



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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

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DEPARTMENT OF BIOMEDICAL ENGINEERING BOARD OF STUDIES (2021 – 2022) ODD Semester

Minutes of the Meeting

03-07-2021

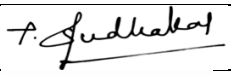
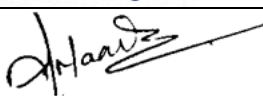
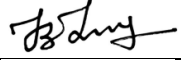
1. As per discussion with the BOS members the following new professional elective courses has been introduced from Academic year 2021 - 2022 onwards Course Medical Robotics and Wearable systems for health care. The members suggested that few lecture topics can be taken by the industrial experts and they can share their industrial knowledge to student for motivating them to implement in mini project.
2. **MEDICAL ROBOTICS**
UNIT 5
Students will be given real time surgeries as studies with respect to journals, internet sources and assignments.
3. **WEARABLE SYSTEMS FOR HEALTH CARE**
UNIT 4
IOT will be incorporated along with wireless health systems.
Unit 5
Topics regarding to sensors should be incorporated in unit 1
Applications to be included in unit 5
4. The above suggestions were given by the BOS members during their meeting and this come to existence from Academic year 2021 – 2022 onwards.

Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

1. Dr. **G. Harikrishnan**, 
Associate Professor & Research Coordinator,
Department of Electrical & Electronics Engg.,
Sree Vidyanikethan Engg. College, Tirupati
2. Dr. **C.M. Sujatha**,
Associate Professor, Department of ECE, Anna University, Chennai

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. T. Sudhakar, HoD	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Ms. Bethanne Janney	
7	Mr. G. Umashankar	

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



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DEPARTMENT OF BIOMEDICAL ENGINEERING BOARD OF STUDIES (2021 – 2022) EVEN Semester

Minutes of the Meeting

01-11-2021

1. Industry 4.0 for Bio & Chemical Engineers for UG and Industry 4.0 for Bio engineers PG introduced as PBLA course. The conduction of examination will be based 50 % theory and 50 % practical course. Internal marks will be calculated from CAE I & CAE II, TWO assignments which was conducted periodically during the course. ESE written exam will be assessed based on the case study (design, implementation, operations) and prototype model.
2. UHV course was introduced for Batch 2020 as per the AICTE guidelines, 3 credits was given according to norms of AICTE
3. The above suggestions were given by the BOS members during their meeting and this come to existence from Academic year 2021 – 2022 onwards.

Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBER - Dr. G. Harikrishnan,

Associate Professor & Research Coordinator,
Department of Electrical & Electronics Engg.,
Sree Vidyanikethan Engg. College, Tirupati

INTERNAL MEMBERS

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3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Dr. J. Bethanne Janney	

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

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

END SEMESTER EXAMINATION PATTERN

Max Marks: 100

PROJECT PRESENTATION

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

5. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, Handbook of Industry 4.0 and SMART Systems, 1st Editio, CRC Press, 2020
6. Sider W.D., Seader J. D., and Lewin D.R., Product and Process Design principles, Synthesis, Analysis and Evaluation, 2nd Edition, John Wiley and Sons, 2010.
7. Thomas Varghese & K.M. Balakrishna, Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials, Atlantic, 2012
8. 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

SAIC4003	UNIVERSAL HUMAN VALUES	L	T	P	Credits	Total Marks
		2	1	0	3	100

COURSE OBJECTIVES

- To develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence
- To understand (or developing clarity) the harmony in the human being, family, society and nature/existence
- To strengthen self-reflection
- To develop commitment and courage to act

MODULE 1 COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
 2. Self-Exploration-what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.
- Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

MODULE 2 UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
 8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
 9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
 10. Understanding the characteristics and activities of 'I' and harmony in 'I'
 11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
 12. Programs to ensure Sanyam and Health.
- Practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

MODULE 3 UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
 14. Understanding the meaning of Trust; Difference between intention and competence
 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
 17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.
- Practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

MODULE 4 UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

18. Understanding the harmony in the Nature
19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self regulation in nature
20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

21. Holistic perception of harmony at all levels of existence.

Practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

MODULE 5 IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

22. Natural acceptance of human values

23. Definitiveness of Ethical Human Conduct

24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems

27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Total: 28 Lectures And 14 Practice Sessions

COURSE OUTCOMES

On completion of the course, the student are expected

CO1: To become more aware of themselves, and their surroundings (family, society, nature)

CO2: They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind

CO3: To have better critical ability

CO4: To become sensitive to their commitment towards what they have understood (human values, human relationship and human society)

CO5: To apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction

TEXT /REFERENCE BOOKS

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj – PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

ASSESSMENT:

Assessment by faculty mentor: 10 marks

Self-assessment:: 10 marks

Assessment by peers: 10 marks

Socially relevant project/Group Activities/Assignments: 20 marks
Semester End Examination: 50 marks



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES - 2020

Minutes of the Meeting

26-06-2020

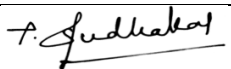
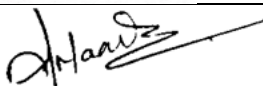
1. As per discussion with the BOS members the new subject Industry 4.0 introduced in the fourth semester for second year B.Tech (Biomedical Engineering) 2019-2023 batch, the members suggested that few lecture topics can be taken by the industrial experts and they can share their industrial knowledge to student for motivating them to implement in mini project.
2. The Courses SBM1201 (Bioinstrumentation & measurements) & SBM1202 (Biosensors & transducers) has be merged into SBMA1301 (Biosensors & Measurements). The curriculum has been designed as per the industrial demands as suggested by the alumni.
3. SBMA1404 (Radioimaging & Therapeutics) few topics has been included in order to meet the relevant to the latest technologies as suggested by the industrial experts.
4. SBMA3004 (Analytical Instrumentation) Unit IV has been completely revised with Centrifugation, taking into consideration of the prerequisite knowledge of basic concepts in research and feedback obtained from students and faculty members in that subject.
5. The Board ofMembers suggested that work shop, engineering drawing syllabus content were correlating on par to the demand of Biomedical engineering domain.

Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

1. Dr. G. Harikrishnan, 
Associate Professor & Research Coordinator,
Department of Electrical & Electronics Engg.,
Sree Vidyanikethan Engg. College, Tirupati
2. Dr. C.M. Sujatha,
Associate Professor, Department of ECE, Anna University, Chennai

INTERNAL MEMBERS

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5	Ms. Sindu Divakaran	
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7	Mr. G. Umashankar	

S.No.	Course Code	Course Name	Deleted Topics	Added Topics
1	SBM1201	Bioinstrumentation & Measurements	Unit 2,3,4	Unit 1 & 5 combined as a single unit 1
2	SBM1202	Biosensors & transducers	NIL	Unit 1,2, 3 & 5 combined as a Unit 2,3,5
3	SBMA1301	Biosensors & Measurements	NIL	Biological Sensors: Study of various corpuscles like Pacinian, functions and modelling, Chemoreceptor, hot and cold receptors, baroreceptors, 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 4
4	SBMA1404	Radioimaging & therapeutics	NIL	collimators, grids - bucky grids, Body section radiography, Xeroradiography, Cine Angiography, Digital subtraction Angiography, Mammography and Dental x-

				ray unit
5	SBMA3004	Analytical Instrumentation	Unit IV - Microscope and its types	Unit IV – Centrifugation & its types
6	SEC1217	Basic Electronic Devices	Unit 1 Unit 2 - Transistor as a switch basewidth modulation Transistor breakdown applications Unit 5	Display devices – LED Laser diodes JFET, MOSFET, UJT, Thyristor, IGBT
7	SEC1219	Linear Electronic Circuits	Unit 1 Unit 2 – Stability factor analysis Unit 3 distortion in amplifier medical applications Unit 5 – multivibrators	MOSFET, small signal analysis gain & frequency response Bismos cascade amplifier, differential amplifier common and differentmode analysis
8	SBMA1305	Basic Electronic Devices, circuits & its applications		Display devices – LED Laser diodes JFET, MOSFET, UJT, Thyristor, IGBT MOSFET, small signal analysis gain & frequency response Bismos cascade amplifier, differential amplifier common and differentmode analysis

*SBM1201 (Bioinstrumentation & Measurements), *SBM1202 Biosensors & transducers has been revised as a single course *SBMA1301 (Biosensors & Measurements)

*SEC1217 (Basic Electronic devices), *SEC1219 (Linear Electronics Circuits0) has been revised as a single course *SBMA1305 (Basic Electronic Devices, circuits & its applications)

Unit 2,3,4 - Deleted topics

*Unit 1, 2, 3 & 4 combined as a Unit 2,3,5 – Added topics

SEC1217	BASIC ELECTRONIC DEVICES	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- ☐ To help the student understand the basics of the principles of circuit analysis and design
- ☐ To understand the basic concepts and characteristics of the electronic devices and circuits.

UNIT 1 SEMICONDUCTOR DIODE 9 Hrs.

Intrinsic and Extrinsic semiconductor, PN junction Diode: Construction, Working and VI Characteristics, Junction capacitance: Diffusion Capacitance and Transition Capacitance, Application of diode: Diode switch, Clipper, Clamper and Voltage multipliers - Zener diode - Zener voltage regulators. Applications - Devices - number

UNIT 2 BIPOLAR JUNCTION TRANSISTOR 9 Hrs.

Construction and Operation of NPN and PNP transistor - Characteristics of Common Base, Common Emitter and Common collector configuration, Transistor as Switch, Base width modulation, Transistor breakdown. Applications - Devices - number - examples.

UNIT 3 FIELDEFFECT TRANSISTOR 9 Hrs.

JFET: Construction, Operation and Characteristics, Expression for pinch off voltage and drain current, MOSFET: Enhancement mode and Depletion mode MOSFET operation and characteristics, handling precautions of MOSFET, FET as VVR - Comparison of MOSFET and JFET - Comparison of BJT and JFET.

UNIT 4 SPECIAL SEMICONDUCTOR DEVICES 9 Hrs.

SCR - UJT - DIAS - TRIAC - Varactor diode - PIN diode - Principle of photo electronic devices - Solar cell, Photo diode and Phototransistor - LED, LCD, LASER diode, CCD - Operation, Characteristics and Applications. Circuits

UNIT 5 PRINCIPLES OF CRT 9 Hrs.

Force on charged particle in electric field and magnetic field - Motion of charged particle in electric and magnetic field - Principles of CRT - Deflection and focusing of electron beam in CRT and TV picture tube - Orientation of electric and magnetic field in CRT - Applications of CRO.

