Department of Biomedical Engineering
B.Tech. Third Year (Semester-A)
Lecture Plan
Session: July-Dec 2024

Subject Code: BM 49003   **Subject Nomenclature: Medical Imaging Systems**

Lecture No.	Topic Covered	Unit
1.	Introduction of subject, its syllabus, related books and prerequisite's	1
2.	Principle of X-rays, its properties & generation process	1
3.	Fundamentals of Computed Tomography machine	1
4.	Principles of sectional imaging	1
5.	Scanner configuration & Data acquisition system	1
6.	Image formation & System electronics of CT machine	1
7.	Storing, documentation & patient dose in CT	1
8.	Basics of MRI machine	2
9.	Pulse sequence, Image acquisition and reconstruction techniques	2
10.	MRI instrumentation assembly	2
11.	RF coils & receiver system	2
12.	Functional MRI machine	2
13.	Applications of MRI	2
14.	Computer console of MRI machine & its generations	2
15.	Introduction to ultrasound machine	3
16.	Production of ultrasonic waves	3
17.	Principles of image formation	3
18.	Principles of A-mode, B-mode and M-mode display	3
19.	Principles of scan conversion	3
20.	Doppler ultra sound and colour flow mapping	3
21.	Application of diagnostic ultrasound	3
22.	Fundamentals of Radio-isotope imaging	4
23.	Rectilinear and scanners	4
24.	SPECT	4
25.	PET	4
26.	The gamma camera	4
27.	Radionuclide for imaging	4
28.	Emission computed tomography	4
29.	Fundamentals of Infra-Red Imaging	5
30.	Physics of thermography	5
31.	Pyro-electric vidicon camera	5
32.	Clinical thermograph,	5
33.	Liquid crystal thermography	5
34.	Imaging systems	5
35.	Application areas	5
36.	Doubt clearing session (Unit-One)	
37.	Doubt clearing session (Unit-Two)	
38.	Doubt clearing session (Unit-Three)	
39.	Doubt clearing session (Unit-Four)	
40.	Doubt clearing session (Unit-Five)	

PREPARED BY: Mr. Sunny Ganavdiya (Assistant Professor, BMED)

Shri G.S. Institute of Technology & Science, Indore

Department of Biomedical Engineering

Semester A July - Dec 2024

Biological Control Systems   **BM-49005**

Day	Topic
1.	**Unit I:** Introduction to physiological control systems and its examples; difference between physiological and engineering control systems.
2.	Art of modelling physiological Systems, Distributed parameters versus lumped parameter models, Simple models of muscle stretch reflex action.
3.	Across variable and through variables, Generalized system properties (viz ,Impedance, compliance and inertance)
4.	Generalized system properties (viz, Impedance, compliance and inertance) continued….
5	**Unit II:** Respiratory Mechanism, Linear model of respiratory mechanics
6	Gas exchange and ventilation-perfusion relationship in the lung
7.	Chemical regulation of ventilation
8.	**Unit III:** Cardiac cycle and pressure-volume loops
9.	Cardiac pressure versus time graph
10.	The cardiac output curve
11.	The venous return curve
12.	Close loop analysis: Heart and systemic circulation combined
13.	**Unit IV :** The Hodgkin-Huxley model.
14.	Structure of Eye & Functioning
15.	Westheimer's saccadic eye model
16.	Westheimer's saccadic eye model continued
17.	Compartmental models
18.	Compartmental models continued
19.	Integrated cardiopulmonary model
20.	Integrated cardiopulmonary model continued
21.	**Unit V:** Basic problems in physiological system analysis
22.	Basic problems in physiological system analysis continued…
23.	Nonparametric and parametric identification:
24.	Numerical Deconvolution
25.	Least Square Estimation
26.	Estimation using correlation functions
27.	Estimation in the frequency domain
28.	Optimization techniques
29.	Problems in parameter estimation
30.	TEST

Department of Biomedical Engineering

B.E.II Year (Biomedical Engineering)

Lecture Plan

Subject Code: BM-29007 Subject Name: Bioelectricity and transducers

L1	**UNIT I:-Introduction of subject**
L2-3	Bioelectric signals &Biopotential Electrodes : Cell membrane– Nernst equation, Resting and action potential,
L4	Electrical activity of muscles.
L5	Electrical activity of the heart, and brain.
L6	Electrode theory and recording issues: Electrode-tissue interface,
L7	Metal-Electrolyte Interface, Electrode-Skin Interface .
L8	Motion Artifact, Electrode impedance,
L9	Electrical conductivity of Electrodes: jellies and creams, Body Surface Electrodes.
L10	Internal Electrodes: Needle and Wire Electrodes
L11	Micro-electrodes: Metal, Supported Metal Micropipette.
L12	**UNIT II:-**Transducer and Transduction Principles, Type of transducers.
L13	Displacement and Pressure Measurement : (with applications) Resistive: Potentiometers,
L14	Strain Gauges and Bridge Circuits..
L15	Inductive: Variable Inductance and LVDT.
L16	Capacitive type.
L17	Piezoelectric Transducers
L18	**UNIT III:-** different types of temperature transducers:Thermistor,
L19	Thermocouple,
L20	Resistive Temperature Detector, IC based Temperature.
L21 ,22	Measurement. different types of pressure transducers: Types of Diaphragms, Bellows, Bourdon Tubes
L23	QUIZ
L24,25	**UNIT IV:-**Blood gas and Acid−Base Physiology Potentiometric Sensors,.
L26	Ion Selective Electrodes,
L27	Amperometric Sensors,
L28,29	Clark Electrode with examples − pH, pO_2, pCO2 Electrodes
L30	Reference electrodes
L31	**UNIT V:-**Biosensors and optical sensor
L32	Two examples of each biosensors and Immunosensors.
L33	Optical Sensors,
L34	Photo detectors,
L35	Pyrometers, Optical Sources.
L36	DOUBT CLEARING

