



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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

www.sathyabama.ac.in

DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES – 2023 - 2024 [ODD SEMESTER]

Minutes of the Meeting

07/06/2023

Agenda

- Syllabus under regulations 2023
- Introduction of Mandatory Audit Courses
- Introduction of Lab Heavy Courses
- PBLA courses
- Credits increase in Skill Enhancement course
- Design thinking & Innovations

The members had a brainstorming discussion and interaction among themselves. After discussion, fruitful suggestions were incorporated appropriately in the Curriculum and Syllabi. Based on the suggestions given by the members, BOS resolved to recommend the following to the Academic Council for further approval.

- a. The syllabus of B. Tech (Biomedical Engineering) Programme under Regulation 2023
- b. Mandatory Audit courses were included in the curriculum.
- c. Lab heavy courses was recommended to create an environment where students are physically engaged with concepts in the field through active exploration or experimentation
- d. PBLA courses was included to impart logical thinking expected by industry
- e. Design thinking & innovations is introduced to practice with technology while considering feasibility, economic and customer value and market potential
- f. Skill enhancement courses was designed to provide students with value based / skill based knowledge in hand to increase their employability

Dr. T. Sudhakar thanked all the members for their kind cooperation and the meeting came to an end.



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Members of BoS – Biomedical Engineering

EXTERNAL MEMBERS

1. Dr. G. Harikrishnan, Associate Professor & Research Coordinator, Department of Electrical & Electronics Engg., Sree Vidyanikethan Engg. College, Tirupati *G. Harikrishnan*

INTERNAL MEMBERS

1. Dr. T. Sudhakar, Member, Department of Biomedical Engg., *T. Sudhakar*
2. Dr. J. Premkumar, Member, Department of Biomedical Engg., *J. Premkumar*
3. Ms. Sindu Divakaran, Member, Department of Biomedical Engg., *S. Sindu*
4. Dr. P. Grace Kanmani, Member, Department of Biomedical Engineering, *P. Grace Kanmani*



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES – 2023 - 2024 [EVEN SEMESTER]

Minutes of the Meeting

20/11/2023

Agenda

- Machine learning and AI for healthcare applications (SBMA3014)
Venture creation (SBAA4004)

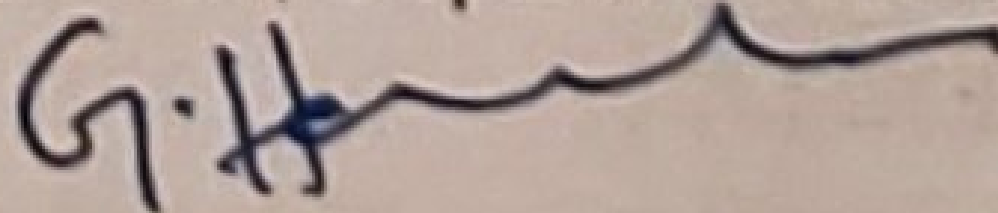
. Based on the suggestions given by the members, BOS resolved to recommend the following to the Academic Council for further approval.

- a. **Machine learning and AI for healthcare applications (SBMA3014)** was introduced to understand opportunities and challenges in real word clinical applications.
- b. **Venture creation (SBAA4004)** was introduced as a elective in eight semester in which students explore the on-going creation of a new venture as a primary aspect of their formal study

