

SBMA1101	CELL BIOLOGY AND GENETICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To introduce extensive knowledge in cell structure, functions, cell signaling pathways and transfer across membranes in cells.
- To learn about the transmission, distribution, arrangement, and alteration of genetic information and how it functions and is maintained in populations.

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

Structure and functions of Eukaryotic cell, Membrane models and Permeases, Passive and active transports, 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.

UNIT 3 CELL DIVISION AND ROLE OF CHROMOSOMES **9 Hrs.**

Cell division - Mitosis & Meiosis, Structural organization of chromosome, variation in the number and structure of chromosome; Haploids, Euploid and aneuploid; Deletion, Duplication, Translocation.

UNIT 4 GENETIC MATERIAL AND MUTATION **9 Hrs.**

Linkage and crossing over, DNA and RNA as genetic material. Mutations - types and causes of mutation, DNA repair Mechanisms. Physiochemical properties of DNA: Denaturation, Annealing and C-value paradox.

UNIT 5 HUMAN GENETICS **9 Hrs.**

Human Chromosomes, Chromosomal abnormalities - sex chromosomal and autosomal. Inherited disorders, Genetic engineering, gene therapy, inborn errors of metabolism and Genetic counseling.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

- CO1 - Understanding the principles of cell structure and transport across the cell membrane.
- CO2 - Demonstrate the role of various cell receptors and the signaling between the cells.
- CO3 - Learning the process of cell division and recognize the importance of chromosome.
- CO4 - Identify the genetic material and demonstrate the types of mutation and their importance.
- CO5 - Understanding the procedure of genetic engineering and gene therapy.
- CO6 - Outline the problem encountered due to chromosomal abnormality and counseling to the society.

TEXT / REFERENCE BOOKS

1. Principles of Molecular Biology: Veer Bala Rastogi, 2016
2. Genetics, Veer Bala Rastogi, S. Chand Publication, 4th Edition, 2018
3. Watson, Molecular Biology of Genes, 7th Edition, Benjamin Cummings, 2013
4. Ajoy Paul, A Text Book of Cell and Molecular Biology, Books and Allied Publishers, 2007.
5. David Friefelder, Molecular Genetics, Narosa Publishing House, India, 2006.
6. Kavita B Ahluwalia, Genetics, New Age International Publishers, India. 2008.

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

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

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION

9 Hrs.

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

UNIT 2 BIOLOGY AND ENGINEERING

9 Hrs.

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

UNIT 3 ELECTRONICS AND MEDICINE

9 Hrs.

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

UNIT 4 CLINICAL ENGINEERING

9 Hrs.

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

UNIT 5 RESEARCH IN BIOMEDICAL

9 Hrs.

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

Max.45 Hrs.

COURSE OUTCOMES

On completion of the course, students will be able to

CO1 - Understand his/her role as a biomedical engineer. CO2 -

Interpret the application of biology in engineering. CO3 -

Assimilate the role of electronics in medicine.

CO4 - Examine his/her responsibility as a clinical engineer.

CO5 - Apply his/her knowledge to research in different areas of biomedical engineering

CO6 - Implement the knowledge gained in understanding the concepts better in forthcoming semesters

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

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

SBMA1201	MICROBIOLOGY AND PATHOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To enable students to learn about the principles of Microbiology to emphasize structure and biochemical aspects of various microorganisms.
- To know the control and preventive measures of pathophysiology of various disorders.

UNIT 1 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 and fungi (sexual and asexual reproduction). Microbial growth types of media, growth curve, pure culture and culture techniques (Pour plate, Spread plate, and Streak plate), Enumeration of microorganisms, preservation of pure culture.

UNIT 2 STAINING TECHNIQUES AND MICROSCOPY

9 Hrs.

Microscope definition, classification - bright field microscope, dark field microscope, phase contrast microscope, fluorescent microscope, electron microscope - Transmission electron microscope, scanning electron microscope. Sterilization and disinfection methods, Staining techniques, simple staining, Grams staining, acid fast staining, capsule and spore staining.

UNIT 3 INFLAMMATION AND NEOPLASIA

9 Hrs.

Introduction to pathology, Necrosis, inflammation, acute and chronic inflammation, apoptosis, neoplasia, classification, difference between benign and malignant tumor spread of tumors and etiology of tumors

UNIT 4 FLUID AND HEMODYNAMIC DEARRANGEMENT

9 Hrs.

Edema, shock, hemorrhage, thrombus, embolism, disseminated intravascular coagulation, hematological disorder, bleeding disorder, leukemia and lymphoma.

