NEW PROPOSED COURSE STRUCTURE

ELECTRONICS AND COMMUNICATION BIO-MEDICAL ENGINEERING (2025-2026Batch)			
Course Code	**Course Title**	**Credit**	**Type**
	V SEMESTER		
CUBM2549	Medical Imaging and Techniques	4	3+0+1
CUBS2545	Biomedical Instrumentation	4	3+0+1
CUBS2546	Anatomy and Medical Physiology	4	3+1+0
CUBS2547	Project	4	0+0+4
	VI SEMESTER		
CUBM2553	Bio Medical Equipment 1	4	3+1+0
CUBM2554	Medical Device Regulations	4	3+0+0
CUBM2555	Calibration of Medical Devices	2	1+1+0
CUBM2556	Bio Medical Equipment 2	3	3+1+0
CUBM2557	INTERNSHIP	4	0+0+4
	TOTAL CREDITS	33	

CUBS2545	BIOMEDICAL INSTRUMENTATION	(3+0+1)

Course Overview

This course introduces the fundamental concepts of biomedical instrumentation including physiological systems, bio-signals, bio-potential electrodes, transducers, measurement of physiological parameters, patient monitoring systems, medical assist devices, and medical imaging systems. The course provides knowledge on measurement techniques for physiological parameters such as ECG, EEG, EMG, blood pressure, respiration, and temperature, along with patient monitoring and imaging systems like CT, MRI, and X-ray. The course helps students understand biomedical instrumentation systems used in hospitals and healthcare applications.

Prerequisites

- Basic Electronics
- Electrical Circuits
- Human Anatomy and Physiology
- Sensors and Transducers
- Signals and Systems

Course Objectives

1. To understand physiological systems and bio-signals of the human body.
2. To learn bio-potential electrodes and biomedical transducers.
3. To understand measurement of physiological parameters.
4. To study patient monitoring systems and medical assist devices.
5. To understand medical imaging systems such as X-ray, CT, and MRI.

Course Learning Outcomes (COs)

After completion of this course, students will be able to:

CO1: Understand physiological systems and bio-signals of the human body.
CO2: Explain bio-potential electrodes and biomedical transducers.
CO3: Measure physiological parameters such as ECG, EEG, EMG, blood pressure, respiration, and temperature.
CO4: Understand patient monitoring systems and medical assist devices.
CO5: Understand medical imaging systems such as X-ray, CT, and MRI.

CO – PO Mapping Table

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	3	2	2	-	2	-	-	-	-	-	-	2
CO3	3	3	2	2	3	-	-	-	-	-	-	2
CO4	3	2	2	-	2	-	-	-	2	-	-	2
CO5	3	2	-	-	2	2	-	2	-	-	-	2

MODULE– I
Physiological systems and Bio-signals:
Physiological systems of the human body, Functional structure of the cell, electrical activity
of cells: resting and action potentials, functioning of the heart, different physiological signals of human body.

MODULE – II
Bio potential Electrodes and Transducers:
Introduction components of the Bio Medical instrument system, Electrodes and types of Electrodes, Half-cell potential, Electrode paste, Transducers and applications

MODULE – III
Measurement of Physiological parameters:
Measurement of blood pressure, blood flow and cardiac output – Plethysmography,
Respiration rate, temperature, ECG, EEG, EMG, Safety measures for Medical Instrumentation.

MODULE– IV

Patient Monitoring Systems and Medical assist devices:
Intensive cardiac care units and Central monitoring systems, Patient monitoring through
Biotelemetry.Pacemakers, Defibrillators. Artificial heart valves, Heart-Lung machine, Kidney machine.

MODULE– V
Medical Imaging Systems:
Introduction to X-rays and X-ray machine, Principles of computer tomography (CT), Principles of Nuclear Magnetic Resonance (NMR) and Basic MRI system, MR Imaging: T1 and T2 based imaging,.

Text Books
1. Biomedical Instrumentation and Measurements, Leslie Cromwell, Fred J Weibell, and
Erich A Pfeiffer, PHI/Pearson Education, 2003.
2. Hand Book of Biomedical Instrumentation, RS Khandpur, TMH, 2003.
3. Bio-Medical Instrumentation, M.ArumugamAnuradha Agencies, 2003.