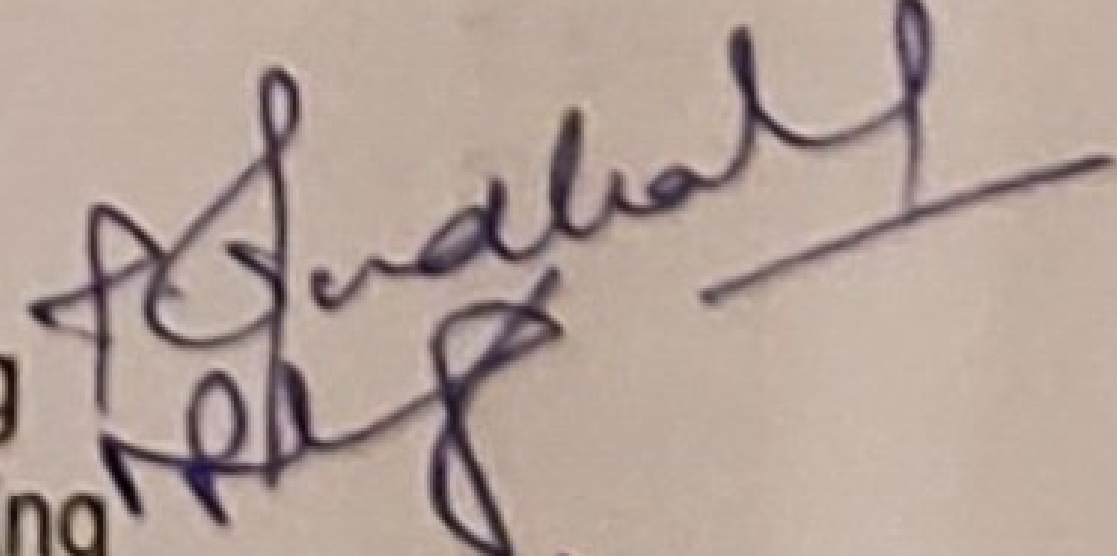
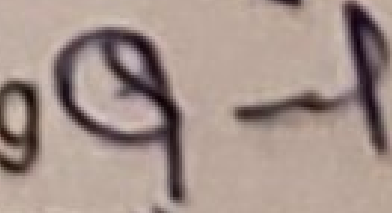
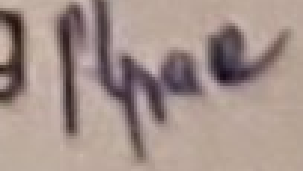
Dr. T. Sudhakar thanked all the members for their kind cooperation and the meeting came to an end.

Members of BoS – Biomedical Engineering

EXTERNAL MEMBERS

1. Dr. **G. Harikrishnan**, Associate Professor & Research Coordinator, Department of Electrical & Electronics Engg., Sree Vidyanikethan Engg. College, Tirupati 

INTERNAL MEMBERS

1. Dr. **T. Sudhakar**, Member, Department of Biomedical Engineering 
2. Dr. **J. Premkumar**, Member, Department of Biomedical Engineering
3. Ms. **Sindu Divakaran**, Member, Department of Biomedical Engineering 
4. Dr. **P. Grace Kanmani**, Member, Department of Biomedical Engineering 

SBMA1101 (Old)	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.

Course outcomes:

Max. 45 Hours.

On completion of the course students will be able to:

- CO1: Understanding the principles of cell structure and transport across the cell membrane. L2
CO2: Demonstrate the role of various cell receptors and the signaling between the cells L4
CO3: Learning the process of cell division and recognize the importance of chromosome L1
CO4: To identify the genetic material and demonstrate the types of mutation and their importance L3
CO5: Understanding the procedure of genetic engineering and gene therapy. L1
CO6: Outline the problem encountered due to chromosomal abnormality and counseling to the society.

TEXT / REFERENCE BOOKS

- Principles of Molecular Biology: : Veer Bala Rastogi,: 2016
- Genetics: By: Veer Bala Rastogi, S. Chand publication: 4th Edition 2018
- Molecular Biology of Genes-Watson, 7th Edition, Benjamin Cummings, 2013
- Ajoy Paul, A text Book of Cell and Molecular Biology, Books and Allied Publishers 2007.
- David Friefelder, Molecular Genetics, Narosa publishing house, India, 2006.
- Kavita B Ahluwalia, Genetics, New age international publishers, India. 2008.

 Added Content

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SBMB1101 (Revised)	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

- 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 - Understands the scope of microbiology, structure of microbes and their microbial growth.
- CO5 - Demonstrates the morphology of microbes using various microscopes and staining techniques.
- CO6 - 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**

Added Content



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S.No.	CourseCode	CourseName	DeletedTopics	AddedTopics
1	SBMB1101	CELL BIOLOGY AND MICROBIOLOGY	UNIT 4 GENETIC MATERIAL AND MUTATION 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.	Plasma Membrane models and chemical composition Transport through cell membrane role of IP3, DAG and calcium in cell signaling. DNA replication- Conservative, Semi-Conservative, & Dispersive models of DNA replication UNIT 4 INTRODUCTION TO MICROBIOLOGY AND MICROBIAL GROWTH 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 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.
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SBMA1301 (Old)	BIOSENSORS AND MEASUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- 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 I 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. Bridge Circuits: Wheatstone bridge, Maxwell's bridge, Wein's bridge and Schering bridge.

