

**V SEMESTER
OPEN ELECTIVE - I**

INTRODUCTION TO MEDICAL ELECTRONICS	
Course code: MLOE01	
Credits: 3:0:0	Contact hours: 42
Course Coordinators: Mrs Prabhu Ravikala Vittal, Mrs Uma Arun	
Course contents	
UNIT I	
Electro-Physiology And Bio-Potential Recording: The origin of Bio-potentials; biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.	
UNIT II	
Bio-Chemical And Non Electrical Parameter Measurement: pH, PO ₂ , PCO ₂ , colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters.	
UNIT III	
Assist Devices: Cardiac pacemakers, DC Defibrillator, Dialyser, Heart lung machine.	
UNIT IV	
Physical Medicine and Biotelemetry: Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy Telemetry principles, frequency selection, biotelemetry, electrical safety.	
UNIT V	
Recent Trends In Medical Instrumentation: Thermograph, endoscopy unit, Laser in medicine, cryogenic application, Introduction to telemedicine.	
Text Books	
1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.	
2. John G.Webster, "Medical Instrumentation Application and Design", 3rd Edition, Wiley India Edition, 2007	
Reference Books	
1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA McGraw-Hill, New Delhi, 2014	

2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2004.

Course Outcomes

At the end of the course, students will be able to

1. Understand the electro-physiology and bio-potential recording. (PO-1,2& PSO-1)
2. Describe the bio-chemical and non electrical parameter measurement (PO-1,2&PSO-1)
3. Outline the different types of assist Devices. (PO-1 &PSO-1)
4. Describe the concepts of physical medicine and biotelemetry. (PO-1,2&PSO-1)
5. Discuss the various recent trends in medical instrumentation (PO-1&PSO-1)

BIO MEMS	
Course code: MLOE02	
Credits: 3:0:0	Contact hours: 42
Course Coordinators: Mrs Chandana S, Dr Vani Damodaran	
Course contents	
UNIT I	
MEMS and Microsystem: History of MEMS, Materials in MEMS, Silicon Piezo resistors, Ga As, quartz, polymer. Micromachining- Lithography, thin film deposition, ION Implantation, Diffusion, Oxidation, Chemical and Physical vapour Deposition, Sputtering, Deposition by epitaxial, etching	
UNIT II	
Microsensors and Actuators: Mechanics for MEMS design - Static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators -beam and cantilever, microplates. Thermal sensors and actuators micromachined thermocouple probe, peltier effect heat pumps, thermal flow sensors.	
UNIT III	
Physical Micro Sensors: Design of Acoustic Wave sensor, resonator sensor, Capacitive and Piezo resistive pressure sensor.	
UNIT IV	
Microactuators: Design of Actuators: Actuation based on thermal forces, Actuation using Shape Memory alloys, Actuators using piezoelectric crystals, Actuation using electrostatic forces (Parallel plate, torsion bar, comb drive actuators). Micromechanical motors and pumps	
UNIT V	
Micro Fluidics Systems: Fluid Dynamics, laminar flow in circular conduits. fluid flow in micro and nano conduits. Microscale fluid flow - expression for liquid flow in channel, fluid actuation methods, dielectrophoresis, micro fluid dispenser, microneedle, micropumps - continuous flow systems.	
Text Books	
1. Tai-Ran Hsu. MEMS and Microsystems, Design Manufacturing and Nanoscale engineering, John wiley & Sons, 2014	
Reference Books	

1. G.K. Anantasure, K.J.Vinoy, S.Gopala Krishnan, K.N. Bhat, V.K. Aatre. Micro and Smart systems, Springer ed, 2014

Course Outcomes

At the end of the course, students will be able to

1. Discuss the basic material s used in MEMs and Microsystems (PO-1 & PSO-1)
2. Explain the various sensors and actuators used in MEMS (PO-1 & PSO-1)
3. Implementation of physical Micro Sensors (PO-1 & PSO-1)
4. Explain the design of actuators based on different techniques (PO-1 & PSO-1)
5. Discuss the properties & types of Micro fluidic systems (PO-& PSO-1)

HOSPITAL MANAGEMENT	
Course code: MLOE03	
Credits: 3:0:0	Contact hours: 42
Course Coordinators: Dr Prabha Ravi, Mr.S J Mahendra	
Course contents	
UNIT I	
Overview of Hospital Administration: Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning - Current Issues in Hospital Management – Telemedicine - Bio-Medical Waste Management.	
UNIT II	
Human Resource Management in Hospital: Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD –Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer, Communication – nature, scope, barriers, styles and modes of communication.	
UNIT III	
Marketing Research Process: Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations – Consumer Markets & Consumer Buyer Behaviour - Model of consumer behaviour - The buyer decision process - Model of business buyer behavior – Major types of buying situations - WTO and its implications.	
UNIT IV	
Hospital Information Systems & Supportive Services: Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services.	
UNIT V	
Quality and Safety Aspects in Hospital: Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – Environment Management Systems. NABA, JCI, NABL. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care – Medical Audit – Hazard and Safety in a hospital Setup.	