Reference:
1. Principles of Medical Imaging, K.KirkShung, Benjamin Tsui and Michael. B. Smith,
Academic Press Inc., New York.
2. Introduction to Biomedical Equipment Technology, Joseph J Carr, John M.Brown, 4th
Edition, Pearson Education, Singapore, 2001.

CUBS2546	**ANATOMY AND MEDICAL PHYSIOLOGY**	**(3+1+0)**

MODULE – I
Introduction to Cellular System:
Structure and organelles, Functions of each component in the cell. Cell membrane, transport
Across membrane, origin of cell membrane potential (Nernst and Goldman and Katz
Equations), Action potential.

MODULE – I I

Haematological System:

Blood composition, functions of blood, functions of RBC. WBC types and their functions.

Blood groups, importance of blood groups, identification of blood groups.

Blood flow factors

Regulating blood flow such as viscosity, radius, density, etc

(Fahraeuslindqvist effect,

Poiseuille's Law).

MODULE – III

Renal and Respiratory System:

Structure of Kidney and nephron. Mechanism of Urine formation and acid base regulation,

Dialysis.Components of respiratory system. Oxygen and carbon dioxide transport and acid

Base regulation.

MODULE – IV

Cardiac System:

Structure of heart, Properties of Cardiac muscle, Cardiac muscle and pacemaker potential,

Cardiac cycle, ECG, Heart sound, volume and pressure changes and regulation of heart rate

MODULE – V

Sensory System:

Structure of a Neuron, Synaptic conduction, Conduction of action potential in neuron, Parts of brain cortical localization of functions EEG. Simple reflexes, withdrawal reflexes. Autonomic nervous system and its functions, Structure of eye, ear and auditory and visual pathways.

Text Books

1. Elaine N. Marie, "Essential of Human Anatomy and Physiology", 8th edition. Pearson Education,

New Delhi, 2007.

Reference:

1. W. F. Ganong, "Review of Medical Physiology", Second Edition.McGraw Hill, New Delhi, 2000.

2. Prof. A. K. Jain, "Text Book of Physiology", Third edition, Volume I and II, Avichal Publishing

Company, New Delhi, 2005

CUBM2549	MEDICAL IMAGING AND TECHNIQUES	(3+0+1)

Course Objectives:

- Understand the fundamental concepts in imaging techniques and processing
- Apply algorithms and techniques to reconstruct and interpret image data
- Evaluate and analyze the medical image on pre-processing.

Course Outcomes

- Demonstrate and understand of the importance of image pre-processing steps
- Apply algorithms for classification and extraction of data based on images
- Assess the robustness and generalization capabilities of trained models through cross-validation and testing on unknown image data

MODULE-I

Introduction to different modalities of medical imaging; Conventional Tomography, Longitudinal Section Tomography, Computed Tomography, Reconstruction Techniques: Algebraic, Iterative reconstruction Techniques,

Radon Transform and its applications. Back Projection, Filter Back Projection Algorithms.

MODULE-II

Fundamentals of Acoustic Propagation: Reflection and Refraction, Attenuation, Absorption, Scattering, Non linearity Parameter and Doppler effect.

Ultrasonic Diagnostic Methods: Pulse-Echo Systems, Transmission Methods, Doppler Methods, Duplex Methods, Duplex Imaging. Biological effects due to Ultrasound.

MODULE-III

Radio Nuclide Imaging: Fundamentals of Radioactivity, Generation and Detection of Nuclear Emission, Diagnostic Methods using Radiation Detector. Radio Nuclide

Imaging Systems: SPECT, PET, Attenuation compensation. Characteristics of Radio nuclide Images, Internal Radiation, Dosimetry and Biological effects,

MODULE-IV

Magnetic Resonance Imaging: Fundamentals of Nuclear Magnetic Resonance, Fourier Spectrum of the NMR Signal, Spin Density, Relaxation Times, Pulse Sequences. Generation and Detection of NMR signal: Magnetic field Gradients, The NMR Coil/ Probe, The Transmitter, and The Receiver.

MODULE-V

Characteristics of Magnetic Resonance Imaging: Spatial Resolution, Image contrast. Imaging Methods: Data Acquisition, Spin.Echo Imaging, Gradient Echo Imaging, Blood Flow Imaging, NMR Spectroscopy, Sensitivity and Resolution, Imaging Safety. Biological Effects of Magnetic Fields.

