Supervised Learning after clustering - Hierarchical clustering - Nonparametric Methods - Density estimation - Generalization of multivariate data - Smoothing models -Decision Trees - Univariate trees - Multivariate trees - Learning rules from data - Linear Discrimination-Gradient Descent.

COURSE OUTCOMES

45 Hrs

- On completion of the course, students will be able to
- CO1 -Understand the complexity of Machine Learning algorithms and their limitations;
 - CO2 -Understand modern notions in data analysis-oriented computing;
 - CO3 -Be capable of confidently applying common Machine Learning algorithms in practice
 - CO4 -Be capable of performing distributed computations;
 - CO5 -Can demonstrate working knowledge of reasoning in the presence of incomplete and/or uncertain information
 - CO6 -Gain the ability to apply knowledge representation, reasoning, and machine-learning techniques to real-world problems

TEXT BOOK / REFERENCE BOOK

1. EthemAlpaydin, "Introduction to Machine Learning", MIT Press, 2004.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 1997.
3. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
4. James A. Freeman & David M.Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education 1991.
5. S.Haykin, Neural Networks: A Comprehensive Foundation, Pearson Education (Asia) Pvt. Ltd., Prentice Hall of India, 2003.

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 with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Skill Development

S24BPB74	DEEP LEARNING FOR BIOMEDICAL APPLICATIONS	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To gain knowledge on the concepts of deep learning
- To provide insight into recent CNN architectures and deep models
- To enable the students to know deep learning techniques to support real-time applications

UNIT-I FOUNDATION OF NEURAL NETWORKS AND DEEP LEARNING

9 Hrs

Neural Networks-Training neural networks, Activation Functions, Loss functions, Hyperparameters, Fundamentals of Deep Networks-Defining Deep Learning, Common Architectural Principles of Deep Networks, Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyperparameters.

UNIT-II CONVOLUTION NEURAL NETWORKS

9 Hrs

Architectural Overview – Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet.

UNIT-III RECURRENT AND RECURSIVE NETS - SEQUENCE MODELLING

9 Hrs

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks

UNIT-IV AUTO ENCODERS AND DEEP GENERATIVE MODELS

9 Hrs

Introduction to Android, Creating Android Activities, Android User interface design, Access Wi-fi and Bluetooth with mobile applications-Web based App for e-health applications

UNIT-V RECENT TRENDS IN DEEP LEARNING

9 Hrs

Recent Models of Deep Learning, Genomics, Predictive Medicine, Clinical Imaging, Lip Reading, Visual Reasoning

COURSE OUTCOMES

45 Hrs

On completion of the course, students will be able to

- CO1: Ability to differentiate the concept of machine learning with deep learning techniques
- CO2: understand and visualize Convolutional Neural Networks for real-world applications
- CO3: demonstrate the use of Recurrent Neural Networks and Transformer based for time series prediction
- CO4: Illustrate autoencoder and deep generative models to solve problems with high dimensional data
- CO5: design and develop an application-specific deep-learning model
- CO6: Analyse the latest trends in deep learning

TEXT BOOK / REFERENCE BOOK

6. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
7. Wei Di, Anuragh Bharadwaj, "Deep Learning Essentials", Jianing Wei, Packt Publishers, 2018.
8. Nikhil Buduma, Nicholas, "Fundamentals of Deep Learning", O'Reilly Media, 2017.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
10. Suraj Sawant. "Deep Learning", IGI Global, 2018.
11. Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" A press, 2018.

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 with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Skill Development

S24BPB75	PYTHON FOR SIGNAL AND IMAGE APPLICATIONS	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To gain the knowledge necessary to launch a biomedical start-up
- To implement the concepts into practice and copyright the Inventions
- To understand the significance of sales and marketing

UNIT I INTRODUCTION TO PYTHON, DATA TYPES, EXPRESSIONS, LOOPS

9 Hrs.

Introduction to Python Programming - Running Code in the Interactive Shell, Input, Processing and Output, Editing, Saving and Running a Script - Data Types, String Literals, Escape Sequences, String Concatenation, Variables, and the Assignment Statement - Numeric Data Types Module, The Main Module, Program Format, and Structure and Running a Script from a Terminal Command Prompt, Conditional loops, and iterations.

UNIT II STRINGS AND TEXT FILES

9 Hrs.

Strings - Accessing Characters and Substrings in Strings, Data Encryption, Strings and Number Systems and String Methods - Text Files - Text Files and Their Format, Writing Text to a File, Writing Numbers to a File, Reading Text from a File, Reading Numbers from a File and Accessing and Manipulating Files and Directories on Disk.

