Total No. of printed pages = 4

ECE 181405

Roll No. of candidate

11/07/23

2023

B.Tech. 4th Semester End-Term Examination

INSTRUMENTATION

New Regulation (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19)

Full Marks – 70   Time – Three hours

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

Answer Question No. 1 and any *four* from the rest.

1. Answer the following (MCQ) : $(10 \times 1 = 10)$

    (i)   A bridge circuit is used for the measurement of which of the following components?

        (a)   Resistance, capacitance, and inductance

        (b)   Diode, triode, and thyristor

        (c)   Transistor, thermistor, and antenna

        (d)   LED, op amp, and transducer

    (ii) The fact as to how closely the instrument reading follows the measured variable is called the

        (a)   accuracy   (b)   precision

        (c)   fidelity   (d)   sensitivity

    (iii) The difference between the indicated value and true value of a quantity is

        (a)   gross error   (b)   absolute error

        (c)   dynamic error   (d)   relative error

    (iv) A resistor is specified by a magnitude of 200Ω with a limiting error of $\pm 20\Omega$. What is the fractional error?

        (a)   0.2   (b)   0.5

        (c)   0.1   (d)   10

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(v) A wattmeter has a range of 1000 W with an error of ±1% of full scale deflection. If the true power passed through it is 100 W, then the relative error would be

(a) ±10%

(b) ±5%

(c) ±1%

(d) ±0.5%

(vi) A 0 to 200 V voltmeter has a guaranteed accuracy of 1% of full scale reading. The voltage measured by the instrument is 50 V. What is the limiting error?

(a) 4%

(b) 2%

(c) 1%

(d) 0.25%

(vii) A Wheatstone bridge requires a change of 6Ω in the unknown arm of the bridge to produce a change in deflection of 3 mm of the galvanometer. The sensitivity of the instrument is

(a) 0.5%

(b) 2%

(c) $0.5 mm/\Omega$

(d) $2.0\Omega/mm$

(viii) Change in output of sensor with change in input is ——————

(a) Threshold

(b) Slew rate

(c) Sensitivity

(d) None of the mentioned

(ix) Smallest change which a sensor can detect is ——————

(a) Resolution

(b) Accuracy

(c) Precision

(d) Scale

(x) Peak to peak voltage is given by ——————

(a) V_{p-p} = number of units × (1 division)

(b) V_{p-p} = (volts/division)

(c) V_{p-p} = number of units × volts

(d) V_{p-p} = number of units × (volts/division)

2. (a) Give an account of various errors involved in measurement. Classify them into broad categories.

(b) A voltmeter reading of 70 V on its 100 V range and an ammeter reading of 80 mA on its 150 mA range are used to determine the power dissipation in a resistor. Both these instruments are guaranteed to be accurate within ±1.5% at full scale deflection. Determine power and limiting error of the power

(c) A multimeter having a sensitivity of $2000\Omega/V$ is used for measurement of voltage across a circuit having an output resistance of $10 K\Omega$. The open circuit voltage of the circuit is 6 V. Find the reading of the multimeter when it is set to its 10 V scale. Find the percentage of error.   (5+5+5=15)

3. (a) With proper circuit diagram find the equation for the measurement of unknown resistance using Kelvin's double bridge.

   (b) With proper circuit and phasor diagram find the equation for the measurement of unknown capacitance using Schering bridge.

   (c) A sheet of Bakelite 4.5 mm thick is tested at 50 Hz between electrodes 0.12 m in diameter. The Schering's bridge employs a standard air capacitor C_2 of 106 pF capacitance, a non reactive resistance R_4 of $1000/\pi\,\Omega$ in parallel with variable capacitor C_4 and a non reactive variable resistance R_3. Balance is obtained with $C_4 = 0.5\ \mu F$ and $R_2 = 260\ \Omega$. Calculate the capacitance, power factor and relative permittivity of the sheet. (5+5+5=15)

4. (a) The behaviour of a permanent magnet moving coil galvanometer is given by an equation of the form

   $$J\frac{d^2\theta}{dt^2} + D\frac{d\theta}{dt} + C\theta = Gi.$$

   Where the symbols have their usual meanings. Find out the solution of this equation Derive the three ways by which the galvanometer deflection with time is categorized with the help of the curves.

   (b) Show that the motion of the undamped galvanometer is an oscillation around θ_F with a constant amplitude θ and angular velocity ω. (10+5=15)

5. (a) With diagram explain Binary weighted resistor DAC. What are its disadvantages?

   (b) How the disadvantage of Binary weighted resistor DAC has been overcome in R-2R ladder DAC.

   (c) Explain with diagram and an example of the working of successive approximation ADC. (5+5+5=15)

6. (a) What are the different types of special purpose oscilloscope? Explain with proper diagram digital storage oscilloscope.

   (b) What do you understand by Lissajous pattern? How we can calculate the phase difference between the two sinusoidal signals having same frequency? (8+7=15)

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7. Write short notes on (any *three*) : (3×5=15)

    (a) Wave Analyser

    (b) Data Acquisition System (DAS)

    (c) Spectrum Analyzer

    (d) Transducers and its types.

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