UNIT II PASSIVE AND ACTIVE TRANSDUCERS

9 Hrs

Classification of transducers and characteristics for selection of transducers - Resistive transducers-Strain Gauge, Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics. Piezoelectric active transducer- Equivalent circuit and its characteristics. photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, Optical displacement sensors and optical encoders.

UNIT III 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 IV BIOSENSORS

9 Hrs

Biological Sensors: Study of various corpuscles like Pacinian, functions and modelling, Chemoreceptor, hot and cold receptors, baro- receptors, 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.

UNIT V 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, PMMC writing systems. Recorders: Graphic recorders, strip chart recorders, Galvanometer type recorders and self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders.

Max. 45 Hrs

COURSE OUTCOMES

On completion of the course, student will be able to

- 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 / REFERENCE BOOKS

1. A.K.Sawhney, A course in electronic Measurements and Instruments, Dhanpat Raisons, 2014
2. H.S.Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 2011
3. John G. Webster, —Medical Instrumentation Application and Design II, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
4. Transducers for Biomedical Measurements: Principles and Applications, Richard S.C. Cobbold, John Wiley & Sons, 2004.
5. Electronics in Medicine and Biomedical Instrumentation by Nandini K. Jog PHI Second Edition 2013.
6. Biomedical sensors – fundamentals and application by Harry N, Norton. 2001
7. Biomedical Transducers and Instruments, Tatsuo Togawa, Toshiyo Tamma and P. Ake Öberg, 2018

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks:100

PART A: 10 questions of

Exam Duration: 3 Hrs.

2 marks each - No choice

20

Marks

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

S24BLH21 (Revised)	BIOSENSORS AND MEASUREMENTS					Total Marks
	L	T	P	EL	C	
	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.

PRACTICE EXERCISE

15 Hrs

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

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

 Added Content  Deleted Content

S.No.	CourseCode	CourseName	DeletedTopics	AddedTopics
1	S24BLH21	BIOSENSORS AND MEASUREMENTS	Bridge Circuits: Wheatstone bridge, Maxwell's bridge, Wein's bridge and Schering bridge. Equivalent circuit and its characteristics. photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, Optical displacement sensors and optical encoders.	SMART SENSORS. Introduction to Smart Sensors and Semiconductor sensors, MEMS. 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

SBMA5103 (Old)	ADVANCED BIOMEDICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

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

UNIT 1 BIOMEDICAL SIGNALS & ELECTRODES 9 Hrs.

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

UNIT 2 ASSISTIVE DEVICES CARDIAC SYSTEM AND MONITORS 9 Hrs.

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

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

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

UNIT 4 ULTRASONIC AND NEONATAL INSTRUMENTS 9 Hrs.

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

UNIT 5 TELEMEDICINE AND SAFETY MEASUREMENTS 9 Hrs.

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

Max. 45 Hours

TEXT / REFERENCE BOOKS

- Joseph J Carr and John M Brown – Introduction to Biomedical equipment Technology - Pearson Education 4th edition New Delhi 2001.
- R.Ananda Natarajan, Biomedical Instrumentation and Measurements, 2nd Edition, PHI, 2016.
- Webster J.G Medical Instrumentation application and design – John Wiley and sons New York 4th edition 2005.
- Khandpur R.S Hand Book of Biomedical Instrumentation – Tata McGraw Hill publication, New Delhi 2nd edition 2014.
- John Denis Enderle, Joseph D. Bronzino, Susan M. Blanchard, 'Introduction to Biomedical Engineering: Academic Press, 2005, 2nd Edition ISBN 0122386620, 9780122386626.

