

GANPAT UNIVERSITY				
FACULTY OF DIPLOMA ENGINEERING				
Programme	Diploma in Electrical Engineering			
Semester	III	Version	1.0.0.0	
Effective from Academic Year	2026-27	Effective for the batch Admitted in	JULY 2025	
Course code	1EE3104	Course Name	Electrical Measurements and Instrumentation	

I. TEACHING-LEARNING AND ASSESSMENT SCHEME																			
Course Type	Course code	Course Title	Teaching & Learning Scheme									Examination Scheme							
			Credit				Actual Contact Hrs/week			SLH	Total Learning Hrs/Week	TH			PR			SLA	Total
			CL	TL	LL	Total	CL	TL	LL			CE	SEE	Total	CE	SEE	Total		
DSC	1EE3104	Electrical Measurements and Instrumentation	3	0	1	3	3	0	2	1	6	40	60	100	30	20	50	20	170

Abbreviation:	CL - Classroom Learning	TL - Tutorial Learning	LL - Laboratory Learning
	SLH - Self Learning Hours	SLA - Self Learning Assessment	SA - Summative Assessment
	CE – Continuous Evaluation	SEE – Semester End Examination	

II. PRE-REQUISITES

Basic knowledge of measurements of different electrical parameters.

III. INDUSTRY / EMPLOYER EXPECTED OUTCOMES

The purpose of this course is to help the student to learn about the various electrical instruments used for different electrical and non-electrical parameters.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

- CO1- Apply the basics of measurement to the measuring instruments.
- CO2- Measure circuit parameters using potentiometers and DC and AC bridges.
- CO3- Measure precisely electrical power and energy using appropriate meters.
- CO4- Maintain required pressure for given application using pressure transducer.
- CO5- Use digital measuring instruments for different applications.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's) & CO's	Marks	Hours
Unit-1 Fundamentals of Measurements	TLO 1.1 Define static and dynamic characteristics of measuring instruments. TLO1.2 Write the classification of measuring instruments. TLO 1.3 Explain types of errors in a measuring instrument and their compensation. TLO1.4 Production of different types of torques in measuring instruments. TLO1.5 Describe the procedure for calibration of a given device.	1.1Measurement: Definition, need and significance, Methods of measurement, Generalized system of measuring instrument, Static and Dynamic characteristics of measuring instruments. 1.2Classification of Instruments, Terms related to measurements 1.3Types and Sources of errors in measurement. 1.4Deflecting, controlling and damping torque. 1.5Calibration: Need, significance and calibration of voltmeter, ammeter, wattmeter and 1-phase energy meter. General procedure of calibration.	12	08
Unit-2 Potentiometers and	TLO 2.1 D.C. potentiometer, principle, working and list of	2.1 Understand the working of DC potentiometer.	12	10

Bridges	<p>applications.</p> <p>TLO 2.2 Dial type (Crompton) potentiometer, construction and working.</p> <p>TLO 2.3 A.C. Potentiometer, principle, working and its application.</p> <p>TLO 2.4 D.C. bridges- Wheatstone bridge, Kelvin's double bridge.</p> <p>TLO 2.5 A.C. bridges and its principle and working.</p> <p>TLO 2.6 Universal impedance bridge</p>	<p>2.2 Understand the working of Dial type potentiometer and Two-range potentiometer.</p> <p>2.3 Study about working of A.C. potentiometer.</p> <p>2.4 Application of different types of potentiometers.</p> <p>2.5 Understand the working of Wheatstone's bridge and its advantages-limitations. Kelvin's double bridge and advantages of D.C. bridges.</p> <p>2.6 Understand the types of A.C. bridges- its construction and working.</p> <p>2.7 Understand the construction and working of Universal Impedance bridge.</p>		
Unit-3 Electromechanical Instruments	<p>TLO 3.1 Describe construction and working on PMMC and PMMI instruments.</p> <p>TLO 3.2 Advantage, disadvantage and errors in PMMI and PMMC instruments.</p> <p>TLO 3.3 Describe dynamometer type Moving coil instruments.</p> <p>TLO 3.4 Construction and working of 1-phase and 3-phase energy meters.</p> <p>TLO 3.5 Explain construction and working principle of Maximum demand indicator, Power factor meter, Trivector meter, Meggar, Earth Tester, Phase sequence indicator, Clip-on meter.</p> <p>TLO 3.6 Understand the construction and working of Instrument transformers- Current Transformer (CT) and Potential Transformer (PT).</p> <p>TLO 3.7 Extend the range of given DC/AC ammeter and voltmeter.</p>	<p>3.1 Construction and working principle of Permanent magnet moving coil (PMMC) and Permanent magnet moving iron (PMMI) instruments.</p> <p>3.2 Comparison between PMMI and PMMC instruments, Errors in both types of instruments.</p> <p>3.3 Construction and working principle of dynamometer type Moving coil instruments. Advantages, disadvantages and errors in dynamometer type instruments.</p> <p>3.4 Understand the construction and working of 1-phase and 3-phase energy meters.</p> <p>3.5 Understand the working of Maximum demand indicator, Power factor meter, Meggar, Earth Tester, Phase sequence indicator, Clip-on meter with its constructional detail.</p> <p>3.6 Learn the working style of CT and PT with its basic construction. Comparison between CT and PT.</p> <p>3.7 Range Extension of ammeter and voltmeter- a) Shunt and multiplier (for DC), b) CT and PT (for AC).</p>	14	12
Unit-4 Transducers	<p>TLO 4.1 Explain the transducer and its types.</p> <p>TLO 4.2 Understand the Resistive transducers- Potentiometer, Strain gauge, Load cell, Resistance temperature detector (RTD), Thermistor.</p>	<p>4.1 Understand the different types of transducers, characteristics and errors in transducers.</p> <p>4.2 Different selection factors for transducers. Difference between Sensors and Transducers.</p> <p>4.3 Describe the construction and working principle of various</p>	14	10