Max. 45 Hours

Course Outcomes:

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

- CO1:** To analyze the working and applications of different Semiconductor devices.
- CO2:** To compare the different characteristics of NPN, PNP and their different configurations
- CO3:** To Compare the various characteristics of Field Effect Transistors
- CO4:** To Analyze the operations of thyristor family and Photo- Electronic Devices
- CO5:** To apply the knowledge of working of Cathode Ray Tube in various measurements
- CO6:** To choose the particular semiconductor device for the desired application

TEXT / REFERENCE BOOKS

1. Millman and Halkias, Electronic devices and circuits, 2nd Edition, McGraw Hill Publication, 2007.
2. G.K. Mithal, Basic Electronic Devices and circuits, 2nd Edition, G.K. Publishers Pvt. Ltd., 1998.
3. David Bell, Fundamentals of Electronic Devices and Circuits, 5th Edition, Oxford University Press 2008.
4. Robert L. Boylestad, Electronic Devices and Circuit Theory, 6th Edition, PHI, 1998.
5. Ben G Streetman and Sanjay Banerjee, Solid State Electronic Devices, 6th Edition, Pearson Education, 2005.
6. Roody and Coolen, Electronic Communications, 4th Edition, Pearson Education, Reprint 2007.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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 12 marks

60 Marks

SEC1219	LINEAR ELECTRONIC CIRCUITS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To familiarize the student with the analysis and design of basic transistor amplifier circuits, feedback amplifiers, wave shaping and multi vibrator circuits as applicable to design medical instruments

UNIT 1 RECTIFIERS AND POWER SUPPLIES 9 Hrs.

Half Wave and Full Wave Rectifier, Bridge rectifier - performance measures of rectifiers, filters: Full Wave rectifier with inductive filter, capacitive filter, LC filter, Regulators-Shunt and series voltage regulators - Performance measures of regulators - Simple power supply circuits for medical instruments.

UNIT 2 BIASING CIRCUITS AND SMALL SIGNAL BJT AMPLIFIERS 9 Hrs.

Biasing circuit of BJT, DC equivalent circuit of BJT, DC and AC Load Lines, Stability factor analysis, Small Signal Equivalent circuit - Calculation of gain, Input and Output Impedance of CB, CC and CE amplifiers using h- Parameters.

UNIT 3 MULTISTAGE AMPLIFIERS AND POWER AMPLIFIERS 9 Hrs.

Introduction to multistage amplifiers, Two stage RC Coupled amplifier, Darlington emitter follower amplifier, Bootstrap amplifier Introduction, Power Amplifiers: Class A Power Amplifier, Push Pull Principle, Class B push pull amplifier and complementary symmetry amplifier, Class C amplifier, Distortion in amplifiers - Medical applications.

UNIT 4 FEEDBACK AMPLIFIERS AND OSCILLATORS 9 Hrs.

Effects of negative feedback, Voltage series, voltage shunt, current series and current shunt feedback amplifiers, Barkhausen Criterion for Oscillation, Construction and working of RC, Wein bridge oscillator, Hartley Oscillator, Colpitts Oscillator, Crystal Oscillator - Medical applications

UNIT 5 TUNED AMPLIFIERS AND MULTIVIBRATORS 9 Hrs.

Single tuned amplifier, Stagger tuned amplifier, Tuned amplifier instability, Neutralization and Unilateralization, Multivibrators: Astable, Bi stable and monostable multivibrators

Max. 45 Hours

Course Outcomes:

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

CO1: Compare the various types of Rectifiers, Filters and regulators

CO2: Analyze the Hybrid model equivalent circuit and small signal analysis of amplifiers and Categorize the Biasing circuits of the Transistor

CO3: Analyze and Design multistage and power amplifiers

CO4: Design of Feedback Amplifiers And Oscillators

CO5: Design the different types of Tuned amplifiers and functioning of Multivibrator circuits

CO6: Construct the circuits for medical applications

TEXT / REFERENCE BOOKS

1. Robert L. Boylestad and Louis Nashelky, Electronic Devices and Circuits, 8th Edition, PHI, 2005.
2. Theodore F. Bogart Jr., Jeffrey S. Beasley, Guillermo Rico, Electronic devices and circuits, PPH, 2004.
3. Millman & Halkias, Integrated Electronics, McGraw Hill International Edition. 1991
4. David A. Bell, Electronic Devices and Circuits, PHI, 2004

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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 12 marks

60 Marks

SBMA1305	BASIC ELECTRONIC DEVICES, CIRCUITS AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	*	0	3	100

COURSE OBJECTIVES:

The objective of this course is to expose the student to gain knowledge on semi conductor devices such as diode, transistor etc and to understand the analysis of different circuits like amplifier, oscillator etc.

UNIT I PN JUNCTION DEVICES

PN junction diode –structure, operation and V-I characteristics, diffusion and transient capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– **Display devices- LED, Laser diodes**- Zener diode characteristics-Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS

BJT, JFET, MOSFET - structure, operation, characteristics and Biasing, **UJT, Thyristor and IGBT** - Structure and characteristics.

UNIT III AMPLIFIERS

BJT small signal model – Analysis of CE, CB, CC amplifiers-Gain and frequency response – **MOSFET small signal model**– Analysis of CS and Source follower – **Gain and frequency response- High frequency analysis.**

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS

Advantages of negative feedback – voltage / current, series / shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

On completion of this course the student will be familiar with

CO1: understands the characteristics of semiconductor diode and the design concepts of Rectifiers and Regulators.

CO2: explores the characteristics and biasing of various transistors.

CO3: explains the design and analysis of different amplifiers

CO4: interpretes the Frequency response of multistage and differential amplifiers

CO5: explains the importance of Tuned and power amplifier and its efficiency

CO6: analyse the effects of feedback on amplifier circuit and analysis of feedback amplifier and oscillators

Reference Books:

1. Electronics Principles by Albert Malvino [seventh Edition]
2. Electronics Device and circuits by S Salivahanan and N Suresh Kumar, McGraw Hill Publication [Second Edition or Higher Edition].
3. Electronics Device and circuits by Jacob Milman and Christos C. Halkias, Tata Macgraw Hill Publication [Second Edition].
4. Basic Electronics devices and Circuits by Mahesh B Patil, PHI Learning PVT. Ltd.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100

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

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

Exam duration: 3Hrs.

20 Marks

80 Marks

SBM1202	BIOSENSORS AND TRANSDUCERS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- ☐ To enable the student to gain knowledge about the measuring instruments and the methods of measurements
- ☐ To know about the types of transducers available and their applications in different fields.

UNIT 1 INTRODUCTION

9 Hrs.

General measurement system - purpose, structure and elements-Transducers - Definition, Classification. Resistance type- strain gauges, thermometers, potentiometers. Capacitive type, Inductive type- variable reluctance and LVDT. Biomedical Applications.

UNIT 2 TRANSDUCERS

9 Hrs.

Temperature transducers, Piezoelectric transducers, Piezo resistive transducers, Photoelectric transducers, Pressure transducers, Magnetostrictive transducers Biomedical applications.

UNIT 3 BIOPOTENTIAL ELECTRODES

9 Hrs.

Half cell potential (or) Electrode potential, Types of Electrodes - Micro electrodes, Depth and needle electrodes, Surface electrodes, and Chemical electrodes. Catheter type electrodes, stimulation electrodes, electrode paste, electrode material.

UNIT 4 BIOSENSORS

9 Hrs.

Introduction, biological elements, immobilization of biological components. Micro machined biosensor - cantilever based chemical sensors - Biosensors for diabetes mellitus, FAB. Biochip - introduction, gene chip.

UNIT 5 APPLICATIONS OF BIOSENSORS

9 Hrs.

ISFET for glucose and urea. IMFET, MOSFET biosensors, affinity biosensor (catalytic biosensor), Enzyme electrodes, Ion exchange membrane electrodes.

Max. 45 Hours

Course Outcomes:

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

CO1: Attain adequate knowledge about the measuring instruments used for measurement and detection of physical quantities

CO2: Identify the characteristics of various transducers and classify transducers

CO3: Attain adequate knowledge about the various electrodes and chemical sensors used for measurement and detection of physical quantities.

CO4: Apply the suitable design criteria for developing a Biosensor for a particular application.

CO5: Demonstrate the appropriate sensor approach which is most likely to meet a specific biosensor application

CO6: Predict the qualitative performance of advanced medical sensor.

TEXT / REFERENCE BOOKS

1. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995.
2. Brain R Eggins, Biosensors: An Introduction", John Wiley Publication.1996.
3. A. K.Sawhney, A course in Electronic Measurements and Instruments, Dhapat Rai & sons, 1991
4. John G Webster, Medical Instrumentation: Application and design, John Wiley Publications.2007.
5. John P Bentley, Principles of Measurement Systems, 3rd Edition, Pearson Education Asia, (2000 Indian reprint)
6. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications. 1975.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 80

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 12 marks

60 Marks

SBM1201	BIOINSTRUMENTATION AND MEASUREMENTS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- ☐ To study the static and dynamic behavior of analog and digital instruments and basic construction and working of AC and DC instruments for measurement of Voltage and Current.
- ☐ To obtain basic knowledge of digital instruments for measurement of voltage and current.
- ☐ To study signal generator and signal analysis. Also to study the different output devices analog and digital recorders.

UNIT 1 INTRODUCTION

9 Hrs.

Function elements of measuring instrument, Error in Measurement, Sources of Error, Static Characteristics: Accuracy, Sensitivity, Reproducibility, Drift, Static error types and Dead zone, Dynamic Characteristics: Speed of Response, Fidelity, Lag and Dynamic Error, Dynamic response of different order systems, Statistical Analysis: Mean, Deviation, Average deviations and Standard deviations, Measurement Standards, Bridge Circuits: Wheatstone bridge, Maxwell's bridge and Wein's bridge.

UNIT 2 BASICS OF ANALOG INSTRUMENTS

9 Hrs.

D'Arsonval Galvanometer, Moving coil Instruments: Permanent magnet moving coil instrument, PMMC ammeter and PMMC voltmeter, Ohmmeter: Shunt type and Series type. Moving iron instruments: Attraction type, Repulsion type, MI Ammeter and MI Voltmeter, Electrodynamometer type instruments: Basic Electrodynamometer type instrument, Electrodynamometer type Ammeter and Electrodynamometer type voltmeter - Construction and working principle.

UNIT 3 BASICS OF DIGITAL INSTRUMENTS

9 Hrs.

Comparison between analog and digital instruments, Basic building block of a digital instrument, Ramp type digital voltmeter, Digital frequency meter, Digital phase meter and Digital storage oscilloscope.

UNIT 4 SIGNAL GENERATION AND SIGNAL ANALYSIS

9 Hrs.

Standard signal generator, AF Sine and square wave generator, Function generator, RF generator, Basic Wave Analyzer, Heterodyne wave analyzer Spectrum analyzer and Harmonic distortion analyzer.

UNIT 5 DISPLAY DEVICES AND RECORDERS

9 Hrs.

Digital Display System and Indicators: Classification of display devices, DOT MATRIX display, LED Seven Segment display, LED matrix display, LCD seven segment display, Recorders: Graphic Recorders - Strip chart recorders, Galvanometer type recorders and Self balancing type potentiometric recorders, Magnetic tape recorders and Disc recorders.