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 of internal choice, carrying 14 Marks each

70 Marks

SBMB5103 (Revised)	ADVANCED BIOMEDICAL INSTRUMENTATION					L	T	P	E	C	Total
						3	0	0	2	3	Marks
											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), Electoretinography (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

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

Added Content

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S.No.	CourseCode	CourseName	DeletedTopics	AddedTopics
1	SBMB5103	ADVANCED BIOMEDICAL INSTRUMENTATION	Origin of bioelectric signals ECG, EEG, EMG. Medical surface electrodes and problems, MEMS. Electrocardiograph-block diagram, ECG leads, Types of ECG Recorders, Faults and troubleshooting, Phonocardiograph- origin of heart sounds, microphones and amplifiers for PCG, Operating Rooms Fundamentals of Telemedicine, Block diagram of Telemedicine, Scope & Benefits and Limitation of Telemedicine. Applications - Teleradiography, Telecardiology, Telesurgery.	Regulation of Breathing - Humidifier, Nebulizer – Ventilators - different types. Galvanic, Faradic Stimulators, Interferential therapy UNIT V SPECIAL MEDICAL INSTRUMENT AND SAFETY MEASUREMENTS 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

S1SB9101	RESEARCH METHODOLOGY & IPR	L	T	P	E	C	Total Marks
		3	0	0	0	3	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**

 **NEW COURSE**

S44BPB21	INDUSTRY VERSION 5.0	L	T	P	EL	C	Total Marks
		2	0	1	0	3	100

COURSE OBJECTIVE

- Ø To have an in-depth knowledge of advancements in Industries
- Ø To differentiate Industry version 4.0 and version 5.0.
- Ø 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.

COURSE OUTCOMES

45 Hrs

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. Tsihrintzis- 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

NEW COURSE

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

Exam Duration: 3 Hrs.

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

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

20 Marks

80 Marks

NEW COURSE

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- 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

Exam Duration: 3 Hrs.

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

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

20 Marks

80 Marks

NEW COURSE

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

Exam Duration: 3 Hrs.

PART A: 10 Questions of 2 marks each - No choice **20 Mark**

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks **80 Marks** **NEW COURSE**

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

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Wei Di, Anuragh Bharadwaj, "Deep Learning Essentials", Jianing Wei, Packt Publishers, 2018.
3. Nikhil Buduma, Nicholas, "Fundamentals of Deep Learning", O Reilly Media, 2017.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
5. Suraj Sawant. "Deep Learning", IGI Global, 2018.
6. 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

Exam Duration: 3 Hrs.

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

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

20 Marks

80 Marks

NEW COURSE

S24BPB75	PYTHON FOR SIGNAL AND IMAGE APPLICATIONS	L	T	P	EL	C	To
		2	0	2	0	3	Ma

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

Exam Duration: 3 Hrs.

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

20 Marks

NEW COURSE

PART B: 2 Questions from each unit with internal choice, each carrying 16 marks 80 Marks

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 and

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 deroo 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 Mark

80 Marks

SBMA7007 (Old)	MEMS IN HEALTHCARE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- This course introduces students to Micro Electro Mechanical Systems (MEMS), small devices that perform tasks and functions involving various types of signals, and teaches the fundamentals of micromachining and microfabrication.
- Students will also learn the basics for designing and analyzing devices and systems in mechanical, electrical, fluidic, and thermal energy/signal domains, as well as basic techniques for multi-domain analysis.

UNIT1 MEMS AND MICROSYSTEMS 9Hrs.

Mems and Microsystems- General principles, advantages, Materials for bio-MEMS and their properties. Technology involved in MEMS: Fabrication techniques- Lithography- etching- Ion implantation- wafer bonding. Integrated processing- Bulk Micromachining- Surface micromachining- coating technology and CVD-LIGA process.

UNIT2 MICROSENSORS AND TISSUE MICROENGINEERING 9Hrs.

Introduction to biomimetic substrates, micro scaffolds, cellular co-cultures. Microsensors and Microactuators- working principle, types- pressure sensors, thermal sensors and actuators, piezoelectric crystals- Intelligent materials and structures, Magnetic sensors and actuators- magnetic materials used for MEMS.

UNIT3 MOEMS AND MICROFLUIDIC SYSTEM

9Hrs.

Principle of MOEMS- light modulator, beam splitter, digital micro mirror device, light detectors and optical switch. Microfluidic System- Fluid actuation method, dielectrophoresis, microfluid dispenser, microneedle, micro pumps. Applications of BioMEMS- Healthcare, drug delivery, micro total analysis system detection and measurement methods,

UNIT4 INTRODUCTION TO NANOTECHNOLOGY 9Hrs.

