Code: A-12 **Subject: INSTRUMENTATION AND MEASUREMENTS**
Time: 3 Hours **Max. Marks: 100**

NOTE: There are 11 Questions in all.

- **Question 1 is compulsory and carries 16 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Answer any THREE Questions each from Part I and Part II. Each of these questions carries 14 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or best alternative in the following: (2x8)

a. In a wire type of strain gauge if the change in the resistance is 0.6Ω, the resistance of the unstrained wire is 120Ω and the gauge factor is 2.5, then the strain is _____.

(A) 0.025. **(B)** 0.005.
(C) 0.002. **(D)** 0.0015.

b. Apart from the preamplifier and a push-pull vertical amplifier, the parts of the vertical section of a CRO are _____.

(A) Trigger circuit and a time base generator.
(B) AC/DC coupling and an attenuator.
(C) Delay line and trigger circuit.
(D) Delay line and a time base generator.

c. Resolution is _____ whereas sensitivity is _____

(A) smallest increment in the input quantity to which the system responds, ratio of change in the output signal to the change in the input signal.
(B) Closeness with which the same quantity is measured at different times, degree of refinement with which a measured value is stated.
(C) proportionality between the input and output signals, closeness with which the same value is measured at different times.
(D) Degree of refinement with which a measured value is stated, proportionality between the input and output signals.

d. The decimal number 97 can be represented in the BCD code as _____.

(A) 0110 0001. **(B)** 1001 0110.
(C) 1110 1001. **(D)** 1001 0111.

e. In a frequency counter, the time base module resets the counter, stores the count and _____.
(A) Initialises and converts the count into a BCD number.

(B) Doubles the count as and when desired.
(C) opens the count gate and closes it .
(D) Halves the count as and when desired.

f. A phase sensitive detector is used as the demodulator in _____.

(A) AM and FM receivers. **(B)** AM and PM receivers.
(C) FM and PM receivers. **(D)** Only FM receivers.

g. The 1,2,3,4 outputs for the c
Fig.1, with inputs A=1 and l
are _____.

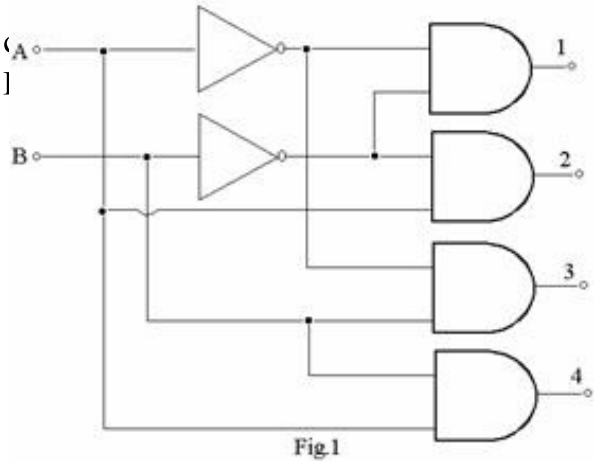

Fig.1

(A) 0,1,0,0.
(B) 1,0,0,0.
(C) 0,0,1,0.
(D) 0,0,0,1.

h. Considering a sample-and-hold circuit, the uncertainty in the time for change of state of the switch is called the _____.

(A) Quantization error. **(B)** acquisition time.
(C) holding time. **(D)** aperture time.

PART I
Answer any THREE Questions. Each question carries 14 marks.

Q.2 a. (i) Explain the terms : dynamic error, bandwidth and time constant as applied to dynamic systems. **(4)**

(ii) Distinguish between primary, secondary and working standards. **(4)**

b. What are the considerations for choosing an analog voltmeter? **(6)**

Q.3 a. Describe a wavemeter and list out its applications. **(7)**

b. Distinguish between a wavemeter and tuned harmonic analyiser. If $B_1, B_2 \ldots\ldots$ represent the amplitudes of 1^{st}, 2^{nd} …..harmonics of a waveform give an expression for the total harmonic distortion. **(7)**

Q.4 a. Describe a Q-meter that operates with series connection. **(7)**

b. An unknown coil with a resistance of 4.5 Ω is connected to the terminals of the Q-meter of Fig.2. Resonance occurs at an oscillation frequency of 5.5 MHz and a resonating capacitor of 120 PF. Discuss how an error occurs due to the insertion resistance $R_{SH} = 0.1\Omega$.
(7)

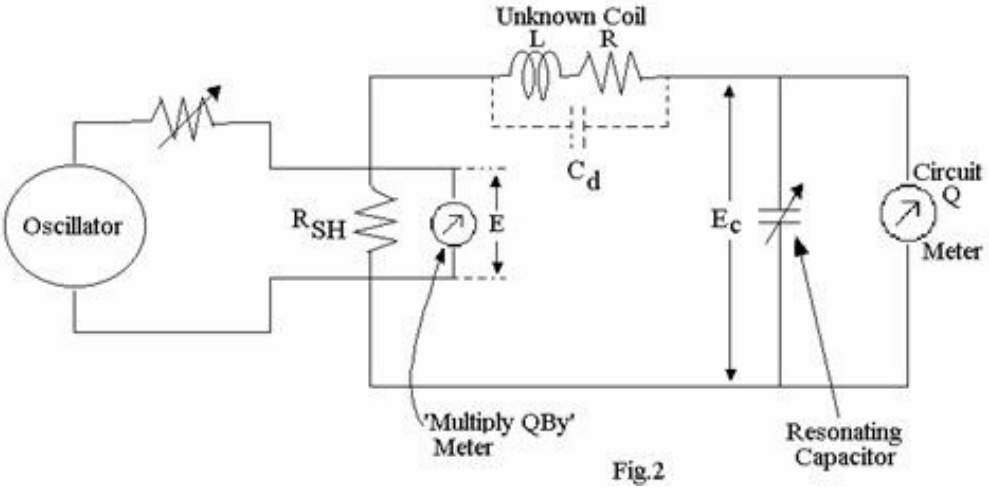

Fig.2

Q.5 a. Give the block diagram of a true-RMS reading voltmeter and explain its working principle.
(6)

