Code: A-12   **Subject: INSTRUMENTATION AND MEASUREMENTS**

> **December 2005**

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.   A dynamic range of 60 dB indicates that the measuring system can handle a range of input signals of amplitude

     (A) 1000 to 1.   **(B)** 100 to 1.
     (C) 600 to 1.   **(D)** 60 to 1.

   b.   The analog-to-digital converter that has the least conversion time for the same number of output bit is

     (A) Ramp type   **(B)** Integrating type
     (C) Continuous balance type   **(D)** Successive approximation type

   c.   The duty-cycle of a square-wave generator is:

     (A) 20%   **(B)** 40%
     (C) 50%   **(D)** 75%

   d.   The Lissajous pattern obtained when the two frequencies are equal to each other is:

     (A) a circle   **(B)** a vertical straight line

     (C) a straight line inclined at 45° **(D)** a shape of figure '8'

   e.   A thermal RF wattmeter connected to a transmitter through an attenuator, reads 60mW. When the attenuation is 17 dB, the transmitter power is approximately

     (A) 1 W   **(B)** 2 W
     (C) 3 W   **(D)** 4 W

   f.   A ratio detector is used for

(A) Sweep alignment   (B) AM alignment
(C) Dual sweep alignment   (D) FM receiver alignment

g. Pick the false statement from the following:

(A) Semiconductor strain gauges are more temperature sensitive than metallic strain gauges.
(B) The gauge factor values of semiconductor strain gauges are quite small as compared to those of metallic strain gauges.
(C) Metallic strain gauges have positive temperature co-efficient of resistance.
(D) Semiconductor strain gauges have negative temperature coefficient of resistance.

h. The Principle of working of an electromagnetic flow meter is based on

(A) Laws of electromagnetic induction.
(B) Change of inductance of a flowing medium.
(C) Principle of magnetostriction.
(D) Modulation of conductivity by magnetism.

i. Trigger-time error in a time measuring counter system can be reduced by using _____ at the controlling gate

(A) slower rise-time input.
(B) an input as small in amplitude as possible.
(C) an input both slower in rise time and smaller in amplitude.
(D) an input with faster rise time.

j. Tachometer is used to measure the

(A) temperature of hot bodies.
(B) strain in a member under stress.
(C) angular speed of a shaft.
(D) brightness of a light source.

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

Q.2 a. Define the terms:

  (i)   Time constant.
  (ii)   Settling time.
  (iii)   Measurement lag.   **(7)**

  b. Explain the relevance of characterising electrical / electronic signal conditioners in terms of input impedance and out impedance.   **(9)**

Q.3   a.   What is a multimeter? Using simple circuit schemes, show how a wide range of d.c. voltages and resistances are measured using the meter.   **(8)**

       b.   The four arms of a bridge are:-
arm AB is 1000 Ω resistor in parallel with capacitance of 0.16 μF.
arm BC is a resistance of 1200 Ω.
arm CD is a resistance of 600 Ω.
arm DA has an unknown resistance in series with a capacitance of 0.64 μF.
Calculate the frequency at which the bridge is in balance and the value of the unknown resistance which produces the balance.   **(8)**

Q.4   a.   Explain the need for a delay line in a CRT. Mention the types of the delay line commonly used in a CRO.   **(7)**

       b.   Give the block schematic of a digital storage oscilloscope and clearly label all the blocks. Explain briefly its operation.   **(9)**

Q.5   a.   Describe with the help of a neat circuit diagram, the principle of operation of an audio-frequency signal generator.   **(8)**

       b.   Write a logic scheme for generation of time base signal for a frequency counter and explain its operation.   **(8)**

Q.6   a.   Describe the induced-emf method to measure the magnetic flux in an iron ring specimen.   **(8)**

       b.   Illustrate by drawing a neat diagram, a set-up to measure RF power by bolometer Bridge. Delineate the procedure for the measurement.   **(8)**

Q.7   a.   Describe a technique to measure the thickness of an insulating sheet in motion without making physical contact, using capacitive transducer.   **(8)**

       b.   What are 'bimorphs' and 'multimorphs'? Explain how they enable measurement of force. Show how bimorphs may be used in measurement of torque.
(8)

Q.8   a.   Draw a block schematic to illustrate the system of Heterodyne Harmonic Analyzer and describe its working.   **(8)**

b. Show a set-up for measurement of selectivity of a receiver, and delineate a procedure for the measurement.
(8)

Q.9   a.   Describe using a block schematic and timing diagrams, the operation of a successive approximation type of analog-to-digital converter.   **(10)**

b. An analog signal of 1 kHz frequency is to be converted to digital form with a resolution of 0.01% over the voltage range, zero to 10V. Find

(i)   The minimum number of output bits required.
(ii)   The analog value of the LSB.   **(6)**