



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3162422

Semester VI

Subject Name: BIOMEDICAL INSTRUMENTATION

Type of course: Professional Elective Course

Prerequisite: Basic concepts of Electronics, Measurement & Instrumentation Engineering.

Rationale: The course has been designed to introduce fundamental principles of Instruments used in biomedical engineering. This subject is intended to make student aware with Various Techniques and principles like bio potentials, bio sensors, Bioelectric Amplifiers, Patient Monitoring Systems, and Biomedical Recording Systems of in this course.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Course Content	Teaching Hours	Module Weightage
1	Introduction: Sources, types and nature of bioelectric signals, Interaction of signals to perform various functions of body, Electrical circuit model of the membrane, Stimulation and conduction in a nerve impulse, Electrophysiological Signals- ECG, EMG, EEG their generation, propagation, recording and diagnostic applications.	6	20
2	Bio potentials: Bio potentials, Resting potential, Action potential, Synaptic Potential-their generation, transmission, and propagation.	4	10
3	Biosensors: Sensors/receptors in the human body and their basic mechanism of action, organization of nervous system neural mechanism, Chemoreceptor, hot & cold receptors, Baroreceptors, Sensors for - smell, touch, sound, vision and taste, Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Principles of MOSFET & BioMEMS, Smart sensors.	10	10
4	Bioelectric Amplifiers: Electrodes, Electrode-tissue interface, Galvanic Skin Response, BSR, Motion artifacts, Instrumentation amplifiers, Special features of bioelectric amplifiers, Carrier amplifiers, Chopper amplifiers, Phase sensitive detector.	8	20
5	Patient Monitoring Systems: System concepts, Cardiac monitor, selection of system parameters, Bedside monitors, Central monitors, Heart rate meter, Pulse rate meter, Measurement of respiration rate, Holter monitor and Cardiac stress test, Catheterization laboratory Instrumentation, Organization & equipment used in ICCU & ITU.	8	20



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6	Biomedical Recording Systems: Basic Recording systems, General consideration for signal conditioners, Preamplifiers, Differential Amplifier, Isolation Amplifier, Electrocardiograph, Phonocardiograph, Electroencephalograph, Electromyography, Digital stethoscope Other biomedical recorders, Biofeedback instrumentation, Electrostatic and Electromagnetic coupling to AC signals, Proper grounding, Patient isolation and accident prevention.	10	20
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Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	20	10	10	10	10

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)

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 above table

Suggested Reading:

1. R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill.
2. Cromwell, Weibell & Pfeiffer, “Biomedical Instrumentation & Measurement”, PHI, India.
3. S.C. Cobbold, “Transducers for Biomedical Instruments”, Wiley, 1974.
4. Gabor Harsanyi, “Sensors in Biomedical Applications: Fundamental Technologies and Applications” CRC Press, 1St Ed, 2000.
5. Deric P. Jones, ”Biomedical Sensors”, Momentum press, 1St Ed, 2010.

References Books:

1. J.J.Carr & J.M.Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
2. Joseph Bronzino, “Biomedical Engineering and Instrumentation”, PWS Engg., Boston.
3. J.Webster, “Bioinstrumentation”, Wiley & Sons.
4. Joseph D.Bronzino, “The Biomedical Engineering handbook”, CRC Press.
5. Rao & Guha, “Principles of Medical Electronics & Biomedical Instrumentation”, University Press, India.
6. D. L. Wise, “Applied Bio Sensors “, Butterworth, London.
7. Shakti Chatterjee & Aubert Miller, “Biomedical Instrumentation Systems”, Delmer Cengage Learning, 1st Edition, 2010.
8. John G. Webster, “Medical Instrumentation Application and Design” 4th Ed, Wiley, 2011.
9. Carr & Brown, Introduction to Biomedical Equipment Technology, Pearson Edition, Asia.

Course Outcomes: At the end of this course, students will be able to clarify

Sr. No.	CO statement	Marks % weightage	Topics Covered
	At the end of this course, students will demonstrate the ability to		
CO1	understand various functions of human body.	20	1
CO2	apply knowledge of bio potentials and bio sensors for measurement of signals.	20	2, 3
CO3	understand the use of bioelectric amplifiers.	20	4
CO4	study the Patient Monitoring Systems.	20	5



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CO5	analyze working of Biomedical Recording Systems.	20	6
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List of Experiments: The following are suggested list of experiments based on theme.

1. Interaction of bio - medical signals to perform various functions of human body.
2. Electrophysiological Signals- ECG, EMG, EEG.
3. Sensors in the human body and their basic mechanism of action.
4. Sensors for - smell, touch, sound, vision and taste.
5. Chemoreceptor.
6. Principles of BIoMEMS & Smart sensors.
7. Bioelectric amplifiers.
8. Holter monitor and Cardiac stress test.
9. Organization & equipment used in ICCU & ITU.
10. Biomedical Recording Systems.

Major Equipment: kits, computers, open source software, etc.