UNIT III LISTS AND DICTIONARIES

9 Hrs.

Lists - List Literals and Basic Operators, Replacing an Element in a List, List Methods for Inserting and Removing Elements, Searching and Sorting a List, Mutator Methods and the Value None, Aliasing and Side Effects, Equality, and Tuples - Defining Simple Functions - Syntax, Parameters and Arguments, return Statement, Boolean Functions, and main function, DICTIONARIES - Dictionary Literals, Adding Keys and Replacing Values, Accessing Values, Removing Keys and Traversing a Dictionary.

UNIT IV DESIGN WITH FUNCTIONS AND DESIGN WITH CLASSES

9 Hrs.

Design with Functions and Design with Classes - Functions as Abstraction Mechanisms, Problem Solving with Top-Down Design, Design with Recursive Functions and Managing a Program's Namespace -DESIGN WITH CLASSES - Objects and Classes, Data Modeling and Structuring Classes with Inheritance and Polymorphism.

UNIT V Case Studies in Biomedical Engineering

9 Hrs.

Medical Imaging, Speech Recognition, Genomics, Drug Discovery, Patient Health Monitoring, Virtual Assistance, and Predictive Analytics in Healthcare.

COURSE OUTCOMES

45 Hrs

- On completion of the course, students will be able to
- CO1: Understand the overview of NLP and modeling of Language
 - CO2: Describe various word-level analysis
 - CO3: Analyse Grammar and NLP Models
 - CO4: Explore various methods of speech processing and Discourse analysis
 - CO5: Apply the principles of NLP in Biomedicine
 - CO6: Develop NLP for biomedical application

TEXT BOOK / REFERENCE BOOK

1. Richard M Reese, —Natural Language Processing with Java, O'Reilly Media, 2015.
2. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
3. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech, Pearson Publication, 2014
4. Doan S, Conway M, Phuong TM, Ohno-Machado L. Natural language processing in biomedicine: a unified system architecture overview. Methods Mol Biol. 2014; 1168:275-94. doi: 10.1007/978-1-4939-0847-9_16. PMID: 24870142.

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 with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Skill Development

S24BPB76	MEDICAL BIG DATA ANALYTICS	L	T	P	EL	C	Total Marks
		2	0	2	0	3	100

COURSE OBJECTIVE

- To understand the underlying concepts of Big Data.
- To study the various tools used for Big Data Analytics
- To apply Big Data in the field of health care systems and Biomedical Data

UNIT- I INTRODUCTION

9 Hrs

Introduction to Big Data – Issues and Challenges in the traditional systems - Evolution of Big Data – Four V's of Big Data – Big Data Use Cases and Characteristics – Intelligent Data Analysis – Data Analytic Tools – Big Data Storage Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error – Random Sampling.

UNIT II HADOOP AND NoSQL

9 Hrs

Introduction to Hadoop – Hadoop Distributed File System – Analyzing data with Hadoop – Scaling – Streaming – Clustering: Single Node and Multi-Node – Working with Hadoop Commands – Working with Apache Oozie- Introduction to NoSQL- NoSQL business drivers-; NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores - Variations of NoSQL architectural patterns; Big data NoSQL solution- Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer.

UNIT III BIG DATA TOOLS AND MAP REDUCE

9 Hrs

Big Data Applications using Pig and Hive – Fundamentals of HBase and ZooKeeper – IBM Infosphere Big Insights – Introduction to FLUME – KAFKA. Algorithms using map-reduce - Matrix-Vector – Multiplication – Word Count - Understanding inputs and outputs of MapReduce, Data Serialization – Introduction to YARN – MapReduce Vs YARN – YARN Architecture – Scheduling in YARN – Fair Scheduler – Capacity Scheduler.

UNIT IV Mining Data Stream AND FRAMEWORKS

9 Hrs

Mining Data Stream: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, estimating moments, counting oneness in a Window, Decaying Window, Real-time Analytics Platform (RTAP) applications, - Using Graph Analytics for Big Data: Graph Analytics.

UNIT V Sources and Techniques for Big Data in Healthcare

9 Hrs

Motivation for Big data analytics in Health care-Structured EHR Data – Unstructured Clinical Notes – Medical Imaging Data – Genetic Data – Epidemiology & Behavioral data analysis.