b. The saw tooth wave voltage of Fig.3 is applied to an average responding a.c. voltmeter with a scale calibrated in terms of the RMS value of the sine wave. Calculate

(i) the form factor of the saw tooth wave voltage and

(ii) the percentage error in the meter indicator as compared to a sine wav

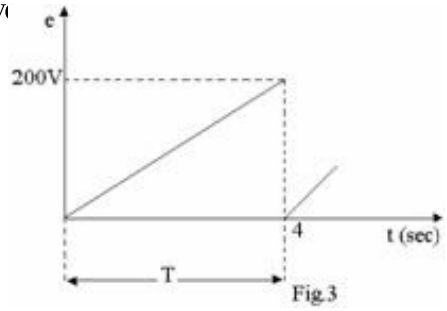

Fig.3

Q.6 a. Explain the following thermoelectric phenomena: Seebeck effect and Peltier effect. Describe a typical set-up for measuring temperature based on these effects. **(7)**

b. A resistance strain gauge is fastened to a steel member that is subjected to a stress of 1250 Kg/ cm^2 and whose modulus of elasticity is unknown. If the change in resistance of the gauge, original resistance and gauge factor are respectively 0.2 Ω, 200 Ω and 2.5, determine the modulus of elasticity of steel.
(7)

PART II

Answer any THREE Questions. Each question carries 14 marks.

Q.7 a. Describe a multiplexed A/D conversion system. Explain how the principle of multiplexing is

applied in a converter type A/D converter. **(8)**

b. Explain the operation of the simultaneous A/D converter shown in Fig.4. **(6)**

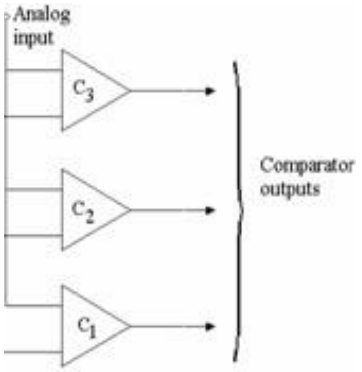

Fig.4

Q.8 a. Draw the diagram of a shaft angular encoder and give its applications. **(7)**

b. A synchro-control transformer is connected to the synchro-transmitter as shown in Fig.5. Explain working of this combination and give its applications. **(7)**

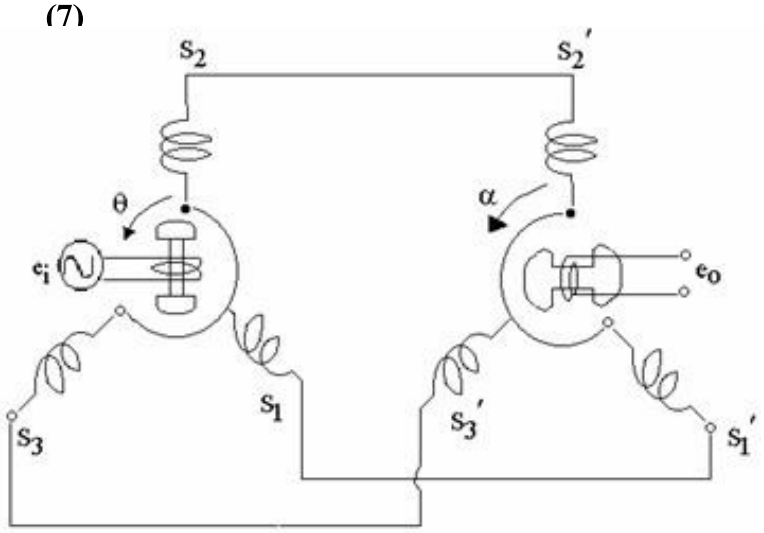

Fig.5

Q.9 a. Describe a set up for measuring phase angle and time delay measurement using a CRO. **(7)**

b. Explain the principle and describe the working of a sampling oscilloscope. **(7)**

Q.10 a. Describe a method each, for measuring (i) the sensitivity and (ii) selectivity of a receiver. **(6)**

b. In order to measure the sensitivity of a receiver by using the quieting method, the signal level required to produce 10 dB of quieting is to be determined. Assuming that the zero signal noise voltage is 6.2volts RMS, calculate the voltage that should exist where the receiver is quieted – 10 dB. **(8)**

Q.11 Write notes on any **TWO** of the following:

(i) Thermal method for measuring R.F. power.

(ii) Trigger level error in (a) time-interval and (b) period measurements.

(iii) A method for obtaining B-H curves by A.C. testing methods. **(7+7)**