ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AEEB24	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: NIL				Total Classes: 45		

I. COURSE OVERVIEW:

This course introduces and develops the basic understanding of measurement principles and measuring instruments used in numerous electrical applications. The course provides the concept of measure- ment, analysis of errors and various specification parameters used to judge and compare measuring instruments. It provides an insight to develop advanced instruments in industries.

II. OBJECTIVES:

The course should enable the students to:

I The types and characteristics of instruments employed for measuring electricalquantities.

II The construction, operation and maintenance of different types of instruments.

III The concepts of Cathode Ray Oscilloscope and transducers to measure thephysical quantities in the field of science, engineering and technology.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Illustrate** the working of PMMC, MI and electrostatic voltmeter in view of principle of operation, construction, extension of range and various errors.	Understand
CO 2	**Make use of** potentiometer and instrument transformers in view of construction, extension of range and various errors.	Understand
CO 3	**Demonstrate** the construction and operation of wattmeter and energy meter for obtaining power and energy in single phase and three phase networks.	Understand
CO 4	**Select** the DC and AC bridges suitable for the measurement of passiveparameters.	Apply
CO 5	**Summarize** various working models, features and applications oftransducers and oscilloscopes.	Apply

IV. SYLLABUS:

MODULE-I	INTRODUCTION TO MEASURING INSTRUMENTS	Classes:09

Introduction: Classification of measuring instruments, deflecting, damping and control torques, types of errors, ammeter and voltmeter: PMMC, MI instruments, expression for deflection and control torque, errors and compensation, extension of range using shunts and series resistances; Electro static voltmeter: attracted type, disc type, extension of range of voltmeters, electro dynamic type voltmeters.

MODULE-II	POTENTIOMETERS AND INSTRUMENT TRANSFORMERS	Classes:09

DC Potentiometers: Principle and operation of Crompton potentiometer, standardization, measurement of unknown resistance, current, voltage; AC potentiometers: polar and coordinate type, standardization, applications; Instrument transformers: CT and PT, ratio and phase angle error.

MODULE-III	MEASUREMENT OF POWER AND ENERGY	Classes:09

Measurement of Power: Single phase dynamometer type wattmeter, LPF and UPF, double elements and three elements dynamometer wattmeter; Expression for deflection and control torque, extension of range of wattmeter by using instrument transformers, measurement of active and reactive power for balanced and unbalanced Systems.

Measurement of Energy: Single phase induction type energy meter, driving and braking torques, errors and compensations, testing by phantom loading using RSS meter, three phase energy meter, introduction to net energy metering (web ref: 4 and 5), maximum demand meters.

MODULE-IV	DC AND AC BRIDGES	Classes:09

Measurement of Resistance: Methods of measuring low, medium, high resistance, Wheatstone bridge, carry foster, Kelvin's double bridge, loss of charge method; Measurement of Inductance: Maxwell's bridge, Hay's bridge, Anderson's bridge, Owen's bridge; Measurement of Capacitance: Desauty's bridge, Wein's bridge, Schering bridge.

MODULE-V	TRANSDUCERS AND OSCILLOSCOPES	Classes:09

Transducers: Definition of transducers, classification of transducers, advantages of electrical transducers, characteristics and choice of transducers, principle of operation of LVDT and capacitor transducers, LVDT applications, strain gauge and its principle of operation, gauge factor, thermistors, thermocouples, synchros, piezo-electric transducers, photovoltaic, photo conductive cells, photo diodes; Cathode ray oscilloscope: Cathode ray tube, time base generator, horizontal and vertical amplifiers, CRO probes, applications of CRO, measurement of phase and frequency, Lissajous patterns, sampling oscilloscope, analog oscilloscope, tubeless oscilloscopes, digital storage oscilloscope (web ref: 6).

Text Books:

1. A K Sawhney, "Electrical and Electronic measurement and instruments", Dhanpat Rai and Sons Publications, 2002.
2. E W Golding and F C Widdis, "Electrical measurements and measuring instruments", Wheeler publishing, 5th Edition, 2006.

Reference Books:

1. Buckingham and Price, "Electrical measurements", Prentice Hall.
2. D V S Murthy, "Transducers and Instrumentation", Prentice Hall of India, 2nd Edition, 2009.
3. A S Morris, "Principles of measurement of instrumentation", Pearson/Prentice Hall of India, 2nd Edition, 1994.
4. H S Kalsi, "Electronic Instrumentation", Tata McGraw-Hill Publications, 1st Edition 1995.

Web References:

1. https://www.researchgate.net
2. https://www.aar.faculty.asu.edu/classes/
3. https://www.electrical4u.com
4. https://www.efficientcarbon.com/wp-content/uploads/2013/07/Net-Metering-and-Solar-Rooftop_Whitepaper_EfficientCarbon.pdf
5. https://www.electrical4u.com/digital-storage-oscilloscope/
6. https://www.iare.ac.in

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1. https://www.jntubook.com 2. https://www.freeengineeringbooks.com 3. https://www.bookboon.com/en/mechanics