COURSE OUTCOMES

45 Hrs

- On completion of the course, students will be able to
- CO1: Understand the fundamentals of Big Data
 - CO2 Analyze the usage of HADOOP and NoSQL in Big data
 - CO3: Familiarize tools used for Big Data
 - CO4: Comprehend the data mining concepts and Frameworks.
 - CO5: Apply the concepts of Big Data in the field of healthcare
 - CO6: Develop Big data solutions for healthcare applications

TEXT BOOK / REFERENCE BOOK

1. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2012.
2. Tom White, "HADOOP: The Definitive Guide", O Reilly 2012.
3. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", Packet Publishing 2013.
4. Jimeng Sun, Chandan K. Reddy, Big Data Analytics for Healthcare, IBM Wayne State, <http://dmkd.cs.wayne.edu/TUTORIAL/Healthcare>.

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 with internal choice, each carrying 16 marks

Exam Duration: 3 Hrs.

20 Marks

80 Marks

Skill Development



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School of Bio and Chemical Engineering

Department of Biomedical Engineering

1.1.3 Courses having focus on Employability / Entrepreneurship / Skill Development

M.Tech. – Medical Instrumentation

CONTENTS

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Entrepreneurship			
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Skill Development			
27	SBMB7006	Mems and Nanotechnology in Healthcare	34
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SBMB5103	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 principles and working of therapeutic and surgical equipments
- To enrich students' knowledge with ultrasonic applications and neonatal equipment
- To learn about the safety measures while working on medical equipments

UNIT I BIOSIGNAL MEASUREMENTS

9Hrs

Sources of biomedical signals, Basic medical instrumentation system, Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Electrodes for ECG, EEG, EMG, ECG, EEG, EMG - Lead systems and recording methods. Electrooculography (EOG), Electroretinography (ERG).

UNIT II CARDIAC AND RESPIRATORY CARE UNIT

9Hrs

Cardiac Pacemakers-different types and their comparison, batteries for pacemakers, Defibrillators- Need, DC Defibrillator, Implantable defibrillators, Heart lung machine -Different types of Oxygenators, Pumps, Monitoring Process, Hemodialyser- Principle of Hemodialysis, Membranes, Dialysate, Wearable Artificial Kidney, Regulation of Breathing - Humidifier, Nebulizer – Ventilators - different types.

UNIT III RADIOLOGICAL, SURGICAL SCOPY AND DIATHERMY EQUIPMENT

9Hrs

Digital radiography, Mammography, Angiography, Endoscopy, Laparoscopy Bronchoscopy, Gastroscopy, Physiological effects of HF radiation, Depth of Penetration, Short wave, Ultrasonic and microwave diathermy, Surgical diathermy, Galvanic, Faradic Stimulators, Interferential therapy, Cryosurgery.

UNIT IV ULTRASONIC AND NEONATAL INSTRUMENTS

9Hrs

Basic principles of Echo technique, display techniques A, B, M modes, Echo cardiograms, Echo encephalogram, Ultrasonic applied as diagnostic tool in ophthalmology, obstetrics and gynaecology. Infusion Pumps. Baby incubator, Phototherapy, Radiant warmer - Working principle, block diagram, description, and function of basic blocks, Foetal Monitoring System.

UNIT V SPECIAL MEDICAL INSTRUMENT AND SAFETY MEASUREMENTS

9Hrs

Principles and operations of thermographic Equipment, applications of thermography. Lithotripters- Principles and operations of Lithotripter system, Ophthalmic equipment- slit Lamp, Keratometer, Tonometer, Retinal response Plotter, Electric shock hazards – Gross shock, Effects on human body, Micro and macro electric shock, Leakage current and types, Safety techniques, Testing of Biomedical Equipment.

COURSE OUTCOMES

45 Hrs

On completion of the course, student will be able to

- CO1: Describe and emphasize particular components of the cardiac and respiratory care units and assistive devices
- CO2: Design amplifier and Isolation circuits for any bio signals
- CO3: Familiarize with radiological and surgical instruments in hospital
- CO4: Solve design related problems in diathermy and various scopes
- CO5: Design ultrasound and neonatal equipment
- CO6: Analyze the principles of special equipment and safety measures in various equipment

TEXT BOOK / REFERENCE BOOK

1. John G. Webster, Amit J. Nimunkar, Medical Instrumentation application and design – 5th Edition, (An Indian Adaptation), Wiley India, 2021.
2. R. AnandaNatarajan, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 2016.
3. Leslie Cromwell, —Biomedical Instrumentation and measurement, Prentice Hall of India, New Delhi, 2nd edition, 2015.
4. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 3rd edition, 2014.
5. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", edition, 2015. Pearson education, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 6 Questions of 5 marks each - No choice

PART B: 2 Questions from each unit with internal choice, each carrying 14 marks

Exam Duration: 3 Hrs.

