Total number of printed pages: **002** **Programme(UG)/ 3rd Semester/UIE304**

2023

FUNDAMENTALS OF INSTRUMENTATION

Full Marks: 100

Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

(Note: Students are allowed to use tables for the calculation of the chi square value)

<table>
<tr><td>1</td><td>a)</td><td>With the help of an example, write the role of variable conversion element in measurement system? Are transducers and sensors same? If not, how are they different from each other? What are the different categories of transducers- briefly describe each with some examples.</td><td>2+1+1 +5=9</td></tr>
<tr><td></td><td>b)</td><td>With the help of examples write the differences between the -
1. Null and deflection type instruments
2. Analog and digital type instruments
3. Self generating and externally powered instruments</td><td>2 ×3=6</td></tr>
<tr><td></td><td>c)</td><td>Give a suitable example of a measurement system which includes primary sensing, variable conversion, variable manipulation and data presentation elements and highlight their functions.</td><td>5</td></tr>
<tr><td>2</td><td>a)</td><td>Define Systematic error and give a description about the different types of systematic errors.</td><td>1+4=5</td></tr>
<tr><td></td><td>b)</td><td>Why random errors are also called chance errors? What are the techniques to reduce the random and gross errors?</td><td>1+2=3</td></tr>
<tr><td></td><td>c)</td><td>Determine the mean, median and mode of the following readings: 24, 25, 31, 30, 36, 26, 28, 25, 31, 25, 27, 32, 25</td><td>3</td></tr>
<tr><td></td><td>d)</td><td>What does a normal distribution curve indicate? Prove that the area under a normal distribution curve is unity.</td><td>1+3=4</td></tr>
<tr><td></td><td>e)</td><td>Determine the average deviation, standard deviation, probable error of mean and standard deviation of mean of the following readings:
4.9, 5.1, 5.0, 5.2, 5.3, 4.8, 4.7</td><td>5</td></tr>
<tr><td>3</td><td>a)</td><td>Determine the least square coefficients of the following:
<table>
<tr><td>Resistance (Ω)</td><td>100</td><td>110</td><td>115</td><td>122</td><td>130</td><td>135</td><td>140</td></tr>
<tr><td>Temperature (°C)</td><td>31</td><td>32.5</td><td>33.1</td><td>34</td><td>35</td><td>35.8</td><td>36.3</td></tr>
</table></td><td>6</td></tr>
<tr><td></td><td>b)</td><td>In a measurement of viscosity coefficients, following data are found:
Viscosity coefficient (poise) Observed frequency
2-4 3
4-6 5</td><td>14</td></tr>
</table>

		6-8 7 8-10 4 10-12 2 Determine if the viscosity coefficient follows the Gaussian distribution or not. Test χ^2 values up to 10% level.	
4.	a)	What do you mean static characteristics of instruments? Give the definition of 3 desirable and 3 undesirable static characteristics.	1+3 =4
	b)	What is a hysteresis effect-briefly explain? What are the differences between threshold, dead time, dead zone and resolution?	3+4=7
	c)	What are the loading effects of input impedance and output impedance in measurements?	3+3 =6
	d)	What do you mean by time and frequency domain response? Give an example of first order system	2+1=3
5.	a)	Write a short note on Fundamental SI Units.	05
	b)	Draw the differential amplifier circuit with output equation and advantages?	05
	c)	Block diagram of simplified traceability ladder. Explain.	05
	d)	Draw the block diagram of weight measurement system and describe in brief all functional blocks	05
6.	a)	Draw the Instrumentation amplifier circuit with output equation and advantages?	05
	b)	Discuss the characteristics of an ideal operational amplifier.	05
	c)	Explain the advantages of current transmission over voltage transmission.	05
	d)	How voltmeter and Ammeter is calibrated?	05
7.	a)	Explain with circuit diagram of Op-Amp based constant current source.	05
	b)	Explain Calibration of wattmeter using standard voltage and current sources.	05
	c)	Explain Kelvin-Varley Voltage Divider to avoid the loading effect	10

**********End of UIE304**********