

POSTAL
Book Package

2023

GATE • PSUs

Instrumentation Engineering

Objective Practice Sets

Measurements

Contents

| Sl. Topic | Page No. |
|--|-----------------|
| 1. Static and Dynamic Characteristics, Error Analysis | 2 - 8 |
| 2. Galvanometers, Voltmeters and Ammeters | 9 - 20 |
| 3. Measurement of Resistance, Potentiometer, AC & DC Bridges | 21 - 31 |
| 4. Measurement of Energy and Power | 32 - 37 |
| 5. Digital Voltmeter (DVM) and Q-meter | 38 - 42 |
| 6. Cathode Ray Oscilloscope | 43 - 46 |
| 7. Instrument Transformers | 47 - 51 |



MADE EASY
Publications

Note: This book contains copyright subject matter to MADE EASY Publications, New Delhi. No part of this book may be reproduced, stored in a retrieval system or transmitted in any form or by any means. Violators are liable to be legally prosecuted.

Multiple Select Questions (MSQs)

- Q.34** Which of the following is/are base units of S.I. system?
 (a) Meter (b) Ampere
 (c) Degree Celsius (d) Mole
- Q.35** Which of the following is/are true for standardisation of systems?
 (a) Secondary standards are calibrated using primary standards.
 (b) Absolute measurement of current is done using Rayleigh's current balance method.
 (c) International standards are more accurate than primary standards.
 (d) Working standards are more precise and accurate w.r.t. secondary standards.
- Q.36** True value of current flowing through a resistance is 5.25 A. Meter A reads 5.202 A and Meter B reads 5.27 A then
 (a) Meter A is more accurate.
 (b) Meter B is more accurate
 (c) Meter A is more precise
 (d) Meter B is more precise.
- Q.37** Systematic error is an error which is not determined by chance but is introduced by an inaccuracy in measurement. Which of the following is/are systematic error?
 (a) Parallax error (b) Environmental error
 (c) Instrumental error (d) Random error
- Q.38** Precision index of curve A is 0.42 while precision index of curve B is 0.54 then
 (a) Curve B is sharper than A.
 (b) Curve A drops sharply to low values.
 (c) Deviation of curve A is larger w.r.t. B.
 (d) Curve B has wider error limit than A.
- Q.39** The Gaussian distribution is mathematically expressed as :
 (a) $y = 1.13 \exp[-4x^2]$
 (b) $y = \frac{1}{0.56 \exp[x^2]}$
 (c) $y = 1.13 \exp[-4x]$
 (d) $y = \frac{1}{0.56 \exp[x]}$
- Q.40** A certain resistor has uncertainty in measurement of voltage of ± 0.3 V. The voltage drop and current are respectively 50 V and 15 A. Then uncertainty in measurement of power is _____.
 (a) ± 4.8 W (b) ± 2.7 W
 (c) ± 3.2 W (d) ± 5.7 W



Answers Static and Dynamic Characteristics, Error Analysis

- | | | | | | | |
|------------|---------------|------------|------------|-------------|---------------|---------------|
| 1. (c) | 2. (c) | 3. (b) | 4. (c) | 5. (d) | 6. (c) | 7. (c) |
| 8. (b) | 9. (c) | 10. (b) | 11. (a) | 12. (4.55) | 13. (c) | 14. (0.54) |
| 15. (a) | 16. (a) | 17. (a) | 18. (c) | 19. (c) | 20. (d) | 21. (c) |
| 22. (c) | 23. (a) | 24. (c) | 25. (b) | 26. (95.83) | 27. (135.30) | 28. (0.125) |
| 29. (c) | 30. (d) | 31. (c) | 32. (d) | 33. (a) | 34. (a, b, d) | 35. (a, b, c) |
| 36. (b, c) | 37. (a, b, c) | 38. (a, c) | 39. (a, b) | 40. (a, d) | | |

Explanations **Static and Dynamic Characteristics, Error Analysis**
1. (c)

$$\text{Pressure per division} = \frac{150}{300} = 0.5 \text{ Pa/division}$$

$$\text{Resolution} = \frac{1}{20} \times 0.5 = 0.025 \text{ Pa}$$

2. (c)

These all are the corresponding definitions.

3. (b)

Accuracy = 3%, of full scale value

$$\therefore \text{Absolute error} = \frac{3}{100} \times 300 = \pm 9 \text{ V}$$

$$\text{So limiting error \%} = \frac{9}{230} \times 100 = 3.9\%$$

$$\text{So, range of reading for 200 V is} = 200 \pm 9 \\ = 191 - 209 \text{ V}$$

4. (c)

$$P = I^2 R$$

$$\frac{dp}{p} \% = 2 \frac{dI}{I} \% + \frac{dR}{R} \% \\ = 2 \times 5\% + 0.2\% = 10.2\%$$

5. (d)

In multiplication, we add directly percentage error.
In addition, we add directly error value.

6. (c)

Magnitude of limiting error

$$= \frac{1}{100} \times 300 = 3 \text{ V}$$

$$\therefore \text{percentage limiting error} = \frac{3}{83} \times 100 = 3.62\%$$

7. (c)

Standard equation

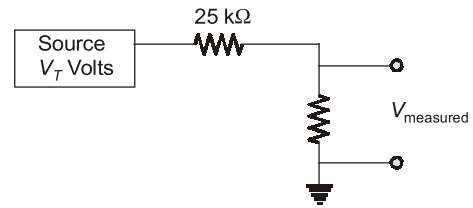
$$\tau \frac{dp(t)}{dt} + p(t) = Sr(t)$$

by comparing,

$$\frac{A}{B} = \tau, \quad \frac{3}{B} = S$$

$$B = \frac{3}{S} = \frac{3}{0.51} = 5.88$$

$$A = B\tau = 5.88 \times 2 = 11.76$$

8. (b)

$$V - \frac{R}{R+25} \times V \\ \frac{V}{V} \times 100 = 2$$

$$\frac{(R+25) - R}{R+25} \times 100 = 2$$

$$\frac{25}{R+25} \times 100 = 2$$

$$2R + 50 = 2500$$

$$2R = 2450$$

$$R = 1225 \text{ k}\Omega$$

$$R = 1.225 \text{ M}\Omega$$

9. (c)

$$I' = 100 + 200 = 300 \text{ A}$$

$$I_{\sigma} = \sqrt{\sigma^2 + \sigma_2^2} = \sqrt{3^2 + 4^2}$$

$$= \sqrt{9 + 16} = \sqrt{25} = 5$$

\therefore

$$I' = 300 \pm 5 \text{ A}$$

10. (b)

$$I' = 150 + 250 = 400 \text{ A}$$

$$I_{\sigma} = \sqrt{\sigma^2 + \sigma_2^2} = \sqrt{1^2 + 2^2}$$

$$= \sqrt{1 + 4} = \sqrt{5} = 2.24$$

\therefore

$$I' = 400 \pm 2.24 \text{ A}$$

12. (4.55)

$$\theta(t) = (\theta_i - \theta_f)e^{-t/\tau} + \theta_f$$

$$65 = (35 - 80)e^{-5/\tau} + 80$$

\therefore

$$\tau = 4.55 \text{ sec}$$

13. (c)

Accuracy is defined as 'percentage of true value'.

14. (0.54)

The maximum difference between measuring and reference junctions = $100 - 25 = 75^\circ\text{C}$

For a step input of $\theta_1 = 75^\circ\text{C}$, the solution for voltage output is

$$V = K \left[1 - e^{-\frac{t}{\tau}} \right] \theta_1$$