B.TECH/AEIE/4TH SEM/AEIE 2203/2022

ELECTRICAL AND ELECTRONIC MEASUREMENTS
(AEIE 2203)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

Group – A
(Multiple Choice Type Questions)

1.   Choose the correct alternative for the following: **10 × 1 = 10**

    (i)   An electrodynamometer type of instrument finds its major use as
        (a) standard instrument only   (b) both as standard and transfer instrument
        (c) transfer instrument only   (d) indicator-type instrument.

    (ii)   A set of reading has a wide range and therefore it has
        (a) low precision   (b) low accuracy
        (c) high precision   (d) high accuracy.

    (iii)   Energy meters do not have a control spring to
        (a) avoid unnecessary friction losses
        (b) enable continuous rotation of the disc
        (c) avoid damping during movement
        (d) all of the above.

    (iv)   Maxwell's Bridge is used for the measurement of self inductance of coils with
        (a) Low Q-factors   (b) High Q-factors
        (c) Medium Q-factors   (d) All of these.

    (v)   Schering bridge can be used for measurement of
        (a) capacitance and dissipation factor   (b) dissipation factor only
        (c) inductance with inherent loss   (d) capacitor but not dissipation factor.

    (vi)   Controlling torque in a meggar is provided by
        (a) control springs   (b) balance weights
        (c) control coil   (d) any one of the above.

    (vii)   Chopper stabilized dc amplifier type EVM overcomes the effect of
        (a) amplifier CMRR   (b) amplifier drift
        (c) amplifier sensitivity   (d) electromagnetic interference.

(viii)   The screen material of CRT is formed by the deposition of the coating of
(a) copper   (b) phosphor
(c) graphite   (d) aluminium.

(ix)   A DVM measures
(a) peak value   (b) rms value
(c) average value   (d) peak to peak value.

(x)   How many decade counters are required to get 100Hz clock signal from 1MHz crystal oscillator?
(a) 6   (b) 4   (c) 5   (d) 8.

Group- B

2.   (a)   List the errors associated with single phase induction type energy meter and the possible remedies to overcome these errors.   [(CO2)(Remember/LOCQ)]

     (b)   Define resolution of an analog instrument. A measuring instrument has a calibrated range of 10-50 mA, which has 100 divisions and can be read ½ a division correctly. Find out the resolution of that instrument.
                                     [(CO1)(Remember/LOCQ)/(Analyze/IOCQ)]

     (c)   Discuss the role of operating torques in analog indicating instruments.
                                                         [(CO2)(Evaluate/HOCQ)]
                                                         5 + (2 + 2) + 3 = 12

3.   (a)   Define accuracy and precision. A 0-25 A ammeter has a guaranteed accuracy of 1 percent of full scale reading. The current measured by this instrument is 10 A. Determine the limiting error in percentage.
                                     [(CO1)(Remember/LOCQ)/(Analyze/IOCQ)]

     (b)   Describe the working principle and constructional details of an attraction-type moving iron instrument.   [(CO2)(Understand/LOCQ)]
                                                         (4 + 2) + 6 = 12

Group - C

4.   (a)   A voltmeter of resistance 600 Ω and a miliammeter of 0.8 Ω resistances are used to measure two unknown resistances by voltmeter-ammeter method. If the voltmeter reads 40 V and miliammeter reads 120 mA in both cases, calculate the percentage error in the values of measured resistances if
          (i)   In the first case, the voltmeter is put across the unknown resistance and the miliammeter connected in series with the supply
          (ii) In the second case, the voltmeter is connected in the supply side and the miliammeter connected directly in series with the unknown resistance.
                Justify the selection of the above methods for medium resistance measurement.   [(CO3)(Analyse/IOCQ)/(Evaluate/HOCQ)]

     (b)   Discuss the advantages and disadvantages of Maxwell's bridge for measurement of unknown inductance.   [(CO3)(Evaluate/HOCQ)]
                                                         (3 + 3 + 3) + 3 = 12

5. (a) Describe with suitable schematic diagrams, the Murray loop test for localization of earth fault in low voltage cables. [(CO3)(Understand/LOCQ)]

   (b) An ac bridge is configured as follows:
   Arm AB : A resistance of 600 Ω in parallel with a capacitance of 0.3 μF
   Arm BC : An unknown non-inductive resistance
   Arm CD : A noninductive resistance of 1000 Ω
   Arm DA : A resistance of 400 Ω in series with a capacitance of 0.1 μF
   If a supply is given between terminals A and C and the detector is connected between nodes B and D, calculate the resistance required in the arm BC and also the supply frequency for the bridge to be balanced. [(CO3)(Analyse/IOCQ)]

   (c) With neat diagram, explain the loss of charge method for measurement of high resistance. [(CO3)(Understand/LOCQ)]

   4 + (2 + 2) + 4 = 12

Group - D

6. (a) An emitter-follower voltmeter circuit using two transistors has 3.9 kΩ resistances connected to emitters of two transistors. The transistors are biased with V_{cc} = ±12 Volts. Determine emitter currents when input voltage is zero. Also calculate the meter circuit voltage when input voltages are 1 Volt and 0.5 Volts. [(CO4)(Analyze/IOCQ)]

   (b) A ±20 V, 250 Hz triangular wave is applied to the vertical deflecting plates of a CRT, and a ±25 V, 125 Hz sawtooth wave is applied to the horizontal deflecting plates. The CRT has a 0.2 cm/V vertical deflection sensitivity and a 0.16 cm/V horizontal deflection sensitivity. Assuming that the two inputs are synchronized, construct the waveform displayed on the screen. [(CO5)(Analyze/IOCQ)]

   6 + 6 = 12

7. (a) Draw the block diagram of automatic time base of CRO. If the input to the vertical deflection amplifier is a sine wave then draw the outputs at each stages of the time base. [(CO5)(Apply/IOCQ)]

   (b) Discuss the use of blanking circuit and hold-off circuit in a CRO. [(CO5)(Evaluate/HOCQ)]

   6 + 6 = 12

Group - E

8. (a) A 3½ digit seven segment LED display uses diodes that require a 15 mA forward current. Calculate the total supply current required. Determine the supply current required for a similar LCD display that uses 10 μA per segment. [(CO6)(Analyze/IOCQ)]

   (b) With neat sketch, explain the operation of ramp type DVM. [(CO6)(Understand/LOCQ)]

   (c) Compare between common cathode and common anode seven segment displays. [(CO6)(Analyze/IOCQ)]

   (2 + 2) + 6 + 2 = 12

9. (a) Design a 3-bit successive approximation type digital voltmeter for measurement of an input analog dc voltage of 3.9 volt. [(CO6)(Design/HOCQ)]
   (b) With neat sketch describe the function of dual slope integrating type digital voltmeters. [(CO6)(Understand/LOCQ)]

7 + 5 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	35.42	41.66	22.92

Course Outcome (CO):

After the completion of the course students will be able to:
1. Define and understand the static and dynamic characteristics of measuring instruments.
2. Compare among the operation of measuring instruments and choose the suitable one for measurement of electrical quantities.
3. Apply appropriate method/instrument for measurement of resistance, capacitance, inductance and quality factor of coil & capacitor.
4. Recognize suitable electronic instrument for measurement of voltage, current, frequency/phase.
5. Explain the construction and working principle of cathode ray tube, oscilloscope time base, CRO probes & dual trace oscilloscope and describe their applications.
6. Analyze the working principles of digital voltmeters, digital frequency meter and digital display units.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question