

## Sample questions

### Electrical & Electronic Measurement (EE402)

#### Multiple choice questions:

1. Tick the correct alternative:
  - i. The internal resistance of an ideal voltmeter & a practical ammeter will be:
    - a. Infinite  $\Omega$ ,  $0\Omega$
    - b. Few hundred  $M\Omega$ ,  $0\Omega$
    - c. Few  $G\Omega$ , Fraction of  $\Omega$
    - d. Infinite  $\Omega$ , Fraction of  $\Omega$
  - ii. Which type of instrument is preferred for power measurement?
    - a. MI instruments
    - b. PMMC instruments
    - c. Dynamometer instruments
    - d. Electrostatic instruments
  - iii. Wheatstone bridge was developed for the measurement of:
    - a. High resistance
    - b. Medium resistance
    - c. Low resistance
    - d. All of these
  - iv. \_\_\_\_\_ is the minimum change in the measuring quantity which can be detected by any measuring instrument.
    - a. Sensitivity
    - b. Accuracy
    - c. Resolution
    - d. Repeatability
  - v. In an indicating instrument, the pointer moves around the final steady point with decreasing deflection & require some time to settle down. It may be due to:
    - a. Zero damping
    - b. Under damping
    - c. Critical damping
    - d. Over damping
  - vi. A group of students had measured a resistance 25 times by a measuring instrument & computed the mean, average deviation & standard deviation of the obtained reading. Later it was found that due to meter inaccuracy, the measured value was 2% less than the actual value. Which of the following will vary when the readings are added with  $(0.02 \times \text{Actual resistance}) \Omega$ .
    - a. Mean
    - b. Average deviation
    - c. Standard deviation
    - d. All of these
  - vii. A 0-200V PMMC voltmeter does not have any controlling mechanism. What will be the pointer reading if a voltage of 50V is applied across it?
    - a. 200V
    - b. 50V
    - c. No pointer movement
    - d. None of the above
  - viii. The standardized output of CT & PT in modern power system is:
    - a. 10A, 110V
    - b. 1A, 110V
    - c. 5A, 110V
    - d. 2.5A, 110V
  - ix. For an instrument, static sensitivity means:
    - a.  $\frac{\text{Infinitesimal change in output}}{\text{Infinitesimal change in input}}$
    - b.  $\frac{\text{Infinitesimal change in input}}{\text{Infinitesimal change in output}}$
    - c.  $\frac{\text{Output function in } s\text{-domain}}{\text{Input function in } s\text{-domain}}$
    - d.  $\frac{\text{Input function in } s\text{-domain}}{\text{Output function in } s\text{-domain}}$
  - x. Electrostatic instruments are generally used for:
    - a. Voltage measurement
    - b. Current measurement
    - c. Power measurement
    - d. Any of these
  - xi. In a measurement system, modifying input is the input which:
    - a. Changes the input-output relationship for desired input only
    - b. Changes the input-output relationship for interfering input only

