Code: AE12 **Subject: INSTRUMENTATION AND MEASUREMENT**
Time: 3 Hours **Max. Marks: 100**

DECEMBER 2007

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 error due to the constant zero offset in a meter can be classified as

(A) Random error **(B)** Systematic error
(C) Standard error **(D)** Uncontrollable error

b. Kelvin bridge is used mainly for measurement of

(A) Very small values of resistances
(B) Very high values of resistances that cannot be measured by Wheatsone's bridge
(C) Inductance of transformer windings
(D) Capacitances used in tuning circuits

c. The value nearest to the resonant frequency of a Wien bridge of an audio frequency generator having its resistors of 10 KΩ each and capacitors of 0.1μF each is

(A) 15.9 Hz **(B)** 159 Hz
(C) 1.59 kHz **(D)** 15 kHz

d. The triggered horizontal sweep is a CRO is generated by

(A) Pulsing a trigger circuit manually
(B) The signal being measured
(C) A Hall probe
(D) A differentiating circuit at the signal input terminal

e. The frequency range of a frequency counter can be increased by

(A) Increasing the clock speed
(B) Increasing the number of digits in the display unit
(C) using a prescaler or divide-by-N counter
(D) An A/D converter of suitable number of output bits

f. A thermocouple RF ammeter measures a transmitter line current of 1A into a load of 50 Ω. The power delivered to the load is

(A) 50 W **(B)** 500 W
(C) 5 W **(D)** 5 mW

g. Quieting method is a technique used in

(A) AM alignment
(B) FM alignment
(C) Transmitter output impedance measurement
(D) Receiver sensitivity measurement

h. The principle of working of harmonic distortion analyzer is based on

(A) Heterodyning of two frequencies

(B) amplification of fundamental frequency
(C) Suppression of fundamental frequency
(D) Suppression of harmonics

i. Which of the following material may be used for obtaining output of electrical potential by applying the mechanical force ?

(A) Ferrite **(B)** Alloy of Rhodium and Platinum
(C) Rochelle Salt **(D)** Tungsten

j. A 12-bit successive approximation A/D converter uses a clock of 2 kHz. Its conversion time is

(A) 3.6 ns **(B)** 4.8 ms
(C) 2.4 ms **(D)** 6ms

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

Q.2 a. Distinguish between 'passive' and 'active' transducers. Give two examples of each. **(6)**

b. Explain the following terms as understood in measurement practice :
(A) Accuracy (B) Static error
(C) Repeatability (D) Uncertainty
(E) Resolution **(10)**

Q.3 a. Draw the circuit diagram of amplified current and voltage meter and describe its operation. What are its limitations? **(8)**

b. Write the circuit of Maxwell's bridge. Derive the conditions for its balance, and solve the problem given below.
A Maxwell Bridge is used to measure an inductive impedance Zx composed of Rx and Lx in series. The bridge shows balance for R1 = 450 kΩ, C1 = 0.012 μF, R2= 5 kΩ and R3= 100 kΩ. Find the values of Rx and Lx. **(8)**

Q.4 a. Explain 'indirect' method of frequency synthesis' using phase-locked loop. **(8)**

b. Write block schematic of digital frequency meter and explain its operation. **(8)**

Q.5 a. Show the circuit of a 10-to-1 probe of an oscilloscope and describe its operation. Explain the effects of incorrect setting of the probe taking the example of a fast risetime pulse. **(8)**

b. Explain how modulation characteristics of a modulated waveform may be measured using oscilloscope. **(8)**

Q.6 a. Delineate, using a circuit schematic, how hysterisis loop of a ring specimen of magnetic material can be traced using a CRO. **(8)**

b. How may the RF power be measured by measurement of load voltage? Explain by drawing a circuit scheme. **(8)**

Q.7 a. Define `sensitivity' of a receiver. Explain with diagrams, any one method of measuring receiver sensitivity. **(8)**

b. Show a set up of equipments and circuits for FM receiver sweep alignment and describe the procedure for alignment. **(8)**

Q.8 a. What is the function performed by a wave analyzer? Draw a block diagram

of heterodyning wave analyzer and explain its working. **(8)**

b. Draw a circuit of 4-bit digital-to-analog converter based on R-2R ladder network. Deduce the value of the output voltage as a fraction of the reference voltage for a digital input 0100 **(8)**

Q.9 a. Define the 'gauge factor' of a resistive strain gauge. Show a Wheatstone bridge circuitry for strain measurement with the facility for 'zero' and 'sensitivity'– adjustment, and describe its operation. **(2+6)**

b. Explain the basic principle of working of thermocouples. Give examples of at least two metal pairs useful in constructing thermocouples. **(8)**