Max. 45 Hours

Course Outcomes:

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

- CO1:** Analyze the different characteristics of measuring instruments
- CO2:** Compare the working of few analog instruments that are used measure current, voltage and resistance
- CO3:** Apply the knowledge of working of digital instruments to measure digital parameters.
- CO4:** Choose proper device to generate or analyze signals.
- CO5:** Select instruments suitable for display and recording.
- CO6:** Choose a device for measuring a parameter or analyze a signal or display a measurement.

TEXT / REFERENCE BOOKS

1. A. K. Sawhney, A course in electronic Measurements and Instruments, Dhanpat Rai sons, 1991.
2. H.S. Kalsi, Electronic Instrumentation & Measurement, Tata McGraw HILL, 1995
3. W.D cooper and A. D. Helfrick, Electronic Instruments and Measurements Techniques, Prentice Hall of India-1991
4. E. O. Doebelin, Measurement System - Application & Design, Mc Graw Hill, 1990

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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

PART B : 2 questions from each unit of internal choice; each carrying 12 marks

Exam Duration : 3 Hrs.

20 Marks

60 Marks

SBMA1301	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 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. 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

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

SBM1205	RADIO IMAGING AND THERAPEUTICS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To obtain the knowledge about the specialty of medicine those deals with the study and application of imaging technology and enable the students to understand about radiation therapy and effects of radiation.

UNIT 1 ELEMENTS OF RADIATION 9 Hrs.

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

UNIT 2 RADIATION GENERATORS 9 Hrs

Particle Accelerators- Cyclotron, Klystron, Magnetron, Cascade generator, Van De Graff generator
X ray films, X ray film processing, X Ray cassettes, Intensifying screens-New phosphor technology, Photostimulable phosphor imaging.

UNIT 3 RADIO DIAGNOSIS 9 Hrs.

Fluoroscopy, Digital radiography, Angiography, Image intensifier, PET, SPECT, collimators, grids - bucky grids, Body section radiography, Xeroradiography

UNIT 4 RADIOTHERAPY 9 Hrs

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

UNIT 5 RADIATION SAFETY MEASURES 9 Hrs.

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

Max. 45 Hours

Course Outcomes:

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

- CO1: Understanding the elements of radiation and radioactive decay involved in radiation therapy
- CO2: Illustrate the working principle of radiation generators with the processing of X ray machine and its application
- CO3: Understanding the technique of fluoroscopy and various radio diagnosis techniques
- CO4: Demonstrate the applications of radiotherapy
- CO5: Attain the adequate knowledge about radiation measurements and effect of radiation on body
- CO6: Outline the methods of radiation safety.

TEXT / REFERENCE BOOKS

1. Thomas S. Curry, III, James E. Dowdey, Robert C. Murry J R., Christensen The Physics of Diagnostic Radiology Lea & Febiger 4th edition 1990.
2. Faiz M.Khan, The Physics of Radiation Therapy, 4th edition, 2009.
3. Gopal, B. Saha, Physics & Radiology of nuclear medicine, Springer 2nd Edition, 2006.
4. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing company Ltd, New Delhi, 1997.
5. K Thayalan, Basic Radiological Physics, Jaypee Brothers Medical Publishers (P) Ltd., 2001

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 80

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 12 marks **60 Marks**

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

COURSE OBJECTIVE

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

UNIT 1 ELEMENTS OF RADIATION 9 Hrs.

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

UNIT 2 RADIATION GENERATORS 9 Hrs

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

UNIT 3 RADIO DIAGNOSIS 9 Hrs.

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

UNIT RADIO THERAPY 9 Hrs

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

UNIT 5 RADIATION SAFETY MEASURES 9 Hrs.

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

Max. 45 Hours

Course outcomes:

On completion of the course students will be able to:

- CO1: Understanding the elements of radiation and radioactive decay involved in radiation therapy
CO2: Illustrate the working principle of radiation generators with the processing of X ray machine and its application
CO3: Understanding the technique of fluoroscopy and various radio diagnosis techniques
CO4: Demonstrate the applications of radiotherapy
CO5: Attain the adequate knowledge about radiation measurements and effect of radiation on body
CO6: Outline the methods of radiation safety.

TEXT / REFERENCE BOOKS

1. Thomas S. Curry, III, James E. Dowdey, Robert C. Murry JR., Christensen The Physics of Diagnostic Radiology Lea & Febiger 6th edition 2008.
2. Faiz M.Khan, The Physics of Radiation Therapy, 4th edition, 2009.
3. Gopal, B. Saha, Physics & Radiology of nuclear medicine, Springer 2nd Edition, 2006.
4. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing company Ltd, New Delhi, and revised edition 2007.
5. K Thayalan, Basic Radiological Physics, Jaypee Brothers Medical Publishers (P) Ltd., revised edition 2005.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 100

Exam Duration : 3 Hrs.

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

20 Marks

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

80 Marks

SBM1302	ANALYTICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course offers a wide portfolio of study programs in the areas of technology, engineering and other application fields.
- It provides an introduction to the fundamental principles of chemical measurement used in medical diagnosis, quality assurance and control and research studies.
- It helps understand and appreciate the role of instruments in solving problems in physical, chemical and Biological source and discover the impact of the relevant scientific and technological advancements.

UNIT1 SPECTROPHOTOMETER 12Hrs

Analytical methods and instrumentation types, Electromagnetic spectrum, Interaction of radiation with matter, Absorption spectra, Beer-Lambert's Law. Spectrophotometers: UV and visible ranges, single and Double Beam Instruments, FTIR and Raman Spectra- Basic principles, biomedical applications.

UNIT2 MASS SPECTROPHOTOMETER AND RADIOCHEMICAL INSTRUMENTS 12Hrs.

Spectrofluorimeter, Flame photometry- flame emission spectrometer, atomic absorption spectrometer, Mass Spectrometer - Magnetic deflection - Time of flight - quadrupole - GCMS - Basic Principles and biomedical applications. Radiochemical Analytical Instruments - Radiation types - Ionization chamber - GM Counter - Proportional counter.

UNIT3 AUTOMATED BIOCHEMICAL ANALYZER AND ELECTROPHORESIS 12Hrs.

System concepts- system components- sampler control units- sampling mechanisms, dialyzer- samac-II, Principles of Electrophoresis, Paper electrophoresis, Agarose Gel Electrophoresis, Isoelectric focusing, SDS PAGE, Pulse Field Electrophoresis

UNIT4 MICROSCOPIC TECHNIQUES AND GAS ANALYZER 12Hrs.

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy (STM), X-ray Diffraction (XRD)- Basic Principles and Applications, Gas Analyzers: Paramagnetic Oxygen Analyzer, Flow Analyzer- Ultrasound & NMR Blood flow analyzer.

UNIT5 CHROMATOGRAPHY 12Hrs.

Principles, Types of chromatography- Paper Chromatography, Thin Layer Chromatography, Column Chromatography, Ion exchange Chromatography, Gel permeation Chromatography, Gas Chromatography - High Pressure Liquid Chromatography- applications in biomedical field.

Max. 60 Hours.

Course Outcomes:

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

CO1- Understands the elements of UV visible radiation and to characterize their spectrum analysis

CO2- Illustrates the working principle emission of mass spectrum and radiation chamber

CO3- Explore the knowledge of electrophoresis and analyser to separate the constituents from a complex mixture

CO4- Analyse the working mechanism and correlate it with types of electron microscope

CO5- Determines the oxygen level using gas analyser by applying both electrostatic and magnetic properties.

CO6- Compares the types of chromatography and their importance and applications in biomedical field

TEXT / REFERENCE BOOKS

1. D.A. Skoog, F.J. Holler & T.A. Nieman, Principles of Instrumental Analysis, 5th Edition, 1998.
2. Williard H.H., Merrit, Dean J.A., Seattle F.L., CBS, Instrumental Methods of Analysis, 1995.
3. Ewing G.W., Instrumental Methods of Analysis, McGraw Hill, 1992.
4. Robert D. Braun Introduction to Instrumental Analysis, McGraw Hill, 1987.
5. R.S. Khandpur, A Handbook of Analytical Instrumentation, 2nd Edition Tata McGraw Hill Publication, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks 80

Exam Duration: 3Hrs.

PART A: 10 questions of 2 marks each- No choice 20 Marks

PART B: 2 questions from each unit of internal choice; each carrying 12 marks 60 Marks

SBMA3004	ANALYTICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course offers a wide portfolio of study programs in the areas of technology, engineering and other application in biomedical fields.
- It provides an introduction to the fundamental principles of chemical measurement used in medical diagnosis, quality assurance and control and research studies.

UNIT 1 SPECTROPHOTOMETER 9 Hrs

Electromagnetic spectrum, interaction of radiations with matter, absorption spectra Beer Lambert's law, spectrophotometer UV and visible ranges, single and beam instruments, FTIR and Raman spectra. Spectrofluorimeter, flame photometry, flame emission, atomic absorption spectrometer. Basic principles and biomedical applications.

UNIT 2 MASS SPECTROMETER AND RADIOCHEMICAL INSTRUMENTS 9 Hrs.

Mass spectrometer, magnetic detection, time of flight, quadrupole mass spectrophotometer, GCMS, LCMS, Basic principle biomedical applications. Radiochemical analytical instruments Radiation types ionization chamber, GM counter, proportional counter Liquid scintillation and applications.

UNIT 3 AUTOMATED BIOCHEMICAL ANALYZER AND ELECTROPHORESIS 9 Hrs.

System concept, system components, sampler control units, sampling mechanism, dialyser, SAMACII. Principle of electrophoresis paper electrophoresis agarose gel electrophoresis Iso electric focussing, SDS page, pulse field electrophoresis and its applications

UNIT 4 CENTRIFUGATION AND GAS ANALYZER 9 Hrs.

Basic principles of centrifugation, instrumentation types, centrifugation preparative, differential centrifugation, density gradient centrifugation, Isopycnic centrifugation, Analytical centrifugation Basic principles and biomedical applications. Gas analyser paramagnetic oxygen analyzer

UNIT 5 CHROMATOGRAPHY 9 Hrs.

Principles types of chromatography, paper chromatography, thin layer chromatography, column chromatography, ion exchange chromatography, gel permeation chromatography, high pressure liquid chromatography, HPTLC and applications in biomedical.

Max. 45 Hours.

Course outcomes

On completion of the course, student will be able to

CO1: Understands the elements of UV visible radiation and to characterize their spectrum analysis

CO2: Illustrates the working principle emission of mass spectrum and radiation chamber

CO3: explore the knowledge of electrophoresis and analyser to separate the constituents from a complex mixture.

CO4: Analyse the sedimentation coefficient of the sample using centrifuge.

CO5: determines the oxygen level using gas analyser by applying both electrostatic and magnetic properties.

CO6: Compares the types of chromatography and their importance and applications in biomedical field.

