# POSTAL Book Package 2023

# GATE • PSUs

## Instrumentation Engineering

### Objective Practice Sets

## Electric Machines

*Contents*




MADE EASY Publications

# Transformers

## MCQ and NAT Questions

**Q.1** The power transformer is a
(a) constant voltage device
(b) constant main flux device
(c) constant current device
(d) constant power device

**Q.2** $P_i$ = core loss, $P_c$ = copper loss. A transformer has maximum efficiency when
(a) $P_i/P_c = 2$ (b) $P_i/P_c = 15$
(c) $P_i/P_c = 1$ (d) $P_i/P_c = 0.5$

**Q.3** For a single-phase transformer, $r_e$ = total equivalent resistance, $x_e$ = total equivalent leakage reactance, $P_c$ = core loss. The load current at which maximum efficiency occurs is
(a) $\frac{P_c}{x_e}$ (b) $\sqrt{\frac{P_c}{x_e}}$
(c) $\frac{P_c}{r_e}$ (d) $\sqrt{\frac{P_c}{r_e}}$

**Q.4** If the iron core of a transformer is replaced by an air core, then the hysteresis losses in the transformer will
(a) increase (b) decrease
(c) remain unchanged (d) become zero

**Q.5** A 2 kVA transformer has iron loss of 150 Watts and full-load copper loss of 250 Watts. The maximum efficiency of the transformer would occur when the total loss is
(a) 500 W (b) 400 W
(c) 300 W (d) 275 W

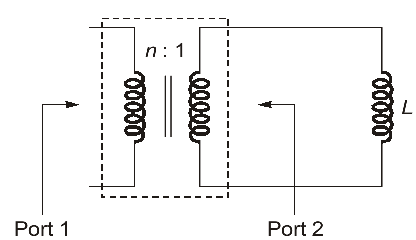
**Q.6** A 1-phase 250/500 V transformer gave the following result. Open-circuit test 250 V, 1 A, 80 W on l.v. side what is the power factor?
(a) 0.24 (b) 0.32
(c) 0.28 (d) 0.30

**Q.7** Which of the following is not true relating to an ideal transformer?
(a) The iron loss in an ideal transformer is zero
(b) The winding resistance has a zero value
(c) The leakage reactance has a non-zero value
(d) The magnetizing current is zero

**Q.8** Two transformers with identical voltage ratings are working in parallel to supply a common load. The impedance of one transformer is higher compared to that of the other. The load sharing between the two transformers will
(a) be proportional to their impedances.
(b) be independent of their impedances.
(c) be inversely proportional to their respective impedances.
(d) depend on the resistance to leakage reactance ratio of each transformer.

**Q.9** A 20 kVA, 2000/200 V transformer has name plate leakage impedance of 8% what voltage must be applied on the HV side to circulate full load current with the LV shorted:
(a) 200 V (b) 2000 V
(c) 160 V (d) 240 V

**Q.10** If an ideal transformer has an inductive load element at port 2 as shown in the figure below, the equivalent inductance at port 1 is




(a) $nL$ (b) $n^2L$
(c) $\frac{n}{L}$ (d) $\frac{n^2}{L}$

**Q.11** A transformer operates most efficiently at 3/4[th] full-load. Its iron loss ($P_i$) and full-load copper loss ($P_c$) are related as:
(a) $P_i/P_c = 16/9$ (b) $P_i/P_c = 4/3$
(c) $P_i/P_c = 3/4$ (d) $P_i/P_c = 9/16$

**Q.52** A 1-$\phi$, 3 kVA, 240/120 V, 60 Hz transformer has the following parameters:

$R_{HV} = 0.25\ \Omega,\quad R_{LV} = 0.05\ \Omega$

$X_{HV} = 0.75\ \Omega,\quad X_{LV} = 0.18\ \Omega$

If the transformer is supplying full load on *LV* side at 110 V and 0.9 leading power factor, then the voltage regulation is

(a) –1.21% (b) 0.95%
(c) –0.95% (d) 1.21%

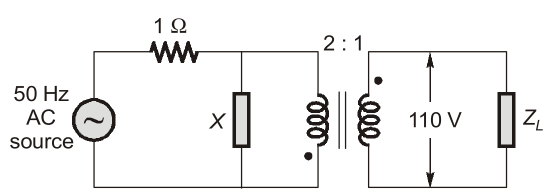
**Q.53** The resistance and leakage reactance of a 10 kVA, 50 Hz, 2300/230 V distribution transformer are:

$r_1 = 3.96\ \Omega,\quad r_2 = 0.0396\ \Omega$

$x_1 = 15.8\ \Omega,\quad x_2 = 0.158\ \Omega$

the transformer delivers rated kVA at 0.8 p.f. lagging to a load on LV side, to maintain 230 V across load terminals the HV side voltage is ________ kV.

