Subject: INSTRUMENTATION AND MEASUREMENTS

Time: 3 Hours **DECEMBER 2010** **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.**
- **The answer sheet for the Q.1 will be collected by the invigilator after half an hour of the commencement of the examination.**
- **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 the best alternative in the following: (2×10)

a. A wattmeter has a full scale range of 2500 W. It has an error ± 1% of true value. What would be range of reading if true power is 1250 W

(A) 1225 W – 1275 W **(B)** 1245 W – 1255 W
(C) 1200 W – 1300 W **(D)** 1237.5 W – 1262.5 W

b. A set of readings has a wide range and therefore, it has

(A) low precision **(B)** high precision
(C) low accuracy **(D)** high accuracy

c. The equations under balance conditions for a bridge are:

$R_1 = R_2 R_3/R_4$ and (i)
$L_1 = R_2 R_3 C_4$ (ii)

Where R_1 and L_1 are unknown resistance and inductance respectively. In order to achieve converging balance

(A) R_2 and R_3 should be chosen as variables.
(B) R_2 and C_4 should be chosen as variables.
(C) R_4 and C_4 should be chosen as variables.
(D) R_3 and C_4 should be chosen as variables.

d. The power consumption of PMMC instruments is typically about

(A) 0.25 W to 2 W **(B)** 0.25 mW to 2 mW
(C) 25 μW to 200 μW **(D)** none of the above

e. The Moving iron voltmeters indicate

(A) the same value of d.c. and a.c. voltage
(B) lower values for ac voltages than the corresponding d.c. voltages
(C) higher values for a.c. voltages than for corresponding d.c. voltages.
(D) none of the above

f. In a digital frequency meter, the schmitt trigger is used for

(A) converting sinusoidal wave into rectangular pulses
(B) scaling of sinusoidal wave forms
(C) providing time base
(D) none of the above

g. In a Q – meter, the value of shunt resistance connected across the oscillator is typically of the order of

(A) Ω
(B) n Ω
(C) μ Ω
(D) k Ω

h. A wheatstone bridge cannot be used for precision measurements because errors are introduced into, on account of

(A) resistance of connecting leads
(B) thermo-electric effect
(C) contact resistance
(D) All of the above

i. An aquadag is used in a CRO to collect

(A) primary electrons
(B) secondary emission electrons
(C) both primary and secondary emission electrons
(D) none of the above

j. X-Y recorders

(A) record one quantity with respect to another quantity
(B) record one quantity on X axis with respect to time on Y- axis
(C) record one quantity on Y- axis with respect to time on X – axis.
(D) none of the above

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

Q.2 a. Distinguish between direct and indirect methods of measurement. Give example to support your answer. **(8)**

b. Three resistors have the following ratings

$R_1 = 37\ \Omega \pm 5\%$

$R_2 = 75\ \Omega \pm 5\%$

$R_3 = 50\ \Omega \pm 5\%$

Determine the magnitude and limiting error in ohm and in percent of resistance of these resistances connected in series. **(8)**

Q.3 a. What are the different difficulties encountered in the measurement of high resistances? Explain how these difficulties are over come. **(8)**

b. An ac bridge has the following constants (refer Fig.1)

Arm AB – capacitor of 0.5μF in parallel with
1k Ω resistance
Arm AD – resistance of 2 k Ω
Arm BC – capacitor of 0.5 μF
Arm CD – unknown capacitor Cx and resistance Rx in series.
Frequency – 1 k Hz

Determine the unknown capacitance and dissipation factor **(8)**

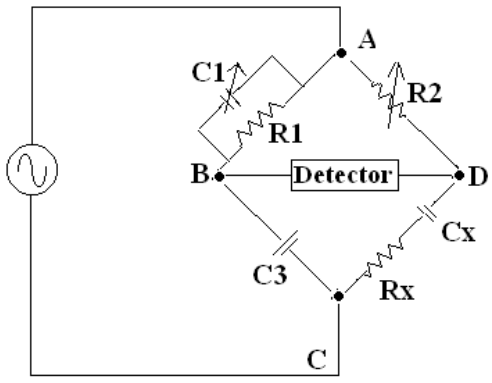

Fig.1

Q.4 a. With the help of a neat diagram explain the operation of a basic digital multimeter **(8)**

b. Explain the principle of operation of ac voltmeter using half wave rectifiers. **(8)**

Q.5 a. Discuss the merits of and limitations of DVM over an analog meter. **(8)**

b. A circuit consisting of a coil, a resistance and a variable capacitor connected in series is tuned to resonance using Q-meter. If the frequency is 500 k Hz, the resistance 0.5Ω and the variable capacitor set to 350 pF. Calculate the effective inductance and resistance of the coil, if the Q – meter indicates 90. **(8)**

Q.6 a. Draw the block diagram of a function generator and explain the method of producing sine waves. **(8)**

b. Draw the basic block diagram of an oscilloscope and explain the function of each block. **(8)**

Q.7 Write notes on any **TWO** of the following: **(8×2)**

(i) Heterodyne wave analyser
(ii) Spectrum analyser
(iii) SWR measurements

Q.8 a. What are the primary function of galvanometer recorders? **(8)**

b. Explain the working of a circular chart recorder. **(8)**

Q.9 a. Draw and describe the following for thermistors. **(8)**
(i) Resistance-temperature characteristics
(ii) Voltage-current characteristics
(iii) Current time characteristics

b. A strain gauge is bonded to a 0.1m long beam and has a cross – sectional area 4 cm^2**.** Young's modulus for steel is 207 GN/m^2. The strain gauge has an unstrained resistance of 240Ω and a gauge factor of 2.2, when a load is applied, the resistance of the gauge changes by 0.0132 Ω . Calculate the change in length of the steel beam and the amount of force applied to the beam. **(8)**