TEXT / REFERENCE BOOKS

1. D.A. Skoog, F.J. Holler & T.A. Nieman, Principles of Instrumental Analysis, 5th Edition, 2008.
2. Willard H.H., Merritt, Dean J.A, Seattle F.L, CBS, Instrumental Methods of Analysis, 2005.
3. Ewing G.W., Instrumental Methods of Analysis, McGraw Hill, 2002.
4. Robert D. Braun Introduction to Instrumental Analysis, McGraw Hill, 2007.
5. R.S. Khandpur, A Handbook of Analytical Instrumentation, 2nd Edition Tata McGraw Hill Publication, 2006.

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**



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY
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23/11/2020

DEPARTMENT OF BIOMEDICAL ENGINEERING BOARD OF STUDIES - 2020 Minutes of the Meeting

As per the discussions with the subject experts of the Institution and in accordance with the norms of AICTE, the Department of Biomedical Engineering has incorporated various new courses in the curriculum of Undergraduate course of **B. Tech (Biomedical Engineering)**.

Agenda of Meeting

1. Industrial version 4.0 is introduced for the second year B. Tech in fourth semester for current academic year 2020-2021.
2. SBMA1102 - Principles of Biomedical Engineering
SBMA3001 – Medical Equipment Maintenance and Troubleshooting
SBMA3010 – Telehealth Technology
SBMA4005 - Virtual and Augmented Reality
SBMA4009 - Human Factors in Engineering and Design have been introduced to meet the requirements of the today's competent world.
3. The above new courses have been proposed for the current academic year as per suggestions given by the industrial experts, notable alumni of the department.

Signature of the Internal Members

S.No.	Name of the Internal Member	Signature
1	Dr. T. Sudhakar Head i/c	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Ms. Bethanne Janney	
7	Mr. G. Umashankar	

HOD / Biomedical

DEPARTMENT OF BIOMEDICAL ENGINEERING
SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Jagadhar Nagar Rajiv Gandhi Salai
Chennai - 600 079

Pro Vicechancellor

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

COURSE OBJECTIVE

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

UNIT I INTRODUCTION

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 II BIOLOGY AND ENGINEERING

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 III ELECTRONICS AND MEDICINE

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

UNIT IV CLINICAL ENGINEERING

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 V RESEARCH IN BIOMEDICAL

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

Course Outcomes:

At the end of the course, the student should 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

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 I – 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 II – 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 III – 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 IV – 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 V – 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 Hours**Course Outcomes:**

At the end of the course, the student should 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", McGraw Hill Professional edition, 2013.
3. Rao S, "Testing, Commissioning, Operation and Maintenance of Electrical Equipment", Khanna Publishers, New Delhi, 2014.
4. Francis Hegarty, John Amore, "Health care technology management – A systematic approach", CRC Press, USA, 2017.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****Exam Duration : 3 Hrs.****PART A:** 10 questions of 2 marks each - No choice**20 Marks****PART B :** 2 questions from each unit of internal choice; each carrying 16 marks**80 Marks**

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 Hours**Course Outcomes:**

At the end of the course, the student should 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 A. C Norris, Essentials of Telemedicine and Telecare, John Wiley & Sons 2002

END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks: 100****PART A:** 10 questions of 2 marks each - No choice**PART B:** 2 questions from each unit of internal choice; each carrying 16 marks**Exam Duration : 3 Hrs.****20 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 I 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 II VR DEVELOPMENT PROCESS**9 Hrs**

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

UNIT III CONTENT CREATION CONSIDERATIONS FOR VR**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 IV VR ON THE WEB & 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 V APPLICATIONS**9**

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

Max: 45 Hours**Course outcomes:**

At the end of the course, the student should 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 TechnologyII, 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****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

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

COURSE OBJECTIVE

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

UNIT I 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 II 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 III 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 IV ENVIRONMENTAL CONDITIONS & HUMAN MACHINE INTERFACE**9Hrs**

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 V 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 Hours**Course Outcomes:**

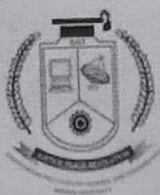
At the end of the course, the student should be able to:

- CO 1: 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. 3 Wesley E. Woodson, Human Factors Design Handbook, McGraw-Hill Professional; 2nd edition, 1992

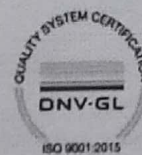
END SEMESTER EXAMINATION QUESTION PAPER PATTERN**Max. Marks : 100****Exam Duration : 3 Hrs.****PART A : 10 questions of 2 marks each - No choice****20 Marks****PART B : 2 questions from each unit of internal choice; each carrying 16 marks****80 Marks**



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DEPARTMENT OF BIOMEDICAL ENGINEERING

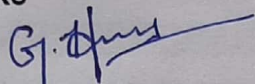
BOARD OF STUDIES – 2019 - 2020 (ODD Semester) Minutes of the Meeting

03-06-2019

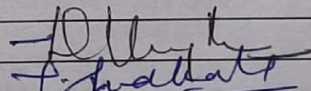
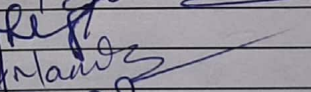
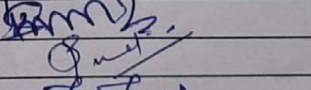
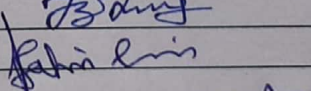
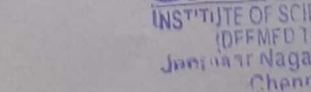
1. SBT1101 Cell and Molecular Biology & SBT – Genetics has been merged as SBMA1101 – Cell Biology & Genetics depending upon the faculty expertise and infrastructure availability.

Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

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

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. Daniel Alex Anand	
2	Dr. T. Sudhakar	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Ms. Bethanne Janney	
7.	Ms. A. Sabarivani	

HEAD OF THE DEPARTMENT
DEPARTMENT OF BIOMEDICAL ENGINEERING
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Jeppiaar Nagar Rajiv Gandhi Salai
Chennai - 600 119

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

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



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES – 2019 - 2020 (EVEN Semester)

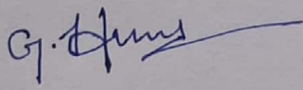
Minutes of the Meeting

04-11-2019

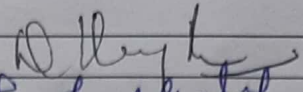
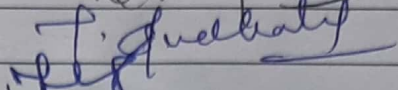
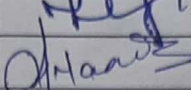
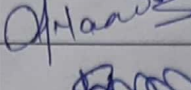
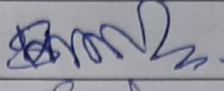
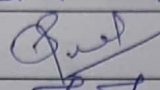
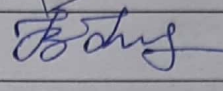
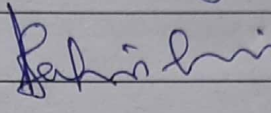
1. Board of Members has suggested revising the SBM1206 Microbiology has been changed as SBMA1201 Microbiology & Pathology due to redundancy with the Microbiology & pathology course. In view of this board has suggested some changes which were incorporated. The new syllabus of SBMA1201 Microbiology & Pathology is prepared as provided in Appendix I.
2. Industry 4.0 PG has been introduced
3. Students should be encouraged to focus on the self learning and problem solving. They should be encouraged to ask questions in the class.
4. Assignments should be designed properly so as to benefit the students. Give unsolved problems in the assignments.
5. The basic subject syllabi be carefully reviewed to be consistent with Gate syllabi, and semester exams should reflect the important concepts emphasized in Gate

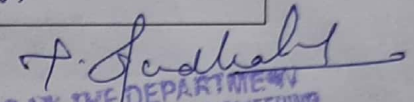
Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS


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

INTERNAL MEMBERS

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HOD/BIO MEDICAL
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Chennai 600 095

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

COURSE OBJECTIVE

- 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 9Hrs
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 9Hrs
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, Gram's staining, acid fast staining, capsule and spore staining.

UNIT 3 INFLAMMATION AND NEOPLASIA 9Hrs
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 9Hrs
Edema, shock, hemorrhage, thrombus, embolism, disseminated intravascular coagulation, hematological disorder, bleeding disorder, leukemia and lymphoma.

UNIT 5 INFECTIOUS DISEASES AND IMMUNE DISORDER 9Hrs
Bacteria, fungi and virus as potential pathogens, mechanism of pathogenicity, mechanism of development of microbial resistance (Staphylococcus, Salmonella, Candidiasis, Filariasis, Influenza). 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 Hours

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 neoplasia.
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 McGrawHill -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

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

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

20 Marks

80 Marks

Exam Duration : 3 Hrs.

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

UNIT1 TRANSFORMING TECHNOLOGIES IN BIOENGINEERING**7 Hrs.**

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

UNIT 2 ADVANCEMENTS IN SUSTAINABLE BUILT ENVIRONMENT**7 Hrs.**

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

UNIT 3 SMART MANUFACTURING**8 Hrs.**

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

UNIT 4 SMART WORLD**8 Hrs.**

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

UNIT 5 CYBER PHYSICAL SYSTEMS**8 Hrs.**

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

Max. 45 Hrs.**TEXT / REFERENCE BOOKS**

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



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES – 2018 - 2019 (ODD Semester)

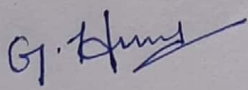
Minutes of the Meeting

03-07-2018

1. S24PROJ & S44PROJ has been divided into Phase I & Phase II, allocation of guides will be done during phase I and literature survey, methodology design and during phase II Execution of methodology, Observation and validation of results, submission of reports and final viva voce examination.
2. Project at the end of the semester should be such as to covers all the points of the concerned subject which he/she learns.
3. Professional training II S24PT2 has been included in order to gain the hands on and exposure to the industrial needs and acquired inplant training, NPTEL courses, industrial training, placement and hospital training.
4. Credits should be given for the Industrial Training and if required lab facilities can be provided to the students interested in doing the training in the campus during summer.
5. SBM1609 - Medical Optics and Laser Applications has been introduced as a CORE elective.
6. SBM1610 – Drug delivery systems has been chosen as CORE elective
7. SBMX1024 – Forensic Science Unit IV introduction to Handwriting, SBM1609 – Forensic toxicology was added

Members of Board of studies – Biomedical Engineering

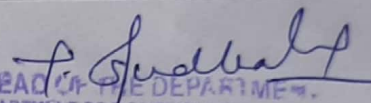
EXTERNAL MEMBERS

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

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. Daniel Alex Anand	
2	Dr. T. Sudhakar	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Ms. Bethanne Janney	
7	Mr. G. Umashankar	

S.No.	Course Code	Course Name	Deleted Topics	Added Topics
1	SBMX1024	Forensic Science	UNIT-IV Introduction to examination of Handwriting – development of handwriting science – handwriting experts – expert witness in courts – relationship between investigating officers and handwriting experts – relevant sections of Indian Penal Code – criminal procedure code and evidence act	UNIT 4 TOXINS Forensic toxicology – poison and drugs, classifications, Source, nature, Actions and diagnosis of poisoning cases, postmortem findings and examination, treatment of poisoning cases, medico legal aspects; corrosive agents, irritants – mechanical and animal


 HEAD OF THE DEPARTMENT
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 Chennai - 600 096

SBMX1024	FORENSIC SCIENCE	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

UNIT-I 10

Cell and its inclusions – structure and function – types of cells: Blood & Body fluids – forensic significance – morphological identification of bones – forensic importance.