TEXT BOOK

1. K.Kirk Shung, Michael B. Smith, Benjamin Tsui. Principles of Medical Imaging.,Pub : Academic Press, 1992

2. Rangaraj M. Rangayyan, Biomedical Image Analysis", CRC Press, Boca Raton, FL, 2005.

REFERENCE:

1. Avinash C. Kak, Principles of Computerised Tomographic Imaging. IEEE PRESS

CUBM2554 3+0+0 Medical Device Regulations

Course Overview: This course provides knowledge on Indian and global medical device regulations, quality management systems, risk management, EU MDR, US FDA regulations, auditing and regulatory approval processes.

Prerequisites: Basic Biomedical Engineering, Medical Devices, Quality Systems.

Course Objectives:
1. Understand Indian and global medical device regulations.
2. Learn quality and risk management.
3. Understand EU MDR and US FDA regulations.
4. Learn regulatory documentation.
5. Understand auditing and MDSAP.

Course Learning Outcomes:
CO1 Understand Indian Medical Device Regulations.
CO2 Apply Quality Management Systems.
CO3 Understand EU MDR.
CO4 Explain US FDA regulations.
CO5 Understand auditing systems.

CO-PO Mapping Table:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2	2	2	2

Module/ Subject	Details
1	**Indian Medical Device Regulations**
	Introduction to Indian Medical Device Regulations, Overview of IMDR, Chapters I to XII, Schedules I to VIII, Overview of all forms and rules related to IMDR, Submission process for licensing process, Overview of Global Regulations
2	**Medical Device Quality Management System and Risk Management**
	Process Approach, Plan Do Check Act, ISO 13485 Overview, Clause 1 to 8, ISO 14971 Overview, Medical device risk management process, ISO/ TR 24971 Overview, AI Management system Introduction
3	**European Union- Medical Device Regulation**
	Description of MDR 2017/745 and 2017/746, Technical Documentation under MDR, Unique Device Identification (UDI), EUDAMED, Post-Market Surveillance, GSPR
4	**US-FDA Regulation**
	Overview of US FDA Regulations and Guidelines for Medical Devices, Understanding of 21 CFR, General FDA Requirements, QMSR, Product Classification, Investigational Device Exemption (IDE), Premarket Approval Application (PMA), 510(k) Premarket Notification, Marking/ UDI, Post market Requirements, De-Novo
5	**Auditing Management Systems and Medical Device Single Audit Program**
	Description of ISO 19011, Principles of Auditing, Introduction to MDSAP and regulatory framework, Purpose and scope of MDSAP, MDSAP audit model and its alignment with international standards, MDSAP country - specific requirements (USA, Brazil, Australia, Canada and Japan), Understanding in-depth: MDSAP QMS requirements, Preparing for QMS audits and assessments, Audit reporting and documentation

Textbooks			
SN	**Name of the book**	**Author**	**Edition / volume**
1.	Medical Device Guidelines and Regulations Handbook	Prakash Srinivasan Timiri Shanmugam, Pugazhenthan Thangaraju, Nandakumar Palani and Thamizharasan Sampath	` Springer International Publishing, 2022
2.	Medical Device Regulations A Complete Guide	Aakash Deep	Elsevier Science, 2022
3.	Risk Management for Medical Device Manufacturers: [MD and IVD]	Joe W Simon	ASQ Quality Press, 2022
4.	Medical Device Regulation FDA-CDRH Manufacturing Policies and Regulation Handbook	Elijah Wreh	Elsevier Science, 2023

CUBM2553 3+1+0. Bio Medical Equipment – 1

Course Overview: This course focuses on troubleshooting biomedical equipment, PCB repair, electrical safety testing, installation safety and calibration of biomedical equipment.

Prerequisites: Basic Electronics, Electrical Circuits, Biomedical Instrumentation.

Course Objectives:
1. Troubleshoot electronic circuits.
2. Learn PCB troubleshooting.
3. Understand electrical safety.
4. Learn installation safety.
5. Learn calibration of biomedical equipment.

