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No. of Printed Pages—4   EC-604

B. TECH.

SIXTH SEMESTER EXAMINATION, 2002-2003

MEASUREMENTS & INSTRUMENTATION

Time : 2 Hours   *Total Marks : 50*

1. Attempt any FOUR parts of the following :—   **(4×4=16)**

     (*a*) Explain the construction and working of the Weston type frequency meter.

     (*b*) Describe the construction and working of a single phase electrodynamometer type of power-factor meter.

     (*c*) 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 $\pm 1.5\%$ at full-scale deflection. Determine Power and limiting error of the Power.

     (*d*) Explain the term, Noise Factor.

         A differential amplifier with a common-mode input of 500 mV and a difference mode input of 30 mV has an output of 5 mV due to the common mode input and 3 V due to difference mode input. Find the Common Mode Rejection Ratio (CMRR).

     (*e*) What method can be used to increase the frequency range of frequency counter ? How can this be achieved without degrading the accuracy of the counter ?

     (*f*) Write short notes on R-F impedance measurement.

2. Answer any TWO of the following :— (5×2=10)

(a) What are three major classes of digital displacement transducers ? Discuss their merits and demerits. Why is the Gray code preferred to binary code in commercial encoders ?

The output of an LVDT is connected to a 5 V voltmeter through an amplifier with a gain of 250. The voltmeter scale has 100 divisions and the scale can be read to 1/5th of a division. An output of 2 mV appears across the terminals of the LVDT, when core is displaced through a distance of 0·5 mm. Calculate and determine :

(i) Sensitivity of LVDT and entire set-up,

(ii) The resolution of instrument.

(b) Draw the equivalent circuit of a peizo electric transducer and hence deduce that the output is zero when the pressure is static. State advantages and disadvantages of peizo electric transducer.

A quartz peizo electric transducer has the following specifications :—

area = 1 cm^2, thickness = 1 mm, Young's modulus = 9×10^{10} Pa, charge sensitivity = 2 p C/N, relative permittivity = 5 and resistivity = 10^{14} Ω cm. A 20 pF capacitor and a 100 MΩ resistance are connected in parallel across the electrodes of peizo electric transducer. If a force $F = 0·02 \sin (10^3 t)$ N is applied, calculate :

(i) Peak to peak voltage generated across the electrodes, and

(ii) the maximum change in crystal thickness.

(c) What are different transducers used for temperature measurement ? Compare and contrast a thermo-couple and thermistor as temperature transducers.

A platinum resistance thermometer is used to measure the temperature between $0°C$ and $200°C$. Given that resistance at $t\,°C$

as $R_t = R_0 \left(1 + \alpha\,t + \beta\,t^2\right)$, $\quad R_0 = 100\cdot0\ \Omega$

$R_{100} = 138\cdot50\ \Omega \quad$ and $\quad R_{200} = 175\cdot83\ \Omega$, calculate the nonlinearity at $100°C$ as a per cent of full-scale deflection.

3. Attempt any THREE of the following :— $\quad(4\times3=12)$

(a) Write short notes on IEEE standard instrumentation bus.

(b) Draw the block diagram of Telemetry System and explain its working.

(c) What are "ROSETTES" ? Compare its advantages and disadvantages, in brief, with that of plain strain gauges.

(d) Explain, with block schematic, the working principle of A/D converter using D/A converter.

(e) It is required to design a data acquisition system with the following requirements :—

(i) No. of channels = 4

(ii) Minimum frequency = 1·2 KHz

(iii) Maximum frequency = 15 KHz

(*iv*) Minimum input level = 20 mV

(*v*) Maximum input level = 1 V

Suggest a block based schematic of the proposed system assuming a 5 V unipolar 12 bit ADC is available.

Describe the specifications of the different blocks of the system.

4. Attempt any TWO parts of the following :— (6×2=1˙

(*a*) What are different alphanumeric display devices ? Give the construction and principle of field effect type LCD. Compare LED and LCD displays.

(*b*) Draw the block diagram of storage oscilloscope and explain the working of each block.

(*c*) What are the applications of Spectrum Analyzer ? Draw the block diagram of Spectrum Analyzer and explain its working.