Electrical and Electronic Measurements Test 2

Number of Questions: 35 **Section Marks: 90**

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. An ammeter has a full scale deflection of 10 A with a specified accuracy of ± 1.25 %. The error in the reading while measuring 6 A current would be
(A) ± 1.25 % of measured value
(B) ± 0.125 % of measured value
(C) ± 2.03 % of measured value
(D) ± 0.208 % of measured value

2. The input power given to a 3 phase induction motor is measured as 3000± 1 % and the mechanical power output of the machine is 2500 ± 0.5%. Percentage error in the measurement of losses and efficiency respectively amounts to
(A) ± 8.5%, ± 1% (B) ±8.5%, ±1.5%
(C) ± 1.5%, ±1.5% (D) ±0.5%, ±0.5%

3. When a current of 6A flows through the moving coil of a spring controlled PMMC, it produces a deflection of 60°. If the instrument is modified with a new permanent magnet which produces thrice the flux density as before, with same spring constant and all other features of PMMC remaining the same. When a current of 2 A flows through the coil, deflection produced by the meter is
(A) 90° (B) 120°
(C) 20° (D) 60°

4. Moving iron type indicating instruments would indicate
(A) ac voltages only
(B) Higher values for ac voltages than for corresponding dc voltages
(C) Same value for dc and ac voltages
(D) Lower value of ac voltages than for corresponding dc voltages

5. For a current transformer, the nominal ratio is the ratio of
(A) Number of turns of secondary winding to number of turns of primary winding
(B) Primary winding current to secondary winding current
(C) Rated primary winding current to the rated secondary winding current
(D) Choices (A) (B) & (C)

6. The energy consumed by a load, consuming 20 A at 230 V, 0.8 p.f for 2 hours, is measured using an energy meter with a meter constant of 180 rev/kwh. The number of revolutions made by the meter is
(A) 1320 (B) 368
(C) 1325 (D) 1570

7. A dynamometer type wattmeter with its current coil connected to the load side of the instrument reads 500 W. If the current coil has a resistance of 12.8Ω & if the load consumes a current of 2.5A, what power is actually being absorbed by the load
(A) 500 W (B) 80 W
(C) 420 W (D) 580 W

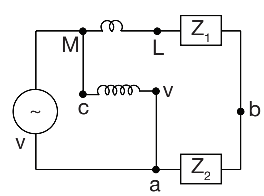
8. A (0 – 10) A ammeter has its internal resistance of 0.4Ω. In order to increase range by 5 times, the resistance to be added should be
(A) 0.1Ω in series with the meter
(B) 0.1Ω in parallel with the meter
(C) 1 Ω in series with the meter
(D) 1 Ω in parallel with the meter

9. Which of the following bridges can be used for capacitance measurements
(1) Maxwells inductance capacitance bridge
(2) Owens bridge
(3) Desauty's Bridge
(4) Weins bridge
(A) 3 & 4 (B) 2 & 3
(C) 1 & 2 (D) 1 & 4

10. A CRO has 10 divisions on the horizontal scale. A voltage signal of 20 sin (314*t* + 60°), when observed and analysed such that 5 complete cycles of the waveform is to be viewed on the screen. The time/div setting should be set at
(A) 20 ms/div (B) 5 ms/div
(C) 10 ms/div (D) 1 ms/div

11. A series combination of 4V dc & (6sin 8*t*) V ac is connected across a moving iron attraction type voltmeter, it would read
(A) 7.82 v (B) 4 v
(C) 6 v (D) 5.83 v

12.

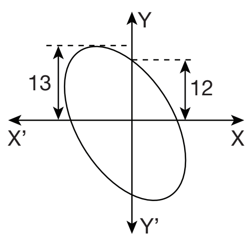


The potential coil of the wattmeter when connected in the following sequence
(i) *v* connected to *a*
(ii) *v* connected to *b*
(iii) *c* connected to *b*
These would indicate the power consumed by
(A) Z_1 & Z_2, Z_1,Z_2 respectively
(B) Z_1 & Z_2 in all cases
(C) Z_1 only in all cases
(D) Z_2 only in all cases

13. Guard terminal provided in the measurement of high resistance is used to
(A) guard the resistance against stray electrostatic fields
(B) guard the resistance against over voltage
(C) guard the resistance against overload
(D) Bypass any leakage current

14. Which among the following bridges is used for measurement of mutual inductance with reference to a standard known capacitance
(A) Carey fosters bridge
(B) Schering Bridge
(C) Heaviside's Bridge
(D) Cambell's Bridge

15.



