ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2007

ELECTRICAL & ELECTRONICS MEASUREMENT

SEMESTER – 3

Time : 3 Hours] [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) The high torque by weight ratio in an analog indicating instrument indicates

a) high friction loss b) low friction loss

c) slow response d) fast response. ☐

ii) Calibration of D.C. potentiometer is done with the help of standard cell of voltage

a) 1·5 V b) 1·01864 V

c) 1·001864 V d) 1·0864 V. ☐

iii) A 1 mA full scale deflection ammeter has a resistance of 100 Ω . It is to be converted to 1 A ammeter. The value of the shunt resistance is

a) 0·001 Ω b) 10000 Ω

c) 0·1001 Ω d) 100 Ω. ☐

iv) To compensate error due to pressure coil inductance in electrodynamometer wattmeter

a) a capacitor is connected across pressure coil

b) a capacitor is connected across the multiplier resistance used in pressure coil circuit

c) a capacitor is connected across multiplier resistance as well as pressure coil

d) a capacitor is connected across a portion of multiplier resistance. ☐

v) Creeping is observed in

a) watt-hourmeter b) wattmeter

c) ammeter d) power-factor meter.

vi) Horizontally mounted moving iron instruments use

a) eddy current damping b) electromagnetic damping

c) fluid friction damping d) air friction damping.

vii) Which of the following bridges is preferred for the measurement of inductance having high Q-factor ?

a) Maxwell bridge b) Hay bridge

c) Owen bridge d) De Sauty's bridge.

viii) In case of potential transformer

a) the phase angle error is always positive

b) the phase angle error is always negative

c) phase angle error is zero

d) none of these.

ix) A PMMC meter rated at 50 μA is used in a rectifier type of instrument which uses full-wave rectification. What is the sensitivity on sinusoidal A.C. ?

a) 20 kΩ/V b) 9 kΩ/V

c) 22·2 kΩ/V d) 18 kΩ/V.

x) The household energymeter is

a) an integrating instrument b) an indicating instrument

c) a recording instrument d) none of these.

xi) A current carrying conductor is shown in Fig. (a). It is brought in a magnetic field shown in Fig. (b).

Fig. (a)

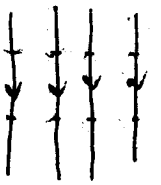

Fig. (b)

a) It will experience no force

b) It will experience a force acting from left to right

c) It will experience a force acting from right to left

d) It will experience a force acting from top to bottom.

xii) The torque produced in a wattmeter is proportional to

a) the average value of currents in two coils

b) the r.m.s. value of currents in two coils

c) the average value of supply voltage

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Show that the driving torque in a moving iron instrument is given by

$T_D = \frac{1}{2} I^2 \frac{dL}{d\theta}$, where the symbols have their usual meaning.

3. Define the terms accuracy, precision, resolution, speed of response and error.

4. Consider a 3 phase, 500 V, motor load which has a power factor of 0·4. Two wattmeters are connected to measure the power input to the motor. The input to the motor is found to be 30 kW. What are the readings of the two meters ?

5. a) What are meant by sensors and transducers ? 3

   b) What is a swamping resistor ? 2

6. How do we measure phase and frequency of a.c. quantity with the help of a CRO ?

GROUP – C

(Long Answer Type Questions)

Answer any *three* questions. $3 \times 15 = 45$

7. a) Derive the equations of balance for an Anderson's bridge. Draw the phasor diagram for condition under balance. 5 + 2

   b) The four arms of a bridge are :

   Arm *ab* : an imperfect capacitor C_1 with an equivalent series resistance of r_1

   Arm *bc* : a non-inductive resistance R_3

   Arm *cd* : a non-inductive resistance R_4

   Arm *da* : an imperfect capacitor C_2 with an equivalent series resistance of r_2, series with a resistance R_2.

   A supply of 450 Hz is given between terminals *a* and *c* and the detector is connected between *b* and *d*.

   At balance : $R_2 = 4.8\ \Omega$, $R_3 = 2\ k\Omega$, $R_4 = 2.85\ k\Omega$, $C_2 = 0.5\ \mu F$ and $r_2 = 0.4\ \Omega$.

   Calculate the values of C_1, r_1 and also calculate dissipation factor of this capacitor. Deduce the expression used. 8

8. a) Draw the equivalent circuit and phasor diagram of a current transformer. 4

   b) Derive the expression for ratio and phase angle errors. 8

   c) Explain the difference between CT and PT. 3

9. a) Draw the diagram of a laboratory type (Crompton's) d.c. potentiometer. What do you mean by standardization of potentiometer ? 6

b) How can potentiometer be used for

i) calibration of a voltmeter

ii) calibration of a wattmeter ? 6

c) In the measurement of a low resistance by means of a potentiometer, the following readings were obtained :

Voltage drop across the low resistance under test : 0.83942 volt

Voltage drop across a standard resistance connected in series with the unknown : 1.01575 volt.

If the value of the standard resistance is 0.10014 Ω, find the value of the unknown resistance. 3

10. a) Draw a neat sketch for single phase energymeter and briefly describe the working principle. 3 + 4

b) What are creeping and phantom loading ? 2 + 2

c) The meter constant of a 230 volt, 10 A wattmeter is 1800 revolutions per kWh. The meter is tested at half load and rated voltage and unity power-factor. The meter is found to make 80 revolutions in 138 sec. Determine the meter errors at half load. 4

11. Write short notes on any *two* of the following : $2 \times 7\frac{1}{2}$

a) Frequency counter

b) Digital voltmeter

c) Signal generator.

END