

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM

COURSE TITLE: DIAGNOSTIC MEDICAL INSTRUMENTATION

(Code: 3340304)

Diploma Programme in which this course is offered	Semester in which offered
Bio-Medical Engineering	4 th Semester

1. RATIONALE

Diagnostic medical instruments play a major role in the field of health care in providing information about the disease. This course will enable the students to understand functioning and constructional features of different diagnostic medical instruments used in biomedical engineering for sensing various parameters of human body. Biomedical engineers should be able to operate, calibrate and maintain these instruments/ equipment. And hence this course is a key course for biomedical engineers.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire following competency:

- **Operate, calibrate and maintain different diagnostic medical instruments used for sensing various parameters of human body.**

3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes

- Identify various biomedical diagnostic instruments
- Maintain different types of biomedical recorders
- Maintain various patient monitoring instruments
- Maintain pulmonary function analyzers
- Operate audiometer and maintain various hearing aids

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	200
4	0	4	8	70	30	40	60	

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. DETAILED COURSE CONTENT

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – 1 Fundamentals of Medical Instruments	1a. List different body potential and explain generation of bio potentials in human body. 1b. Explain generalized block diagram of a diagnostic medical instrumentation system. 1c. Classify medical instruments based on different working principles. 1d. List diagnostic medical instruments	1.1 Fundamental of medical instrumentation. 1.1.1 Sources of biomedical Signals. 1.1.2 Generalized medical instrumentation block diagram. 1.1.3 Classification of medical instruments based on different principles. 1.1.3.1 Based on application (diagnostic, therapeutic, Imaging, analytical). 1.1.3.2 Based on physiological parameter and bio-potential. 1.1.3.3 Based on Biological system. 1.1.3.4 Based on different departments in the hospital.
Unit – 2 Biomedical Recorders	2a. Describe working principle of Electrocardiograph and explain its block diagram. 2a.1 List the steps to Test & calibrate the ECG machine 2a.2 List the steps to Maintain ECG machine 2b. Classify and explain bipolar and unipolar leads used for ECG measurements. 2c. Explain blockdiagram of Vector cardiograph. 2d. Explain phonocardiograph. 2e. Define 10-20 electrode placement method used for EEG 2f. Explain Electroencephalograph with its working principle. 2g. Explain EMG readout device. 2h. Explain biofeedback instrumentation with neat diagram.	2.1 Electrocardiograph 2.1.1 ECG readout device (Block diagram, working principle) 2.1.2 Bipolar & unipolar leads 2.1.3 Vector cardiograph 2.1.4 Phonocardiograph 2.2 Electroencephalograph 2.110-20 electrode placement system 2.2EEG readout device (Block diagram, working principle) 2.3 Electromyograph 2.3.1 EMG readout device (Block diagram, working principle) 2.4 Biofeedback Instrumentation
Unit – 3 Patient Monitoring System	3a. Define heart rate. 3b. Explain average heart rate meter. 3c. Explain instantaneous heart rate meter. 3d. Define Pulse rate. 3e. Describe technique of pulse rate measurement. 3f. Enlist different techniques of BP measurements. 3g. Explain direct and indirect methods of blood pressure measurements. 3h. List the steps to maintain BP	3.1 Techniques of heart rate measurement. 3.1.1 Average heart rate meter 3.1.2 Instantaneous heart rate meter 3.2 Measurement of pulse rate 3.3 Blood Pressure measurement 3.3.1 Direct method 3.3.2 Indirect method such as korotkoff Method (Sphygmomanometer) 3.3.3 Manual & automatic BP Instrument 3.3.4 Measurement of respiration rate. 3.4.1 Impedance pneumography

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	Instruments 3i. Define respiration rate. 3j. Describe impedance pneumography technique. 3k. Draw and explain apnoea monitor. 3l. Define: Invivo and Invitro measurements. 3m. Explain ear oxymeter and pulse oxymeter.	3.4.2 Apnoea monitor 3.5 Oxygen Saturation measurement (Oxymetry) 3.5.1 Ear oxymeter 3.5.2 Pulse oxymeter
Unit – 4 Pulmonary Function Analyzer	4a. Define Spirogram. 4b. Describe various lung volumes & capacities. 4c. Define spirometry. 4d. Explain various types of spirometers.	4.1. Spirogram 4.1.1 Lung volumes and capacities (Respiratory volumes) 4.2. Spirometry 4.2.1 Basics Spirometer 4.2.2 Wedge Spirometer 4.2.3 Ultrasonic Spirometer
Unit – 5 Audiometers and Hearing Aids	5a. Define: Air and Bone conduction. 5b. Describe threshold of hearing and its importance. 5c. Explain measurement of sound. 5d. Explain different hearing transducers in detail. 5e. List and describe various types of audiometers. 5f. Classify hearing aids. 5g. Explain with block diagram hearing aids	5.1 Air & bone conduction 5.2 Threshold of hearing 5.3 Measurement of sound 5.4 Hearing transducers 5.5 Types of audiometers 5.6 Hearing aid 5.6.1 Conventional 5.6.2 Digital

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Fundamentals of Diagnostic Medical Instruments	10	6	4	-	10
II	Biomedical Recorders	12	6	4	8	18
III	Patient Monitoring System	14	2	12	4	18
IV	Pulmonary Function Analyzer	10	2	8	4	14
V	Audiometers and Hearing Aids	10	-	6	4	10
	Total	56	16	34	20	70

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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.

