FUNDAMENTALS OF ELECTRONIC MEASUREMENTS
(AEIE 3222)

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

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   Frequency can be measured by using
              (a) Wien bridge   (b) Schering bridge
              (c) Maxwell bridge   (d) Anderson bridge.

    (ii)   The Ac Bridge used for the measurement of medium Q coil of inductance is/are
              (a) Maxwell's inductance bridge   (b) Schering bridge
              (c) Anderson's bridge   (d) All of these

    (iii)   For a 1000 µA movement with $R_m = 100\ \Omega$, its voltage V_m at full-scale deflection is
              (a) 250 micro volt   (b) 0.1 Volt   (c) 0.2 Volt   (d) 0.5 Volt.

    (iv)   What is the relation between Q factor and dissipation factor D?
              (a) QD = 1   (b) Q/D = 1   (c) D/Q = 1   (d) No relation

    (v)   In CRT the focusing anode is located
              (a) between pre-accelerating and accelerating anodes
              (b) after accelerating anodes
              (c) before pre-accelerating
              (d) none of the above.

    (vi)   A square wave oscillator has f_o =1kHz. Assume the resistor value to be 10kΩ and find the capacitor value?
              (a) 3.9 µF   (b) 0.3 µF   (c) 2 µF   (d) 0.05 µF.

    (vii)   Under balanced condition, the current flowing through the detector voltage across the two ends of detector are equal to
              (a) infinity voltage and zero current
              (b) infinity current and zero voltage
              (c) zero voltage and zero current
              (d) infinity voltage and infinity current.

(viii) A voltmeter uses a meter with full scale = 2 mA. Its sensitivity is
     (a) 500 ohm/V   (b) 500 V/ohm
     (c) 2000 ohm/V   (d) 2000 V/ohm .

(ix) Triangular wave form has
     (a) Rise time < fall time   (b) Rise time = fall time
     (c) Rise time ≥ fall time   (d) None of the mentioned

(x) AC bridge is an outcome of _____
     (a) Kelvin bridge   (b) Megger
     (c) De Sauty bridge   (d) Wheatstone bridge.

Group- B

2. (a) Draw the circuit diagram of a full-wave rectifier voltmeter. Explain this circuit with necessary circuit analysis.   [(CO2)(Remember/LOCQ)]

   (b) A PMMC instrument with FSD = 100 μA and R_m = 1kΩ is to be connected as an ac voltmeter with FSD 100V rms. Silicon diodes are used in question (a) circuit. Calculate the multiplier resistance value required to design this rectifier circuit.
                                                    [(CO2)(Analyse/IOCQ)]

   (c) What is the difference between precision and accuracy?
                                         [(CO1)(Understand/LOCQ)]
                                          (2 + 2) + 6 + 2 = 12

3. (a) Sketch the circuit of one transistor based emitter-follower voltmeter. Explain the circuit Operation.   [(CO2)(Remember/LOCQ)]

   (b) In the above emitter-follower voltmeter circuit has V_{cc} = 20V, R_m+ R_s = 10kΩ, I_m = 1 μA at the full scale and I_B = 10μA.
     (i) Determine the corresponding emitter current, when E = 10V.
     (ii)Calculate the input resistance with and without transistor.
                                                  [(CO2)(Solve/IOCQ)]

   (c) In the above circuit, how input resistance can be improved?
                                          [(CO2)(Understand/LOCQ)]
                                          (2 + 4) + 4 + 2 = 12

Group - C

4. (a) Draw the circuit diagram of an Anderson Bridge.   [(CO3)(Remember/LOCQ)]
   (b) Derive the balance condition for the Anderson Bridge.   [(CO3)(Analyze/LOCQ)]
   (c) If the all resistors are R = 400 Ω, r = 500 Ω and C = 2 μF. Calculate inductive branch components in circuit question (a).   [(CO3)(Solve/IOCQ)]
                                                      3 + 6 + 3 = 12

5. (a) Derive the equation to convert a series RC circuit into its equivalent parallel circuit.   [(CO3)(Understand/LOCQ)]
   (b) An unknown circuit behaves as a 0.005 μF capacitor in series with a 8KΩ resistor when measured at frequency of 1 kHz. The terminal resistance is

measured by an ohmmeter as 134 KΩ. Determine the actual circuit components and method of connection. [(CO3)(Analyze/IOCQ)]

(c) What do you mean by 'D' factor of the capacitor for parallel and series connection? [(CO3)(Understand/LOCQ)]

5 + 5 + 2 = 12

Group - D

6. (a) Sketch the proper circuit diagram of deflection amplifier of an oscilloscope with an input attenuator. [(CO4)(Remember/LOCQ)]

(b) Carefully explain the circuit diagram. [(CO4)(Remember/LOCQ)]

(c) Discuss the factors affecting the brightness of the CRO display. [(CO4)(Understand/LOCQ)]

4 + 4 + 4 = 12

7. (a) Suppose you have a CRO. What will be the phase difference between input signal and output signal if the maximum peaks of the two are at 2.5 ms and 3.625 ms for 100Hz signal frequency? [(CO4)(Solve/IOCQ)]

(b) Draw the block diagram of a dual trace oscilloscope. [(CO4)(Remember/LOCQ)]

(c) What are the advantages of DSO? [(CO4)(Remember/LOCQ)]
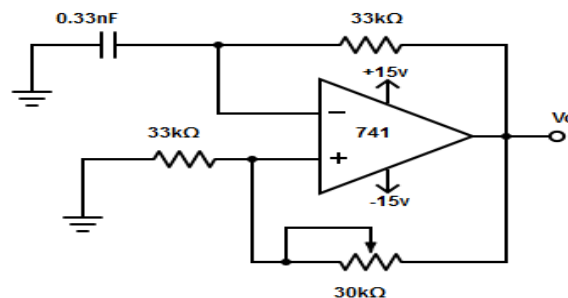
3 + 5 + 4 = 12

Group - E

8. (a) Draw the circuit diagram of a square waveform using Schmitt trigger. What do you mean by UTV and LTV? [(CO5)(Remember/LOCQ)]

(b) Explain the operation with necessary plot if a sine wave is applied at the inverting input of the Op-amp. [(CO5)(Understand/LOCQ)]

(c) What are advantages of DAS? [(CO6)(Remember/LOCQ)]

(2 + 2) + 6 + 2 = 12

9. (a)

Derive the output frequency of the above circuit diagram. [(CO5)(Solve/IOCQ)]

(b) Draw the output waveform and capacitor voltage on the same plot. [(CO5)(Analyse/IOCQ)]

(c) Design and redraw the circuit in question (a) for the 50% duty cycle and frequency of oscillation is 10 kHz. [(CO5)(Design/HOCQ)]

4 + 2 + (4 + 2) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	65.62	28.13	6.25

Course Outcome (CO):

After the completion of the course, the students will be able to:
1. Familiar with the basic characteristics of a measurement system.
2. Understand the circuit and operations for the measurement of electronic meters.
3. Use AC and DC bridges and apply the knowledge for relevant parameter measurement.
4. Learn the operation and construction of CRO and other special type Oscilloscopes and their applications.
5. Know the principle and functions of signal Generator and spectrum analyzers.
6. Get the basic knowledge about single and multichannel DAS.

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