UNIT-II 10

Identification of Human remains – methods of reconstruction – personal identity in the living and the dead – DNA fingerprinting – Blotting types (Southern, Northern, Western) – post mortem examination – poisoning – medico legal aspects.

UNIT-III 10

Finger Prints – importance of plastic and visible finger prints – transfer methods of finger prints – fingerprint patterns – their classification – ridge characteristics – foot prints – importance – gait patterns and their characteristics – photography of foot prints – sunken and surface foot prints.

UNIT-IV 10

Introduction to examination of Handwriting – development of handwriting science – handwriting experts – expert witness in courts – relationship between investigating officers and handwriting experts – relevant sections of Indian Penal Code – criminal procedure code and evidence act

UNIT-V 10

Serology – basic principles of serology – concept of antigen and antibody and their reaction – application of serology in forensic science. Karyotyping – banding patterns - chromosomal abnormalities – sex determination – sex linked inheritance.

TOTAL NUMBER OF PERIODS: 50**TEXT BOOKS:**

1. De Robertis, "General Cytology", Sannders, 6th Edition, 2008 (Unit – I & V)
2. E J Gardner, "Principles of Genetics", Tata Mc Graw Hill, 7th Edition, 2001 (Unit – II, III & IV)

REFERENCES:

1. M. Krawczak and J. Schmidtke, "DNA Finger printing", BIOS Scientific Publisher, 2nd Edition, 1995
2. Richard Saferstein Ed, "Forensic Science Hand Book" Prentice Hall, 2010 (Unit – IV)
3. P L Carpenter, "Immunology and Serology", W B Saunders Company, 2nd Edition, 1965
4. David Friedfielder, "Molecular Biology", Narosa, 4th Edition, 1995

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each - No Choice

Part B: 5 questions from each of the FIVE units of internal Choice, Each carries 12 marks

Exam Duration: 3 hrs

20 marks

60 marks

SBM1609	FORENSIC SCIENCE	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- ☐ The syllabus is designed to provide a brief and basic knowledge to understand the forensic science particularly to the biomedical student. The main aim is to provide reasonable coverage of subject to know the basic concepts of the science so that the student can implement their knowledge in higher studies.

UNIT 1 ANIMAL CELL STRUCTURE

9 Hrs.

Cell and its inclusions – structure and function – types of cells: Blood & Body fluids – forensic significance – morphological identification of bones – forensic importance.

UNIT 2 BLOTTING TECHNIQUES

9 Hrs.

Identification of Human remains – methods of reconstruction – personal identity in the living and the dead – DNA fingerprinting – PCR - Blotting types (Southern, Northern and Western)

UNIT 3 FINGERPRINTS

9 Hrs.

FingerPrints – importance of plastic and visible finger prints – transfer methods of finger prints – fingerprint patterns – their classification – ridge characteristics – foot prints – importance – gait patterns and their characteristics – photography of foot prints – sunken and surface foot prints.

UNIT 4 TOXINS

9 Hrs.

Forensic toxicology – poison and drugs, classifications, Source, nature, Actions and diagnosis of poisoning cases, postmortem findings and examination, treatment of poisoning cases, medico legal aspects, corrosive agents, irritants – mechanical and animal.

UNIT 5 SEROLOGICAL AND CHROMOSOMAL TECHNIQUES

9 Hrs.

Serology – basic principles of serology – concept of antigen and antibody and their reaction – application of serology in forensic science. Karyotyping – banding patterns - chromosomal abnormalities – sex determination – sex linked inheritance.

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. De Robertis, General Cytology, Sannders, 6th Edition, 2008
2. Apurba Nandy, Principles of Forensic Medicine, New Central Book Agency, 2nd Edition, 2001
3. M. Krawczak and J. Schmidtke, DNA Finger printing, BIOS Scientific Publisher, 2nd Edition, 1995
4. Richard Saferstein Ed, Forensic Science Hand Book, Prentice Hall, 2010
5. P L Carpenter, Immunology and Serology, W B Saunders Company, 2nd Edition, 1965
6. David Friedfielder, Molecular Biology, Narosa, 4th Edition, 1995
7. Narayan Reddy, The Essential of Forensic Medicine and Toxicology, 31st Edition, 2012.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

Exam Duration : 3 Hrs.

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

20 Marks

PART B: 2 questions from each unit of internal choice; each carrying 12 marks

60 Marks



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DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES – 2018 - 2019 (EVEN Semester)

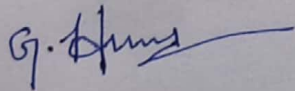
Minutes of the Meeting

02-11-2018

1. The syllabi of SBM1024 – Neuroscience to be reframed as per AICTE and reference can be taken from other reputed institution offering such courses.
2. SBM1607 - Pharmacology & Toxicology – Unit 1,3 – parenteral, Unit 4 – drug development process revised
3. SBM1604 – Brain computer interface has been deliberated as OPEN elective
4. Based on the suggestion of committee members SCS1312 – Fuzzy logic & neural networks was converted into elective from CORE
5. Rehabilitation engineering – Unit V completely changed
6. The members suggested to do the refinement of each course taking care of typographical errors if any and to add newly published books or revised editions.

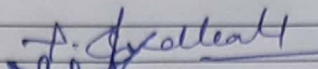
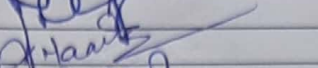
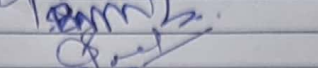
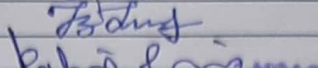
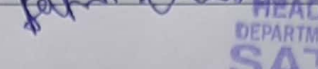
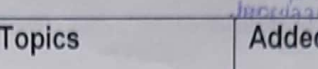
Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

Dr. G. Harikrishnan, 

Associate Professor & Research Coordinator,
Department of Electrical & Electronics Engg.,
Sree Vidyanikethan Engg. College, Tirupati

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. T. Sudhakar	
2	Dr. J. Premkumar	
2	Dr. Anima Nanda	
3	Dr. S. Krishnakumar	
4	Ms. Sindu Divakaran	
5	Ms. Bethanne Janney	
6	Ms. A. Sabarivani	

HEAD OF THE DEPARTMENT
DEPARTMENT OF PHARMACEUTICAL ENGINEERING
SATYANARAYANA
INSTITUTE OF SCIENCE AND TECHNOLOGY
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S.No	Course Code	Course Name	Deleted Topics	Added Topics
1	SBMX1023	Pharmacology & Toxicology	UNIT-I Preclinical studies, Clinical trials, Regulatory aspects in drug development, Role of FDA, Important amendments in drugs regulation. Indian drugs and cosmetic act. UNIT-III Analgesic, antipyretic and anti-inflammatory agents, drug in rheumatoid arthritis and gout, drug in bronchial asthma, drug in allergic disorders. Chemical and biological aspects of certain drugs, respiratory drugs, diuretics & prostaglandin's. Unit IV – parental solutions-oral liquids – injections-ointments-topical Applications-ointments preservation Packing – Packing Techniques.	UNIT 1 SYSTEMIC PHARMACOLOGY Introduction to pharmacology pharmacognacy, pharmacokinetics. Analgesic, antipyretic and anti-inflammatory agents, drug in rheumatoid arthritis and gout, drug in bronchial asthma, drug in allergic disorders. Chemical and biological aspects of respiratory drugs, diuretics & prostaglandins. UNIT 3 PARENTAL PREPARATION Tablets-wet granulation – dry granulation of slugging –coating of tablets Capsules Sustained action dosage forms-parental solutions-oral liquids – injections-ointments topical Applications-ointments preservation Packing – Packing Techniques. UNIT 4 DRUG DEVELOPMENT PROCESS 9 Hrs Methods involved in the development of new drugs. Preclinical toxicological studies. Calculation of LD50 & ED50 High throughput screening (invitro and invivo) for pre-clinical pharmacokinetic and pharmacodynamic studies. Regulatory aspects in drug development, Role of FDA, Important amendments in drugs regulation. Indian drugs and cosmetic act.
2	SBMX1012 / SBM1307	Rehabilitation Engineering	UNIT –V COMPUTER APPLICATIONS IN	UNIT 5 ADVANCED

SBMX1012	REHABILITATION ENGINEERING	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

UNIT – I INTRODUCTION TO REHABILITATION**10**

Introduction Concepts and principles of rehabilitation engineering, Ergonomics - Positioning anatomical site, simplicity and intuitive operation, adaptability and flexibility, mental and chronological age appropriateness. Basics and Fundamentals in Rehabilitation and its applications. Knowledge of disability act 1995 for physically disabled, visually impaired, hearing impaired and others.

UNIT-II MOTOR REHABILITATION**10**

Orthopedic prosthetics and orthotics in Rehabilitation Fundamentals, Applications: Computer Aides Engineering in customized component design. Intelligent prosthetic knee. A hierarchically controlled prosthetic hand. A self-aligning orthotic knee joint. Externally powered and controlled orthotics and prosthetics: FES System: Restoration of hand function; restoration of standing and walking. Hybrid Assistive systems (HAS) Active prostheses. Active Above knee Prosthesis. Myoelectric hand and arm prostheses. The MARCUS Intelligent Hand Prosthesis

UNIT – III WHEELED MOBILITY**10**

History and Categories of Wheelchairs. Wheelchair Structure and Component Design. Ergonomics of wheel chair propulsion. Power Wheelchair Electrical System. Personal transportation. Auxiliary drives and system.

UNIT – IV SENSORY AUGMENTATION AND SUBSTITUTION**10**

Visual System: Visual augmentation. Tactual vision substitution. Auditory vision substitution: Auditory System: Auditory augmentation. Cochlear implantation. Visual auditory substitution. Tactual auditory substitution. Tactual system: Tactual augmentation. Tactual substitution. Augmentative communication, Control and Computer Access: AAC; User Interface: Outputs: Acceleration Techniques.

UNIT –V COMPUTER APPLICATIONS IN REHABILITATION ENGINEERING**10**

Interfaces in Compensation for visual perception. Improvement of orientation and mobility. Computer – assisted lip reading. Brain – computer interface. Computer – Aided Engineering in customized component design. Cost – Effectiveness of High Vs Low – Technology Approaches; Intervention and other Issues; Environmental Control and Access to computers.