- c. Changes the input-output relationship for both desired & interfering input  
d. None of these
- xii. In high resistances, guard terminal is used to:
- |                                |                               |
|--------------------------------|-------------------------------|
| a. Bypass leakage current      | c. Avoid stray magnetic field |
| b. Provide mechanical strength | d. All of these               |
- xiii. Which of the following temperature sensor has a linear response:
- |                 |              |
|-----------------|--------------|
| a. Thermocouple | c. RTD       |
| b. Thermistor   | d. IC sensor |
- xiv. In CT, primary winding current depends upon:
- Secondary winding burden of transformer
  - Voltage developed across secondary
  - Load current for which CT is installed
  - All of these
- xv. While measuring power factor of a balanced load by 2 wattmeter method of 3- $\Phi$  power measurement, it was found that one wattmeter is giving negative value. For measuring the magnitude of this power, which of the following is preferred:
- Interchanging the terminal connections of PC
  - Interchanging the terminal connections of CC
  - Interchanging the terminal connections of either PC or CC
  - Interchanging the terminal connections of both PC & CC
- xvi. Sampling oscilloscope is used for:
- Visualizing high frequency transient waveform
  - Visualizing low frequency transient waveform
  - Visualizing low frequency non-transient waveform
  - Visualizing high frequency non-transient waveform
- xvii. Which of the following is true for PMMC type instruments?
- |                                |  |
|--------------------------------|--|
| a. Operate only with DC supply | c. Generally provided with electromagnetic damping |
| b. Sensitivity is high         | d. All of these                                    |
- xviii. Standardization of AC potentiometer can be done by:
- Using standard AC sources directly
  - Using standard DC sources & d'Arsonval galvanometer
  - Using standard DC sources & transfer instruments
  - Using standard AC sources & transfer instruments
- xix. In a 1- $\Phi$  energy-meter, creeping may be due to:
- |                                  |                 |
|----------------------------------|-----------------|
| a. Overcompensation for friction | c. Vibrations   |
| b. Overvoltage                   | d. All of these |
- xx. In comparison to deflection type instruments, null type instruments have:
- |                      |                       |
|----------------------|-----------------------|
| a. Sluggish response | c. Higher sensitivity |
| b. Higher accuracy   | d. All of these       |
- xxi. If  $y = (a-b)$ , then  $\frac{\delta y}{y}$  equals:
- |   |   |
|---|---|
| a. $\pm \left( \frac{a}{y} \cdot \frac{\delta a}{a} + \frac{b}{y} \cdot \frac{\delta b}{b} \right)$ | c. $\pm \left( \frac{\delta a}{y} + \frac{\delta b}{y} \right)$ |
| b. $\pm \left( \frac{\delta a}{a} + \frac{\delta b}{b} \right)$                                     | d. None of these  |
- xxii. Which of the following is particularly used for voltage measurement:

- a. MI instruments  
b. Hot wire instrument
- xxiii. Which of the following have a linear scale:  
e. MI instruments  
f. PMMC instruments
- xxiv. Which of the following is true about rectifier type instruments?  
a. Higher sensitivity than MI & Electrodynamometer  
b. Scale is calibrated for RMS value  
c. Linear scale  
d. All of these
- xxv. For CT, percentage ratio error is expressed as:  
a.  $\frac{K_n - R}{R} \times 100$   
b.  $\frac{R - K_n}{R} \times 100$   
c.  $\frac{K_n - R}{K_n} \times 100$   
d.  $\frac{R - K_n}{K_n} \times 100$
- xxvi. The no. of significant digits in  $5.01 \times 10^4$  is:  
a. 2  
b. 3  
c. 4  
d. 5
- xxvii. A Transducer is used for the conversion of:  
a. One form of energy to another form  
b. Mechanical energy to electrical energy  
c. Heat energy to chemical energy  
d. Any form of energy to electrical energy
- xxviii. Gravity control can be used in:  
a. Horizontally mounted instruments  
b. Vertically mounted instruments  
c. Instrument tilted at any angle  
d. All of these
- xxix. Which is the most effective damping?  
a. Air friction damping  
b. Fluid friction damping  
c. Eddy current damping  
d. Electromagnetic damping
- xxx. LVDT stands for:  
a. Linear Variable Differential Transducer  
b. Linear Variable Differential Transformer  
c. Light Variable Differential Transducer  
d. Length Variable Differential Transformer
- xxxi. Which of the following condition are avoided in C.T.?  
a. Short circuiting CT secondary  
b. Open circuiting CT secondary  
c. Inductive load is applied to CT secondary  
d. Capacitive load is applied to CT secondary
- xxxii. In energy meter, 'Shading band' is used for:  
a. Producing rotational magnetic field  
b. Lag adjustment  
c. Avoiding saturation of shunt magnet  
d. All of these
- xxxiii. Which of the following methods are not employed for measuring high resistances?  
a. Megger  
b. Megaohm bridge  
c. Carey- Foster slide wire bridge  
d. Both (b) & (c)
- c. Dynamometer instruments  
d. Electrostatic instruments  
g. Dynamometer instruments  
h. Electrostatic instruments

