GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3160301
Semester – VI
Diagnostic Instrumentation

Type of course: Professional Core Course

Prerequisite: Human Anatomy & Physiology -I and II, Fundamentals of Biopotentials, Biomedical Sensors & Transducer.

Rationale: The objective of this course is to impart necessary theoretical and practical knowledge of basic principles and phenomena in the area of medical diagnostic instrumentation. This subject will enable students to understand the design, operation and maintain the diagnostic medical instruments. Students may explore for research gap of current diagnostic techniques or diagnostic instruments and identify the opportunities of innovation in specific diagnostic domain.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
4	0	2	5	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Cardiovascular Disorders and their Diagnosis:** Cardiovascular System Disorders, Physiology of Heart & ECG waveform, Normal and Abnormal Electrocardiogram (ECG) Features, 12-Lead ECG Electrode placement & Lead system, ECG Artifacts, Block diagram and operation of ECG machine, Isolation Pre-amplifier, Driven-Leg ECG Amplifier, Signal conditioning circuits, Normal & Abnormal Heart sounds, Phonocardiography, Heart rate and Pulse rate measurements, Cardiac Output measurement, and other noninvasive techniques like trade mill and holter monitoring, Bedside Patient Monitoring System,	15	25
2	**Nervous System Disorders and their Diagnosis:** Nervous System Disorders, EEG waveform (Frequency range & Amplitude), 10-20 system of EEG electrode placement, EEG machine Block Diagram, Signal Conditioning Circuits, Magnetoencephalograph, EMG waveform, Block diagram of EMG machine, Artifacts in EMG, Signal Conditioning Circuits, Nerve Conduction Velocity measurement.	11	21
3	**Respiratory Disorders and their Diagnosis:**	11	16

	Respiratory System Disorders, Pulmonary function measurement, Spirometry, Types of Spirometers, Pneumotachometers, Pulmonary Function Analyzer, Respiratory Gas Analyzers, Measurement of Respiration Rate.		
4	**Special Senses Disorders and their Diagnosis:** **Ocular System –** Ocular Disorders, Perimetry, Refractometry, Tonometry, Ophthalmoscopy, Slitlamp, Electroretinography (ERG), Electrooculography (EOG), Electronystagmography (ENG). **Auditory System –** Auditory system Disorders, Mechanism of Hearing, Air and Bone conduction, Threshold of Hearing, Otoscopes, Transducers for Audiometry, Types of Audiometers, Audiometer System Bekesy, Evoked Response Audiometry system, Auditory Steady-State Response (ASSR), Auditory Brainstem Evoked Response (ABER), Electrocochleogram.	14	22
5	**Biomedical Telemetry and Telemedicine:** **Telemetry:** Wireless Telemetry, ECG Telemetry system, Multichannel wireless Telemetry system, Implantable Multi-sensor Radiotelemetry, Biotelemetry application on WIMAX network. **Telemedicine:** Essential Parameters, Delivery Modes, Telemedicine system, Clinical data Interchange/Exchange standards, Applications.	9	16
	Total	**60**	**100**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20%	30%	25%	15%	10%	00%

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 the above table.

Reference Books:

1. R. S. Khandpur, "Handbook of Bio-Medical Instrumentation", 3rd Edition, Tata McGraw Hill.
2. Carr & Brown, "Introduction to Biomedical Equipment Technology" Pearson Education, Asia.
3. Robert B. Northrop, "Noninvasive Instrumentation & Measurement in Medical Diagnosis", CRC Press.
4. J.Webster, "Bioinstrumentation", Wiley & Sons.
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", Prentice-Hall.

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Course Outcomes:

At the end of this course students will be able to

Sr. No.	CO statement	Marks % weightage
CO-1	Explain the signal generation, measurement technique, instrumentation design and signal analysis used in diagnosis of cardiovascular system disorders using advanced diagnostic devices.	25%
CO-2	Describe the signal generation, measurement technique, instrumentation design and signal analysis used in diagnosis of nervous system disorders using advanced diagnostic devices.	21%
CO-3	Explain various lung parameters, parameter measurement technique, instrumentation design and signal analysis used in diagnosis of respiratory system disorders using advanced diagnostic devices.	16%
CO-4	Illustrate various diagnostic techniques and instrumentation for abnormalities of human eye and ear (special senses).	22%
CO-5	Understand the basics of Wireless Telemetry & Telemedicine and its applications in Medical field.	16%

Suggested List of Practical:

Sr No	Title	Duration (hrs)
1	To study the Electrocardiogram (ECG) machine.	02
2	To study the Phonocardiograph (PCG) machine.	02
3	To study the Heart-rate & Pulse-rate Measurement.	02
4	To study the Electroencephalogram (EEG) machine.	02
5	To study the Electromyogram (EMG) machine.	02
6	To study the Pulmonary Function Analyzer (PFA).	02
7	To study the technique of Respiration rate measurement.	02
8	To study the Electrooculogram (EOG) machine.	02
9	To study the Audiometry.	02
10	To study the Biomedical Telemetry and Telemedicine with its Applications.	02

Major Equipment:

Biomedical Trainer kit, ECG,EEG, EMG