



PRESIDENCY UNIVERSITY

BENGALURU

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Make Up Examinations - December 2025

Date: 27-12-2025

Time: 09:30am - 12:30pm

School: SOE	Program: B.Tech		
Course Code : ECE3015	Course Name: Measuring Instruments and Sensors		
Semester: MK	Max Marks: 100	Weightage: 50%	

CO - Levels	C01	C02	C03	C04	C05
Marks	26	24	26	24	

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	Differentiate between Scale Span and Scale range of an instrument.	2 Marks	L1	C01
2	Explain dispersion with example.	2 Marks	L1	C01
3	State the equations for static error and relative static error.	2 Marks	L1	C01
4	Define threshold with example	2 Marks	L1	C02
5	Write the equations for the standard deviation, when the number of samples are greater than 20 and also the number of samples are less than 20	2 Marks	L1	C02
6	Identify a bridge that can be used to measure unknown Inductance	2 Marks	L1	C03
7	Define accuracy and precision in the context of measurements, illustrating their differences with examples.	2 Marks	L1	C03
8	List the various types of errors the can present in measuring instruments.	2 Marks	L1	C03

9	Define tolerance, Suppose a voltage is measured as 10 V using an instrument which is known to have a ± 0.1 V error. The measured voltage can then be written as-----	2 Marks	L1	C04
10	Explain parallax error, which can be encountered during measurement	2 Marks	L1	C04

Part B

Answer the Questions.

Total Marks :80M

11.	a.	<p>A spring balance is calibrated in an environment at a temperature of 20°C and has the following deflection/load characteristic:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>Load (kg)</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Deflection (mm)</td> <td>0</td> <td>20</td> <td>40</td> <td>60</td> </tr> </table> <p>It is then used in an environment at a temperature of 30°C, and the following deflection/ load characteristic is measured:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>Load (kg)</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>Deflection (mm)</td> <td>5</td> <td>27</td> <td>49</td> <td>71</td> </tr> </table> <p>Determine the sensitivity at each temperature and the zero drift and sensitivity drift per °C change in ambient temperature. Also evaluate the zero drift and sensitivity drift coefficients.</p>	Load (kg)	0	1	2	3	Deflection (mm)	0	20	40	60	Load (kg)	0	1	2	3	Deflection (mm)	5	27	49	71	5 Marks	L2	C01
Load (kg)	0	1	2	3																					
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	b.	<p>Six students recorded their individual weight measurements as 68 kg, 72 kg, 70 kg, 69 kg, 71 kg, and 73 kg. Compute:</p> <p>(b) The deviations from the mean</p> <p>(c) The average deviation</p> <p>(d) The standard deviation</p> <p>(e) The variance</p>	15 Marks	L3	C01																				
Or																									
12.	a.	<p>A measuring system is designed to provide precise and dependable data about the physical value of a measured variable.</p> <p>a) Explain the various measurement methods and support each with an appropriate example.</p> <p>b) Describe the essential static characteristics of measuring instruments and discuss their importance in ensuring measurement accuracy.</p>	15 Marks	L3	C01																				

	b.	A 10000 Ω variable resistance has a linearity of 0.1% and the movement of contact arm is 320° . (a) Determine the maximum position deviation in degrees and resistance deviation in Ω . (b) If this instrument is to be used as a potentiometer with a linear scale of 0 to 1.6 V, determine the maximum voltage	5 Marks	L2	C01
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13.	a.	Measurements conducted in a laboratory or any other setting are always subject to errors. These errors can originate from multiple sources, making it impossible to achieve completely error-free measurements. Categorize the different types of measurement errors and illustrate each with a relevant example.	15 Marks	L3	C02
	b.	A component manufacturer constructs certain resistances to be anywhere between 44.65 kΩ and 49.35 kΩ and classifies them to be 47kΩ resistors. What tolerance should be stated? What color code should be given?	5 Marks	L2	C02