Course Learning Outcomes:
CO1 Understand electronics troubleshooting.
CO2 Analyze PCB troubleshooting.
CO3 Understand electrical safety.
CO4 Apply installation safety.
CO5 Perform calibration.

CO-PO Mapping Table:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2	2	2	2

Module/ Subject	Details
1	**Basic Electronics Troubleshooting**
	Testing of AC and DC power supply - Required Equipment for Power Supply Testing - Test Procedures for DC and AC supply; Grounding/ Earthing - Issues related to improper or No grounding – Shielding – Types of Shielding – Guarding – Insulation - Insulation failure causes - Insulation Resistance Measurement – Testing methods; Circuit Breakers
2	**Printed Circuit Board Troubleshooting**
	Printed circuit boards (PCBs) – Types - Materials and Construction - Issues and troubleshooting; Sensors and calibration; De-soldering techniques, replacement of Component /Solder Pad /Track repairing methods.
3	**Electrical Safety Test on Medical Equipment**
	Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety
4	**Electrical Safety during Installation, Testing and Commissioning, Operation and Maintenance**
	Preliminary preparations –safe sequence –risk of plant and equipment –safety documentation –field quality and safety -personal protective equipment –safety clearance notice –safety precautions – safeguards for operators –safety
5	**Medical Equipment Calibration**
	ECG; Infusion Pump, cardiac pacemaker and defibrillators. Electrical and patient safety, safety standards, different types of safety circuits for medical equipment and measures to reduce shock hazards, Safety Codes for Electromedical Equipment, Electrical Safety Analyser, and Testing of Biomedical Equipment.

Textbooks			
SN	**Name of the book**	**Author**	**Edition / volume**
1.	Electrical safety Engineering	Cooper.W.F	Newnes-Butterworth Company, 1978.
2.	Electrical safety hand book	John Codick	McGraw Hill Inc., New Delhi, 2000.

CUBM2556 3+1+0 Bio-Medical Equipment– 2

Course Overview: This course covers critical care equipment, OT equipment, radiology equipment, laboratory equipment and other hospital equipment.

Prerequisites: Biomedical Equipment I, Biomedical Instrumentation.

Course Objectives:
1. Understand critical care equipment.
2. Learn OT equipment.
3. Understand radiology equipment.
4. Study laboratory equipment.
5. Understand hospital equipment.

Course Learning Outcomes:
CO1 Understand critical care equipment.
CO2 Explain OT equipment.
CO3 Understand radiology equipment.
CO4 Explain laboratory equipment.
CO5 Understand hospital equipment.

CO-PO Mapping Table:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2	2	2	2

Module/ Subject	Details
1	**Critical Care Equipment**

	Introduction to ECG, Different types of ECG machines, block diagram of ECG Machine, working principle, trouble shooting, printers, paper loading. Block diagram of Multipera monitor, spo2, ECG, NIBP, TEMP, RR, IBP Explanation. Trouble shooting. Basic function of Infusion pump and Syringe pump, , Block diagrams, operating procedures, Trouble shooting. Construction of Defibrillator, working principle, types of defibrillators, block diagram, trouble shooting. Basic principle of ventilator, block diagram, flow and pressure measerements, gasses mixing and controlling, block diagram of ventilator, modes of ventilation, trouble shooting.
2	**Operation Theater Equipment**
	Construction of OT Light, various models of OT light, basic principle, block diagram, lumens intensity, trouble shooting. Construction of anasthesia machine, block diagram, modes of operation, trouble shooting. Designs of OT Table, operating procedure of OT, types of ot table, troubleshooting , Electrosurgical diathermy unit principle, operation,
3	**Radiology Equipment**
	Production of X Ray, energies of X Ray, Filtration of X Ray, Radiation Hazards. Block diagram Of Basic X Ray Machine, Trouble shooting. X RAY production, high frequency technologies, trouble shooting. C Arm image intensifier, working principle, block diagram, digital image processing, image processing. X RAY Cassets, Developer fixer, CR System
4	**Clinical Laboratory Equipment**
	Overview of clinical laboratory equipment, Hematology Equipment, Clinical Chemistry Equipment, Immunology and Serology Equipment, Microbiology Equipment, Blood Gas and Point-of-Care Testing (POCT) Equipment, Molecular Diagnostics Equipment
5	**Other Medical Equipment**

	Nebulizer & Suction Apparatus: Basic principle of nublizer and suction operators, block diagram trouble shooting; Infant Warmers: Basic principle of infant warmers, block diagram trouble shooting; Phototherapy: Basic principle of phototherapy, block diagram trouble shooting; Baby Incubator: Basic principle of baby incubators, block diagram trouble shooting; CTG Machine: Basic principle of CTG Machine, block diagram trouble shooting Ultrasound Scanners: Basic principle of ultrasound scanners, block diagram trouble shooting, Different Probes and clinical application of ultra sound, measurements.