The phase difference between the applied signal is
(A) 67.38° (B) 112.62°
(C) 0.6435° (D) 22.62°

16. A moving iron ammeter carries a current of 3A and has a control spring torque of 20μ Nm/rad. If the variation of inductance of the coil with deflection is mathematically expressed as follows

$$L = \left[4\theta - \frac{\theta^2}{3} + 12\right]\mu\text{H}$$

The deflection of the pointer (in degrees) is
(A) 30 (B) 45
(C) 60 (D) 90

17. A current of 5A, when flows through a moving iron attraction type ammeter of 120° full scale deflection, produces a full scale torque of 120 μ Nm. The rate of change of self inductance (with respect to deflection) at full scale is
(A) 4.8 μH/deg (B) 4.8 H/deg
(C) 9.6 H/deg (D) 9.6 μH/deg

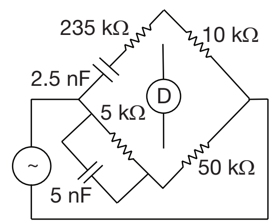
18. A galvanometer of 1000Ω, used in the measurement of unknown resistance by substitution method, gives a deflection of 80 divisions with standard resistance in loop and 92 division with unknown resistance. If a standard resistance of 200KΩ is used the value of unknown resistance is
(A) 173.91 KΩ (B) 200 KΩ
(C) 230 KΩ (D) Insufficient Data

19. For a 230 V, 1ϕ, induction type watthour meter, the voltage flux adjustment is soaltered that the phase angle between supply voltages and flux due to it is 88° (instead of 90°). The error introduced in the reading of this meter, when the current of 10A is being drawn at 0.8 pf lagging is
(A) 49.03 W (B) –49.03 W
(C) 85.1 W (D) –49.03 mW

20. The measuring range of an analog voltmeter is varied by an external multiplier. With a multiplier setting of 10 KΩ it reads 220 V and with a multiplier setting of 40 KΩ it reads 176 V. For a multiplier setting of 20 KΩ the voltmeter would read.
(A) 185 V (B) 190 V
(C) 194 V (D) 205 V

21. P = 100Ω, Q = 10Ω, R = 55Ω, S = 5Ω are values of resistances of various arms in a wheatstone bridge. A 10V source (with negligible internal resistance) and a galvanometer with an internalresistance of 20Ω, having a current sensitivity of 5 mm/mA are used. The bridge sensitivity in terms of deflection per unit change in resistance is
(A) 5.54 mm/Ω (B) 4.43 mm/Ω
(C) 2.26 mm/Ω (D) 3.98 mm/Ω

22. The weins bridge given below is balanced at a frequency of



(A) 3.31 KHz (B) 13.13 KHz
(C) 23.13 KHz (D) 13.13 Hz

23. A single phase domestic energy meter with a meter constant 111 rev/kwh is operated at 230 V, 50 Hz supply at upf. The meter having made 1200 revolutions in 3 hours, the current drawn by the load is
(A) 10 A (B) 15 A
(C) 20.32 A (D) 25.78 A

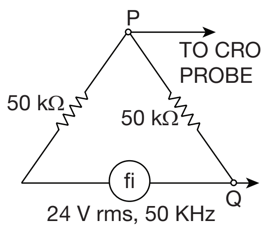
24. A single phase energy meter has a meter constant of 150 rev/kwh, the meter is operated at 380 v, 12 A, for 3 hours. At what power factor will the meter makes 1350 revolutions [Assume that there was no error]
(A) *u.p.f* (B) 0.98
(C) 0.88 (D) 0.66

25. The operational specifications for a current transformer is given below.
Exciting component of no load current = 20 A.
magnetizing component of no load current = 50 A.
secondary winding current = 5 A
Turns ratio = 200
Phase angle between secondary induced emf and secondary current = 65.16°.
Transformation ratio for the given operating conditions is

