**Code: A-12**                 **Subject: INSTRUMENTATION AND MEASUREMENTS**
**Time: 3 Hours**                              **June 2006**                              **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 Q meter works on the principle that_____.
   **(A)** the applied voltage is equal to the ratio of the voltage across the coil (or capacitor) and Q of the coil.
   **(B)** The applied voltage is equal to the product of the voltage across the coil (or capacitor) and Q of the coil.
   **(C)** The applied voltage is equal to the sum of the voltage across the coil (or capaitor) and Q of the coil.
   **(D)** The  Q of the coil is equal to the reciprocal of the product of the applied voltage and the voltage across the coil (or capacitor).

b.   Sensitivity is defined as _____.

   **(A)** The ratio of the change in the output signal to a change in the input quantity.
   **(B)** The  smallest increment of the input quantity to which the measuring system responds.
   **(C)** The degree of refinement with which a measured value is stated.
   **(D)** The closeness with which the same value of the input quantity is measured at different times.

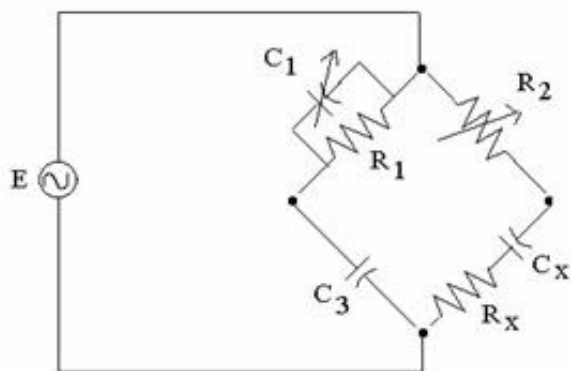c.   In the schering bridge shown in Fig. 1, the balance condition requires that



Fig.1

   **(A)** The power factor of the arms 1 and 4 should be equal.
   **(B)** The sum of the phase angles of the arms 1 and 4 should be equal to the sum of the phase angles of the arms 2 and 3.

**(C)** The ratio $\dfrac{R_1}{C_1}$ should be twice that of the ratio $\dfrac{R_2}{C_3}$.

**(D)** The product $R_2 C_3$ should be exactly equal to $10^{-3}$.

d.  The time base generator in a CRO is_____

    **(A)** To counteract the disadvantages of the signal not being applied directly to the vertical plates.
    **(B)** To deflect the spot on the screen at a constant time-dependent rate.
    **(C)** To synchronize the horizontal deflection with the vertical input.
    **(D)** To improve the linearity of the sweep produced by the UJT.

e.  If a wire type of strain gauge has gauge factor of 2.5 and a ratio $\dfrac{\Delta R}{R}$ of $0.5 \times 10^{-3}$ and the unstrained length ($\ell$) is 120 cm, then the change in length ($\Delta \ell$) is_____.

    **(A)** 0.58                   **(B)** 0.042
    **(C)** 0.024                **(D)** 0.028

f.  Among the following statements, the false statement is that given at_____.

    **(A)** The gauge factor of a semiconductor strain gauge is between 100 and 200.
    **(B)** The strain gauge can be used as a force transducer.
    **(C)** It is possible to utilize a strain gauge as a pressure pick up by connecting it between a stationary frame and a moving armature as shown in fig.2.



Fig. 2

    **(D)** It is not possible to compensate for any temperature changes when a wire type of strain gauge is used for the measurement of strain.

g.  Considering a radio receiver, for the measurement of_____, important equipment consists of an RF amplifier, an IF amplifier, a mixer, automatic gain control module, among others.