Essence of Nanotech, Nanofying electronics, Properties of nanomaterials, metal nano clusters, semiconductor nanoparticles, nanocomposites. Introduction to carbon nanostructure, carbon molecules, carbon clusters, nanotubes-application.

UNIT5 MEDICAL APPLICATIONS OF NANOTECHNOLOGY 9 Hrs.

Nanotechnology and Biomedicine- Drug synthesis and delivery- nano fabrication methods- biomimetic nanodevices nanomaterials in human body- toxicity in nanomaterials.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Tai Ram Hsu, Mems and Microsystems, Design and Manufacture, TMH 2008.
2. Mohammed Had-el-hak, MEMS Introduction & Fundamentals, CRC Press, 2005.
3. Marc J. Madou, Fundamentals of Microfabrication and Nanotechnology, Third Edition, 2011, CRC Press. ISBN 9780849331800
4. Harsingh Nalwa, Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers. 2007.
5. Neelina Malsch, Biomedical Nanotechnology. CRC, 2005
6. Richard Booker and Earl Boysen, Nanotechnology For Dummies, John Wiley & Sons, 2011

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3Hrs.

PART A: 6 Questions of 5 Marks each- No Choice 30 Marks

PART B: 2 Questions from each unit of internal choice, carrying 14 Marks each 70 Marks

SBMB7006	MEMS AND NANOTECHNOLOGY IN HEALTH CARE	L	T	P	EL	C	Total Marks
		3	0	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, Nano orthopedies and Nano Ophthalmology.

COURSE OUTCOMES

45Hrs

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.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3 Hrs.

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

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

30 Marks

S.No.	CourseCode	CourseName	DeletedTopics	AddedTopics
1	SBMB3018	BIOMEMS AND NANOTECHNOLOGY	General principles, advantages, Materials for bio-MEMS and their properties. Technology involved in MEMS. Fabrication techniques materials used for MEMS. UNIT2 MICROSENSORS AND TISSUE MICROENGINEERING Introduction to biomimetic substrates, micro scaffolds, cellular co-cultures. Microsensors and Microactuators— working principle, types—pressure sensors, thermal sensors and actuators, piezoelectric crystals—Intelligent materials and structures, Magnetic sensors and actuators—magnetic materials used for MEMS. Principle of MOEMS- light modulator, beam splitter, digital micro mirror device, light detectors and optical switch UNIT5 MEDICAL APPLICATIONS OF NANOTECHNOLOGY Nanotechnology and Biomedicine—Drug synthesis and delivery—nano fabrication methods- biomimetic nanodevices nanomaterials in human body- toxicity in nanomaterials.	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 UNIT III APPLICATIONS OF MEMS IN MEDICINE 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 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 Nanotechnology in oncology Nano neurology, Nano cardiology.

SBMA7005 (Old)	HOSPITAL EQUIPMENT MAINTENANCE & SAFETY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To train students and thus provide skilled technologists to the medical community. This course aims to give a thorough grounding in issues of safety for maintenance personnel working in medical establishments. The course will emphasize both theoretical and practical parts.

UNIT1 EQUIPMENT MANAGEMENT

9Hrs.

Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of equipment and operating instructions. Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT2 LOGISTIC SUPPORT & RELIABILITY

9 Hrs.

Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials. Reliability fundamentals.

UNIT3 ELECTROMAGNETIC INTERFERENCE IN HOSPITALS

9Hrs.

Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.

UNIT4 HOSPITAL SAFETY

9Hrs.

Radiation safety, Safety precautions, Hazardous effects of radiation, allowed levels of radiation, ICRP regulations for radiation safety.

UNIT5 ELECTRICAL & FIRE SAFETY

9Hrs.

Sources of shocks, macro & micro shocks, monitoring and interrupting the Operation from leakage current- Elements of fire, causes of fire & fire protection.

Max. 45 Hours

TEXT / REFERENCE BOOKS

- Maintenance and repair of laboratory diagnostic imaging and hospital equipment, WHO 2010 (revised)
- Antony Kelly, Maintenance Planning & Control Butterworth, London, 2004.
- Hans Pleiffveradammann (ed), Hospital Engineering in developing countries, GTZ report Eschborn, 2006.
- Webster J. and Albert M. Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc. Englewood Cliffs, New Jersey, 2009.
- B.M. Sakharkar, Principles of Hospital administration and Planning, Jaypee Brothers Medical Publishers (P) Ltd. 1st edition 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

Exam Duration: 3Hrs.

