Total number of printed pages:

Programme(UG)/ 3<sup>rd</sup> Semester/UIE304

## 2024

#### 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)

1	a)	What do you mean by direct and indirect measurements? What are the primary and auxiliary functional elements of a measurement systems' Explain their functions.				e the ems?	2+5=7		
	b)	Enlist the different t and give a brief desc	ypes of <mark>n</mark> cription o	neasuring : f them.	instrument	s based on	various fa	ctors	2+8=10
	c)	Write the definition of is the role of sensor	of transdu in measu	icer and se rement sys	nsor with t stem?	he help of	examples. V	What	2+1=3
2	a)	Write the features of a practical operational amplifier. Show how an OPAMP2+6=8can be used as an adder and integrator with the help of circuit diagram.							
	b)	Which type of feedb are the disadvantage the overall gain of a	ack ampl s of posit negative	ifier is pre ive feedba feedback	ferred for s ock amplifi amplifier.	stability of er? Give tl	a system? he expression	What on of	1+2+3=6
	c)	What do you mean b conditioning operati	y signal o ons.	conditionin	ng? Discus	s about the	different s	ignal	1+5=6
3	a)	What are the fundamental and derived units? Give some examples for each.					2+2+6=10		
		Describe about secondary and working standards.							
	b)	What is gross error? With the help of examples explain the causes of gross error. What are the ways to reduce the gross error?							1+3+2=6
	c)	Prove that the area under the Gaussian distribution curve is unity.							4
4	a)	Determine the average deviation, standard deviation and probable error of one reading and standard deviation of mean for the following set of readings:						or of ings:	6
		Resistance (Ω)	990	995	1002	1010	1015	]	

Resistance $(\Omega)$			990	995	1002	1010	1015
Fr	equency	of	3	5	9	6	4
oc	currence						

4 b) Determine if the following readings given by a voltmeter follows the Gaussian distribution or not. Test  $\chi^2$  values up to 10% level.

Voltage (V)	Observed frequency
4.87-4.91	4
4.91-4.95	12
4.95-4.99	20
4.99-5.03	11
5.03-5.07	7

- a) What do you mean by static and dynamic characteristics of instruments? 2+5 =7 Give the definitions of the following: Precision, Sensitivity, Linearity, Resolution and Hysteresis
  - b) What is meant by transient and steady-state response? What is the transfer 2+1+6=9 function of a system? Obtain the expressions of magnitude ratio and phase angle of a first order system when sinusoidal input is applied.
  - c) How do the output impedance of a source cause loading effect? Give the 4 mathematical expression of power loss due to output impedance.
- 6 a) What do you mean by traceability and reliability of instruments? Describe 2+6=8 about primary, secondary and indirect calibration.
  - b) With the help of circuit diagram explain how a voltmeter is calibrated? Why 5+2=7 measuring instrument requires calibration?
  - c) What are the different types of systematic errors encountered in 5 measurement? Briefly explain.

7 Write short notes on any four of the following

- i) Typical applications of instruments
- ii) Roles of sensors and transducers in measurement systems
- iii) Loading effects in measurement
- iv) Routine calibration
- v) Frequency response of a system
- vi) Automatic instruments and their basic principle of working

 $4 \times 5 = 20$