



# 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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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. Bethanney Janney	
7	Mr. G. Umashankar	

HOD / Biomedical

DEPARTMENT OF BIOMEDICAL ENGINEERING  
**SATHYABAMA**  
INSTITUTE OF SCIENCE AND TECHNOLOGY  
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Jadavaar 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**

- C. Raja Rao, Sujoy K. Guha, Principles of Medical Electronics and Biomedical Instrumentation, Universities Press, 2001.
- W. Mark Saltzman, Biomedical Engineering: Bridging Medicine and Technology, Cambridge University Press, 2015.
- Sundararajan V. Madihally, Principles of Biomedical Engineering, Artech House Publishers, 2010..
- 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**

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

**END SEMESTER EXAMINATION QUESTION PAPER PATTERN****Max. Marks: 100****PART A:** 10 questions of 2 mark 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**

<b>SBMA3010</b>	<b>TELEHEALTH TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Total Marks</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>100</b>

**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**

<b>SBMA4005</b>	<b>VIRTUALITY AND AUGMENTED REALITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>	<b>Total Marks</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>100</b>

**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:**

- C. Burdea & Philippe Coiffet, –Virtual Reality TechnologyII, Second Edition, Gregory, John Wiley & Sons, Inc.,2008
- Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA, . 2015.
- Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016.
- 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

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

**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

