Total No. of printed pages = 7

END SEMESTER EXAMINATION – 2019

Semester : 6th

Subject Code : CAI-503

PRINCIPLES OF INSTRUMENTATION

Full Marks –70

Time – Three hours

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

PART – A

Marks – 25

All questions are compulsory.

1. Choose the correct answer : 1×5=5

(i) The instrument with null output is

(a) Light meter

(b) Bourdon tube

(c) A two pan weighing scale

(d) A mercury manometer

[Turn over

(ii) The lower and higher cut-off frequency of a band-pass filter are 2.5 kHz and 10 kHz. Its bandwidth is

(a) 750 Hz (b) 7500 Hz

(c) 75000 Hz (d) 750000 Hz

(iii) Electro-optical effect is produced in

(a) LED (b) LCD

(c) OFC (d) AMOLED

(iv) X-Y recorder is a type of

(a) Magnetic tape recorder

(b) Digital recorder

(c) Graphic recorder

(d) Oscillography recorder

(v) A pirani gauge is used to measure

(a) Gas pressure (b) Blood flow

(c) Temperature (d) Humidity

2. State whether the following statements are true or false : 1×10=10

(i) It is not possible to have precise measurements which are not accurate.

(ii) Measurement is a process of comparison which may be either direct or indirect or both.

(iii) To prevent loading of circuit under test, the input impedance of the voltmeter must be very low.

(iv) The deflection sensitivity of a CRT is defined as the deflection of the screen per unit deflection voltage.

(v) Moisture content in the soil decreases the earth soil resistance.

(vi) An indication of the precision of the measurement is obtained from the number of significant figures in which it is expressed.

(vii) To minimize parallax errors, highly accurate meters are provided with mirrored scales.

(viii) The example of a zero order system is potentiometer.

(ix) The transfer function of a linear time invariant system is defined to be the ratio of Laplace transform of the output variable to the Laplace transform of the input variable with all initial conditions are zero.

(x) The first order system tracks the unit step input with zero static error.

3. Fill in the blanks : 1×10=10

(i) Peak to peak voltage in CRO is given by _____.

(ii) The ratio of change in output to the change in input is the _____ of the instrument.

(iii) The screen material on the inner surface of a CRT is called _____.

(iv) The semiconductor material commonly used for construction of LED is _____.

(v) A meter reads 127.50V and the true value of the voltage is 127.13V. The static error is _____.

(vi) Earth electrode provides _____ resistance.

(vii) The span of an instrument is expressed by _____.

(viii) For a second order system the settling time for ± 5% band is _____.

(ix) For critically damped system the ζ value is _____.

(x) Laplace transform of unit impulse signal is _____.

PART – B

Marks – 45

Answer any *five* questions.

4. (a) With a suitable diagram explain the functional elements of a measurement system. Also highlight the basic and auxiliary elements in it. 6

(b) State the working principle of Hot Wire Anemometer. 3

5. (a) Write down few desirable characteristics of a transducer element that you have to consider before selecting one for a particular application. 5

(b) Name two natural and two synthetic materials that exhibit piezoelectric property. 4

6. (a) What are the two different forms by which the accuracy of an instrument can be specified ? Also state their expressions. 3

(b) Define the following terms : 6

(i) Resolution

(ii) Hysteresis

(iii) Linearity

7. (a) Define the term "Transducer". Differentiate between the terms "Sensors" and "Actuators". 4

(b) Make a classification of different types of errors that appear in a measurement process. 5

8. Draw the diode arrangement for 7 × 5 dot matrix display and prepare the functional table for displaying character "E". 9

9. What are the two different types of 7 segment display ? Prepare the functional table for any one type (out of these two) to display the characters "A", "0" and "F". 2+7=9

10. (a) Three resistors have the following ratings :

$R1 = 37\Omega \pm 5\%$, $R2 = 75\Omega \pm 5\%$,
$R3 = 50\Omega \pm 5\%$.

Determine the magnitude and limiting error in Ω and in percent of the resistance of these resistances connected in series. 3

b) A voltmeter with internal resistance of 120 kΩ is connected across an unknown resistance. It reads 200V and the milli-ammeter connected in series with the same resistance reads 10 mA. Determine the apparent resistance, actual resistance and the loading error due to the voltmeter. 6

11. (a) What are the different types of electrical earthing ? 3

(b) Write short notes on any *two* : 6

(i) CRO

(ii) LCD display

(iii) X-Y Plotter.