

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
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) Kelvin double bridge is used to measure
(a) high frequency (b) medium frequency
(c) very low frequency (d) very high frequency.
 - (ii) Out of the following which one is a inverse transducer?
(a) Piezoresistive (b) Thermistor (c) LVDT (d) Piezoelectric.
 - (iii) If an instrument can measure 300-1500 units, now this instrument to be calibrated in 4 mA – 20 mA. What is the value of current if it is at 1200 units?
(a) 4 mA (b) 8 mA (c) 12 mA (d) 16 mA.
 - (iv) Full form of SCADA is
(a) Super Computer And Data Analysis
(b) Supervisory Control And Data Acquisition
(c) Supervisory Complex And Data Acquisition
(d) Super Complex And Data Analysis.
 - (v) If a measurement data are around a fixed measured data but all are far from true value. Then
(a) high accuracy and high resolution
(b) high accuracy and high precision
(c) low accuracy and high precision
(d) low accuracy and low precision.
 - (vi) A free running oscillator has $f_0 = 10\text{kHz}$. Assume the resistor value to be $10\text{k}\Omega$ and find the capacitor value?
(a) 3 nF (b) 5 nF (c) 10 nF (d) 50 nF.
 - (vii) Let assume $\theta_1=30^\circ$, $\theta_2=30^\circ$, $\theta_3=60^\circ$, $\theta_4=90^\circ$ are the calculated angle for the respective arm of AC bridge with same amplitude. Under balanced condition, amount of angle is required to make them balance
(a) 30° (b) -30° (c) 0° (d) 90° .

- (viii) Noise signal reduction is possible with
(a) comparator (b) integrator
(c) Schmitt trigger (d) differentiator.
- (ix) In case of CRO grid potential is used to control
(a) movement in horizontal direction (b) movement in vertical direction
(c) brightness (d) both (a) and (b).
- (x) Saw tooth wave form has
(a) Rise time < fall time (b) Rise time = fall time
(c) Rise time $\geq$ fall time (d) None of the mentioned.

Group - B

2. (a) Draw circuit diagram of an electronic linear ohmmeter. Explain. *[[CO2] (Remember/LOCQ)]*
(b) A PMMC instrument with FSD = 100 μ A and $R_m=1000 \Omega$ is to be converted into Voltmeter. Determine the required multiplier resistance if the voltmeter is to measure 40 volt at full scale. Also calculate input voltage if the instrument indicate 0.8, 0.5, and 0.1 of FSD reading. *[[CO2] (solve/IOCQ)]*
(c) Write down different static and dynamic characteristics of an electronic measurement system. *[[CO1] (Understand/LOCQ)]*
4 + 4 + 4 = 12
3. (a) Sketch the complete circuit of an Electronic voltmeter using OPAMP and others necessary components. Carefully explain the circuit operation. *[[CO2] (Remember/LOCQ)]*
(b) Sketch the circuit of one transistor based emitter-follower voltmeter. Explain the circuit operation. *[[CO2] (Understand/LOCQ)]*
(c) In the above emitter-follower voltmeter circuit has $V_{cc}=30$ V, $R_m + R_s = 20$ k Ω , $I_m=5$ μ A at the full scale and $I_B= 20$ μ A.
(i) Determine the corresponding emitter current, when $E=12$ V
(ii) Calculate the input resistance with and without a transistor. *[[CO2] (Analyse/IOCQ)]*
4 + (2 + 2) + 4 = 12

Group - C

4. (a) Draw the circuit diagram of an AC Bridge where accurate self inductance of an unknown coil is measured. Write the necessary equations. *[[CO3] (Remember/LOCQ)]*
(b) Derive the expression of self inductance and quality factor when the AC Bridge is balanced. *[[CO3] (Analyse/LOCQ)]*
(c) Explain AC bridge balance using magnitude and phase of the respective signals. *[[CO3] (Analyse/IOCQ)]*
4 + 4 + 4 = 12
5. (a) Derive a mathematical expression to convert a series RC circuit into its equivalent parallel circuit. *[[CO3] (Understand/LOCQ)]*

- (b) An unknown circuit behaves as a $0.005 \mu\text{F}$ capacitor in series with a $8 \text{ k}\Omega$ resistor when measured at frequency of 1 kHz . The terminal resistance is measured by an ohmmeter as $134 \text{ k}\Omega$. Determine the actual circuit components and method of connection. [[CO3] (Analyze/IOCQ)]
- (c) Discuss the advantages of bridge circuit over potential divider circuit. (Use circuit analysis) [[CO3] (Evaluate/HOCQ)]

4 + 4 + 4 = 12**Group - D**

6. (a) Draw the basic block diagram of a CRT. [[CO4] (Remember/LOCQ)]
- (b) Carefully explain the operation of a sweep generator circuit of CRO. [[CO4] (Understand /LOCQ)]
- (c) Derive an expression of the amount of deflection of electron inside the CRT. [[CO4] [(Remember/LOCQ)]]

4 + 4 + 4 = 12

7. (a) Determine the velocity of the electron beam in an oscilloscope when the voltage is applied to its accelerating anode is 2500 V . [[CO4] (Analyse /IOCQ)]
- (b) Briefly describe the different types of the Oscilloscope probes. [[CO4] (Understand/LOCQ)]
- (c) Sketch the block diagram of an automatic time base circuit for an oscilloscope. [[CO4] (Remember/LOCQ)]

4 + 4 + 4 = 12**Group - E**

8. (a) Draw the circuit diagram of a signal conditioning circuit diagram with active sensor using an Instrumentation amplifier. [[CO5] (Design/HOCQ)]
- (b) Hence find the output voltage of the last part of the designed SCC in terms of input as question in above (a). [[CO5] [(Analysis/LOCQ)]]
- (c) Draw the basic block diagram of a 4 channel DAS? Differentiate time division multiplexing and frequency division multiplexing for data transmission. [[CO6] (Remember/LOCQ)]

4 + 4 + 4 = 12

9. (a) Draw the basic block diagram of a DAS using digital multiplexor. [[CO6](Remember/LOCQ)]
- (b) Design a 50% duty based free running oscillator with frequency 20 kHz . [[CO5] (Design/HOCQ)]
- (c) Draw and explain the triangular wave generator circuit diagram. [[CO5] (Analyse/IOCQ)]

4 + 4 + 4 = 12

<i>Cognition Level</i>	<i>LOCQ</i>	<i>IOCQ</i>	<i>HOCQ</i>
<i>Percentage distribution</i>	62.5	25	12.5

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.*