30 Marks

70 Marks

SBMB5102	BIOSENSING TECHNOLOGIES	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- Presenting the student the underlying engineering principles used to detect small molecules, DNA, proteins, and cells in the context of applications in diagnostic testing, pharmaceutical research, and environmental monitoring.
- Covers biosensor approaches including electrochemistry, fluorescence, acoustics, and optics; aspects of selective surface chemistry including methods for biomolecule attachment to transducer surfaces.

UNIT I INTRODUCTION

9Hrs.

Introduction to biosensors Biosensor classification, Main elements in biosensors, General Configuration and functional description of measuring instruments-Characteristics of instrument-Static characteristics - Dynamic characteristic, Error in the measurements. Overview of Biosensors, Fundamental elements of biosensor devices, advantages and limitations.

UNIT II PHYSICAL&CHEMICALSENSORS

9Hrs.

Sensors for physical measurands: pressure, acceleration, flow, volume, temperature and biopotentials. Sensors for measurement of chemicals, ion selective electrodes, ISFETS; Amperometric sensors, Clark Electrode; Biosensors, Catalytic biosensors, Immunosensors. Smart sensors: Introduction -Primary sensors, Converters, Compensation, Recent trends in sensor technology, Basics of detection methods: Fluorescence Spectroscopy, UV-Vis Absorption and Emission.

UNIT III TRANSDUCERS

9Hrs.

Classification of transducers-Resistive, Capacitive, Inductive, Potentiometers, Temperature Compensation, Resistance Hygrometer, Linear variable differential transformer, Capacitive displacement transducers, Equibar differential pressure transducer, Photoelectric, piezoelectric and mechanoelectronics, Principle of fiber optic cable, fiber optic sensors, Photo acoustic sensors.

UNIT IV ELECTRODES&LIFIERS

9Hrs.

Half cell potential, Reference electrodes, polarization effects, Polarisable and non-polarisable electrodes, Micro electrodes,Equivalent Circuits, Liquid and solid ion exchange membrane electrode, Enzyme electrode Signal Conditioning circuits-CharacteristicsofAmplifiers,DifferentialAmplifiers,Filters,A/DConverters.

UNIT V NONELECTRICALPARAMETERMEASUREMENTS

9Hrs.

Measurements of Respiration Rate, Temperature, Pulse rate, Blood pressure Measurements- Direct, Indirect, Blood flow Measurements-Invitro,Invivo,Gas flow measurements.

45 Hrs

COURSE OUTCOMES

On completion of the course the student will be able to

CO1: Apply principles and concepts of biology and engineering to design biosensors

CO2: Apply principles and concepts of electronics and electrochemistry to design electrochemical biosensors.

CO3: Recognize different types of transducers, and their application in biosensor design

CO4: Apply principles and concepts of sensing and engineering to (i) design biosensors for detection of markers in biofluids, and (ii) be able to evaluate quality of biosensors

CO5: Apply engineering tools to evaluate parameters needed for point-of-care health screening and mobile-health, and design of appropriate point-of-care diagnostic devices

CO5: Work in a team to design biosensors and identify applications

TEXT BOOK / REFERENCE BOOK

1. RichardS.C.Cobbold:Transducers for Biomedical Measurements: Principles and Applications,John Wiley & Sons 2012.
2. A.P.F.Turner,I.Karube&G.S.Wilson:Biosensors:Fundamentals & Applications,Oxford University Press,Oxford,2007.
- 3.RanganC.S.,SarmaG.R.,and,Instrumentation devices and system,SecondEdition,Tata McGraw Hill Publishing Company Limited,NewDelhi,2016.
4. JohnG.Webster,Medical Instrumentation,Application and Design,3rdEdition,JohnWileyandSons,2017.
5. JacobKline,Handbook of BioMedical Engineering, Academic press Inc.,Sandiego,2016.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 6 Questions of 5 marks each - No choice

PART B: 2 Questions from each unit with internal choice, each carrying 14 marks

Exam Duration: 3 Hrs.

