Roll No.											

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations - December 2025

Date: 15-12-2025 **Time:** 1.00pm to 04.00pm

School: SOE	**Program:** B.Tech	
Course Code : EEE2032	**Course Name :** Electrical & Electronic Measurements and Instrumentation	
Semester: V	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5	CO6
Marks	14	17	14	19	24	12

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1	What do you understand by the term Gaussian distribution or normal distribution?	2 Marks	L1	CO1
2	Define the concept of dead zone in meters.	2 Marks	L1	CO1
3	What is the purpose of the deflecting torque in electromechanical instruments?	2 Marks	L1	CO2
4	Name the major components used in the construction of a digital voltmeter	2 Marks	L1	CO3
5	Compare analog and digital ammeters based on accuracy and response time	2 Marks	L1	CO3
6	List one application each of CT and PT in electrical measurements.	2 Marks	L1	CO4
7	List any two electrical quantities that can be measured using a Digital Multimeter (DMM).	2 Marks	L1	CO4

8	List any two mechanical quantities that can be measured using suitable transducers.	**2 Marks**	**L1**	**CO5**
9	Name any two transducers commonly used for temperature measurement.	**2 Marks**	**L1**	**CO5**
10	What is meant by "sampling" in a DAQ system	**2 Marks**	**L1**	**CO6**

Part B

Answer the Questions **Total 80 Marks.**

11.	a.	During the testing of an industrial temperature control system, an instrumentation engineer observed that the sensor output did not respond immediately to small temperature changes. Additionally, a certain delay occurred before the controller output started varying after the input change. The engineer decided to analyze these response characteristics to improve system accuracy. Apply your understanding of instrument performance characteristics to explain the concepts of sensitivity, dead time, and dead zone. Support your explanation with a practical example illustrating how these parameters affect the accuracy and responsiveness of a measurement or control system.	5 Marks	L3	CO1
	b.	During a laboratory experiment to measure the resistance of a heating element, a student obtained slightly different readings each time using the same instruments. The instructor explained that such variations could result from different types of measurement errors affecting the accuracy and reliability of results. Interpret the different types of errors in measurements, such as systematic, random, and gross errors, using this experimental situation. Explain how each type of error influences the final measurement and suggest ways to minimize their impact in practical testing scenarios.	5 Marks	L3	CO1

or

12.	a.	In a voltage measurement experiment, a student records six readings of the same quantity using a digital voltmeter to check the consistency of the instrument. The observed values are 100.2 V, 100.5 V, 100.8 V, 100.8 V, 100.3 V, and 100.4 V. The instructor asks the student to evaluate the precision of the measurements and understand their spread around the average value. Solve for the deviation, median, and variance of the given measurements. Interpret the results to comment on the precision and reliability of the recorded data.	5 Marks	L3	CO1

	b.	During a quality inspection in a manufacturing plant, two pressure gauges are tested for performance. Gauge A consistently gives readings close to the true pressure value but with slight variation between trials, while Gauge B provides very consistent readings that differ noticeably from the actual pressure. Contrast the concepts of accuracy and precision using this practical example. Explain how each gauge demonstrates one characteristic more strongly than the other, and discuss why both qualities are essential for reliable measurement systems.	5 Marks	L3	CO1

13.	a.	An industrial automation engineer is tasked with monitoring the temperature of a furnace operating at very high temperatures. Conventional temperature sensors such as RTDs and thermistors fail to perform accurately under such extreme conditions. To ensure reliable temperature measurement, the engineer decides to use a thermocouple. Illustrate the working principle and application of a thermocouple with the help of a suitable diagram or example. Describe how the thermoelectric effect is utilized for temperature measurement and explain why thermocouples are preferred in high-temperature industrial environments.	5 Marks	L3	CO6
	b.	In a smart infrastructure project, engineers are tasked with developing a real-time environmental monitoring system to record parameters such as temperature, humidity, and air quality from different locations across a city. The system must collect data, process it efficiently, and transmit it to a central control station for analysis and decision-making. Demonstrate the elements of a Data Acquisition System (DAS) and explain how telemetry systems are integrated within measurement and monitoring applications like this. Use a suitable block diagram or example to show how sensor data is acquired, processed, and transmitted for remote observation and control.	5 Marks	L3	CO6

or

14.	a.	A manufacturing plant is upgrading its automated production line to ensure accurate measurement and control of various physical parameters such as temperature, pressure, and displacement. Employ the classification of transducers based on the nature of their input and output signals to determine suitable transducers for each parameter. Further, employ the key selection factors – such as sensitivity, range, and environmental conditions–to justify your choice of transducers for this application.	5 Marks	L3	CO6

	b.	An automotive R&D engineer is tasked with designing a vibration monitoring system for an electric vehicle to ensure smooth operation and noise reduction. Interpret the working principles and applications of piezoelectric and inductive transducers in this context. Also, interpret how these two types of transducers differ in their characteristics and suitability for measuring vibration and displacement in dynamic systems.	5 Marks	L3	CO6