Text Books
<ol style="list-style-type: none"> 1. R.C.Goyal, —Hospital Administration and Human Resource Managementl, PHI – Fourth Edition, 2006. 2. G.D.Kunders, —Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.
Reference Books
<ol style="list-style-type: none"> 1. Cesar A. Caceres and Albert Zara, —The Practice of Clinical Engineering, Academic Press, New York, 1977. 2. Norman Metzger, —Handbook of Health Care Human Resources Managementl, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990. 3. Arnold D. Kalcizony& StephenM. Shortell, —Health Care Managementl, 6th Edition Cengage Learning, 2011.
Course Outcomes
<p>At the end of the course, students will be able to</p> <ol style="list-style-type: none"> 1. Explain and compare the organizational elements, structure, performance, terminology, and delivery modalities for Indian and global healthcare systems. (PO-1,6,7 &PSO-2) 2. Understand and apply resource management concepts (personnel, finance, and material resources) and the processes and strategies needed in specific hospital sectors. (PO-7,11 &PSO-2) 3. Develop innovative solutions to strategic, tactical and operational issues in managing healthcare systems and associated information technology through the combined use of information, organizational knowledge, talent management and critical thinking. (PO-5,7& PSO-2) 4. Apply modern change management and innovation management concepts to optimise structures as well as communicate effectively and develop their leadership and teambuilding abilities. (PO-9,12 &PSO-3) 5. Evaluate the ethical, legal, and regulatory requirements of the healthcare industry towards counselling in hospitals and the biomedical waste management. (PO-6,8&PSO-3)

VI Semester
OPEN ELECTIVE - II

BIOSAFETY & HEALTHCARE	
Course code: MLOE04	
Credits: 3:0:0	Contact hours: 42
Course Coordinators: Dr Sanjay H S, Mrs Purnima B R	
Course contents	
UNIT I	
Introduction to biosafety: General principles, Biosafety guidelines: Microbiological risk assessment, biosafety levels 1 and 2 in basic laboratories, biosafety level 3 in containment laboratories, biosafety level 4 in maximum containment laboratory, animal facilities and biosafety, guidelines for facility commissioning and certification, biosecurity	
UNIT II	
Medical laboratory safety: Biological safety cabinets, safety equipment, Microbiological techniques: laboratory techniques, contingency plans and emergency procedures, disinfection and sterilization, transport of infectious substances	
UNIT III	
Safety in hospitals: Chemical, fire and electrical safety: Hazardous chemicals, additional laboratory hazards, Safety organization and training: biosafety personal and committee, safety for support staff, training programs, safety checklist	
UNIT IV	
Other safety aspects: First aid, immunization of the staff, WHO biosafety collaborating centers, equipment safety, chemicals used and their hazards and precautions to be followed	
UNIT V	
Case studies: Biosafety in hospitals: Primary hospitals, Multispecialty hospitals, Biosafety in hospital waste disposals, rules and regulations to be followed, examples of hospitals with regard to biosafety in radiology and exposure	
Text Books	
1. Laboratory biosafety manual, 3 rd edition, World health organization, 2015	
2. Fay A Razovsky, "Handbook of patient safety compliance", Jossey Bass publications, 2014	

Reference Books
1. Gordon R Higson, "Medical device safety", IOP publications, 2012
Course Outcomes
At the end of the course, students will be able to
1. Assess the importance of essential biosafety related rules and regulations to be followed in healthcare (PO-3,8,9 & PSO-1)
2. Comprehend the different types of safety issues in hospitals and laboratories (PO-3,12 & PSO-2)
3. Ascertain the important safety-based issues in terms of equipment and patients in hospitals PO-3, 8 & PSO-2)
4. Illustrate the importance of supportive safety aspects to be considered in healthcare. (PO-3,4,11 & PSO-3)
5. Outline the role of biosafety and their relevance in real-time with the aid of different examples (PO-6,7,11 & PSO-3)

INTRODUCTION TO THERMAL IMAGING	
Course code: MLOE05	
Credits: 3:0:0	Contact hours: 42
Course Coordinators: Dr Sharath D, Dr Prabha Ravi	
Course contents	
UNIT I	
IR Thermography – Theory and Physics: History and evolution of thermography, blackbody radiation laws, IR absorption characteristics, radiometric measurements, heat and temperature, heat transfer mechanism, temperature measurement	
UNIT II	
IR Thermography System - Components: Optics, IR detector, detector performance parameters, image formation, filters, calibration, detector selection, choice of spectral band	
UNIT III	
IR Thermography System – Design and Advanced Methods: Camera performance characterization: temperature accuracy, temperature resolution, spatial resolution, time resolution, image quality. Advanced Methods: Spectrally Resolve IR Imaging, Superframing, Image processing and IR Imaging Software, Recent Advances	
UNIT IV	
IR Thermography Applications - Passive: Introduction, condition monitoring, building inspection, process monitoring and control, night vision and surveillance, medical applications, aircraft monitoring, automobile industry	
UNIT V	
IR Thermography Applications - Active: Active thermography techniques, inspection of composites, thermal property measurement, defect detection, characterization of coatings, corrosion detection, thermomechanics	
Text Books	
<ol style="list-style-type: none"> 1. Michael Vollmer, Klaus-Peter Mollmann, Infrared Thermal Imaging: Fundamentals, Research and Applications, John Wiley, 2010. 2. Holst, Gerald C. Common sense approach to thermal imaging. Washington, DC, USA: SPIE Optical Engineering Press, 2000. 	