30 Marks

70 Marks

- Employability

S1SB9101	RESEARCH METHODOLOGY AND IPR	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To understand the concepts of research.
- To provide an insight into the techniques of research. To learn the requisites of writing a research report.
- To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection

UNIT-I RESEARCH PREPARATION AND PLANNING

9 Hrs

Objectives of research – Understanding research and its goals, Critical thinking, Techniques for generating research topics. Topic selection and justification. Techniques involved in designing a questionnaire – Methods of scientific enquiry – Formulation of hypotheses and testing of the same – Development of a research proposal

UNIT-II RESEARCH RESOURCES

9 Hrs

Sources of information. Literature search. World Wide Web, Online data bases – search tools. Citation in dices – Principles underlying impact factor – Literature review – Case studies, review articles and Meta analysis – Role of the librarian. Ethical and moral issues in Research, Plagiarism, tools to avoid plagiarism

UNIT-III ACADEMIC WRITING AND PRESENTATION

9 Hrs

Proposal submission for funding agencies, Elements of Style. Organization of proposals, Basic knowledge of funding agencies, Research report writing, Communication skills, Tailoring the presentation to the target audience – Oral presentations, Poster preparations, Submission of research articles for Publication in Reputed journal, Thesis writing and Research report writing. Elements of excellent presentation: preparation, visual and delivery, oral communication skills and oral defense.

UNIT-IV DATA COLLECTION, ANALYSIS AND INFERENCE

9 Hrs

Basic statistical distributions and their applications. Sample size determination and sampling techniques. Large sample tests and small sample tests.

UNIT-V INTELLECTUAL PROPERTY RIGHTS

9 Hrs

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents, Patenting under PCT. Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

COURSE OUTCOMES

45 Hrs

On completion of the course, students will be able to

CO1: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

CO2: Understand research problem formulation & Analyze research related information and Follow research ethics

CO3: Correlate the results of any research article with other published results. Write a review article in the field of engineering.

CO4: Appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

TEXT BOOK / REFERENCE BOOK

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.
5. James C. Van Horne, Stanford University, Financial Management and Policy, Prentice Hall,
6. James R. McGuigan, R. Charles Moyer, Frederick H. deB. Harris, Managerial economics – applications, strategy and Tactics, Cengage learning,
7. Philip Kotler, Marketing management Pearson Education, India
8. Modern Production / Operations Management, Elwood S. Buffa & Rakesh Sarin, Wiley India
9. Ronald R. Sims, Organizational success through effective human resources Management, Quorum books, London
10. Ganesan R, Research Methodology for Engineers, MJP Publishers, Chennai. 2011

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

PART A: 6 Questions of 5 marks each - No choice

30 Marks

PART B: 2 Questions from each unit with internal choice, each carrying 14 marks

70 Marks

SBMB7004	E -HEALTH AND TELEMEDICINE	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To introduce the concepts of eHealth
- To assess the advantages of eHealth care
- To design and develop applications for eHealth care
- To explore the advancements of Telemedicine technology

UNIT- I INTRODUCTION TO eHEALTH CARE

9 Hrs

Overview and introduction to eHealth and flow of health information- International regulations in eHealth-Advantages, Challenges and future of eHealth.

UNIT-II MEDICAL DATA ANALYTICS AND WEARABLE DEVICES

9 Hrs

Health care data and Electronic Health Records (EHR) systems- Medical data bases –Wearable Devices-Data collection from wearable devices- Clinical use of personal health data-big data in the field of Medicine.

UNIT-III DIGITAL HEALTH

9 Hrs

Introduction to health care digital transformation- Digital health: Tools, Strategies of digital health-Technologies in digital health-Implementation of Digital health- Advantages and challenges of Digital health.

UNIT-IV APPLICATION DEVELOPMENT FOR e HEALTH

9 Hrs

Introduction to Android, Creating Android Activities, Android User interface design, Access Wi-fi and Bluetooth with mobile applications-Web based App for e-health applications

UNIT-V TELEMEDICINE

9 Hrs

Usage scenarios and operation modes- Telemedicine systems technologies- Standards and best-practices - Telemedicine in developed and developing countries - Telemedicine generations in IndiaTelemedicine for management of Cancer, Stroke cardiology and Diabetes

