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 any 4 (four) from Group B to E, taking one 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) 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

(ii) 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

(iii) Which of the following is known as the transfer instrument among the following indicating instruments?
(a) Moving Iron (b) Electrodynamometer
(c) Electrostatic (d) PMMC

(iv) Unknown frequency is measured by using
(a) De Sauty's Bride (b) Wien's Bridge
(c) Wheatstone Bridge (d) Kelvin's Double Bridge

(v) High resistance is measured by
(a) Megger (b) Ammeter-voltmeter method
(c) Substitution method (d) Kelvin's Bridge

(vi) An impedance has magnitude 200 Ω and phase angle 80°. The reactance of the impedance is given by
(a) 197 Ω (b) 135 Ω (c) 183 Ω (d) 127 Ω

(vii) In a CRO the brightness control is adjusted by adjusting the potential applied to the
(a) Cathode (b) First focussing anode
(c) Horizontal deflection amplifier (d) Grid

(viii) A FET input stage is used in electronic voltmeters because
(a) It provides high input impedance (b) It provides low input impedance
(c) It is cheap (d) None of these

(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) What will be the Hex code to display 'E' in the 7 segment display unit?
(a) 3F (b) 67 (c) 06 (d) 79

Fill in the blanks with the correct word

(xi) Expression of nominal ratio of a current transformer is _____.

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

(xiii) In a pure capacitance, voltage across it lags current by ___ .

(xiv) In spectrum analyzer the attenuation level of a given signal is expressed in _____.

(xv) In ramp type DVM the stop pulse for conversion is produced by _____ .

Group - B

2. (a) Show how the angular displacement of the moving system is proportional to the current through it for PMMC instrument. *[(CO2)(Analyse/IOCQ)]*
(b) What are the advantages of PMMC instrument? *[(CO1)(Remember/LOCQ)]*
(c) A PMMC instrument has a coil of dimensions 18mm x 13mm. The flux density in the air gap is 2×10^{-3} Wb/m^2 and the spring constant is 0.22×10^{-6} Nm/rad. Determine the number of turns required to produce an angular deflection of 90° when a current of 7 mA is flowing through the coil. *[(CO2)(Evaluate/HOCQ)]*

5 + 3 + 4 = 12

3. (a) Derive the expression of deflecting torque of moving iron instrument and hence comment on the nature of the scale for spring controlled instrument.
[(CO2)(Analyse/IOCQ)]
(b) The inductance of a moving iron ammeter with a full scale deflection of 90° at 1.5 A is given by
$L = (300 + 50\theta - 4\theta^2 - \theta^3)$ μH, where θ is the deflection in radian from zero position. Find out the angular deflection of the pointer for a current of 1 A.
[(CO2)(Evaluate/HOCQ)]
(c) With neat diagram show why the scale of an indicating instrument is non-linear when controlling torque is produced by gravity controlled scheme.
[(CO1)(Understand/LOCQ)]

6 + 3 + 3 = 12

Group - C

4. (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 & b 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, $R_3 = R_4 = 110\ \Omega$, $L_2 = 52.8$ mH , $R_2 = 38.7\ \Omega$ and $R_1 = 5.36\ \Omega$. Find the self inductance of the unknown coil along with its resistance. *[(CO3)(Evaluate/HOCQ)]*

(4 + 1) + 3 + 4 = 12

5. (a) Find the balance condition of an a.c. bridge having impedances Z_1, Z_2, Z_3 and Z_4 in its four arms. *[(CO3)(Analyse/IOCQ)]*

(b) An a.c. bridge 'abcd' has impedances $90\ \Omega\ \angle 20^\circ$ in ab arm, $60\ \Omega$ at bc arm, $20\ \Omega\ \angle 10^\circ$ at cd arm and $30\ \Omega\ \angle 30^\circ$ at da arm having supply voltage connected between a and c. Check whether the bridge is in balanced condition or not? *[(CO3)(Evaluate/HOCQ)]*

(c) Showing the circuit diagram of De Sauty's bridge draw the phasor diagram of it. *[(CO3)(Remember/LOCQ)]*

5 + 3 + 4 = 12

Group - D

6. (a) Using a Schmitt Trigger and ramp generator design a time base circuit for CRO. Explain the operation of it. *[(CO5)(Analyse/IOCQ)]*

(b) What is the significance of the term 'TIMES/DIV' ? *[(CO5)(Remember/LOCQ)]*

(c) How brightness of display is controlled in a cathode ray tube? *[(CO5)(Understand/LOCQ)]*

(3 + 4) + 2 + 3 = 12

7. (a) Name the different parts of the focussing section of a cathode ray tube. Explain the operation of the focussing section of it. *[(CO5)(Analyse/IOCQ)]*

(b) 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° and 90° between them is applied to the vertical and horizontal deflecting plates. *[(CO5)(Analyser/IOCQ)]*

(c) How phase difference between two sine waves is measured from the displayed Lissajous figure on the CRO screen? *[(CO5)(Understand/LOCQ)]*

(1 + 3) + 4 + 4= 12

Group - E

8. (a) Draw the block diagram of a digital frequency meter for the measurement of frequency of an ac signal. Hence show the timing diagram of it. *[(CO6)(Analyse/IOCQ)]*

(b) Explain the operation of digital frequency meter for the measurement of unknown frequency. *[(CO6)(Understand/LOCQ)]*

(c) Show the connection of time base and display unit for multiple ranges of the digital frequency meter. *[(CO6)(Remember/LOCQ)]*

(2 + 2) + 6 + 2 = 12

9. (a) Design a circuit for 3 bit successive approximation type digital voltmeter .
[(CO6)(Remember/LOCQ)]

(b) Show the steps to convert 4.9V by 3 bit approximation type DVM using necessary calculations.
[(CO6)(Analyse/IOCQ)]

(c) What is the percentage error in the measurement of 4.9 V by this DVM?
[(CO6)(Analyse/IOCQ)]

4 + 6 + 2 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	35.41	50	14.58