PART A: 6 Questions of 5 Marks each – No Choice

Marks

PART B: 2 Questions from each unit of internal choice, carrying 14 Marks each

SBMB7005 (Revised)	HOSPITAL EQUIPMENT MAINTENANCE & SAFETY					L	T	P	EL	C	Total Marks
						3	0	0	0	3	100

COURSE OBJECTIVE

- Ø To Focus on the acquisition of skills necessary to perform inspection, installation, preventative maintenance and troubleshooting of Basic Clinical Equipment
- Ø To facilitate the related medical device/ electronic systems, including appropriate documentation for all service activities and training the hospital staff.

UNIT I EQUIPMENT MANAGEMENT

9 Hrs.

Organizing the maintenance operation, biomedical equipment procurement procedure, proper selection, compatibility, testing and installation, purchase and contract procedure, trained medical staff, on proper use of equipment and operating instructions. Maintenance job planning, preventive maintenance, maintenance budgeting, contract maintenance.

UNIT II LOGISTIC SUPPORT & RELIABILITY

9 Hrs.

Maintenance equipment and Tools, failure analysis, spare parts and maintenance materials. Reliability fundamentals.

UNIT III CLINICAL ENGINEERING

9 Hrs.

Role to be performed in Hospital, Manpower & Market, Professional Registration, Maintenance of Hospital support system, surveillance network, electric power management, Medical gas production, waste disposal, inventory control. Case study: RF ID tag for inventory.

UNIT IV HOSPITAL SAFETY

9 Hrs.

Radiation safety, Operations of safety devices, Hazardous effects of radiation, radiation measurements, ICRP regulations for radiation safety.

UNIT V ELECTRICAL & FIRE SAFETY

9 Hrs.

Sources of shocks, macro & micro shocks, monitoring and interrupting the Operation from leakage current- Elements of basic fire aid, causes of fire & fire protection Case study: Safety awareness

COURSE OUTCOMES

45Hrs

On completion of the course, students will be able to

CO1: Facilitate Biomedical Instrumentation Services for basic clinical equipment

CO2: understands the strategy of medical equipment maintenance and various options for medical equipment maintenance in the hospital.

CO3: Demonstrate good communication, communicate accurately and appropriately in the role of Medical Equipment Technician

CO4: Deliver and set-up medical equipment

CO5: Calibrate and help in equipment maintenance

CO6: Maintain a safe, healthy, and secure working environment

TEXT BOOK / REFERENCE BOOK

1. Maintenance and repair of laboratory diagnostic imaging and hospital equipment, WHO 2010 (revised) Antony Kelly, Maintenance Planning & Control Butterworth, London, 2004.
2. Hokey Min, "Healthcare Supply Chain Management: Basic Concepts and principles", Business expert press, New York, 2014
3. Syed Amin Tabish "Hospital and Health services Administration Principles and Practices" Oxford Press, New Delhi, 2016
4. M. A. George, The Hospital Administrator, Jaypee Publications, 2015
5. Sanskriti Sharma, Essentials for Hospital Support Services and Physical infrastructure, Publications 2015

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**

S.No.	CourseCode	CourseName	DeletedTopics	AddedTopics
1	SBMA2602	Diagnostic Instrumentation	UNIT 3 ELECTROMAGNETIC INTERFERENCE IN HOSPITALS Principles of EMI, computation of EMI, Method of suppressing and isolating the unit from interference.	UNIT III CLINICAL ENGINEERING Role to be performed in Hospital, Manpower & Market, Professional Registration, Maintenance of Hospital support system, surveillance network, electric power management, Medical gas production, waste disposal, inventory control. Case study: RF ID tag for inventory.

SBMA7001 (Old)	BIOMATERIALS AND ARTIFICIAL ORGANS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

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

UNIT 1 INTRODUCTION

9Hrs.

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

UNIT 2 TISSUE RESPONSE TO IMPLANTS

9Hrs.

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

UNIT 3 CHARACTERIZATION OF OPHTHALMIC AND DENTAL MATERIALS

9 Hrs.

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

UNIT 4 BLOOD INTERFACING IMPLANTS

9Hrs.