15.	a.	At a renewable energy testing laboratory, engineers are analyzing the performance of a three-phase inverter system connected to a balanced delta-connected load. The system operates on a 415 V line-to-line voltage, and the RMS value of the line current is 15 A. Power measurements are taken using the two-wattmeter method. During the test, the first wattmeter (connected between R and Y phases) shows zero reading. Examine the reading of the second wattmeter (connected between B and Y phases) in watts and analyze what this result reveals about the power factor and load characteristics of the inverter system.	5 Marks	L3	CO3
	b.	During the calibration of analog measuring instruments in an electrical laboratory, a technician observes that the behavior of a Permanent Magnet Moving Coil (PMMC) instrument resembles that of a DC shunt motor in certain aspects. To understand this similarity, the technician decides to study the internal mechanism of both devices. Analyze the working principle of the PMMC instrument by comparing it with the operation of a DC shunt motor, highlighting the similarities and differences in their electromagnetic behavior and construction.	5 Marks	L2	CO3

Or

16.	a.	An industrial automation engineer is testing the performance of a three-phase star-connected balanced AC load rated for 50 Hz operation. The line-to-line input voltage is 100 V, and two wattmeters are used to measure the system's power. The voltage coils are connected between the RY and YB phases, while the current coils are connected in the R and Y phases respectively. The load impedance has a magnitude of 5 Ω and a phase angle of 60°. Analyze the readings of both wattmeters when the phase sequence is RYB, and determine how the phase relationship between voltage and current affects the power measurement in this setup.	5 Marks	L2	CO3

	b.	During the testing of a three-phase power measurement setup in an electrical laboratory, a student mistakenly connects the current coil of a wattmeter in the R phase, while the potential coil is connected between the Y and B phases instead of the standard connection. The laboratory supervisor notices an unusual wattmeter reading and asks for an explanation. Analyze this special wattmeter connection by explaining how this configuration affects the phase relationship between voltage and current, and interpret the resulting reading on the wattmeter. Support your analysis with appropriate phasor diagrams and theoretical justification.	5 Marks	L2	CO3

17.	a.	In a residential electricity audit, a technician evaluates the performance of a 230 V, single-phase domestic energy meter. When a constant load of 4 A is supplied for 6 hours at unity power factor, the meter disc makes 2208 revolutions. Later, during testing, the meter disc completes 1240 revolutions under similar conditions. Analyze the operation of the energy meter to determine the actual energy consumed by the load corresponding to 1240 revolutions. Further, interpret how the meter constant influences energy measurement accuracy in this scenario.	8 Marks	L3	CO4
	b.	An electronics service engineer is testing the output voltage of a regulated DC power supply used in a laboratory setup. The voltage is measured using a 4-digit digital multimeter (DMM) set to the 20 V range. The DMM's error specification is ±(0.5% of reading + 3 counts). When the engineer measures the output, the display shows 10.00 V. Calculate the maximum possible percentage error in the measured voltage expressed as a percentage of the reading. Further, analyze how this level of measurement uncertainty could influence the accuracy of the power supply testing process.	7 Marks	L3	CO4

Or

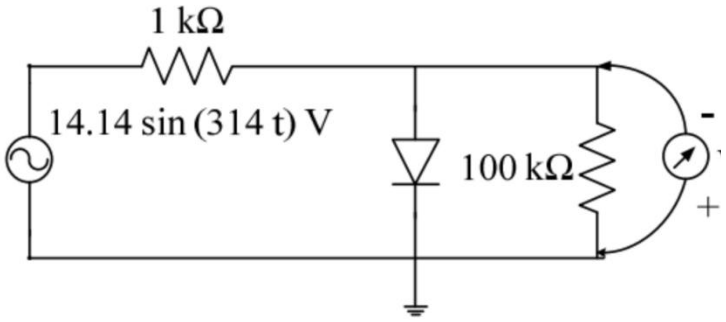
18.	a.	In a cathode-ray oscilloscope (CRO) experiment, a student is analyzing the effect of different design parameters on the screen deflection of an electron beam. The X-deflecting plates of the CRT are 20 mm long and 5 mm apart, and the centre of the plates is located 25 cm from the screen. The accelerating voltage applied is 3000 V. The student needs to understand how these physical and electrical factors influence the beam's motion on the screen. Analyze the given CRT parameters to calculate the deflection sensitivity of the instrument. Also Explain how each design factor plate length, plate separation,	8 Marks	L3	CO4

		distance to the screen, and accelerating voltage affects the deflection characteristics of the electron beam.			
	b.	During a cathode-ray oscilloscope (CRO) calibration experiment, a student observes a 10 cm long trace on the screen while applying an alternating voltage to the X-deflecting plates of the cathode-ray tube (CRT). The plates are 20 mm long and 5 mm apart, with the centre of the plates located 25 cm from the screen. The accelerating voltage applied to the CRT is 3000 V. Apply your understanding of CRT deflection principles to determine the rms value of the input voltage corresponding to the observed trace length. Show the steps involved in the calculation and explain how the geometric and electrical parameters of the CRT influence the resulting deflection on the screen.	7 Marks	L3	CO4

