

Code: AE-12

Subject: INSTRUMENTATION AND MEASUREMENT

JUNE 2007

Time: 3 Hours

Max. Marks: 100

NOTE: There are 9 Questions in all.

- Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.
- Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.
- Any required data not explicitly given, may be suitably assumed and stated.

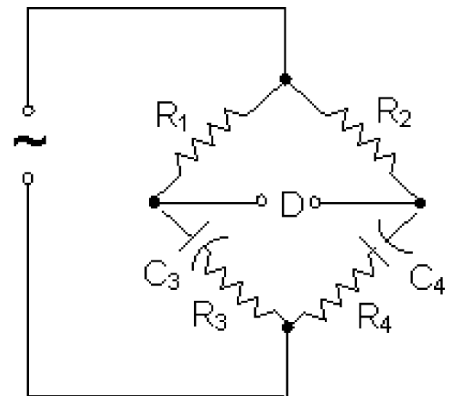
Q.1 Choose the correct or best alternative in the following: (2x10)

- a. The transfer characteristic of a measuring instrument is given below in the tabular form

Input units	0.0	0.1	0.2	0.3	0.4	0.5
Output units	0.2	0.4	0.6	0.8	1.0	1.2

The transfer characteristic can be described as

- (A) Non linear with Zero Error (B) Non linear without Zero Error
 (C) Linear without Zero Error (D) Linear with Zero Error
- b. The condition for the balance in the bridge shown is given by



(A) $R_1 R_4 = R_2 R_3$; $\frac{R_2}{R_1} = \frac{C_3}{C_4}$

(B) $R_1 R_2 = R_3 R_4$; $R_1 C_3 = R_2 C_4$

(C) $R_1 R_4 = R_2 R_3$; $R_1 C_3 = R_2 C_4$

(D) $\frac{R_1}{R_2} = \frac{C_4}{C_3}$; $\frac{R_1}{R_4} = \frac{R_2}{R_3}$

- c. An instrument which can produce sine, triangular, square and sawtooth wave forms at frequencies from a fraction of a hertz to several hundred kHz, is called
 (A) Frequency Synthesizer (B) Function generator
 (C) Wave modulator (D) Sweep frequency generator
- d. Delay line in a CRO is necessary to
 (A) View the signal fully
 (B) Cause a Lissajous pattern
 (C) Cause desired phase difference between two input signals
 (D) Initial horizontal sweep at any amplitude level of the signal
- e. Frequency can be measured by using
 (A) Maxwell's bridge (B) Schering's bridge
 (C) Hay's bridge (D) Wien's bridge
- f. Maxwell's bridge is used for measurement of inductance of
 (A) low Q coils (B) medium Q coils
 (C) high Q coils (D) very high Q coils
- g. The quality factor of a coil is defined as
 (A) $\frac{\omega_0 R}{L}$ (B) $\frac{\omega_0 L}{R}$
 (C) $2 \frac{\omega_0 L}{R}$ (D) $\frac{\omega_0 L}{2R}$
 where R is the resistance and L is the inductance of coil and ω_0 is resonant frequency.
- h. Which of the following devices can measure pressure directly
 (A) tachometer
 (B) strain gauge
 (C) Rotameter
 (D) Bourden tube
- i. A resistance strain gauge of 120Ω , having a gauge factor of 2 is subjected to strain of 1.5×10^{-6} . The change in its resistance due to the strain is
 (A) $360 \mu\Omega$ (B) $360 \text{ m}\Omega$
 (C) 0.36Ω (D) $3.6 \mu\Omega$
- j. In a 5 bit R-2R ladder D/A converter, the digital input is 00100. If the reference voltage used $V_R=10\text{V}$, the output voltage of the converter is
 (A) 1.25 V (B) 2.5 V
 (C) 5.0 V (D) 10.0 V

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Explain the following terms as applied to characterization of dynamic behaviour of instruments

(i) Dynamic error (ii) Fidelity (iii) Bandwidth **(4+3+3)**

b. (i) List the fundamental physical quantities that serve to define all other physical quantities

(ii) Write a note on 'random errors'. **(2+4)**

Q.3 With the help of block diagrams, explain the working principles of the following

(a) Harmonic Distorsion Analyzer

(b) Cavity type Wavemeter **(16)**

Q.4 a. Discuss 'gating error' in frequency counter and explain why sometimes it is preferable to measure frequency by period measurement. **(8)**

b. Show a block schematic of a wideband sweep generator and describe its operation. **(8)**

Q.5 a. Why attenuators are necessary for vertical deflection system of a CRO? Describe the circuit and working of a compensated attenuator scheme. **(8)**

b. Describe briefly, the construction and the principle of working of a current probe which can be used with a CRO to measure current. **(8)**

Q.6 a. Show a circuit scheme employing bismuth metal to measure magnetic field and explain the principle of its working. **(8)**

b. Describe a thermal method to measure RF power. **(8)**

Q.7 a. Explain, using a block schematic, the basics of operation of a Superheterodyne receiver. List the important parameters which characterize a receiver and define each of them. **(9)**

b. Delineate a procedure to measure image response in a receiver. Suggest a method to reduce image response. **(7)**

- Q.8** a. Distinguish between a 'wave analyzer' and 'spectrum analyzer'. Write a block diagram of a spectrum analyser and explain its working. **(8)**
- b. Describe at least two schemes to multiplex A/D converters. **(8)**
- Q.9** a. Show, by drawing neat sketches, at least three arrangements for measurement of thickness of metallic magnetic sheets using inductive transducers. **(8)**
- b. Explain the basic principle of working of the following transducers
- (i) Piezoelectric force transducer
 - (ii) Magnetostrictive force transducer. **(8)**