(A) 200 (B) 205
(C) 211 (D) 222

26. An input signal of 2 KHz is applied to horizontal input of a CRO and a signal with unknown frequency was applied to vertical input, gave a stationary lissajous pattern having 2 horizontal tangencies and 5 vertical tangencies. Then the frequency of vertical input is
(A) 20 KHz (B) 2 KHz
(C) 800 Hz (D) 1 KHz

27. A CRO is used to measure and observe voltage between *P* and *Q* as shown



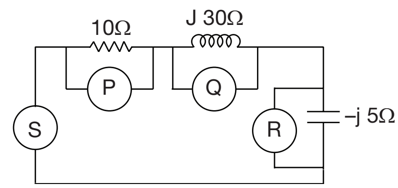
If the CRO probe had an impedance of 200 kΩ in parallel to a capacitance of 20pF. The measured voltage will be
(A) 10.48 V (B) 8.47 V
(C) 11.36 V (D) 12 V

28. In the substitution method of medium resistance measurement, supply voltage is 10 V and with rheostat set at 200Ω, a known standard resistance in loop of value 40Ω gives a galvanometer deflection θ. When unknown resistance is brought into loop it was observed that battery voltage drops down by 10%. To obtain the same galvanometer deflection, the deviation of measured value of unknown resistance from the actual value is
(A) 24Ω (B) 16Ω
(C) 40Ω (D) None of these

29. When a current of 50 mA flows through a certain dynamometer type ammeter, a deflecting torque of 3.75 μ Nm is produced which deflects the pointer by 90°. The variation of mutual inductance *M* with deflections is given as
(A) $M = 3\sin(\theta - 30°)$ H/deg
(B) $M = 3\sin(\theta - 60°)$ mH/deg
(C) $M = 3\sin(\theta - 30°)$ mH/deg
(D) $M = 3\cos(\theta - 60°)$ H/deg

30. A current signal of 5 cos (100 π + 100) A is examined on a CRO having 10 divisions each on the horizontal and vertical scale respectively. If the line base is set to 5 ms/div the number of cycles of signal displayed on the screen will be
(A) 2.5 (B) 5
(C) 7.5 (D) 10

31. If the readings of three moving iron attraction type voltmeters connected as shown below are *P*, *Q*. *R* and *S* as indicated. The correct relationship among their readings is



(A) $S = P + Q + R$ (B) $S = \sqrt{P^2 + Q^2 + R^2}$
(C) $S = \sqrt{P^2 + (Q - R)^2}$ (D) $S = \sqrt{P^2 + Q^2 - R^2}$

Common Data Questions 32 and 33:

Full scale deflection of a moving coil voltmeter, having a resistance of 100Ω, is reached, when a voltage of 50 mV is applied across the terminals. The effective dimensions of the moving coil is 15 mm × 12mm and is wound with 50 turns. The flux density in the air gap is 0.1 wb/m^2

32. The control constant of the spring if the deflection is 50° is
(A) 0.9 μ Nm/deg (B) 0.09 μ Nm/deg
(C) 0.009 Nm/deg (D) 0.009 μNm/deg

33. If 25% of the total instrument resistance is due to the coil winding (assume the resistivity of copper to be 1.7×10^{-8} Ωm) a suitable diameter of the copper wire for the coil winding is
(A) 0.05 mm (B) 0.01 mm
(C) 0.05 cm (D) 0.08 mm

Linked Answer Questions 34 and 35:

Measurement of power across a 3 phase 3 wire, balanced star connected load is done by two wattmeter method. Wattmeters P_1 and P_2 reads 1700 W and (–300 W) respectively. If the load was operated at
220 V, 50 Hz.

34. Value of reactance which causes a power factor while measurement is
(A) 4Ω (B) 23.12Ω
(C) 6.76Ω (D) 15.77Ω

35. The value of capacitance which must be introduced into each phase such that wattmeter P_2 reads ZERO power, would be.
(A) 0.42 mF (B) 2.65 mF
(C) 3.61 F (D) 0.88 F

Answer Keys

1. C	**2.** B	**3.** D	**4.** D	**5.** C	**6.** C	**7.** C	**8.** B	**9.** A	**10.** C
11. D	**12.** A	**13.** D	**14.** A	**15.** B	**16.** B	**17.** D	**18.** A	**19.** B	**20.** D
21. C	**22.** B	**23.** B	**24.** D	**25.** C	**26.** C	**27.** A	**28.** A	**29.** C	**30.** A
31. C	**32.** D	**33.** A	**34.** A	**35.** B					

Hints and Explanations

1. 10A → 1.25% error → 0.125 A
While measuring 6A → error
$= \frac{0.125}{6}\% = 2.08\%$ of 6 A. Choice (C)

2.

