Program : **Diploma in Biomedical Engineering**	
Course Code : **3242**	Course Title: **Medical Instrumentation**
Semester : **3**	Credits: **3**
Course Category: **Program Core**	
Periods per week: **3 (L:2, T:1, P:0)**	Periods per semester: **45**

Course Objectives:

- To provide a thorough knowledge about the working of different biosignal recorders, and measurement principles of various biological parameters

Course Prerequisites:

Topic	Course code	Course name	Semester
Anatomy and physiology of the human body.		Basic Medical science	2

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Describe the working of various recording and monitoring instruments related to heart and characteristics of ECG signals	11	Understanding
CO2	Explain the recording instruments used for EEG and EMG recorders and audiometers.	10	Understanding
CO3	Describe the cardiac output measurement techniques, transducers and biomedical recorders	11	Understanding
CO4	Explain the principle of BP measurements, blood flow meters, spirometer, fetal monitor.	11	Understanding
	Series Test	2	

CO – PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2						
CO2	2						
CO3	2						
CO4	2						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Describe the working of various recording and monitoring instruments related to heart and characteristics of ECG signals**		
M1.01	Summarize ECG signals generation, waveform and arrhythmias	2	Understanding
M1.02	Explain ECG lead configuration and recording system	3	Understanding
M1.03	Explain ambulatory monitoring and stress testing	3	Understanding
M1.04	Explain patient monitoring systems	3	Understanding
Contents: **ECG recorder, 12 lead configuration, Ambulatory monitoring, stress testind and patient recorders** ECG signal characteristics - correlation with cardiac events, Arrhythmias - Tachycardia, Bradycardia, Ventricular Fibrillation, heart blocks. ECG lead system- Einthoven's triangle, unipolar and bipolar recording, 12 Lead configurations. Basic ECG Recorder- block diagram and working, Stress Testing-Treadmill test and bicycle test Ambulatory monitors- block diagram Patient monitoring systems: Bedside monitors - block diagram and working - Central station monitors- block diagram and working			
CO2	**Explain the recording instruments used for EEG and EMG recorders and audiometers.**		
M2.01	Describe EEG signals, Electrode placement, EEG recorder and evoked response.	4	Understanding

M2.02	Summarize EMG signals and recorder	3	Understanding
M2.03	Explain brain stem audiometer and pure tone audiometer	3	Understanding
	Series Test – I	1	

Contents:

EEG recorder, 10-20 electrode placement, EMG recorder, audiometer

EEG - signals - various waves and its relation with brain activity- its characteristics, EEG recording - unipolar and bipolar, Electrode - 10-20- electrode system, Microprocessor based 3 channel EEG machine - block diagram and working, Evoked potential measurement- visual and auditory

Audiometers- pure tone and auditory brainstem evoked potential - principle and working

EMG - signal characteristics-EMG recorder- block diagram and working.

CO3	**Describe the cardiac output measurement techniques, transducers and biomedical recorders, transducers used in biomedical field.**		
M3.01	Describe the different Cardiac output measurement techniques.	3	Understanding
M3.02	Explain the working principle of ERG- EOG- EGG- BCG- VCG- PCG-	2	Understanding
M3.03	Summarize working principle of different transducers	3	Understanding
M3.04	Describe working principle of different Temperature transducers and Photoelectric transducer	3	Understanding

Contents:

Cardiac output measurement, biosignal recorders, transducer, temperature measurement, photoelectric transducers.

Cardiac output measurement: Dye dilution method - Ultrasound method - Continuous measurement from aortic pressure waveform - Working Principle and block diagram

Recorders: ERG- EOG- EGG- BCG- VCG- PCG- basic idea

Transducers: Potentiometric-Variable Capacitance - Variable inductance - LVDT - Piezoelectric- Working principle and application

Temperature transducers: Thermistors - Thermocouples - Radiation thermometry

Photoelectric transducer: Photo voltaic - PMT - Silicon diode arrays - Working principle and application.

CO4	**Explain the principle of BP measurements, blood flow meters, spirometer, fetal monitor.**		
M4.01	Describe invasive and non-invasive BP measurement techniques	3	Understanding

M4.02	Explain the principle of blood flow meters and pulse oximeters	4	Understanding
M4.03	Explain the principle and working of basic spirometer	2	Understanding
M4.04	Describe the working of Doppler Fetal monitor.	2	Understanding
	Series Test – II	1	

Contents:

Blood pressure measurement- direct and indirect, blood flow meters, spirometer, fetal monitor

BP Measurement: definition - atrial and ventricular BP - Sphygmomanometer- principle and working - korotkoff sound - comparison of invasive and non-invasive methods of BP measurements.

Electromagnetic Blood Flow meters - Principle, working and diagram, Doppler Blood Flow meters - Principle, working and diagram

Pulse oximeter - Principle, block diagram and working

Spirometer - Principle, working and diagram of basic spirometer

Doppler Fetal Monitor - Principle, working and diagram

Text / Reference:

T/R	Book Title/Author
R1	R S Khandpur- *Handbook of Analytical Instruments*- McGraw Hill Education; 2 edition (25 January 2006)
R2	R S Khandpur- *Handbook of Biomedical instrumentation*- McGraw Hill Education; Third edition (4 August 2014)
R3	Arumugham- *Introduction to Biomedical Instrumentation* -Anuradha Publications-India
R4	Leslie Cromwell *Biomedical Instrumentation and Measurements* –second edition Prentice Hall-India 2011

Online Resources:

Sl.No	Website Link
1	https://www.researchgate.net/figure/Block-diagram-of-Hemoglobin-sensor_fig2_315574862
2	https://www.slideshare.net/ShreyaAhuja2/ph-meter-54084084
3	https://lecturenotes.in/notes/31-notes-for-biomedical-instrumentation-bi-by-verified-writer
4	http://www.eeeuniversity.com/2013/08/ei2311-biomedical-instrumentation.html
5	https://www.vidyarthiplus.com/vp/Thread-BM2251-Biomedical-Instrumentation-Lecture-Notes-All-Units#.XensMOgzbIU