Total No. of printed pages = 4

CAI-503/PoI/5th Sem/2016/N

PRINCIPLES OF INSTRUMENTATION

Full Marks – 70

Pass Marks – 28

Time – Three hours

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

Answer any *five* questions.

1. (a) Derive the transfer function of a first order electrical system. 7

An RC circuit consists of a capacitor of 5μF in series with a resistor of 7KΩ. A d.c voltage of 30V is suddenly applied across the circuit. Calculate the value of voltage after

(i) 10 ms and

(ii) 20 ms.

(b) Explain the functioning of a basic type of strip chart recorder using a suitable diagram. Also, explain the different types of marking mechanisms and tracing system used in it. 7

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2. (a) Define the following terms and find expression for them : 8

(i) Rise time

(ii) Peak time

(iii) Peak overshoot

(iv) Settling time.

(b) Discuss the dynamic characteristics of an Instrumentation system. 6

3. (a) Name the important test signals and explain each of them with relevant mathematical expression. 6

(b) Describe the working of any *two* of the following devices : 8

(i) LED

(ii) LCD display

(iii) Seven segment display.

4. (a) Differentiate the following : 6

(i) Indicating, Recording and Integrating instruments

(ii) Analog and Digital instruments.

(b) Derive the transfer function of a thermal system when the heat input rate is suddenly increased from its steady condition. 8

A temperature sensitive transducer is subjected to a sudden temperature change. It takes 12 seconds for the transducer to reach equilibrium condition (four time constants). How long will it take for the transducer to read half of the temperature difference ?

5. (a) Define Limiting Errors. Derive the expression for relative limiting error.

A 0-10A ammeter has a guaranteed accuracy of 1% of full scale reading. The current measured by the instrument is 2.5A. Calculate the limiting values of current and percentage limiting error. 6

(b) Define gross errors, systematic errors and random errors. Also mention the causes of these errors. 5

(c) Two resistors have the following ratings :

$R_1 = 40\Omega \pm 2\%$ and $R_2 = 53\Omega \pm 1.5\%$.

Determine the percentage limiting error and actual range of the resistance (equivalent) when these resistances are connected in series. 3

6. (a) Describe the construction and working of X-Y recorder using a suitable diagram. 5

(b) Explain in brief the procedures involved in the calibration of an instrument. 3

(c) Discuss the sources of noise in an instrumentation system. Describe the methods used for reduction of noise. 6

7. Write short notes on any *two* of the following : 7×2=14

(i) Data Logger

(ii) Liquid Level System

(iii) Static characteristics of an Instrumentation System.