ELECTRICAL & ELECTRONICS MEASUREMENTS
(AEI2103)

Time Allotted : 2½ hrs   **Full Marks : 60**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

    Choose the correct alternative for the following

    (i)   A resistance of a moving coil ammeter is 30 Ω. To extend the range from 1mA to 10mA, the required value of shunt is
          (a) 5.55 Ω   (b) 7.25 Ω   (c) 4.35 Ω   (d) 3.33 Ω

    (ii) The full scale deflection current of the basic moving coil of a PMMC type voltmeter is 1 mA. The sensitivity of it is given by,
          (a) 500Ω/V   (b) 1000Ω/V   (c) 1500 Ω/V   (d) 200 Ω/V

    (iii) In a single phase induction type energy meter, for 900 revolutions of the disc energy consumed by it is 0.5 kWh. Meter constant of the energy meter is
          (a) 1000   (b) 1200   (c) 1800   (d) 850.

    (iv) An a.c. bridge 'abcd' has four impedances ab=300 Ω ∠70°, bc= 600 Ω ∠-40°, cd= 400 Ω ∠$x°$ and da = 200 Ω ∠50 and the bridge is in balanced condition. The impedance in the arm cd is
          (a) Pure resistance   (b) Impure capacitance
          (c) Impure inductance   (d) Pure inductance.

    (v)   The maximum sensitivity condition of Wheatstone bridge 'PQRS' is given by
          (a) P/Q = R/S = 2   (b) P/Q = R/S = 3
          (c) P/Q = R/S = 1   (d) P/Q = R/S = 4

    (vi) In dual trace oscilloscope, for measuring the low frequency signal the best selected mode is
          (a) Alternate mode   (b) Chop mode
          (c) Sweep mode   (d) X-Y mode.

    (vii) A 500Hz triangular wave with peak amplitude of 40V is applied to the vertical deflecting plates of a CRT. If the vertical deflection sensitivity is 0.1 cm/Volt, then the maximum vertical deflection of the electron beam in cm will be
          (a) 5 cm   (b) 3 cm   (c) 2 cm   (d) 4 cm.

(viii)   A true r.m.s thermocouple ammeter is used to measure a 10MHz sine wave and it indicates a current of 2 Amperes. The peak current in this waveform is
(a) 2 Ampere   (b) 1.52 Ampere
(c) 2.83 Ampere   (d) 20 Ampere.

(ix)   A circuit which can be used to convert a sine waveform into a pulse waveform is
(a) Non-inverting amplifier   (b) Inverting amplifier
(c) Summing amplifier   (d) Schmitt Trigger.

(x)   Which of the following is the essential part of a dual slope integrating type DVM?
(a) Differentiator   (b) Integrator
(c) Differential amplifier   (d) Summing amplifier.

Fill in the blanks with the correct word

(xi)   For a potential transformer the turns ratio is given by _____.

(xii)   Precision of an instrument is expressed in terms of _____.

(xiii)   Quality factor of a coil is 5 for the frequency of a.c. supply 1 KHz. If the resistive part of the coil is 300 Ω, then the inductance of the coil is _____.

(xiv)   Dissipation factor of an imperfect capacitor is 0.09 for the frequency of a.c. supply 500 Hz. If the resistive part of the capacitor is 4.5 Ω, then the capacitance of the impure capacitor is _____.

(xv)   Deflection factor of a CRO is expressed in _____.

Group - B

2. (a)   Find the expression of the deflecting torque for electrodynamometer type instrument.   *[(CO2)(Analyse/IOCQ)]*

  (b)   The mutual inductance of a 50 Amp electrodynamometer type ammeter changes uniformly at the rate of 0.0042µH/degree. The torque torsion constant of the control spring is 10^{-7} N-m/degree. Determine the angular deflection at full scale.   *[(CO2)(Evaluate/HOCQ)]*

  (c)   Find out the expression of shunt (R_S) to extend the range of a PMMC ammeter having internal resistance (R_m).   *[(CO2)(Analyse/IOCQ)]*

6 + 3 + 3 = 12

3. (a)   What is instrument transformer? Draw the basic circuits of it. What are the uses of it?   *[(CO2)(Remember/LOCQ)]*