COURSE OUTCOMES

45Hrs

- On completion of the course, students will be able to
- CO1: Acquire knowledge on basics of e-health care and its regulations
- CO2: Explore medical data analytics and records
- CO3: Apply digital transformation in the field of medicine
- CO4: Apply Android Application development and its accessing tools for eHealth care
- CO5: Evaluate the development of telemedicine in India and abroad
- CO6: Develop an android App for telemedicine application

TEXT BOOK / REFERENCE BOOK

- Shortliffe, Edward H and Cimino James J. Biomedical Informatics, Computer Applications in Health Care and Biomedicine, Springer-Verlag London 2014
- ICMR- National Centre for Disease Informatics and Research. Framework for Telemedicine use in Management of Cancer, Diabetes, Cardiovascular Disease and Stroke in India. Bengaluru: ICMR-National Centre for Disease Informatics and Research; 2021
- Lavis, JN (ed). Ontario's Health System: Key Insights for Engaged Citizens, Professionals and Policymakers. 2016.
- Hoyt RE, Yoshihashi A, Bailey N. Health informatics: Practical guide for healthcare and information technology professionals. Lulu Press. 2014 Seventh edition.
- Gaddi A, Capello F, Manca M. eHealth, Care and Quality of Life. 2014 electronic library holding in the Health Science Library

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 6 Questions of 5 marks each - No choice

PART B: 2 Questions from each unit with internal choice, each carrying 14 marks

Exam Duration: 3 Hrs.

30 Marks

70 Marks

- Employability

S44BPB21	INDUSTRIAL VERSION 5.0	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To have an in-depth knowledge of advancements in Industries
- To differentiate Industry version 4.0 and version 5.0.
- To acquire knowledge on Internet of Medical things and its security threats and challenges

UNIT I INTRODUCTION TO INDUSTRY 5.0

9Hrs.

Industry 4.0- difference between industry 4.0 and industry 5.0, Society 5.0, Human Centric Approach, Advantages of Industry 5.0, Implementation of Industry 5.0.-Challenges-Human Centric solution

UNIT II FEATURES OF INDUSTRY 5.0

9Hrs.

Smart additive manufacturing- Predictive maintenance- Hyper customization- Cyber Physical Cognitive systems- Supply chain management-Collaborative Robots-6G communication-Big data Analytics

UNIT III INDUSTRY 5.0 IN BIOMEDICINE

9Hrs.

Smart hospitals- Smart Sensors- 4D CT and MRI scans-Holography in medicine-AI in medicine-Robotic Surgery-Smart materials and 4D printing

UNIT IV INTERNET OF MEDICAL THINGS

9Hrs.

Introduction and system architecture: Introduction, IoMT Devices-On-Body Devices, In Home Devices, Community Devices, In-Clinic Devices, In Hospital Devices, IoMT System Architecture-Data Collection Layer, Data Management Layer, Medical Server Layer.

UNIT V INTERNET OF MEDICAL THINGS SECURITY

9Hrs.

Threats, Security Challenges and Potential Solutions: IoMT Attack Types, Challenges in IoMT Security Schemes, Current Security Plans for IoMT, Potential Solutions for Security Vulnerabilities.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: Differentiate Industry 4.0 and Industry 5.0
- CO2: Evaluate features of Industry 5.0
- CO3: Analyse Industry 5.0 in biomedical field.
- CO4: Analyse the aspects of Internet of Medical things
- CO5: Examine the security challenges and threats in Internet of medical things
- CO6: Explore avenues of IoMT in Industry 5.0

TEXT BOOK / REFERENCE BOOK

1. Veneri, Giacomo, and Antonio Capasso- Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1stEd.,Packt Publishing Ltd, 2018.
2. D. Jude Hemanth and J. Anitha George A. Tsihrantzis- Internet of Medical Things Remote Healthcare Systems and Applications, Springer, 2021
3. UthayanElangovan, Industry 5.0: The Future of the Industrial Economy,2021
4. Srivastava J, Routray S, Ahmad S, Waris MM. Internet of Medical Things (IoMT)-Based Smart Healthcare System: Trends and Progress. ComputIntellNeurosci. 2022

SBMB7006	MEMS AND NANOTECHNOLOGY IN HEALTH CARE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To understand Various MEMS fabrication techniques
- Application of MEMS in different field of medicine.
- To know the underlying concept in engineering and implement in nano centric applications

UNIT- I MEMS & FABRICATION

9 Hrs

MEMS and Microsystems, Materials for MEMS-Active Substrate Materials Silicon and Its Compounds, Silicon Piezo resistors, Gallium Arsenide, Quartz Polymers Lithography Etching and Its Types, Wafer Bonding, Micromachining –Bulk, Surface Micromachining, LIGA Process.

