

COURSE TITLE : **ELECTRICAL MEASUREMENTS & INSTRUMENTATION**
COURSE CODE : **3055**
COURSE CATEGORY : **B**
PERIODS/WEEK : **5**
PERIODS/SEMESTER : **90**
TIME SCHEDULE
CREDITS : **5**

TIME SCHEDULE

MODULE	TOPIC	PERIODS
I	Classification and essentials of Instruments Voltmeters & Ammeters Extension of Range	21
	Test I	1
II	Wattmeter Energy meter CT & PT	21
	Test II	1
III	Measurement of Resistance & Bridges Megger & Earth tester Other Instruments	22
	Test III	2
IV	CRO Transducer Sensors	22
	Test IV	1
TOTAL		90

Rationale

The measurements of Electrical quantities such as voltage, current, power and energy etc and the conversion of real physical quantities in to corresponding analog or digital signals are very much essential in this modern world of development. This subject deals with the measuring instruments, measuring techniques and the monitoring of various quantities.

OBJECTIVES

MODULE – I

1.1.0 Explain the theory and construction of voltmeters and ammeters

- 1.1.1 Classify the instruments based on function, construction and methods of measurement
- 1.1.2 Explain the different mechanism of production of deflecting, controlling and damping torque.
- 1.1.3 State the effect of control and damping forces on measuring instruments
- 1.1.4 Study the constructional details of permanent magnet moving coil instrument with necessary sketches
- 1.1.5 Study the construction of moving iron type (Both attraction and repulsion type) instruments
- 1.1.6 Understand the dynamometer type voltmeters and ammeters
- 1.1.7 Sketch and explain rectifier type voltmeter and ammeter

- 1.1.8 Identify the appropriate type of instruments for AC/DC measurement
- 1.1.9 Design the Moving coil and Moving iron instruments to measure current and voltage using shunt and multipliers
- 1.1.10 State the applications of M.I, M.C and rectifier type instruments
- 1.1.11 Explain the general sources of error in measuring instrument and suggest remedies to reduce them.

MODULE - II

2.1.0 Understand the principle of power and energy measurement

- 2.1.1 Sketch the dynamometer type wattmeter and explain its principle of operation
- 2.1.2 Identify the errors in dynamometer type wattmeter.
- 2.1.3 Understand the theory of compensated wattmeter.
- 2.1.4 Describe the constructional details of single phase induction type energy meter.
- 2.1.5 Explain the principle of operation of induction type energy meter.
- 2.1.6 Describe the method of reducing the error due to power factor and friction.
- 2.1.7 Explain the effect of creeping and suggest remedies for its compensation.
- 2.1.8 Draw the diagram of 3-phase energy meter (2 element types).
- 2.1.9 Explain the procedure with circuit diagram the calibration of energy meter using standard wattmeter and stopwatch.
- 2.1.10 Explain calibration of energy meter by phantom loading with circuit diagram.
- 2.1.11 Understand the connection of CTs and PTs in association with other measuring instruments.
- 2.1.12 Know the connection diagram of CTs and PTs
- 1.1.13 Study the working of clip on meters

MODULE – III

3.1.0 Study the methods of measuring Resistance and various commercial instruments

- 3.1.1 Explain the wheat stone's bridge and slide Wire Bridge for measurement of medium resistance measurement
- 3.1.2 Understand the principle of AC Bridge
- 3.1.3 Draw and explain the insulation megger
- 3.1.4 Describe the working principle of megger
- 3.1.5 Explain measurement of insulation resistance using megger
- 3.1.6 Measure the earth resistance by earth tester
- 3.1.7 Know the methods of locating cable fault
- 3.1.8 Understand the method of locating faults by Varley and Murray loop method