TOTAL NUMBER OF PERIODS: 50**TEXT BOOK:**

1. Bronzino, "Biomedical Engineering" Hand Book IEEE Press Volume 1 (Unit – II, III, IV & V)

REFERENCES:

1. Robinson C.J, " Rehabilitation Engineering", CRC Press. 1995 (Unit – I)
2. Ballabio E. et al, " Rehabilitation Technology", IOS Press. 1993.
3. Handbook of "Physical Medicine & Rehabilitation", W.B.Saunders Publication, 2003.
4. Hanfredclynes, "Biomedical Engineering System", McGraw Hill, 1999

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each - No Choice

Part B: 5 questions from each of the FIVE units of internal Choice, Each carries 12 marks

Exam Duration: 3 hrs

20 marks

60 marks

SBM1307	REHABILITATION ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- The course is designed to provide a brief and basic knowledge to understand musculoskeletal, neuromuscular, sensory disorders, prosthetics and orthotics and their applications.
- The main aim is to provide the basic concept so that the students can implement their knowledge for higher studies in developing innovative and effective rehabilitation and assistive technologies.

UNIT 1 INTRODUCTION TO REHABILITATION

9 Hrs.

Introduction Concepts and principles of rehabilitation engineering, Ergonomics - Positioning anatomical site, simplicity and intuitive operation, adaptability and flexibility, mental and chronological age appropriateness. Knowledge of disability act 1995 for physically disabled, visually impaired, hearing impaired and others. Rehabilitation Team.

UNIT 2 ORTHOTICS & ORTHOPROSTHETICS

9 Hrs.

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

UNIT 3 WHEELED MOBILITY

9 Hrs.

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

UNIT 4 SENSORY AUGMENTATION AND SUBSTITUTION

9 Hrs.

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

UNIT 5 ADVANCED APPLICATIONS IN REHABILITATION ENGINEERING

9 Hrs.

Interfaces in Compensation for visual perception. Improvement of orientation and mobility. Computer - assisted lip reading. Brain - computer interface. Electronic Travel Applications (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensor, Electro-cortical Prosthesis, Polarized Ultrasonic Travel Aid

Max. 45 Hours.

TEXT / REFERENCE BOOKS

1. Bronzino, Biomedical Engineering, Hand Book IEEE Press Volume 1.
2. Robinson C. J, Rehabilitation Engineering, CRC Press. 1995.
3. Ballabio E. et al, Rehabilitation Technology, IOS Press. 1993.
4. Handbook of Physical Medicine & Rehabilitation, W.B.Saunders Publication, 2003.
5. Hanfreddlynes, Biomedical Engineering System, McGraw Hill, 1999

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max Marks: 80

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 12 marks 60 Marks

SBMX1023	PHARMACOLOGY AND TOXICOLOGY	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

UNIT-I 10

Preclinical studies, Clinical trials, Regulatory aspects in drug development, Role of FDA, Important amendments in drugs regulation. Indian drugs and cosmetic act.

UNIT-II 10

A fundamental introduction to solid, semisolid and liquid dosage forms, including powders, true solutions, colloids, suspensions and emulsions.

UNIT-III 10

Analgesic, antipyretic and anti-inflammatory agents, drug in rheumatoid arthritis and gout, drug in bronchial asthma, drug in allergic disorders. Chemical and biological aspects of certain drugs, respiratory drugs, diuretics & prostaglandin's.

UNIT-IV 10

Tablets-wet granulation – dry granulation or slugging –coating of tablets. Capsules Sustained action dosage forms-parental solutions-oral liquids – injections-ointments-topical Applications-ointments preservation .Packing –Packing Techniques.

UNIT-V 10

Environmental toxicants-classification - occurrence-sources-effects on plants. Heavy metal toxicity – lead and Chromium bioaccumulation. Atmospheric toxicants - Carbon monoxide, Sulphur oxides. Pollution indicators definition of indicator plants, algae. Toxins of biological origin - botulins, aflatoxins.

TOTAL NUMBER OF PERIODS: 50

TEXT BOOKS:

1. K. D. Tripathi, "Essential of Medical Pharmacology" 6th edition, Jaypee Brothers medical Publisher(p)Ltd, 2008 (Unit – III)

REFERENCES:

1. Howland et Al, "Pharmacology", Lippincott's Illustrated Reviews, ISBN Number:0-7817-4118-1, Third edition, 2006
2. Duffous J.H, "Environmental Toxicology", Edward Arnold Publication, London, 1980 (Unit – V)
3. Sharma P.D, "Environmental Biological and Toxicology", Rastogi & co, Meerat, 1993 (Unit – I)
4. Leon Lachmanetal, "Theory and practice of Industrial Pharmacy", Lea and Feiger (Unit – II & IV)

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each - No Choice

Part B: 5 questions from each of the FIVE units of Internal Choice, Each carries 12 marks

Exam Duration: 3 hrs

20 marks

60 marks

SBM1607	PHARMACOLOGY AND TOXICOLOGY	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- Pharmacology is the backbone of present biomedical sciences. The student will be expected to have an introduction to the basic chemical structures and the mechanism of action of drugs in the system. This will enable the undergraduate student to implement this in their dissertation work.

UNIT 1 SYSTEMIC PHARMACOLOGY 9 Hrs.

Introduction to pharmacology, pharmacodynamics, pharmacokinetics, Analgesic, antipyretic and anti-inflammatory agents, drug in rheumatoid arthritis and gout, drug in bronchial asthma, drug in allergic disorders, Chemical and biological aspects of respiratory drugs, diuretics & prostaglandins.

UNIT 2 DRUG FORMULATIONS 9 Hrs.

A fundamental introduction to solid, semisolid and liquid dosage forms, including powders, true solutions, colloids, suspensions and emulsions.

UNIT 3 PARENTAL PREPARATION 9 Hrs.

Tablets-wet granulation – dry granulation or slugging –coating of tablets, Capsules Sustained action dosage forms-parental solutions-oral liquids – injections-ointments-topical Applications-ointments preservation, Packing – Packing Techniques.

UNIT 4 DRUG DEVELOPMENT PROCESS 9 Hrs.

Methods involved in the development of new drugs, Preclinical toxicological studies, Calculation of LD50 & ED50, High throughput screening (invitro and invivo) for pre-clinical pharmacokinetic and pharmacodynamic studies, Regulatory aspects in drug development, Role of FDA, Important amendments in drugs regulation, Indian drugs and cosmetic act.

UNIT 5 ENVIRONMENTAL TOXICOLOGY 9 Hrs.

Environmental toxicants-classification - occurrence-sources-effects on plants. Heavy metal toxicity –lead and Chromium bioaccumulation. Atmospheric toxicants - Carbon monoxide, Sulphur oxides. Pollution indicators definition of indicator plants, algae. Toxins of biological origin - botulins, aflatoxins.

Max. 45 Hours

TEXT / REFERENCE BOOKS

- K.D. Tripathi, Essential of Medical Pharmacology 6th edition, Jaypee Brothers medical Publisher (p) Ltd, 2008
- Howland et al, Pharmacology, Lippincott's Illustrated Reviews, ISBN Number: 0-7817-4118-1, Third edition, 2006
- Duffous J.H, Environmental Toxicology, Edward Arnold Publication, London, 1980
- Sharma P.D, Environmental Biological and Toxicology, Rastogi & co, Meerat, 1993
- Leon Lachman et al, Theory and practice of Industrial Pharmacy, Lea and Feiger 1986
- Goodman Gillman's The Pharmacological basis of therapeutics. Ed. Hardman JG, Limbird LE (Tenth Edition) McGraw Hill press New York. 2001.
- Drug Discovery and Evaluation – Pharmacological assays. Ed. Vogel HG & Vogel WH. Springer-New York. 1997.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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

PART B: 2 questions from each unit of internal choice; each carrying 12 marks

Exam Duration : 3 Hrs.

20 Marks

60 Marks



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DEPARTMENT OF BIOMEDICAL ENGINEERING BOARD OF STUDIES – 2017 - 2018 (ODD Semester)

Minutes of the Meeting

02-06-2017

1. SEC1320 Fundamentals of Microprocessor & Microcontroller – syllabus has been revised as per industrial demands.
2. SBM1302 – Analytical Instrumentation Unit III – Electrophoresis topic has been included for the benefit of student life sciences projects.
3. SEC1324 – Digital signal processing & its applications – DSP application has been included which will aid in the design of filters used in Biomedical equipments.

Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

Dr. G. Harikrishnan,

Associate Professor & Research Coordinator,
Department of Electrical & Electronics Engg.,
Sree Vidyanikethan Engg. College, Tirupati

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. Daniel Alex Anand	
2	Dr. T. Sudhakar	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
6	Ms. Bethanne Janney	
7	Ms. A. Sabarivani	

HEAD OF THE DEPARTMENT
DEPARTMENT OF BIOMEDICAL ENGINEERING
SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Jeppiaar Nagar, Rajiv Gandhi Salai
Chennai - 600 119

SBMX1009	ANALYTICAL INSTRUMENTATION	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

UNIT-I INTRODUCTION TO ANALYTICAL INSTRUMENTS 10

Analytical methods and instrumentation types, Electromagnetic spectrum, Interaction of radiation with matter, Absorption spectra, Beer-Lambert's Law. **Spectrophotometers:** UV and visible ranges, single and Double Beam Instruments, FTIR and Raman Spectra – Basic principles, biomedical applications.

UNIT-II AUTOMATED BIOCHEMICAL ANALYSIS 10

System concepts – system components - sampler control units - sampling mechanisms, dialyzer - samac-II.
Gas Analyzers: Paramagnetic Oxygen Analyzer.

UNIT-III MASS SPECTROMETER 10

Magnetic deflection - Time of flight - quadrupole - Basic Principles and biomedical applications.
RadioChemical Analytical Instruments: Radiation types - Ionization chamber - GM Counter - Proportional counter.

UNIT-IV MICROSCOPIC TECHNIQUES 10

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy (STM) – Basic Principles and Applications.

UNIT-V CHROMATOGRAPHY 10

Principles, Types of chromatography - Liquid Chromatography - High Pressure Liquid Chromatography – applications in biomedical field.

TOTAL NUMBER OF PERIODS: 50

TEXT BOOK:

1. R.S. Khandpur, "A Handbook of Analytical Instrumentation", 2nd Edition Tata McGraw Hill Publication (Unit I-V)

REFERENCES:

1. D.A. Skoog, F.J. Holler & T.A. Nieman, "Principles of Instrumental Analysis", 5th Edition
2. Williard H.H., Merrit, Dean J.A, Seattle F.L, CBS, "Instrumental Methods of Analysis"
3. Ewing G.W., "Instrumental Methods of Analysis", McGraw Hill, 1992
4. Robert D. Braun "Introduction to Instrumental Analysis", McGraw Hill, 1987.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each - No Choice

Part B: 5 questions from each of the FIVE units of internal Choice, Each carries 12 marks

Exam Duration: 3 hrs

20 marks

60 marks

SEC1320	FUNDAMENTALS OF MICROPROCESSOR AND MICROCONTROLLER	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

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

UNIT 1 INTRODUCTION TO INTEL 8085 9 Hrs.