- xxxiv. Which of the following is true for RTD:
- Passive sensor
  - Temperature sensor
  - Resistive sensor
  - All of these
- xxxv. Conditioning of the signal output of primary sensing element is done for
- Amplifying or attenuating the signal
  - Conversion of the signal to suitable form without losing the information of original signal
  - Reducing the ripple content of the signal
  - Both (a) & (b)
- xxxvi. Drysdale phase-shifting transformer is used for:
- Phase shifting in energy meters
  - Measuring phase angle of unknown emf wrt current flowing due to it
  - Measuring phase angle of unknown emf wrt supply voltage
  - Both (b) & (c)
- xxxvii. For displaying a signal in CRT, the signal applied to its horizontal plates is:
- Ramp signal
  - LV sinusoidal signal
  - Square signal
  - Any of these
- xxxviii. During sampling any signal, it is converted to:
- Analog value to the corresponding digital value
  - Continuous time signal to discrete time signal
  - Discrete time signal to digital signal
  - None of these
- xxxix. In a potentiometer, unknown voltage measurement is done by:
- Comparing with a standard voltage source
  - Directly from scale
  - Both of these
  - None of these
- xl. Which type of damping is preferred in electro-dynamometer type instruments?
- Air friction damping
  - Eddy current damping
  - Electromagnetic damping
  - Any of these

**Short answer type questions:**

- Explain indicating, recording & integrating type instrument. Differentiate between direct measuring & comparison instrument.
- Differentiate between spring & gravity control of indicating type instrument.
- Why knife edge type pointer is usually preferred in portable instruments? Why eddy current damping is not preferred in electro-dynamometer type instruments?
- Prove that gravity control instruments will have a non-linear scale.
- Show that PMMC type instruments will have a linear scale.
- Explain the operation of attraction type MI instruments.
- What is loading effect of any measuring instrument? Explain with suitable example.
- What is meant by extension of instrument range? Differentiate between shunt & multiplier.
- What is meant by standardization of instrument transformers? Differentiate between CT & PT.
- A circuit was tuned for resonance by ten different students & their values in Hz are 1010, 990, 1010, 975, 1000, 1020, 975, 995, 985 & 1015. Determine: (a) Arithmetic mean; (b) Deviations from mean; (c) Average deviation; (d) Standard deviation & (e) Variance.
- Show that for a given set of data, if all elements vary by a small value (say dx), the standard deviation remains unchanged but arithmetic mean varies by dx.

12. Discuss the operating principle of electrostatic type instruments.
13. Define accuracy & precision. How 'Accuracy as a percentage of scale range' is different from 'Accuracy as a percentage of true value'?
14. Draw the equivalent circuit of a potential transformer.
15. Why CT & PT are termed as instrument transformers? What are the different advantages of instrument transformers?
16. Explain the construction of electro-dynamometer type wattmeter.
17. Explain how reactive power of a 3- $\Phi$  balanced load can be computed by using one wattmeter.
18. Briefly discuss 'Induction type energy meters'.
19. Explain the condition of balance of Owen's bridge.
20. What is meant by standardization of potentiometer? Draw the necessary arrangement for calibrating an ammeter using potentiometer.
21. How self reactance of a coil can be measured by using AC potentiometer.
22. Define meter constant of an energy meter. How light load or friction compensation is provided in an energy meter?
23. Draw the necessary arrangement of measuring 1- $\Phi$  power by using instrument transformers. For a three element integrating energy meter, meter constant is 0.12 revolutions/ kWh. If the meter is used with a PT of 22/0.11kV & CT of 500/5A, determine the percentage error for the given test figures for the instrument. Line voltage= 120V; Current= 5.5A; pf= unity; In 1.5 minutes, the meter completes 68 revolutions.
24. What is meant by leakage current in insulators? What is its effect in high resistance measurement? How this problem is eliminated?
25. Why CT should never be open circuited under normal system operation? What are its consequences?
26. Which type of waveform is applied across the horizontal plates of the CRT? What is the role of vertical & horizontal amplifier in CRO?
27. Why DSO is superior over its analog counterpart. Draw the necessary block diagram of DSO.
28. What are the advantages of digital meter over analog meter? What is sampling of a signal? What is the role of Sample & Hold circuit?
29. Draw & explain the block diagram of a digital multimeter.
30. Differentiate between sensors & transducers. Define active & passive transducer with necessary examples.

#### Long answer type questions:

1. What are the various operating forces required for the satisfactory operation of any indicating instrument? What are the different damping mechanisms available for indicating type instruments?
2. Explain the principle of operation of PMMC type instrument. How is it different from rectifier type instrument?
3. Show that the deflection torque experienced in a electro-dynamometer type instruments will be proportional to the amount of current passing through CC & PC. Whether the PC & CC of electro-dynamometer type wattmeter are identical?
4. How repulsion type MI instruments are classified? Differentiate between them with necessary diagrams. Derive the torque equation of MI instruments.
5. Derive the expression of ratio & phase angle error in CT.
6. Derive the expression of ratio & phase angle error in PT.