	<p>TLO 4.3 Understand the Inductive transducers-Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT).</p> <p>TLO 4.4 Explain the Capacitive Transducer.</p> <p>TLO 4.5 Understand the Piezo-electric transducer and Thermo-electric Transducer (Thermocouple).</p> <p>TLO 4.6 Use of transducers for measurements of-displacement, velocity, weight, pressure, liquid level, temperature, strain.</p> <p>TLO 4.7 Selection of Transducer for specific application.</p>	<p>Resistive transducers- Potentiometer, Strain gauge, Load cell, Resistance temperature detector (RTD), Thermistor.</p> <p>4.4 Explain the construction and working principle of Inductive transducers -Linear Variable Differential Transformer (LVDT) and Rotary Variable Differential Transformer (RVDT).</p> <p>4.5 Understand the constructional detail and working of Capacitive Transducer.</p> <p>4.6 Understand the working of Piezo-electric transducer and Thermo-electric Transducer (Thermocouple).</p> <p>4.7 Different application of transducers for measurements of-displacement, velocity, weight, pressure, liquid level, temperature, strain.</p> <p>4.8 Various factors affecting the selection of Transducer for specific application.</p>		
Unit-5 Digital Instruments	<p>TLO 5.1 Understand digital measuring instruments and its merits. Comparison of digital instrument with analog instrument.</p> <p>TLO 5.2 Basic building blocks of digital instruments.</p> <p>TLO 5.3 Digital volt-meter, ammeter, wattmeter, multi meter, phase sequence indicator.</p> <p>TLO 5.4 Explain Digital/Smart energy meter, power factor meter, frequency meter.</p> <p>TLO 5.5 Construction and working of Digital transducer.</p>	<p>5.1 Features of digital instruments over analog instruments.</p> <p>5.2 Block diagram of digital instruments and explain each block.</p> <p>5.3 Understand the Construction and Working of various digital instruments– volt meter, ammeter, wattmeter, multimeter, phase sequence indicator.</p> <p>5.4 Understand the Construction and Working of various digital instruments– Smart energy meter, power factor meter, frequency meter.</p> <p>5.5 Describe the constructional details and working of digital transducer.</p>	08	05

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL

Sr. No.	Practical/Laboratory Learning Outcome (LLO)	Practical Titles	Relevant COs
1	LLO 1.1 Calibrate the ammeter /voltmeter for measurement.	Calibration of the ammeter / voltmeter for measurement of electrical parameters.	CO1
2	LLO 2.1 Calibrate single phase energy meter by direct loading.	Calibration of single-phase energy meter by direct loading.	CO1
3	LLO 3.1 Measurement of medium resistance using Wheatstone bridge.	Test the medium resistance using Wheatstone bridge.	CO2
4	LLO 4.1 Apply Universal Impedance	Test of resistance, inductance and	CO2

