Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Institute of Technology
Semester-5

Subject: Biomedical Engineering - BETEC15311

Type of course: Professional Core and Professional Elective Courses

Prerequisite: Basic knowledge of Electronics, Sensors, and Human Physiology

Rationale:
This course provides a fundamental understanding of biomedical instrumentation used in healthcare systems. It covers physiological signal acquisition, medical electrodes, transducers, diagnostic equipment, and imaging systems. Students will gain knowledge of how engineering principles are applied to medical diagnostics and patient monitoring

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				Theory Marks		Practical Marks		CA	
CI	T	P	C	ESE	MSE	V	P	ALA	
2	0	2	3	60	30	10	20	30	150

Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

Course Content:

Unit. No	Course content	Hrs	% Weightage
1	**Introduction to Biomedical Engineering** Definition and scope of Biomedical Engineering, History and evolution of biomedical engineering, Role of biomedical engineers in healthcare, Interdisciplinary nature (Electronics + Biology + Medicine).Overview of human body systems: Cardiovascular system, Nervous system, Respiratory system, Ethical and safety considerations in the biomedical field	08	25%
2	**Medical Transducers**: Body Temperature (Thermistor, RTD), Blood Pressure (Strain Gauge), Respiration Rate Sensors, Indirect Blood Pressure Measurement	03	10%

3	**Fundamentals of Medical Instrumentation:** Sources of Biomedical Signals, Generation of Bio-potentials (Resting & Action Potential), Generalized Block Diagram of Medical Instrumentation System, Medical Electrodes: ECG, EEG, EMG, Defibrillator	05	20%
4	**Biomedical Recorders and Monitoring Systems** Electrocardiograph (ECG): Block Diagram & Working, , ECG Leads: Bipolar and Unipolar, Einthoven's Triangle, Electroencephalograph (EEG): Electromyograph (EMG): Block Diagram & Working.	06	20%
5	**Medical Imaging Systems:** Characteristics and Generation of X-rays, X-ray Machine: Block Diagram & Working, CT Scan: Principle and Block Diagram.	08	25%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**The System Storyteller** The student are assigned a specific System (e.g.,Respiratory,Circulatory) and must "narrate" its journey through the body from a first-person perspective.upload a comprehensive report on the GMIU Web Portal	10
2	**Sensor Selection Pitch** Present a clinical scenario (e.g., "Design a system for continuous core body temperature monitoring in a ICU").Students must research and Pitch a specific sensor type (e.g., Thermistor, Thermocouple, or Infrared). upload Document on GMIU web Portal	10
3	**Poster Making** Students will make a Poster of any Biomedical Machine.Upload the Poster on the GMIU Web Portal.	10
Total		30

Suggested Specification table with Marks (Theory):60

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weight age	30%	20%	20%	10%	10%	10 %

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from the above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Define the interdisciplinary nature of BME and the professional responsibilities regarding ethics and patient safety.
CO2	Understand the basic principles of medical transducers and their role in biomedical instrumentation.
CO3	Explain the biophysical processes responsible for bio-potential generation and signal acquisition, and explain the operation, working principles, and clinical applications of medical electrodes (ECG, EEG, EMG) in monitoring physiological parameters
CO4	Interpret block diagrams of recorders like ECG, EEG, and EMG to evaluate diagnostic data.
CO5	Evaluate the principles of medical imaging systems and their utility in clinical diagnostics.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs
1.	Simple Op Amp Circuit Measurements.	1	2
2.	Design and analysis of biological pre-amplifiers.	2	2
3.	Experiment of Thermistors	3	2
4.	Blood pressure measurement.	3	2
5.	Experiment of Photo-plethysmography	3	2
6.	Recording of EMG-Signal	4	2
7.	Recording of various physiological parameters using patient monitoring system and telemetry units	4	2
8.	Measurement of respiration rate	1	2
9.	Recording of ECG signal and analysis	3	4
10	Measurement and recording of peripheral blood flow.	4	2
11.	Study of characteristics of optical Isolation amplifier	4	2
12	Measurement of PH and Conductivity.	4	2
13	Measurement of Blood Glucose.	4	2

14	Design and simulate an Instrumentation Amplifier (using Op-Amps) to amplify low-voltage ECG or EEG signals.	3	2
	TOTAL		**30**

Instructional Method:

The course delivery method will depend on the requirements of the content and the needs of students. The teacher, in addition to conventional teaching methods by blackboard, may also use any tools such as demonstration, role play, quizzes, brainstorming, MOOCs, etc.

From the content, 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e- courses, and Virtual Laboratory

Practical/Viva examination will be conducted at the end of the semester for the evaluation of the performance of students in the laboratory.

Reference Books:

[1] John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", Academic Press.

[2] John G. Webster, "Medical Instrumentation: Application and Design", Wiley.

[3] R.S. Khandpur, "Biomedical Instrumentation: Technology and Applications", McGraw-Hill Education.

[4] Laurence J. Street, "Introduction to Biomedical Engineering Technology", CRC Press.

[5] Joseph D. Bronzino, Donald R. Peterson, "Biomedical Engineering and Design Handbook", McGraw-Hill Education.

[6] Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press.

[7] John L. Semmlow, "Signals and Systems for Bioengineers: A MATLAB-Based Introduction", Academic Press.

[8] W. Mark Saltzman, "Biomedical Engineering: Bridging Medicine and Technology", Cambridge University Press.