CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology(Electrical Engineering)**

Semester: **III**

Course Code: **202050303**

Course Title: **Electrical Measurement & Measuring Instruments**

Course Group: **Professional Core Course II**

Course Objectives: Electrical installations ranging from residential consumers to huge industrial estates all are equipped with measuring instruments. In view of this, study of principles of Electrical measurements and measuring instruments becomes mandatory for all electrical engineers. This subject deals with principles of measurements, analog and digital measuring instruments as well as sensors/transducers.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25/9	25/9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Concepts of Measurement:** Measurement Systems, Classification of instruments, Methods of Measurements, Static Characteristics like accuracy, precision, sensitivity, linearity, range, reproducibility, drift, threshold, dead zone etc. Dynamic Characteristics like speed of response, fidelity overshoot etc., Measurement Standards Errors in measurement, Basic statistical evaluation of measurement data and errors - mean, standard deviation.	05
2	**Measurement of Resistance, Inductance and Capacitance:** Measurement of low, medium and high resistance, Insulation and Earth resistance measurements, Concepts of A. C. bridges for inductance measurement - Maxwell, Hay's, Anderson and Owen bridges; Capacitance measurement – De'Sauty and Schering Bridges, Measurement of frequency by Wien's bridge.	08

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3	**Transducers**: Classification and selection criterion for Transducers, Generalized Measurement Systems, Basics of thermometry and thermo sensitive sensors, Concept of Pyrometry, Capacitive, inductive and resistive type transducers for linear and angular displacement measurements, Pressure transducers. Introduction of Flow, level, Force, Torque, Strain and Piezo-electric sensors/transducers, Hall-effect devices, Optical sensors.	**08**
4	**Potentiometers and Instrument Transformers**: Principle of D. C. potentiometer, Direct reading potentiometers, Multirange potentiometers, A. C. potentiometer principle, types and applications of A. C. and D. C. potentiometers, Current and Potential Transformers, Ratio and phase angle errors, Design considerations and testing.	**08**
5	**Analog Instruments**: Classification of Analog instruments, Operating forces, Construction and Principle of Operation of Permanent magnet moving coil, Moving iron, Dynamometer type, Induction type, Electrostatic type instruments, Electrodynamometer type wattmeter, Measurement of active and reactive power, Energy meter for A.C. circuits, Induction type energy meter, Miscellaneous instruments like- Power factor meter, Frequency meters, Calibration of analog measuring instruments, Clamp on meter, Megger(Insulation Tester).	**11**
6	**D.S.O. and Display Devices:** Digital recorders, Digital Storage Oscilloscope - Block Diagram, theory and applications, Power scope, Characteristics of digital display, DVM and Digital multi meter.	**05**

List of Practicals / Tutorials:

1	Introduction to Generalized measurement system and transducers.
2	To measure medium range resistance using Wheatstone Bridge technique.
3	To measure low range resistance using Kelvin's Double Bridge.
4	Measurement of high resistance using Loss of Charge method.
5	Measurement of Earth Resistance using Fall of Potential method.
6	Measurement of unknown Inductance and Capacitance with Maxwell's L/C Bridge.
7	Measurement of unknown Inductance using Anderson's Bridge.
8	Measurement of unknown Capacitance using De'Sauty's Bridge.
9	Measurement of unknown Frequency using Wein's Bridge.
10	Measurement of Linear Displacement with the help of LVDT.
11	Measurement and ON/OFF control of temperature using RTD/Thermocouple.
12	To measure the Mechanical Load/Force with the help of Strain Gauge Load Cell.
13	To calibrate the DC Voltmeter/Ammeter using DC potentiometer.
14	Measurement of High Resistance (Insulation Resistance) using Megger (Insulation Tester).
15	To study the PMMC and Moving Iron type measuring instruments.
16	To study different digital devices used in measuring systems.

Reference Books:

1	A.K.Sawhney, "Electrical and Electronic Measurements and Instrumentation", DHANPAT RAI & CO.

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2	D. Patranabis, 'Sensors & Transducers', PHI.
3	A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Pearson / Prentice Hall of India.
4	Gupta J. B., "A Course in Electronics and Electrical Measurements and Instrumentation", S.K. Kataria & Sons.
5	H. S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill Education.
6	E. W. Golding and F. C. Widdis, Electrical & Electronic Measurements & Instrumentation, Reem Publications Pvt. Ltd.
7	B. G. Liptak, Instrument Engineer's Handbook Vol-2, CRC Press.
8	A.J. Bouwens, 'Digital Instrumentation', Tata McGraw hill.

Supplementary learning Material:	
1	https://electrical-engineering-portal.com/
2	https://www.electrical4u.com/
3	www.nptel.com

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Internal Evaluation: The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
30%	30%	20%	10%	10%	0%	

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Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the concepts of measurement and measurement systems.	**20**
CO-2	Explain basic principle, working, characteristics and applications of the various measuring instruments and transducers.	**30**
CO-3	Design and validate DC and AC bridges.	**15**
CO-4	Analyze the dynamic response and the calibration of instruments.	**10**
CO-5	Understand statistical data analysis.	**10**
CO-6	Prepare the specifications of required measurement systems to be used for measurement of parameters for a specified application.	**15**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	
Next Review on (Month-Year):	June-2025

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