

GUJARAT TECHNOLOGICAL UNIVERSITY

BIO-MEDICAL ENGINEERING (03)

DIAGNOSTIC INSTRUMENTATION

SUBJECT CODE: 2160301

B.E. 6th SEMESTER

Type of course: Core

Prerequisite: Physics, Biopotential Measurement and techniques, Human Anatomy and Physiology.

Rationale: To introduce students to principles, applications and working of medical instruments most commonly used in medical instrumentation systems used for diagnostic medical applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<u>CARDIOVACULAR DISORDERS & DIAGNOSIS:</u> The ECG waveform, Cardiovascular Disorders, Block Diagram, Signal Conditioning Circuits, ECG recorders, non invasive techniques like trade mill and holter monitoring, Phonocardiography.	10	18%
2	<u>NERVOUS SYSTEM DISORDERS & DIAGNOSIS:</u> EEG waveform (Frequency range & Amplitude), Nervous System Disorders, Block Diagram, Signal Conditioning Circuits , Multi channel recording system, magneto EEG, EMG waveform, Block diagram, Signal Conditioning Circuits, Nerve Conduction Velocity.	9	10%
3	<u>OCULAR DISORDERS AND THEIR DIAGNOSIS:</u> Perimetry, Refractometry, Tonometry, Ophthalmoscopy, Visual Evoked Response, ERG, EOG, Electronystagmogram.	8	8%
4	<u>Audiometry & Spirometry :</u> Auditory Disorders, AER, ASSR, ABER, Types of Audiometers, Respiratory Disorders, Spirometry, Volumes & capacity, Spirometers, Pneumotachometers, Pulmonary Function Analyzer.	9	12%
5	<u>Blood Gas Analyzers & Blood cell counters:</u> Blood pH measurement, Measurement of blood PCO ₂ & PO ₂ , Blood Gas Analyzer, Methods of Cell counting, Types of Blood cell counters.	9	15%
6	<u>Clinical Laboratory Instruments:</u> Spectrophotometry, Spectrophotometer, Colorimeters, Flame Photometers, Glucometer, Pulse-oxymeter, Electrophoresis Techniques & apparatus, Chromatography & Types of Chromatograph, ELISA reader, RIA units, PCR units, Auto Analyzer.	10	25%
7	<u>Endoscopy Systems:</u>	5	12%

	Introduction, basic endoscope system and its various types with application.		
Total		60	100%

Reference Books:

1. R. S. Khandpur “Handbook of Bio-Medical Instrumentation”, Tata McGraw Hill.
2. Carr & Brown, “Introduction to Biomedical Equipment Technology” Pearson Education, Asia.
3. J.Webster, “Bioinstrumentation”, Wiley & Sons.
4. R S Khandpur, Handbook of Analytical Instruments, Second Edition
5. Joseph Bronzino, “ Biomedical Engineering and Instrumentation”, PWS Engg . , Boston.
6. Geddes & Baker , “Principles of Applied Biomedical Instrumentation” Wiley.
7. Leslie Cromwell, “ Biomedical Instrumentation and Measurements”

Suggested Specification table with marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20%	30%	20%	20%	10%	0

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.

Course Outcome:

After learning the course the students should be able to:

1. Understand diagnosis related equipments in entirety covering its principle of working, instrumentation related, modes of operation and various advancements.
2. Explain and describe different diagnostic measurement methods for identification of humane biopotentials and their necessary instrumentation.
3. Understand problem and will be able to identify the necessity of equipment to a specific problem.
4. Explain and describe different diagnostic methods of treatment where electrical medical equipment are a vital part of the method and their necessary instrumentation.
5. Understand the position of biomedical instrumentation in modern hospital care.
6. Understand and describe the physical and medical principles used as a basis for biomedical instrumentation.

List of Experiments: (Outlines)

1. Real time acquisition of ECG, EEG & EMG and analysis.
2. Analysis of abnormal ECG wave pattern using arrhythmia Simulator.
3. The study of Pulse oximetry.
4. Acquisition of Heart sounds using PCG.
5. Acquisition and analysis of audiogram using Audiometer.
6. Respiration rate measurement and pulmonary function analysis using spirometer.
7. The study of Blood cell counter.
8. The study of Endoscope and its components.
9. The study of Auto analyser.
10. Analysis of various samples using Colorimeter.
11. The study of Flame photometer.

Design based Problems (DP)/Open Ended Problem:

To design various analytical instrumentation scheme for varied samples.

Major Equipment:

Biomedical Trainer and Demo Kit

Active Learning Assignments: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding of theory and practical work. The faculty will assign topics from which students can grasp knowledge about current scenario of the Diagnostic Instrumentation. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.