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No. of Printed Pages—4 **EC–604**

B. TECH.

SIXTH SEMESTER EXAMINATION, 2003-2004

MEASUREMENTS & INSTRUMENTATION

Time : 2 Hours *Total Marks : 50*

Note :

1. Answer any *THREE* parts of the following :— **(5×3=15)**

(a) Draw a block diagram of a Digital Frequency Counter and explain the principle of its working. How can the range of the frequency counter be increased ?

(b) Describe the Substitution Schering Bridge method of measuring RF impedance or explain the operation of Twin T-admittance measurement method employed in RF range. Use necessary mathematical expressions in support of your answer.

(c) How do you define percentage distortion in a waveform ? Describe the principle of operation of a Distortion Factor Meter. Why do we employ a Notch filter in this meter ?

(d) Define Selectivity, Sensitivity and Fidelity characteristics of a Receiver. How are these measured ?

(e) Define CMRR for an instrumentation amplifier. The output voltage of the amplifier can be expressed as —

$$V_o = A_d V_d \{1 + (1/\rho)(V_c/V_d)\},$$

where A_d = difference mode gain, ρ = CMRR, V_c = common mode voltage signal and

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V_d = difference voltage signal. If $V_1 = 100\ \mu V$ and $V_2 = -150\ \mu V$ signals are applied to an instrumentation amplifier, having CMRR = 100, determine the output voltage. Next, determine the output voltage of the same amplifier if $V_1 = 300\ \mu V$ and $V_2 = 50\ \mu V$ retaining $V_1 - V_2 = 250\ \mu V$ as in the first case. What inference can you draw in this measurement ? Suggest some remedy to improve the performance of the amplifier.

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

(a) Distinguish between Transducers and Sensors; Active and Passive transducers. A resistance strain gauge with a gauge factor of 2 is fastened to a steel rod, subjected to a stress of 500 kg/cm^2. If the modulus of elasticity of the steel is $2\times10^6\ kg/cm^2$, calculate the change in the resistance of the strain gauge element to the applied stress.

(b) Distinguish between a Capacitive Transducer and LVDT (Linear Voltage Differential Transducer) for measurement of displacement.

A parallel plate capacitive transducer is employed as a liquid level indicator in a chemical plant such that the plates are immersed in the liquid with the movable plate of the transducer touching the upper surface of the liquid. With the change in the level of the liquid, the movable plate of the transducer is displaced. If the overlapping area of the plates $A = 1\ m^2$ and the capacitance is found to be 29·5 nF, determine the change in the level of the liquid.

Given ϵ_r for liquid = 80, $\epsilon_o = 8{\cdot}85\times10^{-12}$ F/m .

(c) Describe the principle of operation of a digital pressure transducer or a piezo-electric pressure transducer. Draw a suitable schematic diagram in support of your answer.

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

(a) What is the purpose of IEEE 488 bus ? What do you mean by the "talker" and "listener" as employed in IEEE 488 terminology ? Give examples of two instruments based on this terminology.

What are the basic components of Telemetry ?

(b) Write short notes on :

(i) Frequency telemetry system
(ii) Position type telemetry system

(c) What is Data Acquisition System ? Explain the working of a Multichannel Analog Multiplexed DAS.

4. Answer any *THREE* of the following :— **(5×3=15)**

(a) What is an X-Y Recorder ? How do you distinguish it from a X-t or a Y-t recorder ?

(b) What are the relative advantages of LCD display device over LED display device ? Explain the working of seven-segment LCD display.

(c) Distinguish, the principles of working of a Spectrum analyzer and a Wave analyzer. Draw the block diagram of a spectrum analyzer. How is the spectrum of a given signal displayed on the spectrum analyzer ?

(d) What are the basic components of a Magnetic Recorder ?

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The chart speed of a recording instrument is 10 mm/s. If the time base of the recorded signal is 20 mm, what is its frequency ?

(e) What are the major components of a CRT ? Why are the operating voltages in a CRT arranged so that the deflection plates are nearly at ground potential ?

The horizontal deflection plates in a CRT are 20 mm long and 5 mm apart. The centre of the plates is 20 cm from the screen. Accelerating voltage is 2500 V. Determine the deflection sensitivity.