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

UNIT 5 TRANSPLANTS

9Hrs.

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

Max. 45 Hours

TEXT / REFERENCE BOOKS

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

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max.Marks:100

Exam Duration:3Hrs.

PART A: 6 Questions of 5 Marks each—No Choice

30 Marks

PART B: 2 Questions from each unit of internal choice, carrying 14 Marks each

70 Marks

SBMB7001 (Revised)	BIOMATERIALS AND ARTIFICIAL ORGANS	L	T	P	EL	C	Total Marks
		3	0	0	0	3	100

COURSE OBJECTIVE

- Ø To provide a general understanding of the multidisciplinary field of biomaterials.
- Ø To provide an understanding of material bulk and surface properties, degradation processes, various biological responses to the materials.
- Ø The general concepts of artificial organs learned in this course will further extend the understanding about the interactions of material and biological systems

UNIT-I INTRODUCTION TO BIOMATERIALS

9 Hrs

Overview of Biomaterials, mechanical properties, surface chemistry of materials, surface modification, Corrosion of metallic implants, Tissue Reaction, Bio Compatibility. metallic biomaterials, Ceramic biomaterials, Polymeric biomaterials, Composite biomaterials.

UNIT-II TISSUE REPLACEMENTS

9 Hrs

Hard tissue replacements – Wires, pins and Screws, Joint replacements – Upper extremity and Lower extremity, Soft tissue replacements – sutures, Tapes, Staples, Adhesives, Normal Wound healing process.

UNIT-III OPHTHALMIC AND ORAL

9 Hrs

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

UNIT-IV BLOOD INTERFACING IMPLANTS

9 Hrs

Artificial blood, Neural and neuro muscular implants, Cardiac Implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, Cardiac defibrillators, artificial kidney, Dialysis system.

UNIT-V STERILIZATION OF IMPLANT

9 Hrs

Sterilization techniques: Process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization, filter sterilization.

COURSE OUTCOMES

45Hrs

On completion of the course, students will be able to

- CO1: Understand the basic principles in material science and their contribution towards Biomedical engineering
- CO2: Analyze different types of materials and apply in designing a device.
- CO3: Select the materials for designing an implant in tissue replacement.
- CO4: Acquire knowledge about different types of artificial organs and their implantation.
- CO5: Identify significant gap required to overcome challenges and further developments.
- CO6: Implement the artificial organs to replace malfunctioning of natural organs.

TEXT BOOK / REFERENCE BOOK

1. JD Bronzino, Biomedical Engineering hand book, CRC Press/IEEE Press, Volume 2, 2nd Edition, 2000.
2. Sujata V Bhat, Biomaterials – Narosa Publishing House Pvt. Ltd., 2nd Edition, 2009.
3. Larry L. Hench and Julian R. Jones, Biomaterials, Artificial organs and Tissue Engineering, 2005.
4. Anne Booth Sterilization of Medical Devices Publisher CRC Press 2008

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**

S.No.	CourseCode	CourseName	DeletedTopics	AddedTopics
1	SBMB7001	BIOMATERIALS AND ARTIFICIAL ORGANS	Artificial blood. UNIT 5 TRANSPLANTS Overview, Immunological considerations, individual organs – kidney, liver, heart and lung, bone, cornea, Skin and hair, Pancreas, Mechanism of allograft rejection, Regeneration and ethical considerations, Immunosuppressive drugs.	UNIT-V STERILIZATION OF IMPLANT Sterilization techniques: Process and mechanism of action of steam sterilization, radiation sterilization, electron beam sterilization, ethylene oxide, chlorine dioxide and plasma gas sterilization, filter sterilization.

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

- Burkov, Andriy, — The Hundred-page Machine Learning Book, 2019.
- Theobald, Oliver., — Machine Learning for Absolute Beginners: A Plain English IntroductionII, Scatterplot Press, 2017. .
- Maini, Vishal, and Sabri, Samer. Machine Learning For Humans: Introduction to Machine Learning with Python. Romania, Alanna Maldonado, 2023
- Stephen Lucci and Danny Kopec, "Artificial Intelligence in the 21st Century, Second Edition, Mercury Learning and Information, 2015.
- 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

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**