Category I

BSc. (Hons.) Electronics

DISCIPLINE SPECIFIC CORE COURSE-4 (DSC-4) – : Basic Instrumentation and Measurement Techniques

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic Instrumentation and Measurement Techniques	4	3	0	1	Class 12th Pass with PCM or Physics, Comp. Sc. & Maths.	Nil

Learning Objectives

The Learning Objectives of this course are as follows:
The objective of this subject is to provide insight into electronic instruments being used in the industries and labs. It details the basic working and use of different instruments used for measuring various physical quantities. Also, it details the identification, classification, construction, working principle and applications of various transducers used for displacement, temperature, pressure and intensity measurement.

Learning outcomes

After completion of the course, students will be able to-

Describe the working principle of different measuring instruments.

Choose appropriate measuring instruments for measuring various parameters in their laboratory courses.

Understand the significance of different measuring instruments including oscilloscopes.

UNIT – I Fundamentals of Electronic Measurements (12 Hours)

Qualities of Measurement: SI system of units. Specifications of instruments, their static and dynamic characteristics. Error (Gross error, systematic error, absolute error and relative error) and uncertainty analysis.

Basic Measurement Instruments: PMMC instrument, galvanometer, DC measurement - ammeter, voltmeter, ohm meter, AC measurement (rectifier type, electro dynamo meter), Watt meter. Digital voltmeter systems (integrating and non-integrating types), digital multimeter,

Connectors and Probes: low capacitance probes, high voltage probes, current probes, identifying electronic connectors – audio and video, RF/Coaxial, USB etc.

UNIT – II Impedance Measurement and Power Supplies (12 Hours)

Measurement of Resistance and Impedance: Low Resistance: Kelvin's bridge method, Medium Resistance by Wheatstone bridge method, High Resistance by Megger. A.C. bridges, Measurement of Self Inductance, Anderson's bridge, Measurement of Capacitance, De Sauty's bridge, Measurement of frequency, Wien's bridge.

Regulated Power Supplies: Power Supply characteristics, Fixed power supply (78XX based), Dual power supplies (78XX and 79XX based), Variable power supply (LM317 based), current limiting, short-circuit shut down. Introduction of switch mode power supply (SMPS)

UNIT – III Oscilloscopes and Signal Generators (12 Hours)

Electronic Displays: The Cathode Ray Oscilloscope (CRO): Block diagram of a General Purpose Oscilloscope and its basic operation. Measurement of voltage, frequency and phase by oscilloscope. Oscilloscope probes. Sampling Oscilloscope. Digital storage oscilloscope (DSO), advantages and applications, Oscilloscope specifications (bandwidth, sensitivity, rise time).

Signal Generators: Types of generators and their operation: Audio oscillator, Function generators, Pulse generators, RF generators, Random noise generators.

UNIT – IV Transducers and Sensors (09 Hours)

Transducers and sensors: Classification of transducers, Basic requirement/characteristics of transducers, active & passive transducers, Resistive (Potentiometer, Strain gauge – Theory, types, temperature compensation and applications), Capacitive (Variable Area, air gap and permittivity Type), Inductive (LVDT) and piezoelectric transducers. Measurement of displacement, Measurement of temperature (RTD, thermistor, thermocouple, semiconductor IC sensors), Light transducers (photoresistors, photovoltaic cells, photodiodes).

Practical component (if any) – Basic Instrumentation and Measurement Techniques Lab – 30 Hours

1. Design of ammeter and voltmeter using galvanometer.
2. Measurement of resistance by Wheatstone bridge.
3. Measurement of Capacitance by De Sauty's bridge.
4. Measurement of Inductance by Anderson's bridge.
5. To determine the characteristics of resistance transducer - Strain Gauge.
6. To determine the characteristics of an LVDT.
7. To study the variations of thermo-emf of a thermocouple. (Type J/Type K)
8. To study the I-V characteristics of Solar Cell.
9. To study the Characteristics of LDR, Photodiode
   (i) Variable Illumination (ii) Linear Displacement.
10. Characteristics of one Solid State sensor/ Fiber optic sensor.

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than eight.

Essential/recommended readings

1. H. S. Kalsi, Electronic Instrumentation, 3rd Edition, Tata Mcgraw Hill, (2006).
2. W.D. Cooper and A. D. Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice Hall (2005).
3. Joseph J Carr, Elements of Electronic Instrumentation and Measurement, 3rd Edition, Pearson Education (2005).
4. David A. Bell, Electronic Instrumentation and Measurements, 3rd Edition, Oxford University Press (2013).
5. R. A. Witte, Electronic Test Instruments, Analog and Digital Measurements, 2nd Edition, Pearson Education (2004).
6. A. K. Sawhney, Electrical and Electronics Measurements and Instrumentation, Dhanpatrai and Sons (2007).

   K. Lal Kishore, Electronic Measurements and Instrumentation, 1st edition, Pearson Education India (2009).

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.