UNIT 5 INFECTIOUS DISEASES AND IMMUNE DISORDER

9 Hrs.

Bacteria, fungi and virus as potential pathogens, mechanism of pathogenicity mechanism of development of microbial resistance (*Staphylococcus*, *Salmonella*, Candidiasis, Filariasis, Influenza virus). Immune deficiency syndrome, Respiratory disorder cystic fibrosis, tuberculosis. Neuropsychiatric disorder Parkinson's disease, Alzheimer's disease skin disorder eczema psoriasis, molecular basis of diabetes.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

- CO1 - Understands the scope of microbiology, structure of microbes and their microbial growth.
- CO2 - Demonstrates the morphology of microbes using various microscopes and staining techniques.
- CO3 - Describes the basic elements in cell injury, inflammation and neoplasma.
- CO4 - Explore the various pathological disorders and their clinical manifestations.
- CO5 - Learning the process of infectious diseases and their immune disorders in day today life.
- CO6 - Outline the problem encountered due to infectious microbes and their pathogenesis and clinical symptoms.

TEXT / REFERENCE BOOKS

1. Pelczar, Jr E.C.S Chan and Noel R.Krieg, Microbiology, 5th edition Tata McGraw Hill 2006.
2. Joanne M. Willey, Linda Sherwood, Christopher J. Woolverton, Prescott's Microbiology, 8th Edition, McGraw Hill Higher Education, 2008.
3. Jawetz, Melnick and Adelberg's Medical Microbiology, McGraw Hill Medical, 2007.
4. University of South Carolina School of Medicine (<http://pathmicro.med.sc.edu/book/bact-sta.htm>)

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

SAIC4001	INDUSTRY 4.0	L	T	P	Credits	Total Marks
		2	-	-	2	100

UNIT 1 ADVANCED TECHNOLOGY AND ADVANCED MATERIALS

7 Hrs.

Advanced electro-optical sensing technology-active, passive multi-spectral and hyper spectral imaging; electronic beam steering; vacuum technology, surface and coating technology, health care technology, Nanotechnology- Nanomechanics, Nano optoelectronics; energy storage technology-next generation Li-based Batteries, Hydrogen storage, solar photovoltaic's, Flexible electronics. Intellectual Property Rights -case studies governing/pertaining to Materials/Technology.

UNIT 2 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING

7 Hrs.

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

UNIT 3 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT

7 Hrs.

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

UNIT 4 SMART MANUFACTURING

8 Hrs.

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

UNIT 5 SMART WORLD

8 Hrs

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

UNIT 6 CYBER PHYSICAL SYSTEMS

8 Hrs.

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

Max. 45 Hrs.

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

PART A: 11 Questions of 2 marks each-No choice

PART B: 2 Questions from each unit with internal choice, each carrying 13 marks

Exam Duration: 3 Hrs.

22 Marks

78 Marks

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

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION

9 Hrs.

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

UNIT 2 TESTING AND TROUBLESHOOTING

9 Hrs.

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

UNIT 3 TESTING OF MEDICAL EQUIPMENT

9 Hrs.

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

UNIT 4 TROUBLESHOOTING OF MEDICAL EQUIPMENT

9 Hrs.

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

UNIT 5 MAINTENANCE MANAGEMENT

9 Hrs.

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

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

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

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

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

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

SBMA4005	VIRTUALITY AND AUGMENTED REALITY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

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

UNIT 1 INTRODUCTION

9 Hrs.

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT 2

DEVELOPMENT PROCESS

VR

9 Hrs.

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT 3

CREATION CONSIDERATIONS FOR VR

CONTENT

9 Hrs.

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment

UNIT 4 VR ON THE WEB AND VR ON THE MOBILE

9 Hrs.

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-spatial audio-Assessing human parameters-device development and drivers-Design Haptics

UNIT 5 APPLICATIONS

9 Hrs.

Medical applications-military applications-robotics applications- Advanced Real time Tracking other applications- games, movies, simulations, therapy

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student 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 - Explores the technical resources

CO4 - Propose technical documents and give technical oral presentations related to design mini project results. CO5

- Examine the content and mobile applications of VR.

CO6 - Design various medical applications based on augmented reality.

TEXT / REFERENCE BOOKS

1. C. Burdea & Philippe Coiffet, —Virtual Reality Technology|| , Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & 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; 1 edition, 2015.

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

SBMA4009	HUMAN FACTORS IN ENGINEERING AND DESIGN	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- Introduce the fundamental terms and concepts of human factors
- Learn anthropometric principles and optimize human well-being and overall performance.

UNIT 1 INTRODUCTION

9 Hrs.

Introduction to human factors engineering - relevance of ergonomics. Process of seeing-visual capabilities-factors affecting visual acuity and contrast sensitivity -human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual displays and representational displays-process of hearing- principles of auditory displays.

UNIT 2 MUSCLE PHYSIOLOGY

9 Hrs.

Muscle physiology-muscle metabolism-respiratory response joint motion study-measure of physiological in-efficiency and energy consumption-work rest cycles-aspects of manual material handling (MMH). Bio-mechanical recommended limits of MMH.

UNIT 3 CONTROLS AND COMPABILITY

9 Hrs.

Spatial compatibility -physical arrangement of displays and controls- movement capability - rotary controls and rotor displays movement of displays-orientation of the operator and movement relationships-control orders and control responses human limitations in tracking task.