Textbooks

SN	Name of the book	Author	Edition / volume
1.	Clinical Engineering Handbook	Ernesto Iadanza	Academic Press, 2nd Edition, 2019
2.	Biomedical Equipment Technician - The Comprehensive Guide	VIRUTI SHIVAN	Mar 22, 2024
3.	Medical Equipment Maintenance	Binseng Wang	Springer International Publishing, 2022

CUBM 2555 1+1+0 Calibration of Medical Devices

Course Overview: This course covers healthcare safety, radiation safety, hospital accreditation, biomedical equipment management and hospital engineering management.

Prerequisites: Biomedical Equipment, Safety Engineering.

Course Objectives:
1. Understand healthcare safety.
2. Understand radiation safety.
3. Learn biomedical engineer roles.
4. Understand accreditation.
5. Learn equipment management.

Course Learning Outcomes:
CO1 Understand healthcare safety.
CO2 Understand radiation safety.
CO3 Explain biomedical engineer roles.
CO4 Understand accreditation.
CO5 Apply equipment management.

CO-PO Mapping Table:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	2	2	2	2	2	2	2	2
CO2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	2	2	2	2	2	2	2	2	2	2	2	2

Module/ Subject	Details
1	**Healthcare Safety**
	Electrical safety, Micro / Macro-shock, Chemical, Biological, Fire, laser safety, medical gases safety and stability and Transport, Biomedical waste management, Hazardous, Non-Hazardous, Discarded glass, chemical Waste, plastic Disposables, Liquid Wastes, Pressurized containers,
2	**Radiation Safety**

	X-ray Equipments and production, Radiation Units for Measurement of Radioisotopes, Radiation units for measurement of Ionizing Radiation, personal maximum permissible doses. Radiation Detection and monitoring, Basic principles of Radiation protection, Leakage Radiation test, storage devices, Radiographic Exposure devices, Biological effects of Ionizing Radiation, Nuclear regulatory commission regulations, Documentation and recordkeeping, Transportation of Radioactive Meterial
3	**Biomedical Engineer Role and Responsibilities**
	Biomedical engineering in healthcare systems; Equipment management in hospitals; Installation, commissioning, and acceptance testing; Preventive and corrective maintenance; End-of-life equipment disposal; Medical Equipment Planning & Procurement - Needs assessment and feasibility analysis; Technical specifications and tendering process; Vendor management and negotiations; Equipment selection matrix and value-based purchasing;
4	**Accreditations**
	NABH Access, Assessment & continuity of care, Care of Patients, Management of medication, Patients' Rights and Education. Hospital Infection control, continual quality Improvement, Responsibilities of Management, Facility management and safety. Human resource management, Information management system, Documentation Requirements & Implementation Guidelines, Accreditation process, Final Assessment. JCI, ISO Accreditation and International dimensions, Accreditation criteria and their interpretation, laboratory Accreditation, Process of Accreditation, NABL operations, Accreditation process and Assessment techniques.
5	**General Management**

	Biomedical department management. Asset management, Asset tagging, breakdown calls management, spares management, PPM management, calibrations, Traceability, management, service contracts management, staff Skills, staffing. Incident reports, Internal service reports, CAPEX, Requirements, User Training records, Daily check list for critical care Equipments, Electrical Requirements, medical gases Requirements, operational plan, SOPs, management committee, procurement committee

Textbooks

SN	Name of the book	Author	Edition / volume
1.	Patient Safety and Hospital	Accreditation	

		Sharon Myers	Springer Publishing Company, 2011
2.	Hospital Accreditation Standards		
		Joint Commission Resources	Joint Commission Resources, 2011