    **(A)** Sensitivity by audio power method.
    **(B)** Selectivity.
    **(C)** Sensitivity by quieting method.
    **(D)** FM receiver alignment.

h. The degree of refinement with which a measured value is stated is called the

(A) sensitivity                           (B) precision
(C) resolution                           (D) reproductively

i. In the D/A converter set up of fig 3, if the switches 1, 2 and 8 are ON and $R = 2 \text{ K } \Omega$ then $V_{out}$ will be equal to _____ volts.
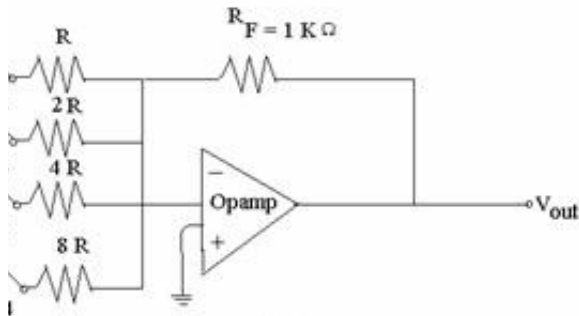


Fig. 3

(A) 4.6875                           (B) 3.8125
(C) 4.0625                           (D) 4.1625

j. In the set-up for RF power measurement using a thermal sensor, a thermal wattmeter connected as in Fig 4 reads 78 mW when 12dB attenuation is used. Then, the applied power will be nearly _____ watts
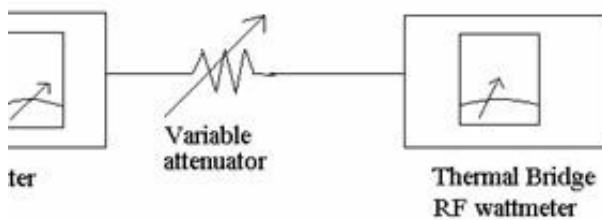


Fig. 4

(A) 1.236                           (B) 1.532
(C) 0.792                           (D) 2.250

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

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Q.2    a. Explain the significance of the characteristics: 'repeatability' and        'reproductivity' for transducers and instruments.                       **(4)**

b. Give a detailed explanation of the terms: (i) bandwidth, (ii) time constant, (iii) speed of response

and (iv)settling time, as applied to dynamic systems. **(12)**

**Q.3**  a. Give the circuit of a Wien bridge and list out its uses. What are its limitations?  **(4)**

  b. A Wien bridge has its arms as follows : AB, with a resistance 500 $\Omega$ in parallel with C=0.3183 $\mu F$ ; BC with a resistance 1000 $\Omega$, CD with a resistance 2000 $\Omega$ and DA, a capacitance 0.318 $\mu F$ in series with an unknown resistance. Find the frequency for which the bridge attains balance condition, also determine the resistance in the arm DA to produce balance. **(12)**

**Q.4**  a. Draw the block diagram of a CRO and explain the function of (i) horizontal deflecting system and (ii) trigger pulse circuit. **(10)**

  b. Draw the circuit of a delay line circuit in a CRT and explain its purpose. **(6)**

**Q.5**  a. Briefly explain the following: gross errors, systemic errors and random errors, as applied to measurements. **(6)**

  b. A resistance strain gauge with a gauge factor of 2.2 is fastened to a steel member subjected to an unknown stress measured in units of kg/cm$^2$. If the modulus of elasticity of steel is $2.05 \times 10^6$ kg/cm$^2$ and the change in resistance $\Delta R$ of the strain gauge element due to the applied stress is 0.25 $\Omega$, determine the stress of the steel member and also the strain. The unstrained resistance of the gauge element is 250$\Omega$. **(10)**

**Q.6**  Write notes on **any TWO** of the following:
  (i)  Any two techniques for extending the frequency range of the frequency counter.
  (ii)  Quantities measured in magnetism.
  (iii)  Multimeter or VOM. **(8+8)**

**Q.7**  a. What is a bolometer? How is RF power measured by the bolometer method. **(8)**

  b. It is intended to measure the sensitivity of a receiver using the quieting method. For this purpose it is required to determine the signal level required to produce 10 db of quieting. Given the zero signal output noise voltage as 5.75 volts RMS, compute the voltage that should exist when the receiver is quieted –10dB. **(8)**

**Q.8**  a. Discuss both the types of signal generator modulation. **(6)**

  b. Draw the block diagram of a fundamental suppression distortion analyser, also describe the function of each of the blocks. **(10)**

**Q.9**  a. Discuss the advantages of a successive approximation type of A/D converter over the counter-type converter. **(4)**

  b. Write notes on : (i) D/A multiplexer in which sample and hold circuits are used. (ii) Spatial encoder using a binary counting system. **(6+6)**