	Bridge for R, L and C measurement.	capacitance by using Universal Impedance bridge.	
5	LLO 5.1 Identify the components of PMMC and PMMI instruments.	Identification of the components of PMMC and PMMI instruments.	CO3
6	LLO 6.1 Extend the range of voltmeter and ammeter by using shunt and multiplier.	Extension of the range of voltmeter and ammeter using shunt and multiplier.	CO3
7	LLO 7.1 Extend the range of ammeter by using CT and take the safety precautions while using CT.	Extension of the range of ammeter using Current Transformer (CT).	CO3
8	LLO 8.1 Various electrical parameters measurements by the use of Clip-on meter.	Measurement of different electrical parameters with the help of Clip-on meter.	CO3
9	LLO 9.1 Demonstration of working of megger for insulation resistance measurement.	Measurement of insulation resistance of a winding with the help of megger.	CO3
10	LLO 10.1 Use of Phase sequence indicator and Power factor meter.	Demonstration and operation of Phase sequence indicator and Power factor meter.	CO3
11	LLO 11.1 Understand about Strain Gauge.	To study about Strain Gauge.	CO4
12	LLO 12.1 Use of LVDT for measurement of displacement.	Measurement of displacement using LVDT.	CO4
13	LLO 13.1 Temperature measurement by using RTD.	Measurement of temperature using RTD.	CO4
14	LLO 14.1 Application of thermocouple for temperature measurement.	Measurement of temperature using Thermocouple.	CO4
15	LLO 15.1 Demonstrate the working of smart energy meter.	Demonstration of smart energy meters.	CO5

VII. SUGGESTED MICRO PROJECT / ASSIGNMENTS / ACTIVITIES FOR SELF LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

- Compare analog and digital meters.
 - Compare PMMC with PMMI meters.
 - Write the industrial applications of RTD, thermistor and thermocouple.
 - Compare analog with digital energy meter.
 - Determine the multiplying factor of a wattmeter.
- Mini projects**
- Prepare a report on usage of level, pressure and flow sensors used in industry.
 - Electronic energy meter: Collect data of power consumption of the equipment in the departmental laboratories/workshops of your polytechnic using an electronic energy meter.
 - PMMC and MI instrument: Dismantle any PMMC and MI instrument each available in the laboratory/workshop and identify different parts, material and function i.e. coil, spring, magnets, former, dial scale etc. and again assemble the same.
 - Prepare a report on usage of temperature sensors in mobile, laptop, domestic and consumer appliances.
 - DMM: Use DMM for measurement of current, voltage, resistance of different range and check the continuity.

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD

1	Model of PMMC and PMMI type instrument (up to 50A)
2	Energy meter (analog/digital) (15A/230V)
3	Smart energy meter.
4	Wheatstone bridge, Mega ohm bridge
5	LVDT trainer kit- Displacement range +/- 20 mm. Accuracy of +/- 2% Primary

	Excitation 4 KHz and 1 Volt, RMS Output: Digital display of +/- 20mm
6	RTD temperature measurement: Temp range 0-1000C, temperature bath, RTD Type pt100, accuracy +/- 1%, power supply 230V AC
7	Thermocouple temperature measurement: Temp range 0-12600C, temp bath, Thermocouple K Type, accuracy of +/- 1%, power supply 230V AC, digital indication of temperature
8	Voltmeter Range (0-110V), Ammeter (0 to 5A)
9	Voltmeter, Ammeter, CT (15/5, 25/5), PT (230/110, 440/110)
10	Wattmeter (5/10A, 110/ 230V), Wattmeter (5/10A, 300/ 600V)

IX. LIST OF REFERENCE BOOKS

Sr. No.	Title	Author	Publication
1	Electrical and Electronic instruments	A.K. Sawhney	Dhanpat Rai Publication
2	Electrical Measurements: fundamentals, concepts, applications	M.U. Reissland	New Age International Publication
3	A course in electronics & electrical measurement & instrumentation	J.B. Gupta	S.K. Katariya
4	Electrical and Electronic Measurement and Instrumentation	R.K. Rajput	S.Chand and Co. New Delhi, 2015, ISBN: 9789385676017
5	Digital Instrumentation	A.J.Baowens	Tata Mc-Graw Hill Publication ISBN: 9780074630488

X. LINK OF LEARNING WEB RESOURCE

1	https://nptel.ac.in/
2	https://swayam.gov.in/nc_details/NPTEL
3	https://www.electrical4u.com/
4	https://ndl.iitkgp.ac.in/
5	www.dreamtechpress.com /ebooks

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	Fundamentals of measurements	CO1	08	2	4	6	12
2	Potentiometers and Bridges	CO2	10	4	4	4	12
3	Electromechanical Instruments	CO3	12	2	4	8	14
4	Transducers	CO4	10	4	4	6	14
5	Digital Instruments	CO5	05	2	2	4	08
Grand Total			60	16	23	21	60

XII. COs AND POs AND PSOs MAPPING

Course outcome (Cos)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	0	1	0	1	1	3	2	1
CO2	3	1	1	2	2	1	2	3	2	3
CO3	3	2	1	2	1	1	2	3	1	2
CO4	3	2	1	2	2	1	2	1	3	2
CO5	3	2	2	2	1	1	3	2	3	1

Legends: - 3- High 2-Moderate/Medium 1-Slight/Low 0-None