3000 × 1 % →	30 w
2500 × 0.5 % →	12.5 w
	42.5 w

% loss $\frac{42.5}{500\,w}\times 100 = \pm 8.5\%$

$\% \eta = \left(\frac{2500}{3000}\right)\left[(\pm 0.5\%)+(\pm 1\%)\right]$

$= 83\% \pm 1.5\%$. Choice (B)

3. For a P.M.M.C T_d = NBIA
$T_c = K\theta$
At equilibrium $K\theta$ = NBIA
Since K, N, A are constant $\theta \propto BI$

$\frac{\theta_2}{\theta_1} = \frac{B_2 I_2}{B_1 I_1}$

$\theta_2 = \left(\frac{3B_1}{B_1}\right)\times\left(\frac{2}{6}\right)\times 60^\circ$

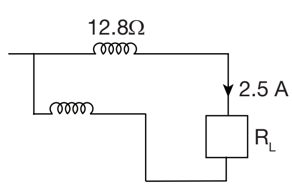
$\theta_2 = 60°$. Choice (D)

4. Choice (D)

5. Choice (C)

6. Actual energy consumed
= 230 × 20 × 0.8 × 2
= 7360 Wh (or) 7.36 kwh
for 1 kwh → 180 revolution
for 7.36kwh → 7.36 × 180 = 1325 rev Choice (C)

7. C.C connected to the load side can be represented as below



Power indicated = Actual power absorbed by the load + power dissipated across current coil
$500 = P_{actual} + I_2^2 R_{cc}$
$P_{actual} = 500 - 2.5^2 \times 12.8$
$= 420$ W. Choice (C)

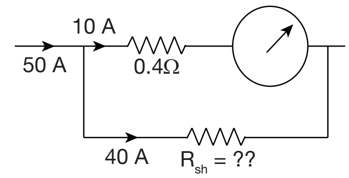
8. I = 5 times × 10 A = 50 A

Multiplying factor $m = \frac{I}{I_m} = \frac{50}{10} = 5$

Original rating $R_m = 0.4\ \Omega$

$R_{add} = \frac{R_m}{m-1} = \frac{0.4}{5-1} = 0.1\Omega$

To be shunted to the meter
(or)



$10 \times 0.4 = 40 \times R_{sh}$

$R_{sh} = \frac{0.40\times 10}{40} = 0.1\ \Omega$. Choice (B)

9. Choice (A)

10. ω → 314
$2\pi f = 314$
$f = 50$ Hz.
$t = \frac{1}{f} = 20$ ms [time period for each 20 ms × 5 cycles
→ 100 ms to be displayed cycle]
100 ms over 10 div
setting 100 ms ÷ 10 → 10 ms/div. Choice (C)

11. Total voltage = 4 + 6 sin 8 t
$M.I$ instruments indicate r.m.s values

$V_{r.m.s} = \sqrt{\frac{1}{\pi}\int_0^{\pi}(4+6\sin 8t)^2}$

$= \sqrt{4^2 + \frac{6^2}{2}} = 5.83$ V. Choice (D)

12. (i) V connected to a, the potential coil is connected across Z_1 & Z_2
(ii) V connected to b, the potential coil is connected across Z_1
(iii) C connected to b, the potential coil is connected across Z_2
C.C however measures current flowing through both Z_1 & Z_2. Choice (A)

13. Choice (D)

14. Choice (A)

15. $\phi = \sin^{-1}\left(\frac{12}{13}\right) = 67.38°$

Since curve lies in 2nd and 4th quadrants
$\phi = 180 - 67.38$
$= 112.62°$. Choice (B)

16. $k\,\theta = \frac{1}{2}I^2\frac{dL}{d\theta}$

$20 \times 10^{-6} \times \theta = \frac{1}{2}\times 3^2 \times \left[4 - \frac{2\theta}{3}\right]\times 10^{-6}$

$$\theta\left[20\times10^{-6}+\frac{3^2\times2}{2\times3}\right]\times10^{-6}=\frac{3^2\times4\times10^{-6}}{2}\quad \theta = 0.78 \text{ rad}$$

