

Roll no.

National Institute of Technology, Delhi

Name of the Examination: B.Tech. (End Sem Exam)

May 2022(Spring)

Branch : B.Tech (ECE)

Semester : IV

Title of the Course : Electronics Measurement and Instrumentation

Course Code : ECB 254

Time: 3 Hour

Maximum Marks : 50

Note: All questions are compulsory.

I. Answer the following Questions.

[40 Marks]

Q1. By using a "micrometer screw", the following readings were taken of a certain physical length: 1.34, 1.38, 1.56, 1.47, 1.42, 1.44, 1.53, 1.48, 1.40, and 1.59 all are in mm. calculate the following; (i) Arithmetic mean, (ii) Average deviation (iii) Standard deviation, and (iv) Variance.

[4 Marks]

Q2. Explain the Hay Bridge with Circuit and Phasor diagram. The Schering Bridge has the following constants $R_1=1.5 \text{ k}\Omega$, $C_1=0.4 \text{ }\mu\text{F}$, $R_2=3 \text{ k}\Omega$ and $C_3=0.4 \text{ }\mu\text{F}$ at frequency 1 kHz. Determine the unknown resistance and capacitance of the bridge circuit and dissipation factor Identify the bridge used for measurement of inductance and explain the construction and operation of this bridge. In the AC bridge circuit shown in Fig. 1, the supply voltage is 20 V at 500 Hz. Arm ab is $0.25 \text{ }\mu\text{F}$ pure capacitance; arm bc is $400 \text{ }\Omega$ pure resistances and arm ad has a $120 \text{ }\Omega$ resistance in parallel with a $0.15 \text{ }\mu\text{F}$ capacitor. Find resistance and inductance or capacitance of the arm cd considering it as a series circuit.

[10 Marks]

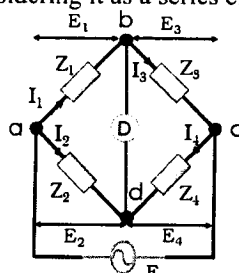


Fig.1 A. C. Bridge

Q3. What is Wien's bridge? Derive the expression for the frequency. A Wein bridge at balance has the following components given as: $R_1 = R_2 = 820 \text{ }\Omega$, $C_1 = 0.2 \text{ }\mu\text{F}$, $C_2 = 0.4 \text{ }\mu\text{F}$, and $R_3 = 1.5 \text{ k}\Omega$. Find the (a) frequency (b) value of resistance R_4

[4 Marks]

Q4. Draw a Block Diagram of CRO and working of CRO and its applications. Explain how time and frequency is measured using CRO. Also, Draw the internal structure of CRT and list its functions. Derive the expression for vertical deflection of electron beam in CRT.

[6 Marks]

(a) In a CRT, the distance between the plates is 1 cm, the length of the deflecting plates is 4.5 cm and the distance of the screen from the centre of the plates is 33 cm. If the accelerating voltage is 300 V and deflecting voltage is 50 V, find (i) Velocity of electron reaching the field (ii) Deflection produced on the screen (iii) Deflection sensitivity.

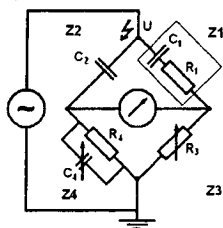
(b) An electrically deflected CRT has an accelerating voltage of 900 V and parallel deflecting plates of 1.5 cm long and 0.5 cm apart. If the screen is 40 cm away from the centre of the plates, calculate (i) Beam speed (ii) Deflection sensitivity of tube (iii) Deflection factor of tube

Assume charge of electron as $1.6 \times 10^{-19} \text{ C}$ and mass of electron as $9.1 \times 10^{-31} \text{ kg}$.

- Q5. (a) Explain the theory and working of an LED. Describe the advantage of LCDs. [5 Marks]
Compare the various display devices in various aspects.
(b) Explain the principle and working of an LVDT. An LVDT produces an rms output voltage of 2.6 V for displacement of 0.4 mm. Calculate the sensitivity of LVDT.
- Q7. (a) Derive the expression for Strain Gauge. A resistance, wire strain gauge with a gauge factor of 2 is bonded to a steel structural member subjected to a stress of 100 MN/m^2 . The modulus of elasticity of steel is 200 GN/m^2 . Calculate the percentage in value of the gauge resistance due to the applied stress. Comment upto the results. [6 Marks]
(b) What are the Thermoelectric Effects? Also write the Laws of thermoelectric Circuit. Write three points in difference between RTD, Thermocouple and Thermistors.
- Q8. Write short note on Biomedical Instruments [5 Marks]
(i) Electrocardiography (ECC) (ii) Electroencephalography (EEG)
(iii) Electromyography (EMG) (iv) X- Ray machine (v) EMI scanner.

II. Select the appropriate answer for the following questions. (1 marks each MCQ) [10 Marks]

- 1) A galvanometer of 50Ω gives full scale deflection with 2mA current. To convert it into ammeter, the range of 10A is connected with it, the shunt resistance should be?
a) 0.1Ω b) 0.2Ω c) 0.01Ω d) 0.02Ω
- 2) An LVDT
a) Exhibits linear characteristics upto a displacement of $\pm 5\text{mm}$
b) Has a linearity of 0.05%
c) Has an infinite resolution and a high sensitivity which is of the order of 40 V/mm
d) All of the above
- 3) An LVDT :
a) Has a very good frequency response as the mass of the core to which the input signal is applied fairly large.
b) Is immune to stray magnetic field
c) Has a zero voltage at the null point even if the supply voltage contains harmonics
d) none of the above
- 4) An electrically deflected CRT has a final anode voltage of 2000V and parallel deflecting plates 1.5cm long and 5mm apart. If the screen is 50cm from the centre of deflecting plates, find the deflection sensitivity of the tube.
a) 0.375 mm/V b) 3.75 mm/V c) 0.375 cm/V d) 3.75 cm/V
- 5) The Schering Bridge shown in figure has $R_4 = 1.5 \text{ k}\Omega$, $C_4 = 0.4 \mu\text{F}$, $R_3 = 3 \text{ k}\Omega$ and $C_2 = 0.4 \mu\text{F}$ at frequency 1 kHz. Determine the unknown capacitance and dissipation factor.
a) $C_1 = 0.2 \mu\text{F}$, $D = 3.77$ b) $C_1 = 2\mu\text{F}$, $D = 377$
c) $C_1 = 0.2\text{F}$, $D = 0.377$ d) $C_1 = 0.02\mu\text{F}$, $D = 3.70$



- 6) Thermistor is a transducer. Its temperature coefficient is
a) Negative b) Positive c) Zero d) None of these
- 7) Principally CRO is a
a) Ammeter b) Wattmeter c) Voltmeter
- 8) Strain gauge, LVDT and thermocouple are examples of
a) Active transducers b) Passive transducers c) Analog transducers d) Primary transducers
- 9) Calculate the velocity of the electron beam in an oscilloscope, if the voltage applied to its vertical deflection plates is 2000V.
- 10) Lissajous figure is also called as
a) Bowditch Curve b) Wheat Stone curve c) Shape shifter d) CRO figure