

Course No.	Course Name	L-T-P-Credits	Year of Introduction
EE208	MEASUREMENTS AND INSTRUMENTATION	3-1-0-4	2016

**Prerequisite : Nil**

**Course Objectives**

To develop understanding of various electrical measuring instruments and instrumentation devices

**Syllabus**

Measurements standards, errors in measurements, operating torques, classification of electrical meters, Measurement of voltage, current, resistance, power, energy, high voltage and high currents. Magnetic measurements, ac potentiometers, ac bridges, CRO, Transducers

**Expected Outcomes:**

After the completion of the course student will be able to:

1. Compare different types of instruments-their working principles, advantages and disadvantages.
2. Explain the operating principles of various ammeters, voltmeters and ohm meters
3. Describe wattmeters and energy meters
4. Describe different flux and permeability measurements methods
5. Identify different AC potentiometers and bridges,
6. Understand the working and applications of cathode ray oscilloscope
7. Identify the transducers for physical variables and to describe operating principle

**Text Book:**

1. Sawhney A.K., A course in Electrical and Electronic Measurements & instrumentation, Dhanpat Rai .
2. J. B. Gupta, A course in Electrical & Electronic Measurement & Instrumentation., S K Kataria & Sons
3. Kalsi H. S., Electronic Instrumentation, 3/e, Tata McGraw Hill, New Delhi, 2012

**References:**

1. Golding E.W., Electrical Measurements & Measuring Instruments, Wheeler Pub.
2. Cooper W.D., Modern Electronics Instrumentation, Prentice Hall of India
3. Stout M.B., Basic Electrical Measurements, Prentice Hall
4. Oliver & Cage, Electronic Measurements & Instrumentation, McGraw Hill
5. E.O Doebelin and D.N Manik, Doebelin's Measurements Systems, sixth edition, McGraw Hill Education (India) Pvt. Ltd.
6. P.Purkait, B.Biswas, S.Das and C. Koley, Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education (India) Pvt. Ltd.,2013

**Course Plan**

Module	Contents	Hours	Sem.ExamMarks
I	General principles of measurements – measurement system-measurement standards – characteristics - errors in measurement-calibration of meters- significance of IS standards of Instruments. Classification of meters - operating forces - essentials of indicating instruments - deflecting, damping, controlling torques. Ammeters and voltmeters - moving coil, moving iron, constructional details and operating, principles shunts and multipliers – extension of range.	9	15%
II	Measurement of resistance: measurement of insulation resistance - loss of charge method, measurement of earth resistance. Measurement of power and energy: Dynamometer type wattmeter – 1-phase and 3-phase power measurement – 1-phase and 3-phase energy meters (induction type) – electronic energy meter, TOD meter.	10	15%

<b>FIRST INTERNAL EXAMINATION</b>			
<b>III</b>	Introduction to high voltage and high current measurements: Measurement of high DC voltages - measurement of high AC voltages - electrostatic voltmeters – sphere gaps - DC Hall effect sensors - high current measurements. Study of Phasor Measurement Units (PMU). Current transformers and potential transformers – principle working, ratio and phase angle errors – numerical problems, Clamp on meters.	9	15%
<b>IV</b>	Magnetic Measurements: Measurement of flux and permeability - flux meter - hall effect Gaussmeter - BH curve and permeability measurement - hysteresis measurement- ballistic galvanometer – principle- determination of BH curve - hysteresis loop. Lloyd Fisher square — measurement of iron losses Measurement of rotational speed using proximity sensors and optical sensors.	9	15%
<b>SECOND INTERNAL EXAMINATION</b>			
<b>V</b>	DC & AC potentiometers - General Principle - calibration of ammeter, voltmeter and wattmeter using potentiometer. AC Bridges: Maxwell's bridge- Schering bridge and Wien's bridge Oscilloscopes – Basic principle of signal display - Block diagram and principle of operation of general purpose CRO - vertical deflecting system - horizontal deflection system - basic sweep generator - XY mode and Lissajous patterns - applications of CRO - dual trace oscilloscope. digital storage oscilloscope	9	20%
<b>VI</b>	Transducers - Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature - basic principles and working of LVDT, electromagnetic and ultrasonic flow meters, piezoelectric force transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors, thermocouple, Need for instrumentation system, data acquisition system.	9	20%
<b>END SEMESTER EXAM</b>			

**QUESTION PAPER PATTERN (End semester exam)**

**Part A:** 8 questions.

One question from each module of Module I - IV; and two each from Module V & VI.

Student has to answer all questions. (8 x 5) = 40

**Part B:** 3 questions uniformly covering modules I&II

Student has to answer any 2 questions: (2 x 10) = 20

**Part C:** 3 questions uniformly covering modules III&IV

Student has to answer any 2 questions: (2 x 10) = 20

**Part D:** 3 questions uniformly covering modules V&VI

Student has to answer any 2 questions: (2 x 10) = 20

**Note:** Each question can have maximum of 4 sub questions, if needed.