Or

14.	a.	Suppose you are asked to measure a temperature and the following set of readings were obtained (in degree centigrade) using five different thermometers (T_1, T_2, T_3, T_4, T_5) <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>T_1</td> <td>35</td> <td>34</td> <td>33</td> <td>36</td> <td>35</td> <td>33</td> <td>36</td> <td>34</td> <td>33</td> <td>33</td> </tr> <tr> <td>T_2</td> <td>32</td> <td>33</td> <td>32</td> <td>31</td> <td>29</td> <td>30</td> <td>28</td> <td>29</td> <td>32</td> <td>31</td> </tr> <tr> <td>T_3</td> <td>33</td> <td>34</td> <td>32</td> <td>34</td> <td>26</td> <td>28</td> <td>33</td> <td>27</td> <td>31</td> <td>33</td> </tr> <tr> <td>T_4</td> <td>36</td> <td>37</td> <td>35</td> <td>34</td> <td>37</td> <td>41</td> <td>43</td> <td>44</td> <td>38</td> <td>38</td> </tr> <tr> <td>T_5</td> <td>32</td> <td>31</td> <td>31</td> <td>30</td> <td>29</td> <td>30</td> <td>29</td> <td>29</td> <td>31</td> <td>31</td> </tr> </table> <p style="text-align: center;">Based on the given data, rank the thermometers based on their precisions and accuracies by filling the tabular column. You may consider the true value to be 30°C.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Rank \rightarrow</td> <td>Rank 1</td> <td>Rank 2</td> <td>Rank 3</td> <td>Rank 4</td> <td>Rank 5</td> </tr> <tr> <td>Accuracy</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Precision</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	T_1	35	34	33	36	35	33	36	34	33	33	T_2	32	33	32	31	29	30	28	29	32	31	T_3	33	34	32	34	26	28	33	27	31	33	T_4	36	37	35	34	37	41	43	44	38	38	T_5	32	31	31	30	29	30	29	29	31	31	Rank \rightarrow	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Accuracy						Precision						15 Marks	L3	C02
T_1	35	34	33	36	35	33	36	34	33	33																																																																				
T_2	32	33	32	31	29	30	28	29	32	31																																																																				
T_3	33	34	32	34	26	28	33	27	31	33																																																																				
T_4	36	37	35	34	37	41	43	44	38	38																																																																				
T_5	32	31	31	30	29	30	29	29	31	31																																																																				
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	b.	Relative Static Error is the ratio of the absolute static error to the true value of the quantity under measurement. Consider a current measuring instrument (i) An error of ± 2 A is negligible when the current being measured is in the order of 1000A	5 Marks	L2	C02																																																																									

		(ii) This same error is not tolerated when the current being measured is in the order of 10 A			
		Indicate precisely the accuracy of measurements in measuring instruments point of view and also state the significance of relative error in deciding the accuracy of the measurement			

15	a.	A student wants to measure the voltage across the circular potentiometer. The readings are taken on different days so that the student can find out the static behavior of the potentiometer. The Following 10 observations are as follows in Volts (V): 41.7, 42.0, 41.8, 42.0, 42.1, 41.9, 42.0, 41.9, 42.5 and 41.8 volt. Compute the arithmetic mean	5 Marks	L2	C03
	b.	Describe the Wheatstone bridge configuration used in D.C. circuits for measuring resistance. Explain its principle of operation and discuss typical applications where Wheatstone bridges are employed. Provide examples of how Wheatstone bridges are utilized in practical engineering scenarios	15 Marks	L3	C03
Or					
16.	a.	The capacitive transducers work on the principle of change in the capacitance of the capacitor. This change in capacitance could be caused by the change in the overlapping area, A of the plates, the change in the distance d between the plates d and the change in the medium between the plates ϵ_r , determine the change in the capacitance with respect to the variation of the all above factors and also calculate sensitivity	15 Marks	L3	C03
	b.	A Barium titanate piezoelectric transducer has dimension of 5mm X 5mm X 1.25mm. The force acting on it is 5N. The charge sensitivity of Barium titanate is 150 pC/N and its permittivity is 12.5×10^{-9} F/m. If Young's Modulus of Barium titanate is 12×10^6 N/m ² . Identify the unknowns that can be calculated from the given data and estimate them	5 Marks	L2	C03
17	a.	A DVM is an instrument used for measuring electric potential difference between two points in an electric circuit. It is connected in parallel. A DVM consist of attenuator, ADC and counter. An electrical engineer wants to design a DVM using resistor and comparator only as an ADC. (a) Identify which ADC will be suitable for the design	5 Marks	L2	C04
	b.	For measuring the liquid pressure during an experiment, Bourdone tube is used which is a sensor that converts pressure into displacement. Identify a transducer that can be used to	15 Marks	L3	C04

		convert the displacement into electrical signal. With neat sketch explain its construction and working.			
Or					
18.	a.	Analog to digital converter produces more accurate digital output for a corresponding analog input. Main component of such ADC is control logic which resets the counter and enables the clock signal generator in order to send the clock pulses to the counter. When it is received the counter starts incrementing and generating 3 bit output. Digital to analog converter is used to convert the counter output. This voltage is applied to comparator inverting terminal and non-inverting with the known analog input voltage V_A . Identify the type of ADC and Describe the same with neat diagram	15 Marks	L3	C04
	b.	A component manufacturer constructs certain resistances to be anywhere between 67.5 kΩ and 82.5 kΩ and classifies them to be 75 kΩ resistors. Estimate the tolerance in the resistor? Identify the color code?	5 Marks	L2	C04