4103 – ELECTRICAL MEASUREMENT & INSTRUMENT

Teaching Schedule Per Week			Progressive Assessment		Examination Schedule (Marks)			
Lectures	Practical	Credits			Theory		Practical Ex.	Total
4	2	6	25	25	3 Hrs	100	50	200

Pre-requisite	Source
1005	ELL

Semester	Theory	Test	Total	TW	PR	Gr Total
	75	25	100	25	50	175

Rationale:- The student must be able t[illegible] the classification, [illegible] construction features of the electrical measuring Instrument as well as their working principles. This subject will also enable a student to select and to connect the Instruments in the right manner, understand the errors involved in their respective connection and suggest the remedies to minimise the errors. The student also gets familiarised with the various methods for extension of ranges of various measuring Instruments.

COURSE CONTENTS	Hrs	Mks
1. QUALITIES OF MEASUREMENT Static & dynamic characteristics, errors (Different types), mean to minimise error/Accuracy and Precision (Different between accuracy and precision) classification of Instruments based on accuracy, resolution, sensitivity and stability.	4	8
2. PRINCIPLES OF ELECTRICAL MEASURING INSTRUMENTS Classification of Measuring Instruments– Absolute Instruments. Secondary Instruments, classification based on various effects of electric current (electromagnetic, Heating, chemical, electrostatics) ,classification based on permissible limits of errors (standard & sub-standard Instruments) Essentials of Indicating Instruments–Deflecting torque. Control torque, damping torque means to achieve this-Importance of damping–effect of control torque on the scale.	6	12

3. AMMETERS AND VOLTMETER Construction and principle of operation of Permanent Magnet Moving Coil(P M M C), Moving Iron (MI)– Ways of production of deflecting torque, control torque and camping torque in these type of Instruments. Errors in moving iron and moving coil instruments. Rectifier type instruments and their advantages. Voltmeter sensitivity, Loading effect of Voltmeter.	10	16
4. WATTMETER Principle of operation, construction and connection of dynamometer type of Wattmeter. Errors (No Derivation) and compensation/minimising of errors. Measurement of 3 phase power – measurement of power in 3 phase, 3 wire circuit (balanced / unbalanced) by two wire wattmeter method – phasor diagrams. Measurement of power in 3 phase and 4 wire circuit by 3 wattmeter method. Variation of wattmeter readings in two wattmeter methods, with load P.F. Construction and operation of polyphase wattmeter.	14	16
5. ENERGYMETER Construction and principle of operation single phase Induction type Energy meter. Errors in meters. Adjustments for speed, friction, inductive load (lag) and over load. Rating of single phase Energy meter, three phase Energy meter (2 element and 3 element type) its connection and application.	6	12
6. RESISTANCE MEASURING Classification of resistance & methods of measurements. Voltmeter– Ammeter method & error due to connection. Principle of working Kelvin's Bridge & measurement of low resistance by it . principle of working of ohm-meter.	4	12
7. EXTENSION OF RANGE OF MEASURING INSTRUMENTS Method of extension of range of measurement instruments:- Extension of range of Ammeter, Voltmeter and wattmeter by use of CT & P.T. measurement of Power 3 phase 3 wire circuit by 2 wattmeter method in conjunction with C.T. & P.T. Extension of range of single phase and 3 phase energy meter by C.T. & P.T. connection diagram and calculation of multiplying factor. Extension of range by shunt and multiplier (no numericals)	10	12
8. OTHER INSTRUMENTS Principle of operation, their connection and application of power factor meter (single phase and three phase) frequency meter, Earth tester, phase sequence Indicator.	10	12
Total	64	100

LIST OF EXPERIMENTS (any 10):

1. Study of IS symbols for various instruments.
2. Measurement of power in 1 phase Inductive circuit by (a) 3-Ammeter method (b) 3-Voltmeter method.
3. Measurement of low resistance by Kelvin 's bridge
4. Measurement of power in 3 phase, three wire circuit by 2 wattmeter method (balance load only).
5. Measurement of power in 3 phase and 3 wire circuit by one wattmeter method (balanced load only). 2 turns.
6. Measurement of reactive power in 3 phase 3 wire circuit by one wattmeter method.
7. Use of C. T. and P. T. for extension of range of wattmeter for 3 phase power measurement.
8. Use of C. T. and P. T. for extension of range of 1 phase 3 phase energy meter and calculation of total energy (2 turns).
9. Calculation of the values of shunts and multiplier for extension of range of Ammeter and Voltmeter and testing. (2 turns)
10. Connection and reading of power factor meter at known loads (R.R.L.,RC)
11. Connection and reading of digital meters. (Ammeter, voltmeter , wattmeter & energy meter) and study the block diagram of each. (2 turns)
12. Connection and reading of Frequency meter, phase sequence indicator.

REFERENCE BOOKS:

1. Electrical Measurement and Measuring Instruments by E. W. Golding, A. H. Wheeler and Co.
2. A Course in Electrical and Electronic Measurements and Instruments by A.K.Sawhney, Danpat Rai & Sons.
3. Electronics Instrumentation and Measurement Techniques by W.D. Cooper. Prentice Hall of India.
4. Electrical Measurement and Measuring Instruments by N. V. Suryanarayana, Tata MC Graw Hill Publishing Company.