Program : **Biomedical Engineering**	
Course Code : **3243**	Course Title: **Electronics Measurements& Instrumentation**
Semester : **3**	Credits: **No credit**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester: **60**

Course Objectives:

- To provide learning experience on characteristics of testing and measuring instruments.
- To introduce the basic features of oscilloscope, analyzers, and recorders.

Course Prerequisites:

Topic/Description	Course code	Course Title	Semester
Basic Engineering Mathematics principles and theorems		Mathematics I & II	1 & 2
Knowledge of current, voltage& magnetism		Applied physics I & II	1 & 2
Representation of AC signals, voltage, current and power		Fundamentals of Electrical and Electronics Engineering	2

Course Outcomes:

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

COn	Description	Duration (Hours)	Cognitive level
CO1	Explain the working principle of various measuring Instruments	15	Understanding
CO2	Explain the working principle of CRT and CRO.	15	Understanding
CO3	Illustrate working principle of bridges, signal generators and analysers.	16	Understanding
CO4	Explain working of transducers and recorders	12	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	**Explain working principle of various measuring instruments**		
M1.01	Summarize specifications of measuring instruments.	4	Remembering
M1.02	Explain the working principle and conversion of galvanometer	3	Understanding
M1.03	Explain PMMC and MI instruments	4	Understanding
M1.04	Explain the working of analog and digital meters.	4	Understanding
Contents: **Measurements and Measuring Instruments** Static characteristics of an instrument-Accuracy &Precision, Resolution, Expected value, Sensitivity. Types of Errors. Working principle of Galvanometers and conversion - Permanent Magnet Moving Coil Instruments (PMMC). Moving Iron type Instruments (MI), Electro Dynamo Type Instruments' Single-Phase Energy Meter. Analog and Digital Voltmeter , Digital Multimeters			
CO2	**Explain the working principle of CRT and CRO.**		
M2.01	Illustrate construction and operation of CRT	4	Understanding
M2.02	Explain working of CRO	3	Understanding
M2.03	Summarize measurements using CRO	4	Understanding
M2.04	Explain block diagram and features of DSO	4	Understanding
	Series Test – I	1	
Contents: **Oscilloscopes** Cathode ray tube: construction, operation, screens, graticules, Vertical deflection system, Horizontal deflection system, Delay line			

Block diagram and working of CRO, Multiple Trace CRO. Measurements-frequency, time delay, phase angle, DSO-block diagram, features. Oscilloscope probe: Structure of 1:1 and 10:1 probe

CO3	**Illustrate working principle of bridges, signal generators and analysers.**		
M3.01	Explain AC and DC bridges	4	Understanding
M3.02	Summarize application of bridges	4	Understanding
M3.03	Explain working principle of function generator	4	Understanding
M3.04	Illustrate working of various types of analysers and Q-meter	4	Understanding

Contents:

Bridges, Analyzers.

DC Bridges - Wheatstone and Kelvin Double Bridge. AC Bridges - Maxwell's Bridge, Hay's Bridge, Anderson's bridge

Function generator-applications, Wave analyzers - spectrum analyzer, applications, principle of Q-meter.

CO4	**Explain working of transducers and recorders.**		
M4.01	List types of transducers	3	Understanding
M4.02	Explain selection criteria of various transducers	3	Understanding
M4.03	Explain working of different types of transducers	3	Understanding
M4.04	Illustrate the basic concept of recorders and types	3	Understanding
	Series Test – II	1	

Contents:

Transducers and Recorders

Classification, Selection Criteria, Characteristics, Construction, Working Principles and Application of Transducers: RTD, Thermocouple, Thermistor. LVDT, Strain Gauge, Load Cell, Piezoelectric Transducers.

Data recorders- basic concept, X-Y recorder, strip chart recorder

Text / Reference:

T/R	Book Title/Author
T1	Electronic Instrumentation - H S Kalsi
T2	A Course in Electrical and Electronic Measurements and Instrumentation - A K Sawhney
T3	Electronics Measurements And Instrumentation- U.A Bakshi and A.V. Bakshi
R1	Electronic Instrument and measurement technique – W.D Cooper
R2	Electronic Measurement and Instrumentation – J.G JOSHI
R3	Electronics and Electrical Measurements and Instrumentation - J B Gupta - S K Kataria.
R4	Industrial Electronics and Control - Biswanath Paul.

Online reference:

Sl. No	Website Link
1	https://myclassbook.org/darsonval-meter-movement-principle/
2	https://www.electrical4u.com/cathode-ray-oscilloscope-cro/
3	https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_transducers.htm
4	http://ei-notes.blogspot.com/2012/04/data-acquisition-system-das-with-neat.html
5	http://www.darshan.ac.in/Upload/DIET/Documents/EE/EMMI_Ch%206_13092018_031526AM.pdf