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

UNIT 2 INTEL 8085 INTERFACING

9 Hrs

Interfacing devices- 8255 Programmable Peripheral Interface- Architecture & various modes of operation - 8251 USART Architecture and programming features - 8237, DMA Controller Architecture & Programming features. Interfacing with ADC and DAC, LCD, keyboard Interface.

UNIT 3 INTRODUCTION TO 8086

9 Hrs

Architecture of 8086 - Registers set of 8086 - Special function of general purpose register - Addressing modes of 8086 - Instruction set - pin diagram of 8086 - Timing diagram- memory read, memory write, I/O read and I/O write - Minimum and Maximum mode of operation Interrupts of 8086.

UNIT 4 MICROCONTROLLER

9 Hrs.

Introduction to 8-bit Microcontrollers - 8051 Microcontroller Architecture - Registers set of 8051 - modes of Timer operation - Serial Port operation - Interrupt Structure of 8051 - Memory and Input / Output Interfacing of 8051.

UNIT 5 APPLICATIONS

9 Hrs

Application of microprocessors: Stepper Motor Control, Temperature control, TTL to RS232 Conversion - RS232 to TTL Conversion - Interfacing EPROMs & SRAMs with 8085. Interfacing Biosignal to Microprocessor- block diagram

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, blishing, New Delhi, 2000
2. Kenneth J. Ayala, 8051 Microcontroller, Thomson, 2005. Edition, Penram International
3. ugles V. Hall, Microprocessor and Interfacing, Tata MC Graw Hill Publication, 2nd Edition, 1992.
4. Charless M. Gilmore, "Microprocessor Principle and application, McGraw Hill publication, 1995.
5. A.NagoorKani, Microprocessor & Microcontroller, Tata Mc Graw Hill, 3rd Edition, 2012
6. B. Ram, Fundamentals of Microprocessors and Microcomputers, Dhanpat Rai Publications, 2001

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

Exam Duration : 3 Hrs.

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

20 Marks

PART B : 2 questions from each unit of internal choice; each carrying 12 marks

60 Marks

SBMX1009	ANALYTICAL INSTRUMENTATION	L	T	P	CREDITS	TOTAL MARKS
		3	1	0	4	100

UNIT-I INTRODUCTION TO ANALYTICAL INSTRUMENTS**10**

Analytical methods and instrumentation types, Electromagnetic spectrum, Interaction of radiation with matter, Absorption spectra, Beer-Lambert's Law. **Spectrophotometers:** UV and visible ranges, single and Double Beam Instruments, FTIR and Raman Spectra – Basic principles, biomedical applications.

UNIT-II AUTOMATED BIOCHEMICAL ANALYSIS**10**

System concepts – system components - sampler control units - sampling mechanisms, dialyzer - samac-II.
Gas Analyzers: Paramagnetic Oxygen Analyzer.

UNIT-III MASS SPECTROMETER**10**

Magnetic deflection - Time of flight - quadrupole - Basic Principles and biomedical applications.
RadioChemical Analytical Instruments: Radiation types - Ionization chamber - GM Counter - Proportional counter.

UNIT-IV MICROSCOPIC TECHNIQUES**10**

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy (STM) – Basic Principles and Applications.

UNIT-V CHROMATOGRAPHY**10**

Principles, Types of chromatography - Liquid Chromatography - High Pressure Liquid Chromatography – applications in biomedical field.

TOTAL NUMBER OF PERIODS: 50**TEXT BOOK:**

1. R.S. Khandpur, "A Handbook of Analytical Instrumentation", 2nd Edition Tata McGraw Hill Publication (Unit I-V)

REFERENCES:

1. D.A. Skoog, F.J. Holler & T.A. Nieman, "Principles of Instrumental Analysis", 5th Edition
2. Williard H.H., Merrit, Dean J.A, Seattle F.L, CBS, "Instrumental Methods of Analysis"
3. Ewing G.W., "Instrumental Methods of Analysis", McGraw Hill, 1992
4. Robert D. Braun "Introduction to Instrumental Analysis", McGraw Hill, 1987.

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each - No Choice

Part B: 5 questions from each of the FIVE units of internal Choice, Each carries 12 marks

Exam Duration: 3 hrs

20 marks

60 marks

SBM1302	ANALYTICAL INSTRUMENTATION	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- The course offers a wide portfolio of study programs in the areas of technology, engineering and other application fields.
- It provides an introduction to the fundamental principles of chemical measurement used in medical diagnosis, quality assurance and control and research studies.
- It helps understand and appreciate the role of instruments in solving problems in physical, chemical and biological source and discover the impact of the relevant scientific and technological advancements.

UNIT 1 SPECTROPHOTOMETER 12 Hrs

Analytical methods and instrumentation types, Electromagnetic spectrum, Interaction of radiation with matter, Absorption spectra, Beer-Lambert's Law. Spectrophotometers: UV and visible ranges, single and Double Beam Instruments, FTIR and Raman Spectra - Basic principles, biomedical applications.

UNIT 2 MASS SPECTROPHOTOMETER AND RADIOCHEMICAL INSTRUMENTS 12 Hrs.

Spectrofluorimeter, Flame photometry - flame emission spectrometer, atomic absorption spectrometer, Mass Spectrometer - Magnetic deflection - Time of flight - quadrupole - GCMS - Basic Principles and biomedical applications. Radio Chemical Analytical Instruments - Radiation types - Ionization chamber - GM Counter - Proportional counter.

UNIT 3 AUTOMATED BIOCHEMICAL ANALYZER AND ELECTROPHORESIS 12 Hrs.

System concepts - system components - sampler control units - sampling mechanisms, dialyzer - samac-II, Principles of Electrophoresis, Paper electrophoresis, Agarose Gel Electrophoresis, Isoelectric focusing, SDS PAGE, Pulse Field Electrophoresis

UNIT 4 MICROSCOPIC TECHNIQUES AND GAS ANALYZER 12 Hrs.

Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic force Microscopy (AFM) and Scanning Tunneling Microscopy (STM), X ray Diffraction (XRD) - Basic Principles and Applications, Gas Analyzers: Paramagnetic Oxygen Analyzer, Flow Analyzer-Ultrasound & NMR Blood flow analyzer.

UNIT 5 CHROMATOGRAPHY 12 Hrs.

Principles, Types of chromatography - Paper Chromatography, Thin Layer Chromatography, Column Chromatography, Ion exchange Chromatography, Gel permeation Chromatography, Gas Chromatography - High Pressure Liquid Chromatography - applications in biomedical field.

Max. 60 Hours.

TEXT / REFERENCE BOOKS

1. D.A. Skoog, F.J. Holler & T.A. Nieman, Principles of Instrumental Analysis, 5th Edition, 1998.
2. Williard H.H., Merrit, Dean J.A, Seattle F.L, CBS, Instrumental Methods of Analysis, 1995.
3. Ewing G.W., Instrumental Methods of Analysis, McGraw Hill, 1992.
4. Robert D. Braun Introduction to Instrumental Analysis, McGraw Hill, 1987.
5. R.S. Khandpur, A Handbook of Analytical Instrumentation, 2nd Edition Tata McGraw Hill Publication, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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

PART B: 2 questions from each unit of internal choice; each carrying 12 marks

Exam Duration : 3 Hrs.

20 Marks

60 Marks

SBMX1006	DIGITAL SIGNAL PROCESSING & ITS APPLICATION	L	T	P	CREDITS	TOTAL MARKS
		3	1	0		

UNIT- I INTRODUCTION**10**

Characterization and classification of signals-examples of signals-continuous versus discrete signals-analog versus digital signals – convolutions – sampling and quantization-concepts of signal processing-typical applications- advantages of digital signal processing compared with analog processing – Applications of signal processing in Biomedical Engineering.

UNIT- II DISCRETE TIME SYSTEMS**10**

Representations – classifications – Analysis of Discrete-Time Linear Invariant Systems- Z-TRANSFORM – inverse Z transform - Properties

UNIT- III FREQUENCY ANALYSIS OF SIGNALS**10**

Discrete Fourier Transform and its properties – computation of DFT – Radix 2 FFT algorithms – DIF and DIT algorithms. Examples of Biomedical signal processing – Estimation of heart rate in ECG (Harmonic Analysis) – Filtering in Ultrasound (Matched and Wiener filter) – Analysis of EMG signal (Independent component analysis).

UNIT- IV**10**

FIR Filter Designing -Digital Filters: FIR filters-designing FIR filters – Hamming window – Hanning window functions – Rectangular Window

UNIT- V**10**

IIR filter Design - Butter worth and Chebyshev Filters – Frequency transformation in analog and digital domain, Realization of digital filters – Direct form I, II.

TOTAL NUMBER OF PERIODS: 50**TEXT BOOK:**

1. Ramesh Babu "Digital Signal Processing" Scitech Publications, 3rd Edition (Unit-I,II,IV.V)

REFERENCES:

1. Salivahanan, "Digital Signal Processing", Tata Mc Graw Hill, 2000
2. John G. Proakis, Vinay K. Ingle, John G. Proakis "A Self-Study Guide for Digital Signal Processing",
3. Nagoorkani, "Digital Signal Processing", RBA Publications,
4. Alan V. Oppenheim, Ronald W. Schaffer, "Digital Signal Processing", Prentice-Hall, 1975
5. Eugene N. Bruce, "Biomedical Signal Processing and Signal Modeling" John Wiley & Sons, 2000.(Unit III)

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each –No Choice-

Part B: 5 questions from each of the FIVE units of internal Choice, Each carries 12 marks. -

Exam Duration: 3 hrs

20 marks

60 marks

Questions May ask in Part B as 20 % THEORY; 80 % PROBLEM

SEC1321	DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- ☐ This course will introduce the basic concepts and techniques for processing signals on a computer.
- ☐ By the end of the course, the student will be familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors.
- ☐ The course emphasizes intuitive understanding and practical implementations of the theoretical concepts.

UNIT 1 INTRODUCTION TO DISCRETE TIME SIGNALS & SYSTEMS 9 Hrs.

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

UNIT 2 FREQUENCY ANALYSIS OF SIGNALS 9 Hrs.

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

UNIT 3 FIR FILTER DESIGN 9 Hrs.

Introduction - Digital filters Linear phase FIR filters - Designing of FIR Filters - Fourier series method of designing FIR filters - Design of FIR filters using windows Rectangular window - Hamming Window - Hanning Window functions - Frequency sampling method of designing of FIR filters - Frequency response and Design.

UNIT 4 IIR FILTER DESIGN 9 Hrs.

Introduction - Frequency selective filters - Digital versus Analog filters - Advantages & disadvantages of digital filters - Butterworth and Chebyshev Filters - Frequency Transformation in analog & Digital domain - Low pass to Low pass - Low pass to High pass - Low pass to Band pass - Low pass to Band stop - Realization of digital filters - Direct form I & II.