$= 0.78 \times \dfrac{180}{\pi} \cong 45°.$ Choice (B)

17. $T_d = \dfrac{1}{2}I^2\dfrac{dL}{d\theta}$

$\left(\dfrac{dL}{d\theta}\right) = \dfrac{120\times10^{-6}\times2}{5^2}$

$= 9.6 \times 10^{-6}$ H/deg. Choice (D)

18. Unknown resistance $R = \left(\dfrac{80}{92}\right)\times200$

$= 173.91$ k Ω. Choice (A)

19. Actual power consumed [when Δ = 90°]

$P_a = V I \cos\phi$

$= 230 \times 10 \times 0.8 = 1840$ W

Measured value of power

$P_m = V I \sin(\Delta - \phi)$

Where Δ is the phase angle between supply voltage and flux in the potential coil → 88°

ϕ → Load phase angle

$\cos^{-1}(0.8) = 36.86°$

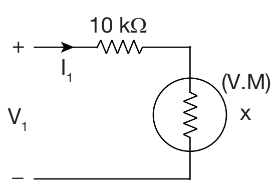
$P_m = 230 \times 10 \times \sin(88 - 36.86)$

$= 1790.97$ W

Error $= P_m - P_a = 1790.97 - 1840$

$= -49.03$ W. Choice (B)

20.



Let x be the internal resistance of the meter

For multiplier setting of 10 k Ω

Total resistance $R_1 = 10\text{ K} + x$

$V_1 = 220$ V

$V_1 = I_1 x$

$I_1 \propto \dfrac{1}{R_1}$

Similarly for multiplier setting of 40 K Ω

Total resistance $R_2 = 40\text{ K}\Omega + x$

$V_2 = 176$ V

$V_2 = I_2 x$

$I_2 \propto \dfrac{1}{R_2}$

$\dfrac{V_2}{V_1} = \dfrac{I_2}{I_1} = \dfrac{R_1}{R_2}$

$\dfrac{176}{220} = \dfrac{10\text{ K}\Omega + x}{40\text{ K}\Omega + x}$

$7040\text{ K} + 176 \times x = 2200\text{ K} + 220\,x$

$44x = 4840$

$x = 110$ K Ω

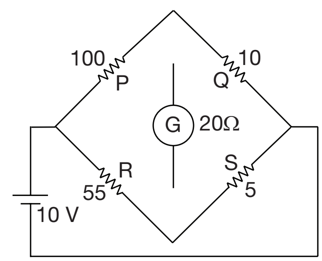
For multiplier setting of 20 KΩ

$R_3 = 20\text{ K }\Omega + 110\text{ K }\Omega = 130\text{ K }\Omega$

$\dfrac{V_3}{220} = \dfrac{10+130}{20+130} \Rightarrow V_3 = 205$ V.

Choice (D)

21.



The current flowing through the galvanometer for an unbalanced wheatstone bridge is found by thevenin's theorem.

Resistance of unknown resistor actually required $R = \left(\dfrac{P}{Q}\right)\times S = 50\ \Omega$ in the bridge used $R = 55\ \Omega$ deviation from balance $\Delta R = 5\ \Omega$

V_{th} across galvanometer

$V_{th} = \left[10\times\dfrac{10}{100+10} - 10\times\dfrac{5}{55+5}\right] = 0.076$ V

$R_{th} = \left(\dfrac{100\times10}{100+10}\right)+\left(\dfrac{55\times5}{55+5}\right) = 13.67$

Current flowing through the galvanometer

$I_G = \dfrac{V_{th}}{R_{th}+G} = \dfrac{0.076}{13.67+20} = 2.26$ mA

Deflection of the galvanometer $\theta = S_i \times I_g$

$\theta = 5\text{mm/mA} \times 2.26\text{ mA} = 11.3$ mm

Sensitivity of bridge $S_B = \dfrac{\theta}{\Delta R} = \dfrac{11.3}{5}$

$= 2.26$ mm/Ω. Choice (C)