Shri G.S. Institute of Technology and Science

BM-49261: Hospital Management and Information Systems

Lecture Plan
(July 2024-Dec 2024)

Day	Topic
1	Introduction to subject and syllabus overview and its requirement B.M.
2	Introduction to Data structures
3	Basics of array data structures
4	Multidimensional array and implementation
5	Introduction to linked list
6	Link list operations and implementation
7	Stack type data structures
8	Operation in stack data structures and implementation
9	Queue and its types
10	Various operation in queue type data structures
11	Non linear data structures and its use
12	Tree, various definition in tree type
13	Different types of tree
14	Binary search tree and its implementation
15	Graphs and its types
16	Use of graph type DS
17	Introduction to DBMS and its use and application in Hospitals
18	Basic concepts of DBMS
19	DBMS architecture
20	Characteristics of DBMS
21	Components of DBMS
22	Relational DBMS and terminologies
23	Keys in DBMS and its types
24	DBMS Methodologies
25	DDL & DML and various operations
26	Relational Schema
27	ER-Diagram and various terminologies
28	ER diagram-examples practice
29	Normalization and its types
30	Basics of SQL
31	Various SQL queries
32	Various SQL queries (constraints)
33	Various SQL queries (joins)
34	Indexing and hashing in DBMS
35	HIS and its role in DBMS
36	Networking and its types
37	Application of various topologies in hospitals
38	Introduction to PACS
39	Different block of PACS
40	DICOM & ISO and requirement in medical domain.

SUBJECT TEACHER
BMED

Shri G.S. Institute of Technology & Science, Indore

Department of Biomedical Engineering

Semester A July - Dec 2024

Human Anatomy and Physiology   **BM: 29003**

Day	Topic
1.	**Unit I:** Introduction of Subject ,Cell structure and its Organelles
2.	Different types of cell, functions of each component in the cell membrane.
3.	Transport across membrane.
4.	Origin of cell membrane Potential, action potential and propagation.
5	Blood composition:-RBC, WBC, and platelets
6	**Unit II:** Structure of heart, types of circulation
7.	Cardiac cycle, volume and pressure changes
8.	ECG ,Heart sounds
9.	Blood pressure ,Regulation of BP
10.	Respiratory system, Mechanics of respiration
11.	Regulation of respiration
12.	Volumes and capacities of lung
13.	Types of Hypoxia.
14.	**Unit III:** Nerve cell anatomy, Human nervous system
15.	Human nervous system continued…. Functions of nervous system
16.	Skeletal system
17.	Structural and functional classification of joints
18.	Functions of Muscular System ,types of muscles
19.	Sliding filament model
20.	Neuromuscular junction
21.	**Unit IV:** Digestive system
22.	Description of GI tract and Accessory organs
23.	Excretory system, Function of urinary system, Structure of Nephron
24.	Physiology of urine formation, Micturition
25.	**UNIT V:** Human reproductive system Male and female
26.	Physiology and function of eyes
27.	Physiology and function of ear
28.	Endocrine glands and their hormones
29.	Maintenance of calcium homeostasis, Maintenance of glucose homeostasis
30.	TEST

Shri G.S. Institute of Technology and Science

BM-29001: Analog Electronics
Lecture Plan
July -Dec 2024

Day	Topics
1	Introduction to Semiconductor Devices
2	Introduction to Transistor and Different Modes of Configuration
3	BJT Configuration and Review of Different Circuits
4	Introduction to Hybrid –π Model and why it is Necessary for AC Analysis of Transistor
5	Frequency Response of Amplifiers
6	Low frequency Analysis with numerical examples
7	High Frequency Analysis with numerical examples
8	Introduction to Power Amplifier and Tuned Amplifier
9	Classification of Power Amplifier
10	Class A Power amplifier, circuit details & efficiency Calculations
11	Class B Power amplifier, circuit details & efficiency Calculations
12	Introduction to Regulated Power Supplies, Advantages &Applications
13	Series Voltage Regulator BasicCircuits
14	Calculations of Circuit Impedance at Resonance.
15	Shunt Voltage Regulators and Some Circuits
16	Basic Principle of Tuned Circuits, BW, Quality Factor and Resonance Frequency Calculations
17	Single Tuned Amplifier Circuit Explanation
18	Double Tuned Amplifier Circuit Explanation &Applications
19	Introduction to the Concept of Feedback and its Different Examples in Various Domains
20	Different Feedback Topology'sBasic Structure
21	Voltage Series Feedback Circuit Analysis
22	Voltage Shunt Feedback Circuit Analysis
23	Current Shunt Feedback Circuit Analysis
24	Current Series Feedback Circuit Analysis
25	Introduction to OPAMP its ideal characteristics
26	Explanation of Different Circuits of OPAMP
27	Emitter Coupled Amplifier Circuit Explanation
28	Different Circuits of OPAMP e.g., Summer, Differentiator
29	Introduction to Integrator, Differentiator
30	Explanation of Instrumentation Amplifier, their applications
31	Introduction to Schmitt Trigger
32	Introduction to Logarithmic and Anti-logarithmic Amplifier