19.	a.	A household is evaluating the accuracy of its single-phase electromechanical energy meter due to unusually high electricity bills. During a test, a constant load of 4 A at 230 V and unity power factor is connected for 6 hours. The homeowner notes that the meter disc completes 2208 revolutions during this test. Later, during normal usage, the disc completes 1240 revolutions, and the homeowner wants to determine how much energy was consumed. Using the given test results, calculate the energy consumed by the household when the meter disc completes 1240 revolutions.	8 Marks	L3	CO 2
	b.	An electrical engineer is comparing two different laboratory instruments used for measuring electrical parameters in a power systems experiment. One of the devices is an Electromagnet moving coil (EMMC) instrument, while the other is a fully digital measuring unit. To decide which one is more suitable for analyzing slow-varying electrical quantities, the engineer needs to understand their operational differences. Contrast the working principle of the EMMC instrument with that of a typical digital measuring unit in this scenario. In your explanation, include a rough diagram to highlight how the internal mechanism of the EMMC instrument differs from the digital device.	7 Marks	L4	CO 2

Or

20.	a.	An electronics engineer is diagnosing a half-wave rectifier-based measurement circuit in which a PMMC voltmeter is connected across a 100 kΩ load resistor. The circuit is driven	8 Marks	L2	CO 2

		by an AC source of 14.14sin(314t) volts through a 1 kΩ series resistor, and a diode is used for rectification. To understand how the PMMC meter responds to this waveform, the engineer needs to determine the rectified output voltage and how the meter interprets it. Analyze the operation of the rectifier-meter circuit and calculate the voltage that the PMMC voltmeter will display across the 100 kΩ resistor. As part of your analysis, calculate and sketch the expected output waveform that appears across the load.  			
	b.	A laboratory technician is troubleshooting a PMMC (Permanent Magnet Moving Coil) voltmeter that has recently begun giving unstable readings. The technician suspects that the issue may be related to mechanical problems within the meter—particularly the control springs that provide restoring torque. To determine the cause of the malfunction, the technician must carefully study how the PMMC instrument normally operates and examine how the behaviour changes when one or both springs are damaged. Analyze the working of a PMMC instrument and examine how its performance is affected when one spring is damaged and when both springs fail. Discuss the resulting measurement errors and mechanical behaviour in each case.	7 Marks	L4	CO 2

21.	a.	A maintenance engineer in a power plant needs to monitor the temperature of a boiler's exhaust gases to ensure safe and efficient operation. Since the temperature is extremely high, conventional sensors cannot withstand the environment. The engineer chooses a thermocouple for accurate temperature measurement. Illustrate the application and working principle of a thermocouple in this scenario. Explain how it measures high temperatures and why it is suitable for monitoring the boiler's exhaust gases.	10 Marks	L3	CO5
	b.	An automated manufacturing unit needs to detect the precise position of a metallic component moving along a conveyor belt to ensure accurate robotic assembly. To achieve non-contact	10 Marks	L3	CO5

		and reliable detection, the automation engineer decides to use an inductive transducer. Employ your understanding of inductive transducers in explaining their working principle and demonstrate how they can be applied in this scenario to detect the position of the metallic component. .			

Or

22.	a.	A team of engineering interns is tasked with selecting appropriate sensors for an automated greenhouse system. They must monitor parameters such as temperature, soil moisture, light intensity, and nutrient flow. To make correct choices, they first need to understand how different transducers are categorized based on the nature of their input and output signals. Classify the transducers needed for this automated greenhouse system based on the nature of their input and output signals, and provide suitable examples for each category relevant to the given scenario.	10 Marks	L3	CO5
	b.	During an energy audit of a large commercial building, an electrical engineer needs to measure high currents and voltages in the distribution panel without directly connecting instruments to the live conductors. To ensure safe and accurate measurements, the engineer relies on a Current Transformer (CT) and a Potential Transformer (PT). While analyzing the recorded values, the engineer also has to verify the nominal ratio, actual ratio, and possible ratio error of these transformers to ensure reliable data. Examine the working principles of the Current Transformer (CT) and Potential Transformer (PT) in the context of this energy audit. Further, examine the concepts of nominal ratio, actual ratio, and ratio error, and explain how these parameters affect measurement accuracy in this scenario.	10 Marks	L3	CO5