7. SUGGESTED LIST OF PRACTICALS/EXPERIMENTS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to

acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

Sr.No.	Unit No.	Practical/Exercises (Outcomes in psychomotor domain)	Approx Hrs. required
1.	III	Measure blood pressure using sphygmomanometer and stethoscope.	2
2.	III	Measure SpO2 using pulse oximeter.	2
3.	III	Measure pulse rate & observation of blood pressure waveform using multiparamonitor.	4
4.	III	Maintain BP instruments (Sphygmomanometer , Digital –Automatic / Manual)	2
5.	III	Measure respiration rate using impedance pneumograph.	2
6.	III	Measure body temperature using digital thermometer.	2
7.	V	Measure air conduction & bone conduction using audiometer kit.	2
8.	III	Measure skin response using Galvanic skin response meter.	2
9.	II	Identify various leads selector network of ECG machine.	4
10.	II	Measure gain and CMRR of ECG pre amplifier using ECG machine.	4
11.	II	Measure gain and CMRR of EMG machine.	4
12.	II	Measure gain and CMRR of EEG machine.	4
13.	II	Demonstrate the performance & testing of EMG stimulators.	2
14.	II	Demonstrate the performance of ECG machine.	2
15.	II	Test & calibrate the given ECG machine	2
16.	II	Demonstrate ECG in v1 to v6 modes using suitable Suction /pre gelled self adhesive electrodes	2
17.	II	Maintain various electrodes of diagnostic medical instruments	2
18.	II	Test patient cable of ECG	2
19.	II	Demonstrate the performance of EMG machine.	2
20.	II	Test patient cable of EMG	2
21.	II	Demonstrate the performance of EEG machine.	2
22.	II	Test patient cable of EEG	2
23.	IV	Demonstrate the performance of spirometer.	2
24.	V	Demonstrate the performance of audiometer.	2
Total Hrs			58

8. SUGGESTED LIST OF STUDENT ACTIVITIES

- i Collect the images of various Diagnostic medical instruments from internet and attach their photographs in file/journal.
- ii Survey the market and collect the specifications of different diagnostic instruments supplied by reputed companies and compare them with respect to their strengths and shortcomings.

9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- i. Show the video/animation films and photographs of constructional features, operations, calibrations, and maintenance of diagnostic instruments.
- ii. Arrange a visit to medium or big hospital and show constructional features, operations, calibrations, and maintenance of diagnostic instruments.

10. SUGGESTED LEARNING RESOURCES**A. List of Books**

Sr.No.	Title of Book	Author	Publication
1.	Medical instrumentation application & design	John G. Webster, Editor	John Wiley and Sons
2.	Handbook of biomedical instrumentation	R. S. Khandpur	Tata McGraw Hill
3.	Biomedical instrumentation measurements.	Lesli P Cromwell, Fred J. Weibell, Erich A. Pfeiffer	Prentice Hall of India
4.	Introduction to biomedical equipment technology	Carr Joseph J., Brown J.M	Pearson education Delhi
5.	Medical Electronics	A. G. Patil	Excel Book New Delhi

B. List of Major Equipment/ Instruments

- i. Heart rate monitor cum ECG trainer
- ii. 12 lead ECG simulator
- iii. Respiration-rate monitor
- iv. Electro-myograph trainer
- v. Phonocardiograph trainer
- vi. Heart/pulse rate measurement trainer
- vii. Blood pressure measurement trainer
- viii. Sphygmomanometer
- ix. Audio meter
- x. Pulse oximeter

C. List of Software/Learning Websites

- i. <http://ocw.mit.edu/courses/health-sciences-and-technology/>
- ii. <http://webcast.berkeley.edu/series.html#c,d,Bioengineering>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. N.D.Makwana**, Lecturer, Dept. of Biomedical Engineering, G.P.Gandhinagar
- **Prof. A. K. Bula**, Lecturer, Dept. of Instrumentation Engineering, G. P. Gandhinagar
- **Prof. M. H. Dave**, Lecturer, Dept. of Biomedical Engineering, G. P. Gandhinagar
- **Prof. S. S. Malkan**, Lecturer, Dept. of Biomedical Engineering, G. G. P. Ahmedabad

Faculty Members from NITTTR

- **Prof. (Ms.) Susan S. Mathew**, Associate Professor, Dept. of Electrical and Electronics Engineering.
- **Dr. S. K. Gupta**, Professor and Coordinator for Gujarat State