UNIT II MICROFLUIDIC SYSTEMS

9 Hrs

Fluid Dynamics, Continuity, Momentum Equation, Equation of Motion Laminar air Flow In- Circular, Circular Conducts, Flow in Micro conducts in Sub micro meter and Nanoscale. Microscale Fluid Expression for Liquid Flow In A Channel, Fluid Methods Actuation, Dielectrophoresis, Microfluid Dispenser, Microneedle, Micropump, Continuous flow System, Micro mixers.

UNIT III APPLICATIONS OF MEMS IN MEDICINE

9 Hrs

CAD for MEMS Biological MEMS Materials Polymers Based Gas Sensor Microbial Analysis Systems Detection and Measurement Methods Microsystems Approaches To PCR, DNA Sensor Drug Delivery Types of Reservoirs CARDIOMEMS Case Study Design of Sensor in Health Care Introduction To 3D Printing.

UNIT IV OVERVIEW OF NANOPARTICLES

9 Hrs

Nanotechnology from medical perspective Different Types of Nano biomaterials And Nanostructure Interactions Synthesis and Characterization of Smart Nano materials Surface Modification Biofunctionalization of Nano materials.

UNIT V NANOTECHNOLOGY IN HEALTH CARE

9 Hrs

Nano shells, Nanopores, Carbon Nanotubes, Synthesis and Monitoring of Antigen Antibody Reactions. Nanowires, Quantum Dots and Biomedical Applications Nanorobots in Surgery Nano oncology Nano neurology, Nano cardiology, Nanoorthopedies and Nano Ophthalmology

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1: Understand the Mems Fabrication Processes and Characterization of Various Mems Materials
- CO2: Applying the Concepts to The Design of Different Types of Microsystems.
- CO3: Design the Procedure Adopted for Mems Device Towards Health Care Applications.
- CO4: Interpret the Latest Scientific Development and Discoveries in The Field of Nanomedicine.
- CO5: Examine the New Findings and Implement the Perspective in The Field of Nanoscience.
- CO6: Create New Approaches in Nanotechnology That Can Be Used in Biomedical Therapies

TEXT BOOK / REFERENCE BOOK

1. Nano: The Essentials: T. Pradeep. McGraw – Hill education, First edition, 2017.
2. Carola Leuschner, Nanofabrication towards Biomedical Applications, Techniques, Tools, Applications and Impact. 2005, Wiley –VCH.
3. Kewal K. Jain, The Handbook of Nanomedicine. Humana Press, (2008).
4. Wanjun Wang, Stephen A. Soper, Bio MEMS: Technologies and applications, CRC Press, New York, 2007
5. Marc J. Madou, Fundamentals of micro fabrication: the science of miniaturization, CRC Press, 2002.

SBMB7010	3D PRINTING TECHNOLOGY AND ITS BIOMEDICAL APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provides opportunities for training and research in all aspects of 3D printing
- To educate the students in the development of high quality of printing technology to provide a satisfactory environment to the manufacturing sector
- To implement 3 D printing in health care industry for future betterment to the society

UNIT- I DIGITAL MANUFACTURING FOR 3D PRINTING

9 Hrs

Introduction- Definition of 3D Printing, Terminologies, Types additive manufacturing operations- Stereolithography (SLA), Digital Light Processing (DLP), Fused Deposition Modeling (FDM), Selective laser sintering (SLS), Selective Laser Melting (SLM), Electron Beam Melting (EBM), Details of Laminated Object Manufacturing (LOM); Granular Materials Binding, 3D innovative printers and application.

UNIT II DIGITAL DESIGN FOR 3D PRINTING

9 Hrs.

Transferring prototyping to 3D printing, STL file for 3D printing, Rapid prototyping, Classification of 3D printing technologies, Design criteria, Design consideration, Types of fast filament fusion support, Top-Down support structures, designing for selective Laser Sintering, Designing for material Jetting, OBJ-VRML files, CAD-STL files, Rules for STL format.

UNIT III 3D PRINTING

9 Hrs.

Introduction, Development of physical goods, Nomenclature; milestones of 3D systems, Nontraditional manufacturing innovative technique, shorter lead time and design freedom, 3D printing possibilities, the digital model, CAD software- 3D scanners process, 3D printing pen, 3D printing geometry restrictions, STL file, Professional and home 3D printers, 3D printersimprovements, Phases of rapid prototyping to home fabrication.