3.2.0 Study of frequency meter, millimeters, maximum demand & energy meter etc.

- 3.2.1 Know classifications of frequency meters
- 3.2.2 Describe the working principle of Reed type and indicating type frequency meter
- 3.2.3 Understand the single phase dynamometer type power factor meter
- 3.2.4 Describe the briefly the connections of synchroscope and phase sequence indicator
- 3.2.5 Understand the principle and working of analog type multimeter
- 3.2.6 Understand the digital multimeter
- 3.2.7 Know the applications of multimeter
- 3.2.8 Explain digital volt meter
- 3.2.9 Describe the principle and operation of maximum demand indicator
- 3.2.10 Study the TOD meter
- 3.2.11 Understand the Electronic single phase energy meter

MODULE - IV

4.1.0 Study the CRO and transducers

- 4.1.1 Study the working principle of CRO
- 4.1.2 Sketch the CRT and name each part.
- 4.1.3 Explain working of CRT
- 4.1.4 Understand the block diagram of CRO
- 4.1.5 List the applications of CRO
- 4.1.6 Understand the measurement of Voltage, Current, Frequency, Time, phase and phase angle by using CRO
- 4.1.7 Study of wave forms in CRO
- 4.1.8 Explain the working of a general transducer
- 4.1.9 Know the different classifications of transducers

4.2.0 Understand the measurement of physical quantities

- 4.2.1 Sketch and describe Strain gauge
- 4.2.2 Sketch and describe Semi conductor strain gauge
- 4.2.3 Sketch and describe LVDT
- 4.2.4 Sketch and describe Capacitance transducer
- 4.2.5 Sketch and describe Burden tube
- 4.2.6 Sketch and describe Diaphragm and Bellows
- 4.2.7 Describe the piezoelectric effect and piezoelectric transducers
- 4.2.8 Study the resistance transducers using resistance wire and potentiometer
- 4.2.9 Understand the applications of transducers
- 4.2.10 Understand the applications of sensors

COURSR CONTENT

MODULE – 1

Theory of Measuring Instruments

General classification of instrument - absolute and secondary instruments – classification of secondary instruments – indicating, integrating and recording type - Essentials of indicating instruments – deflecting - controlling and damping torque - Constructional details and working principle of permanent magnet moving coil and moving iron type (both attraction and repulsion type) instruments - Working principle of dynamometer - voltmeter and ammeter - Rectifier type instruments – voltmeter - ammeter

Extension of range – use of shunts and multiplier problems – multi range instruments – general errors in instruments and their remedy - identification of instruments –

MODULE – II

Measurement of Power and Energy

Construction and working principle of dynamometer type wattmeter – errors – and their remedy correction

factor – compensated wattmeter– Constructions and working of single phase induction type energy meter –

errors – their remedy – poly phase energy meters –2 elements 3 phase energy meter – calibration of energy meter by

direct loading and phantom loading – CTs and PTs

- wattmeter and energy meter connections using CT and PT-clip on meters

MODULE – III

Measurement of Resistance & Commercial Instruments

Classifications of resistance – low, medium and high - Measurement of low resistance by measurement of medium resistance by wheat stone bridge and slide Wire Bridge-AC Bridge- Measurement of high resistance – insulation resistance by megger – working principle and construction details of megger-Measurement of earth resistance by earth tester
Localization of cable fault Varley and Murray loop method-Measurement of frequency – construction and working of vibrating reed type and indicating type-frequency meters (Resonant type)
Measurement of power factor – Construction & working of pf meters-single-phase dynamometer type – working principle and diagram synchroscope and phase sequence indicator
Multimeter analogue and digital– digital voltmeters-
Principle of Maximum demand indicators - TOD meter - Electronic Energy meter – single phase

MODULE – IV

CRO and Transducers

CRO – CRT - block diagram – applications of CRO - Observation of waveforms
Measurement of voltage – current – frequency - time period - phase and phase angle
Transducers – Measurement of physical quantities using transducers – classifications – commonly used transducers – strain gauges – semiconductor strain gauges – LVDT – capacitance transducers – piezoelectric transducers – sketch - description and field of applications -sensors –proximity switch, reed switch
Optoelectric coupler

REFERENCE BOOKS

1. Electrical and Electronics measurements - A.K Shawny
2. Electrical measurements - J.B Gupta
3. Electrical measurements and measuring instruments –R K Rajput