UNIT 4 ENVIRONMENTAL CONDITIONS AND HUMAN MACHINE INTERFACE

9 Hrs.

Illumination, climate, noise, motion, sound, vibration, human system modeling, Human Output And Control, material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices

UNIT 5 ANTHROPOMETRY

9 Hrs.

Anthropometry- anthropometric design principles-work space envelope-factors in design of workspace surfaces-principles of seat design-principles of control panel organization. Classification of human errors-dealing with human errors -theories of accident causes - reducing accidents by altering behaviour.

Max. 45 Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Identify the problems in posture and work efficiency

CO2 - Classify the workspace and related systems

CO3 - Apply signal processing techniques for analysis and feature extraction.

CO4 - Analyze the anthropometric concepts to human system and environment.

CO5 - Suggest practices to avoid errors & accidents in workspace.

CO6 - Create instrumentation techniques for development of user friendly systems

TEXT / REFERENCE BOOKS

- 1 Mark S. Sanders & Ernest J. McCormic, Human Factors in Engineering and Design, Mc-Graw Hill international Edition, 2003.
- 2 Christopher D. Wickens, Introduction to Human Factors Engineering, Prentice Hall; 2nd edition, 2003
- 3 Terence S. Andre, Aaron W. Schopper, Human Factors Engineering in System Design, British Columbia Teacher, 1997.
- 4 Wesley E. Woodson, Human Factors Design Handbook, McGraw-Hill Professional; 2nd edition, 1992

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

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

COURSE OBJECTIVE

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

UNIT 1 INTRODUCTION

9 Hrs

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

UNIT 2 SENSORS AND TRACKING

9 Hrs

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

UNIT 3 SURGERY AND IMAGING

9 Hrs

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

UNIT 4 APPLICATIONS

9 Hrs

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

UNIT 5 CASE STUDIES

9 Hrs

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

Max. 45 Hours

Course Outcomes:

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

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

CO2: Discuss about the sensors used for localization and tracking

CO3: Summarize the applications of surgical robotics

CO4: Classify the types of assistive robots

CO5: Apply robotics to healthcare field.

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

TEXT / REFERENCE BOOKS

- 1 Thomas Bräunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, Third Edition, Springer-Verlag Berlin Heidelberg, 2008.
2. Paula Gomes, "Medical robotics- Minimally Invasive surgery", Woodhead, 2012.
3. Daniel Faust, "Medical Robots", Rosen Publishers, 2016.
4. Jocelyne Troccaz, "Medical Robotics", Wiley, 2013.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

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

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

Exam Duration : 3 Hrs.

20 Marks

80 Marks

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

Course Objectives:

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

Unit 1 Sensors for wearable systems

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

Unit 2 Signal Processing and Energy Harvesting

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

Unit 3 Scope of Wearable Devices

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

Unit 4 Wireless Health Systems

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

Unit 5 Wearable Devices for Healthcare

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

Course Outcomes:

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

References:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability," Cambridge University Press, 2013.
3. Toshiyo Tamura and Wenxi Chen, "Seamless Healthcare Monitoring", Springer 2018
4. Edward Sazonov and Michael R. Neuman, "Wearable Sensors -Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
5. Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, "Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", Springer 2010
6. Hang, Yuan-Ting, "Wearable Medical Sensors and Systems", Springer-2013
7. Mehmet R. Yuce, Jamil Y Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt. Ltd, Singapore, 2012

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

COURSE OBJECTIVE:

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

UNIT 1: MODELLING AND SIMULATION

6 Hours

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

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

UNIT 2: SMART INDUSTRY

6 Hours

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

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.

TEXT / REFERENCE BOOKS

- Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and SMART Systems, 1st Editio, CRC Press, 2020
- 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.
- Thomas Varghese & K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, Atlantic, 2012
- 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

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

COURSE OBJECTIVE:

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

UNIT 1: MODELLING AND SIMULATION

6 Hours

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

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

UNIT 2: SMART INDUSTRY

6 Hours

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

UNIT 3 BIG DATA ANALYTICS AS SERVICE PROVIDER

7 Hours

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

UNIT4 TISSUE ENGINEERING

6 Hours

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

UNIT 5 PROTOTYPING – TESTING AND COMMUNICATION

20 Hours

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

Max.45 Hours

COURSE OUTCOMES:

CO6. Articulate on the new age technologies in the modeling of biochemical engineering.

CO7. Integrate different emerging technologies to evolve Smart Factories

CO8. Deduce the components that lead to industrial digital revolution

CO9. Ability to assess the developments in bioengineering.

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

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

TEXT / REFERENCE BOOKS

- Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and SMART Systems, 1st Editio, CRC Press, 2020
- 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.
- Thomas Varghese & K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, Atlantic, 2012
- Uthayan Elangovan, Smart Automation to Smart Manufacturing: Industrial Internet of Things, Momentum Pr, 1stEdition, 2019.

PROJECT PRESENTATION