UNIT IV ADDITIVE MANUFACTURING

9 Hrs.

Limited prototyping, Hazards of printing materials, 3D printing state and federal laws, Steps towards AM cybersecurity, 3D printing in forensic science, ethics and legality of 3D printing, Intricacy of 3D printing, Impact of 3D printing, 3D printing impact on global manufacturing, Revolutionizing mass manufacturing, Advance perception of additive manufacturing.

UNIT V 3D PRINTING IN HEALTH CARE

9 Hrs.

Bone reconstructive surgery, living tissues- Bioprinting 2D and 3D tissues Bioink components, Hydrogels for Bioprinting; Implants of printed organs- Human Ear, Kidneys artificial liver, Bioprinting skin, Bioprinting nerves, 3D printed ovaries, obstacles to bio printing organs, 3D Bio-Printing, 3D Printing for implant and medical device- Hearing Aid, sensor arm, Knee replacement, Aorta, dental implants, obstacles to bioprinting organs, 3D print future medical implants.

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, students will be able to

CO1: Understands the basic principles of 3D printing.

CO2: Outline the problem encountered during design for 3D printing.

CO3: Recognize the importance and future scope of 3D printing and evolving.

CO4: Demonstrate the types of additive manufacturing in 3D printing technology.

CO5: Application of 3D printing in health care system.

CO6: Identify the importance of 3D printing in health care systems

TEXT BOOK / REFERENCE BOOK

1. Sabrie Soloman, 3D printing and design, Khanna Book Publishing Co., (P) Ltd., 2020.
2. Ad van Wijk and Iris van Wijk, 3D Printing with Biomaterials Towards a Sustainable and Circular Economy, Published by IOS Press, under the imprint Delft University Press. 2020.
3. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2nd Edition. 2015.
4. Andreas Gebhardt, Julia Kessler and Laura Thurn, 3D Printing Understanding Additive Manufacturing, Second Edition, Science Direct, 2019.

SBMB7011	DEEP LEARNING FOR BIOMEDICAL APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To gain knowledge on the concepts of deep learning
- To provide insight into recent CNN architectures and deep models
- To enable the students to know deep learning techniques to support real-time applications

UNIT-I FOUNDATION OF NEURAL NETWORKS AND DEEP LEARNING

9 Hrs

Neural Networks-Training neural networks, Activation Functions, Loss functions, Hyperparameters, Fundamentals of Deep Networks-Defining Deep Learning, Common Architectural Principles of Deep Networks, Parameters, Layers, Activation Functions, Loss Functions, Optimization Algorithms, Hyperparameters.

UNIT-II CONVOLUTION NEURAL NETWORKS

9 Hrs

Architectural Overview – Input Layers, Convolutional Layers, Pooling Layers, Fully Connected Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: ResNet, AlexNet.

UNIT-III RECURRENT AND RECURSIVE NETS - SEQUENCE MODELLING

9 Hrs

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks

UNIT-IV AUTO ENCODERS AND DEEP GENERATIVE MODELS

9 Hrs

.Under complete Autoencoders – Regularized Autoencoders – stochastic Encoders and Decoders – Contractive Encoders. Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine - Generative Adversarial Networks.

UNIT-V RECENT TRENDS IN DEEP LEARNING

9 Hrs

Recent Models of Deep Learning, Genomics, Predictive Medicine, Clinical Imaging, Lip Reading, Visual Reasoning

Max. 45 Hours

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1: Ability to differentiate the concept of machine learning with deep learning techniques
- CO2: understand and visualize Convolutional Neural Network for real-world applications
- CO3: demonstrate the use of Recurrent Neural Networks and Transformer based for time series prediction
- CO4: Illustrate autoencoder and deep generative models to solve problems with high dimensional data
- CO5: design and develop an application-specific deep learning model
- CO6: Analyse the latest trends in deep learning

TEXT BOOK / REFERENCE BOOK

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
 2. Wei Di, AnuraghBharadwaj, "Deep Learning Essentials", Jianing Wei, Packt Publishers, 2018.
 3. Nikhil Buduma, Nicholas, "Fundamentals of Deep Learning", O'Reilly Media, 2017.
 4. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
 5. SurajSawant. "Deep Learning", IGI Global, 2018.
- Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.