7. What is 'Phantom loading'? A 220V, 5A DC energy meter is tested at its marked ratings. If the resistance of pressure coil & current coil be  $800\Omega$  &  $0.7\Omega$  respectively, show that the power consumption is 35.5W if the current coil is excited by a 6V battery (i.e. Phantom loading).
8. Show that the scale of electro-dynamometer type wattmeter will be linear provided that  $dM/d\theta$  is constant over the region. What is ratio correction factor in a wattmeter?
9. How power can be measured by using instrument transformers? Draw the necessary phasor diagram & deduce the relationship between measured power & wattmeter reading.
10. Derive the condition of balance and phasor diagram of Schering bridge. A bridge comprises of the following:
  - a. Arm AB: A choke with resistance  $R_1$  &  $L_1$ .
  - b. Arm BC: A non-inductive resistor,  $R_3=750\Omega$
  - c. Arm CD: A mica capacitor  $C_4=0.35\mu\text{F}$  & internal series resistance  $r_4=0.4\Omega$  connected in series with a non-inductive resistor  $R_4=64.5\Omega$ .
  - d. Arm DA: A non-inductive resistor  $R_2=2.41\text{k}\Omega$

If supply is connected at A and C terminals & detector at B and D terminals, determine the resistance & inductance of the choke coil if balance is obtained at 500Hz.

11. Differentiate between Wheatstone & AC bridge. Determine the condition of balance & necessary phasor diagram of Anderson bridge.
12. Show that, in 'Induction type energy meters' the no. of revolutions is directly proportional to the energy to be measured. Briefly discuss the method for avoiding creeping.
13. Determine the condition of balance of Hay's bridge with necessary phasor diagram. From the circuit arrangement of Maxwell's inductance-capacitance bridge, draw the necessary phasor diagram.
14. Explain the operation of Drysdale phase shifting transformer. How wattmeter can be calibrated by using a potentiometer.
15. Explain the operation of Co-ordinate type AC potentiometer.
16. Explain the construction of  $1-\Phi$  energy meter. In such energy meter, show that the number of revolutions will be in proportion to energy consumed by the load.
17. What are the different methods of testing of any energy meter? Why shading band is used in any energy meter?
18. Why the conventional Wheatstone bridge is not suitable for measuring low resistances? Explain how this problem is eliminated in Kelvin's double bridge?
19. Explain the operation of CRT present in CRO. While viewing a sinusoidal waveform in CRO, the number of vertical & horizontal divisions is 6.4 & 2.9 respectively. If the voltage/division & time/division is 2V/division & 0.5ms/division respectively. Determine the peak-to-peak voltage & supply frequency. Also compute the RMS value of the waveform.
20. How an unknown frequency can be measured by using Lissajous patterns? Explain the operation of Dual beam CRO.
21. How analog storage oscilloscope can be classified? Differentiate between them. Explain Bistable storage oscilloscope.
22. Explain the operation of Ramp type digital voltmeter. For a successive approximation ADC with reference voltage of 5V & the applied voltage is 2.6385V, find the A/D output if it is a 8-bit converter. Also find the quantization error, ADC resolution & its sensitivity if its full scale measurement range is -5V to 5V.

23. Explain the operation of strain gauge. Define gauge factor of a strain gauge & deduce the necessary expression.
24. What is RTD? Explain its principle of operation. Differentiate between the various temperature sensors i.e. Thermocouple, RTD, Thermistor & IC sensor.
25. Write short notes on:
- i. Thermocouple type instruments
  - ii. Creeping of energy meters
  - iii. Phantom loading
  - iv. LVDT
  - v. Low power factor wattmeter
  - vi. Compensating coils in wattmeter
  - vii. Loss of charge method
  - viii. Wien's bridge
  - ix. Drysdale AC potentiometer
  - x. Two element energy meter
  - xi. Megger
  - xii. Murray loop test
  - xiii. Sampling oscilloscope
  - xiv. Successive approximation digital voltmeter
  - xv. Digital frequency meter