SUBJECT TEACHER
BMED

\DEPARTMENT OF BIOMEDICAL ENGINEERING

Session 2024-2025[July-Dec, 2024]

Lesson Plan

Subject: Biomedical Instrumentation 1(BM 39013)	**Total Lecture:** 30
Faculty: Vinay Manurkar	**Semester:** 5th

Lecture 1-2:   Introduction to Biomedical Instrumentation, Bio-potentials, Origin of Bio-potentials: Cellular Level Signals, Resting Membrane Potential

Lecture 3: Action Potential, General Block Diagram of Medical Instrumentation, General constraints in design of Medical Instruments, General consideration for signal conditioners.

Lecture 4: Basics of Potentiometry, Standard Electrode potential, Nernst Equation

Lecture 5-6: Junction Potential, Electrode-Electrolyte Interface, Polarization, Electrode-Electrolyte Interface, Electric Double Layer

Lecture 7-8: Polarization, Polarized and Non- Polarized Electrode, Ag/ Agcl Electrode, Electrode Skin interface, Motion Artifacts

Lecture 9: Surface Electrode configuration. Interesting facts about heart structure.

Lecture 10: Cardiac AP, ECG Basics, Abnormal ECG, 12 LEAD

Lecture 11: Cardiac Dipole, GCT and WCT

Lecture 12-13: ECG Amplifier and Differential Amplifier

Lecture 14: Instrumentation Amplifier

Lecture 15: Block diagram of ECG, RL DRIVEN circuit

Lecture 16-17: Problems and interference in recording ECG, Filtering in ECG AND EMG

Lecture 18: Detailed Study of EMG

Lecture 19-20: EMG based medical devices and EEG

Lecture 21-22: Temperature, Heart rate and Respiratory rate measurements

Lecture 18: Pulse rate and Oximeter. Blood flow meter

Lecture 19: Cardiac output measurement

Lecture 20: BP Measurement

Lecture 21: Plethysmography

Lecture 23-24: Introduction to cardiac arrhythmia and related components
Lecture 25-27: Introduction to Analytical Instruments, spectrophotometry and sources of error.
Lecture 28-30: Flame photometer and Mas spectroscopy
Lecture 31-32: Bio cell counter and PH meter
Lecture 33-34: Chromatography
Lecture 35-36: Biosensors
Lecture 37-38: Blood gas Analysers and Glucose Sensors
Lecture 39-40: Overview of Pacemakers and Defibrillators. Electrical Safety .

Department of Biomedical Engineering

B.E.III Year (Biomedical Engineering)

Lecture Plan

Subject Code: BM-39011/BM -39001 Subject Name: Signals& Systems

Lecture No.	Topic Covered (Unit No.)
1.	Introduction to signals
2.	Classification of Signals, discrete & contuinuous time
3.	Some basic Continuous time signals eg. Impulse, step exponential etc
4.	Basic Discrete time signals
5.	Explanation of Energy & Power Signals with some examples
6.	Defining a system ,different types of systems
7.	Properties of Systems
8.	Properties of system continued
9.	Numericals based on manipulating a signal, eg shifting reversal etc and some from system properties
10.	Problem solving
11.	LTI system introduction
12.	Continuous time LTI system its properties
13.	Convolution of LTI systems
14.	Describing LTI systems using Difference & differential equations
15.	Numerical session based on above 4 lectures

16.	Response of LTI system to complex exponential
17.	continued
18.	Different transforms applicable on signals
19.	Reason for different transformations their usefullness
20.	Introduction to Fourier Series
21.	Concept for Fourier Series
22.	Explanation of importance, condition of convergence of Fourier series
23.	Different forms of representation of Fourier Series
24.	How to calculate coefficients of Fourier Series
25.	Numerical on Fourier series
26.	Numerical on Fourier series
27.	Introduction to Fourier Transforms
28.	Condition of convergence
29.	Discrete Fourier transform
30.	Fourier Transform for periodic and aperiodic signals
31.	Numerical examples of Fourier transform
32.	Numerical examples of Fourier transform
33.	Laplace transform its origin and usefulness
34.	Properties of Laplace transforms
35.	Numerical Problems related to laplace transform
36.	Solving Differential equations using Laplace transform

37.	Basic concepts of Z transform
38.	Properties of Z Transform ., ROC conditions
39.	Numerical Problems based on z transform
40.	Problem solving session