UNIT 5 DSP APPLICATIONS 9 Hrs.

Multirate signal processing: Decimation - Efficient transversal structure & Polyphase structure of Decimator - Interpolation - Efficient transversal structure & Polyphase structure of Interpolator - Polyphase Decimation & Interpolation using Z-Transform - Adaptive Filters - Introduction Applications of adaptive filtering to equalization - Medical applications - ECG, EEG analysis

Max. 45 Hours

TEXT / REFERENCE BOOKS

- John G. Proakis & Dimitris G. Manolakis, Digital Signal Processing - Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
- Allan V. Oppenheim et al, Signals and Systems, 2nd Edition., Prentice Hall of India Pvt. Ltd., 1997.
- Haykin. S and Van Been. B., Signals and Systems, 2nd Edition, John Wiley & Sons, 2003.
- Emmanuel C. Ifeachor, & Barrie W. Jervis, Digital Signal Processing, Second Edition, Pearson Education / Prentice Hall, 2002.
- Sanjit K. Mitra, Digital Signal Processing - A Computer Based Approach, Tata Mc Graw Hill, 2007.
- A.V. Oppenheim, R.W. Schaffer and J.R. Buck, Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, 2004.
- Andreas Antoniou, Digital Signal Processing, Tata Mc Graw Hill, 2006.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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 12 marks 60 Marks



SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with 'A' grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119.
www.sathyabama.ac.in



DEPARTMENT OF BIOMEDICAL ENGINEERING

BOARD OF STUDIES – 2017 - 2018 (EVEN Semester)

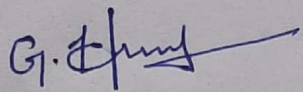
Minutes of the Meeting

01-11-2017

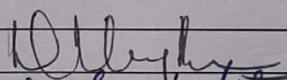
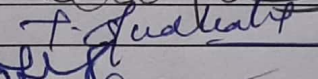
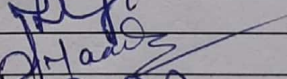
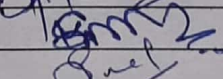
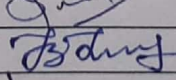
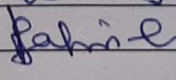
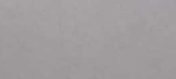
1. SBMX1008 – Artificial organs & prosthesis has been revised as a new subject as artificial organs & tissue engineering SBM1306 Unit IV & V has completely revised.
2. The Courses SBM1305 (Biological control systems) – new topics has been added in order to meet the demands of technological advancements.
3. Professional training I S24PT1 has been included in order to gain the hands on and exposure to the industrial needs. SEC1219 course code has been changed to SEC1221 Linear Electronic circuits since the derivation part in all has been deleted from 2016 batch onwards.

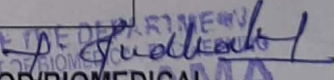
Members of Board of studies – Biomedical Engineering

EXTERNAL MEMBERS

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

INTERNAL MEMBERS

S.No.	Name of the Internal Member	Signature
1	Dr. Daniel Alex Anand	
2	Dr. T. Sudhakar	
2	Dr. J. Premkumar	
3	Dr. Anima Nanda	
4	Dr. S. Krishnakumar	
5	Ms. Sindu Divakaran	
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S.N o.	Course Code	Course Name	Deleted Topics	Added Topics
1	SBM1306	Artificial organs & Tissue engineering	NIL	UNIT 4 TISSUE ENGINEERING Tissue engineering • Basic principles and considerations, Bioreactor • design and applications, Biomaterials • Protein surface interaction, Protein adsorption, Engineering Biomaterials for Tissue Engineering • 10 to 100 micron size scale UNIT 5 STEM CELLS The Biology of Stem cells • Embryonic stem cells, adult stem cells, aging of stem cells, The importance of Stromal cells, Tissue engineering of Bone marrow
2	SBM1305	Biological control systems	Nil	Unit I - Signal flow graphs, Mathematical Models of Physical systems: Differential equations, Transfer functions and block diagrams of simple electrical networks, Translational and Rotational mechanical systems Unit II - P, PI, PD and PID controllers

SBMX1008	ARTIFICIAL ORGANS AND PROSTHESIS	L	T	P	CREDITS	TOTAL MARKS
		3	0	0	3	100

UNIT-I

10

Evolution of organ replacement technology. Organ replacement outlook, Biology of transplantation of tissue products matching. Types of tissue grafts, design considerations, evaluation process.

UNIT-II

10

Artificial heart and lung assist devices, Cardiac pace makers, Pacemaker Implantation, cardioverter. Artificial blood, artificial skin, artificial pancreas.

UNIT-III

10

The Nephron and Mass Transfer, artificial kidney, dialysis membrane, Dialysis Procedure and the Dialysis System, Dialyzer Cartridge Reuse.

UNIT-IV

10

Transplants types, immunological considerations, blood transfusions. Individual organs – Kidney, liver, heart, lung, bone, skin, hair and pancreas. Regeneration and ethical considerations.

UNIT-V

10

Engineering concerns-pressure gradient, effective orifice area. Regurgitation, flow, patterns and turbulent shear stresses. Heart valve prosthesis – mechanical and tissue valves, orthotic devices, fundamentals and engineering principles of limb prosthesis.

TOTAL NUMBER OF PERIODS: 50

TEXT BOOK:

1. Gerald E. Miller, "Artificial organs", 1st edition, A Publication in the Morgan & Claypool Publishers series, United States of America. (unit – II & III)

REFERENCES:

1. J.B. Park and R.S. Lakes, "Biomaterials: An Introduction" 2nd Edition, Plenum press, New York, 1992. (Unit – IV)
2. Joseph D Bronzino, "The Biomedical Engineering hand Book" Vol-11, CRC press, 2000. (Unit – I & V)

UNIVERSITY EXAM QUESTION PAPER PATTERN

Max. Marks: 80

Part A: 10 questions of 2 marks each - No Choice

Part B: 5 questions from each of the FIVE units of internal Choice, Each carries 12 marks

Exam Duration: 3 hrs

20 marks

60 marks

SBM1306	ARTIFICIAL ORGANS AND TISSUE ENGINEERING	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVE

- To provide a general introduction to the use of artificial materials in the human body for the purpose of aiding healing, correcting deformities and restoring lost function.
- It is expected that the student will have successfully completed elementary course in the mechanics of deformable bodies and an introductory course to material science prior to undertake a course in biomaterials.

UNIT 1 ORGAN REPLACEMENT

9 Hrs

Evolution of organ replacement technology. Organ replacement outlook, Biology of transplantation of tissue products matching. Types of tissue grafts, design considerations, evaluation process.

UNIT 2 ARTIFICIAL ORGANS

9 Hrs

Artificial heart valves, Heart valve prosthesis - mechanical and tissue valves, Cardiac pace makers, Pacemaker Implantation, Artificial Lung, Artificial skin, Artificial pancreas, Artificial kidney, Dialysis - The Nephron and Mass Transfer, Dialysis Procedure and the Dialysis System, Dialyzer Cartridge Reuse.

UNIT 3 TRANSPLANTS

9 Hrs

Transplants types, immunological considerations, blood transfusions. Individual organs - Kidney, liver, heart, lung, bone, skin, and pancreas. Regeneration and ethical considerations

UNIT 4 TISSUE ENGINEERING

9 Hrs

Tissue engineering - Basic principles and considerations, Bioreactor - design and applications, Biomaterials - Protein surface interaction, Protein adsorption, Engineering Biomaterials for Tissue Engineering - 10 to 100 micron size scale

UNIT 5 STEM CELLS

9 Hrs

The Biology of Stem cells - Embryonic stem cells, adult stem cells, aging of stem cells, The importance of Stromal cells, Tissue engineering of Bone marrow

Max. 45 Hours

TEXT / REFERENCE BOOKS

- Gerald E. Miller, Artificial organs, 1st edition, A Publication in the Morgan & Claypool Publishers series, United States of America, 2006.
- J.B. Park and R.S. Lakes, Biomaterials: An Introduction 2nd Edition, Plenum press, New York, 1992.
- Joseph D Bronzino, The Biomedical Engineering hand Book Vol-11, CRC press, 2000.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks 80

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 12 marks

60

SBM1305	BIOLOGICAL CONTROL SYSTEMS	L	T	P	Credits	Total Marks
		3	1	0	4	100

COURSE OBJECTIVE

- To study physical system with mathematical and electrical analogues. To study the system efficiency and stability using time domain and frequency domain techniques to study some basic biological systems like cardiovascular, endocrine etc.,

UNIT 1 SYSTEM CONCEPTS 12 Hrs.

Types of systems - Open loop systems, closed systems, Effects of feed back, Block diagram algebra and Signal flow graphs, Mathematical Models of Physical systems: Differential equations, Transfer functions and block diagrams of simple electrical networks, Translational and Rotational mechanical systems

UNIT 2 TIME RESPONSE ANALYSIS OF CONTROL SYSTEMS 12 Hrs.

Standard test signals, Time response of first order and second order systems with unit step as input, Time domain specification, steady state errors and static error constants, P, PI, PD and PID controller, Concept of stability and Algebraic Criteria

UNIT 3 THE CONCEPT OF STABILITY & ROOT LOCUS TECHNIQUE 12 Hrs.

The concept of stability, Routh stability criterion qualitative stability and conditional stability, the Root locus concept, construction of root loci.

UNIT 4 FREQUENCY RESPONSE ANALYSIS 12 Hrs.

Frequency response of the systems - Correlation between time and frequency responses - Gain and phase margins, Bode plots, Polar Plots, Nyquist stability Criteria.

UNIT 5 BIOMEDICAL APPLICATIONS 12 Hrs.

Examples of Biological control Systems: Cardiovascular Control System, Endocrine Control Systems, Pupil Control System, Skeletal Muscle Servomechanism, Oculo - motor system, sugar level Control Mechanism. Temperature control, Blood pressure control.

Max. 60 Hours

TEXT / REFERENCE BOOKS

1. J. Nagrath and Gopal, Control Systems: Engineering, New Age International (P) Limited, Publishers, 5th Edition, 2008
2. Kaushia Ogata, Modern Control Engineering, 3rd Edition, Prentice Hall of India Pvt Ltd, 1998.
3. Milsum John H, Biological Control System Analysis, 2nd Edition, McGraw Hill Publications, 1996.
4. M. Gopal, Control Systems: Principles and Design, Tata McGraw-Hill publishing company Ltd, 1997.
5. N.K Sinha, Control Systems, 3rd Edition, New Age International (P) Limited Publishers, 1998.
6. Milhom T.H., Applications of Control Theory to Physiological Systems, Saunder Publications, 1980.
7. Prof. Nageswara Rao, Control Systems, 3rd Edition, A.R. Publications, 2003.

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 80

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 12 marks

60 Marks