  (b)   Draw the equivalent circuit of a current transformer and explain the operation of it.   *[(CO2)(Understand/LOCQ)]*

  (c)   Draw the phasor diagram of a current transformer.   *[(CO1)(Analyse/IOCQ)]*

(1 + 2 + 1) + (2 + 3) + 3 = 12

Group - C

4. (a)   Show how Kevin's Double Bridge is used to overcome the problem of Wheatstone Bridge while measuring low resistance having value less than 1Ω. *[(CO3)(Analyse/IOCQ)]*

(b) For the measurement of low resistance by Kevin's Double Bridge, the values of outer ratio arms (R_1, R_2) and inner ratio arms (a, b) are 100 Ω, 120 Ω, 100.6 Ω and 120.8 Ω respectively. The value of the standard resistance at balance is 100.06 μ Ω and the lead resistance is 500 μ Ω. Find the value of unknown low resistance. *[(CO3)(Evaluate/HOCQ)]*

(c) With the neat circuit diagram explain the measurement of high resistance by Megger. *[(CO3)(Analyse/IOCQ)]*

5 + 3 + 4 = 12

5. (a) Find the expression of self inductance along with internal resistance of an unknown coil by Maxwell's Inductance-Capacitance Bridge. How the balance of the bridge is achieved? *[(CO3)(Analyse/IOCQ)]*

(b) Draw the phasor diagram of Maxwell's Inductance-Capacitance Bridge. *[(CO3)(Understand/LOCQ)]*

(c) In an a.c. bridge 'abcd', between a & c an unknown coil along with its series resistance (r1) is connected in series with a resistance R_1. Pure resistance R_3 and R_4 are connected between b & c and c & d respectively. Between d & a, a standard variable inductance (L_2) with its series resistance (R_2) is connected. An a.c. supply is connected between a & c. At balance, $R_3 = R_4 = 110$ Ω, $L_2 = 52.8$ mH, $R_2 = 38.7$ Ω and $R_1 = 5.36$ Ω. Find the self inductance of the unknown coil along with its resistance. *[(CO3)(Evaluate/HOCQ)]*

(4 + 1) + 3 + 4 = 12

Group - D

6. (a) Draw the block diagram of sampling, storage and display unit of a digital storage oscilloscope. *[(CO5)(Remember/LOCQ)]*

(b) How an input waveform is sampled, stored and then recovered to display in a digital storage oscilloscope? *[(CO5)(Remember/LOCQ)]*

(c) With a neat diagram show how the Lissajous pattern is formed on the CRO screen if two sine waves having same peak to peak voltage, same frequency but phase difference 0° between them is applied to the vertical and horizontal deflecting plates. *[(CO5)(Analyse/IOCQ)]*

3 + 6 + 3 = 12

7. (a) Draw the block diagram and explain the operation of a swept tuned radio frequency analyzer. *[(CO4)(Analyse/IOCQ)]*

(b) What is the advantage of thermocouple type true R.M.S. voltmeter? *[(CO4)(Remember/LOCQ)]*

(c) What are the disadvantages of D.C. voltmeter while measuring low voltage? How it is overcome by chopper stabilized D.C. voltmeter? *[(CO4)(Analyse/IOCQ)]*

5 + 2 + (1 + 4) = 12

Group - E

8. (a) Draw the block diagram of a microprocessor based ramp type digital voltmeter. *[(CO6)(Remember/LOCQ)]*

(b) Explain the operation of it for measuring an analog voltage. *[(CO6)(Analyse/IOCQ)]*

(c) What are the advantages of digital voltmeter than analog voltmeter?

[(CO6)(Remember/LOCQ)]

3 + 6 + 3 = 12

9. (a) A digital frequency meter has a time base derived from a 1MHz crystal oscillator having 4 decade counters as a frequency divider. Determine the measured frequency when a 1.625 KHz sine wave is applied. *[(CO6)(Evaluate/HOCQ)]*

(b) With a neat diagram show how frequency ratio of two a.c. signals can be measured by using reciprocal counting method of digital frequency meter.

[(CO6)(Analyse/IOCQ)]

(c) What introduces error in the measurement of frequency by digital frequency meter? How can the accuracy of it be expressed? *[(CO6)(Remember/LOCQ)]*

3 + 6 + (2 + 1) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	33.33	53.13	13.54