Reference Books

1. Xavier P.V. Maldague, Nondestructive Evaluation of Materials by Infrared Thermography, Springer Science & Business Media, 2012
2. Kaplan, Herbert. Practical applications of infrared thermal sensing and imaging equipment. Vol. 75. SPIE press, 2007

Course Outcomes

At the end of the course, students will be able to

1. Understand the theoretical background of Infrared Thermography and temperature. (PO-1,2 & PSO-1)
2. Understand the complete IR thermography system and its working principle. (PO-1,2 & PSO-1,2)
3. Analyze and use the advanced concepts of IR thermography system. (PO-2,3& PSO-1,2)
4. Understand the concepts of IR camera operation and choose proper IR imaging system for a given problem. (PO-3& PSO-2)
5. Apply IR thermography techniques for various engineering related problems. (PO-4,5,12& PSO-2)

HEALTH INFORMATICS	
Course code: MLOE06	
Credits: 3:0:0	Contact hours: 42
Course Coordinators: Dr Prabha Ravi, Dr N Sriraam	
Course contents	
UNIT I	
<p>General Overview: Health information technology, Health informatics, Clinical Informatics, Cybermedicine, eHealth, Health 2.0, Public health informatics.</p> <p>Applications in Healthcare Management: Health Administration Informatics, Medical integration environment, Health information exchange, Hospital information system, Healthcare workflow, Computer physician order entry, ICU quality and management tools, Laboratory information management system, Laboratory information system, mHealth, Practice management software, Clinical Quality Management System</p>	
UNIT II	
<p>Health Electronic Records: Electronic health record, Electronic medical record, Personal health record, Computer STored Ambulatory Record, ProRec, Health record trust, Canadian EMR, Clear Health, Laika, openEHR, OpenEMR, OpenMRS, VistA, VistA imaging, VistA Web, WorldVistA, ZEPRS,</p> <p>Decision Support Applications: Clinical decision support system, Computer-aided diagnosis, Medical algorithm, Medical logic module, Physicians' Information and Education Resource.</p> <p>Languages and Development Platforms: MUMPS</p>	
UNIT III	
<p>Medical Imaging Applications: Digital radiography, Imaging informatics, Patient registration, Radiology information system, Picture archiving and communication system, Analysis of Functional NeuroImages,3DSlicer, Analyze, CARET, CAVEman, FreeSurfer, ImageJ, InVesalius, ITK-SNAP, Mango, OsiriX.</p> <p>Medical and biological signal applications: Medical monitor,Holter monitor,Automated ECG interpretation,Open ECG project ,MECIF Protocol,SCP-ECG, European Data Format, OpenXDF</p>	
UNIT IV	
<p>Databases, Digital Libraries and Literature Retrieval: Biological database, Medical literature retrieval, MEDLINE, Entrez, ETBLAST, PMID, PubMed, GoPubMed, Pubget, PubMed Central, UK PubMed Central,TRIP Database, Twease, SciELO.</p> <p>Telehealth and Telemedicine: Connected Health, Telehealth, Telemedicine, Telecare, Telephone triage, Remote guidance, Tele-epidemiology, Telenursing, Teledermatology, Telemental Health, Telepsychiatry,</p>	

Teleradiology, Telerehabilitation, Virtual reality in telerehabilitation, Campus medicus, Wireless Medical Telemetry Service. Virtual Systems: Virtual Physiological Human, Visible Human Project.
UNIT V
Legislation and Regulation: Health Insurance Portability and Accountability Act, Certification Commission for Healthcare Information Technology, Software Systems, Medical software, Dental software, List of freeware health software, List of open source healthcare software, List of neuroimaging software, Mirth, Mpro , Open Dental, Personal Health Application . Clinical Research Informatics: Translational research informatics, Clinical trial management, Clinical data management system, Case report form, Clinical coder, Clinical data acquisition, Data clarification form, Patient-reported outcome. Standards, Coding and Nomenclature: Diagnosis codes, Procedure codes.
Text Books
1. Wikipedia Handbook of Biomedical Informatics, http://code.pediapress.com
Reference Books
Course Outcomes
At the end of the course, students will be able to 1. Understand Health Systems and Policy. (PO-1,2,3 & PSO-1,2) 2. Develop skills in the management of health data, the electronic health record (EHR), health informatics projects and organizational resources. (PO-2,3,4 & PSO-1,2) 3. Know how computers store, access, and process data. (PO- 5,6,7 & PSO-2) 4. Use software applications to solve simple but meaningful real-world problems. (PO-7,8,9& PSO-3) 5. Design and Implement Information Systems Determining the required and available healthcare data and identify an appropriate database design. (PO-9,10,11 & PSO-3)