ECE1011	MEDICAL PHYSICS AND BIOMEDICAL INSTRUMENTATION	L	T	P	J	C
		3	0	2	0	4
Prerequisite	PHY1001/PHY1701- Engineering Physics	**Syllabus version**				
		1.0				

Course Objectives:

1. Introduction to the techniques used for measurement of various physiological parameters and discuss the effects electromagnetic radiations on human body
2. Detailed study of medical ultrasound and provide an overview of its components
3. Describe different types of electrodes used in bio-potential recording and types of cardiovascular measurements
4. Discuss respiratory, neuromuscular and nervous measurement system

Expected Course Outcome:

The student will be able to

1. Develop the systems concerned with measuring various non-electrical quantities in human system.
2. Use of radionuclides in medicine, cause of radiation, maximum permissible occupational doses-protective measures
3. Components of ultrasound, acoustical characteristics of human body, piezo electric receivers
4. Understand the conduction techniques of bioelectric signals and the various types of electrodes for the bio potential measurement.
5. Blood pressure measurement, Blood flow measurement
6. Spirometry, CO2 analyzer and Oxygen analyzer
7. Ability to design and conduct experiments, as well as to analyze and interpret data

Student Learning Outcomes (SLO):	**1, 2, 14**

Module:1	**The Electromagnetic Radiation**	**6 hours**

Interaction of photons and charged particles with matter- Photoelectric effect- Compton scattering-Coherent scattering-Infrared radiation and its biological applications-UV radiation and its applications-damaging effects of UV light. Radiometry and photometry- Electrical impedance and Biological Impedance.

Module:2	**Nuclear Radiation and its effects on the body**	**6 hours**

Radionuclides used in medicine and biology-LD50-Cause of radiation death-Radiation carcinogenesis-Cataract-Genetic effects-Permissible exposures-Maximum permissible occupational doses- Protective measures.

Module:3	**Medical Ultrasound**	**6 hours**

Production-properties and propagation of ultrasonic waves-Bioacoustics-Acoustical characteristics of human body-Ultrasonic Dosimetry-Destructive and nondestructive tests-Cavitation-Piezo electric receivers, thermoelectric probe-Lithotrophy-High power ultrasound in therapy.

Module:4	**Bio Potential Electrodes and Bio-amplifiers**	**8 hours**

Origin of bio potential and its propagation-Electrode-electrolyte interface-Electrode–skin interface, Half-cell potential-Impedance-Polarization effects of electrode-Non polarizable electrodes-Types of electrodes - Surface, needle and micro electrodes and their equivalent circuits-Recording problems - Measurement with two electrodes-Need for bio-amplifier - Single ended bio-amplifier, Differential bio-amplifier –Right leg driven ECG amplifier-Band pass filtering-Isolation amplifiers – Transformer and optical isolation - Isolated DC amplifier and AC carrier amplifier-Chopper amplifier-Power line interference.

Module:5	**Cardiovascular Measurements**	**5 hours**

Blood pressure measurement-Blood flow measurement-Heart sound measurement-ECG-VCG			
Module:6	**Respiratory System Measurements**		**6 hours**
Spirometry-Measurement of functional residual volume-CO_2 analyzer and Oxygen analyzer			
Module:7	**Neuromuscular and Nervous measurement system**		**6 hours**
EEG-procedure-Signal artifacts-Signal analysis-Evoked potential-EMG-Procedure and signal analysis-Nerve conduction study			
Module:8	**Contemporary issues:**		**2 hours**
	Total Lecture hours:		**45 hours**
Text Book			
1.	Abu-Faraj, Ziad O., Handbook of Research on Biomedical Engineering Education and Advance Bioengineering Learning, 2012,Volume 1, IGI Global, Hershey, USA.		
Reference Books			
1.	Leslie Cromwell, "Biomedical Instrumentation and measurement",2012, 1st edition, PHI, New Delhi.		
2	K Thayalan "The Physics of Radiology and Imaging" 2014, 1st edition, Jaypee Medical publishers, India, 2014.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
List of Challenging Experiments (Indicative)			
1.	Design an ECG amplifier using AD620 instrumentation amplifier with necessary numbers of operational amplifiers. Display the output data on computer screen using USB data acquisition board.		6 hours
2.	EEG signals are usually overlapped with noise signals. Design a band pass filter to eliminate or attenuate the artifacts without losing significant component of EEG signals		6 hours
3.	How pulsed Doppler can be used to detect blood flow. Using ultrasonic sensor (HCSR04) distance module design a blood flowmeter and dsplay the recording on the computer screen.		6 hours
4.	Measurement of strength of arm muscle is of high clinical importance especially for athletes. How can we measure the strength of the arm muscle using EMG? Design a EMG system to access the condition.		6 hours
5.	Wired pulse oximeter is widely used in the hospitals to measure oxygen saturation. Design a wireless pulse oximeter using LED (620nm-940nm) and display the data on computer screen		6 hours
Total Laboratory Hours			30 hours
Mode of Evaluation: Continuous Assessments and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017