22. For the given bridge

$Z_1 = R + \dfrac{1}{j\omega C_1}$

$$Z_2 = \frac{R_2\times\dfrac{1}{j\omega C_2}}{R_2+\dfrac{1}{j\omega C_2}}$$

$Z_3 = R_3\ Z_4 = R_4$

For balance $Z_1 z_4 = z_2 z_3$

$$\left(R_1 + \frac{1}{j\omega C_1}\right) \times R_4 = \left(\frac{R_2 \times \frac{1}{j\omega C_2}}{R_2 + \frac{1}{j\omega C_2}}\right) \times R_3$$

$$R_1R_4 + \frac{R_4}{j\omega c_1} = \frac{R_2R_3}{1 + j\omega R_2C_2}$$

$$\left[R_1R_4 + \frac{R_4}{j\omega C_1}\right](1 + j\omega R_2C_2) = R_2R_3$$

$$R_1R_4 + j\,\omega\,R_1\,R_2\,R_4C_2 + \frac{R_4}{j\omega C_1} + R_2R_4C_2 = R_2\,R_3$$

Equating imaginary parts $j\,\omega\,R_1\,R_2\,R_4\,C_2 + \frac{-jR_4}{\omega C_1} = 0$

$$\omega^2 = \frac{1}{R_1R_2C_1C_2} (or)\, \omega = \frac{1}{\sqrt{R_1R_2C_1C_2}}$$

$$\omega = \frac{1}{\sqrt{2.35\times10^3 \times 5\times10^3 \times 2.5\times10^{-9} \times 5\times10^{-9}}}$$

ω = 82.51 rad/sec

f = 13.13 KHz. Choice (B)

23. Energy consumed = $\frac{1200\,\text{rev volutions}}{111\,\text{rev/kwh}}$ = 10.81 kwh

Actual Energy consumed = $\frac{VI\cos\varphi \times t}{1000}$

$= \frac{230 \times I \times 1 \times 3}{1000} = 10.81$

I = 15.67 A. Choice (B)

24. Energy consumed = $\frac{1350}{150}$ = 9 kwh

Actual energy consumed
= 380 × 12 × 3 × cos ϕ = 9 kwh

$\cos\phi = \frac{9}{380\times12\times3} = 0.66.$ Choice (D)

25. $R = n + \frac{I_e\cos\delta + I_m\sin\delta}{I_s}$

$= 200 + \frac{[20\times0.42 + 50\times0.91]}{5}$

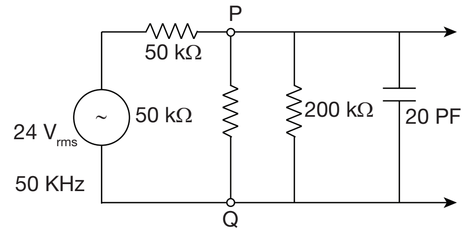
= 210.78 ≃ 211. Choice (C)

26. $\frac{f_x}{f_y} = \frac{\text{Vertical tangencies}}{\text{Horizontal tangencies}}$

$\frac{2\times10^3}{f_y} = \frac{5}{2}$

$f_y = \frac{2\times10^3\times2}{5}$ = 800 Hz. Choice (C)

27.



$$X_c = \frac{-j}{2\pi\times50\times10^3\times20\times10^{-12}}$$

= –j 159.15 K

$(Z_{eq})_{PQ}$ = 20 K // 50 K // – j 159.15 K

= 38.79 K (–14.11°)

$$V_{PQ} = \frac{24\times38.79\,\text{K}}{(38.79\,\text{K} + 50\text{K})}$$

V_{PQ} = 10.48 V. Choice (A)

28. Let S be the known, standard resistance
R be the unknown resistance
when S is in loop

$\theta_1\ \alpha\ I_1 = \frac{10}{200+40}$

when R is in loop voltage drops by 10%
= 10 V × 10% = 1 V

V_2 = 9 V

$\theta_2 \alpha\ I_2 = \frac{9}{200+R}$

to have same deflection $\theta_1 = \theta_2$

$\frac{10}{200+40} = \frac{9}{200+R}$ = 16 Ω

If voltage remained same (i.e., 10V) actual value of R = 40 Ω

Deviation from actual value = 40 – 16
= 24 Ω. Choice (A)

29. For a dynamometer type instrument

$T_d = I^2\left(\frac{dM}{d\theta}\right)$

$\left(\frac{dM}{d\theta}\right) = \frac{T_d}{I^2} = \frac{3.75\times10^{-6}}{(50\times10^{-3})^2}$ = 1.5 mH/deg

option (c) would be correct
M = 3 sin (θ – 30°) mH/deg

$\left(\frac{dM}{d\theta}\right)$ = 3 cos (θ – 30°)

$\left[\frac{dM}{d\theta}\right]$ = 3 cos (90 – 30) θ = 90°

= 3 cos 60 = 1.5 mH/deg. Choice (C)

30. Screen has 10 divisions and line base set at 5 ms/div so a total of 50 ms can occupy the screen
Frequency of the signal $\omega = 2\,\pi f$

$2\,\pi f = 100\,\pi, f = 50$ Hz, $t = \frac{1}{50} = 20$ ms

No of cycles displayed = $\frac{50}{20}$

= 2.5 cycles. Choice (A)

31. $S = I \times |Z|$

$Z = R + j\,(X_L - X_c)$

$$|Z| = \sqrt{R^2 + (X_L - X_c)^2}$$

$$I\,|Z| = \sqrt{(IR)^2 + (I X_L - IX_C)^2}$$

$$S = \sqrt{P^2 + (Q - R)^2}.$$ Choice (C)

32. $k\,\theta = \text{N B I A}$

$$k = \frac{\text{NBIA}}{\theta}$$

$$k = \frac{50 \times 0.1 \times \left(\frac{50 \times 10^{-3}}{100}\right) \times 15 \times 10^{-3} \times 12 \times 10^{-3}}{50}$$

$= 9 \times 10^{-9} = 0.009\ \mu$ Nm/deg. Choice (D)

33. Total length of the wire (coil)

= perimeter of 1 turn × total no of turns

= 2 ($\ell + b$) × 50

= 2[15 + 12] × 50 = 2700 mm = 2.7 m

Resistance of the coil is 25% of total resistance = 100 Ω× 25 % = 25 Ω

$$\frac{\rho\ell}{a} = 25\ \Omega$$

$$a = \frac{1.7 \times 10^{-8} \times 2.7}{25} = 1.836 \times 10^{-9}\ \text{m}^2$$

$$\frac{\pi D^2}{4} = 1.836 \times 10^{-9}$$

$D = 4.83 \times 10^{-5}$ m

(or)

0.0483 mm ≅ 0.05 mm. Choice (A)

34. $P_1 = 1700$ W

$P_2 = -300$W

$$\tan\phi = \sqrt{3}\left[\frac{P_1 - P_2}{P_1 + P_2}\right]$$

$$= \sqrt{3}\left[\frac{1700 - (-300)}{1700 + (-300)}\right]$$

$\tan\phi = 2.47 \Rightarrow \phi = 68°$

$\cos\phi = 0.375$

Total power consumed (P_T)

$= P_1 + P_2 = 1400$ W

Power consumed in each phase = $\frac{1400}{3} = 466.67$ W

Given $V_L = 220$ V (star conn. Load)

$$V_{ph} = \frac{220}{\sqrt{3}} = 127\ \text{V}$$

$$I_{ph} = \frac{P_{ph}}{V_{ph} \times \cos\varphi} = \frac{\frac{140}{3}}{127 \times 0.375}$$

$$= \frac{29.4\ \text{A}}{3} = 9.8\text{A}$$

$$Z_{ph} = \frac{V_{ph}}{I_{ph}} = 12.9\ 6\text{A}$$

$R_{ph} = Z_{ph}\cos\phi$

$= 12.96 \times 0.375 = 1.62\ \Omega$

$X_{ph} = Z_{ph}\sin\phi$

$12.96 \times 0.927 = 4\ \Omega$. Choice (A)

35. In order that P_2 reads zero

$$\tan\phi = \sqrt{3}\left[\frac{P_1 - 0}{P_1 + 0}\right] = \sqrt{3} = 1.73 = \frac{X}{R}$$

$\phi = 60°$

$\cos\phi = 0.5$

$X = R\tan\phi$

$= 1.62 \times 1.73 = 2.8\ \Omega$

Capacitive reactance required

$X_c = 4 - 2.8 = 1.2\ \Omega$

$$C = \frac{1}{2\pi f \times X_c} = \frac{1}{2\pi \times 50 \times 1.2}$$

$= 2.65 \times 10^{-3}$ F = 2.65 mF. Choice (B)