**Q.54** The load shown in the figure absorbs 4 kW at a power factor of 0.89 lagging.




Assuming the transformer to be ideal, the value of the reactance *X* to improve the input power factor to unity is ______ Ω.

## Multiple Select Questions (MSQs)

**Q.55** A 22 kVA, 2200/220 V, 1-$\phi$ transformer has following results

OC Test: 220 V, 0.6 A, 80 W

SC Test: 75 V, 9 A, 60 W

The correct option will be

(a) efficiency at full load at 0.8 pf (lag) is 99.1%.
(b) total losses at 25% of full load will be 84.63 W.
(c) efficiency at half full load at 0.8 pf (lag) is 97.12%.
(d) OC test is usually done with LV winding open circuited.

**Q.56** The emf per turn for a single phase 2500/250 V, 60 Hz transformer is about 16 V.

For a maximum flux density of 2.5 T, the correct options are

(a) No. of primary turns can be 156.
(b) No. of secondary turns can be 10.
(c) No. of secondary turns can be 15.
(d) Net cross-sectional area of core will be 0.24 $m^2$.

**Q.57** A transformer of rating 20 kVA, 2000/200 V has following parameters :

$R_{eq}$ (HV side) = 2.8 Ω

$Z_{eq}$ (HV side) = 4.2 Ω

Core loss at rated voltage = 100 W

If the transformer is delivering 20 kVA, 200 V at 0.8 p.f. lag, then the correct option(s) is/are

(a) The transformer efficiency when delivering 20 kVA at 200 V at 0.8 pf (lag) is 98.5%
(b) The transformer efficiency for the load in part (a) is 97.68%
(c) The voltage must be applied on HV side for load as in part (a) is 2041.18 V.
(d) The percent voltage regulation is 2.02%

**Q.58** A single phase, 125 kVA, 2000/200 V, 50 Hz transformer has impedance drop of 10% and resistance drop of 5%. Then correct option is

(a) For 0.8 pf lagging, the regulation at full load is 9.19%
(b) For 0.8 pf leading, the regulation at full load is negative value.
(c) For zero regulation, pf must be leading.
(d) For zero regulation, pf required is 0.6 (leading).

■■■■

## Answers Transformers

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | (b) | 2. | (c) | 3. | (d) | 4. | (d) | 5. | (c) | 6. | (b) | 7. | (c) |
| 8. | (c) | 9. | (c) | 10. | (b) | 11. | (d) | 12. | (c) | 13. | (a) | 14. | (c) |
| 15. | (a) | 16. | (b) | 17. | (c) | 18. | (3300) | 19. | (98.29) | 20. | (a) | 21. | (c) |
| 22. | (b) | 23. | (a) | 24. | (b) | 25. | (b) | 26. | (d) | 27. | (18) | 28. | (d) |
| 29. | (c) | 30. | (d) | 31. | (15.65) | 32. | (6.02) | 33. | (b) | 34. | (d) | 35. | (d) |
| 36. | (a) | 37. | (3.556) | 38. | (95.92) | 39. | (a) | 40. | (1.2) | 41. | (b) | 42. | (a) |
| 43. | (c) | 44. | (151.95) | 45. | (b) | 46. | (a) | 47. | (1.44) | 48. | (b) | 49. | (c) |
| 50. | (c) | 51. | (a) | 52. | (c) | 53. | (2.4) | 54. | (23.61) | 55. | (a, b) | 56. | (a, c) |
| 57. | (b, c, d) | 58. | (a, b, c) | | | | | | | | | | |

## Explanations Transformers

**1. (b)**

Transformer is a static device which cannot change frequency, but can change voltage and current level of the system. Practically, transformer is a constant flux machine. However due to losses in transformer, power at both sides may vary. Hence (b) is better option.

**2. (c)**

In a transformer, condition for maximum efficiency is copper loss or variable loss = iron loss

Thus, $P_i = P_c$

or $\dfrac{P_i}{P_c} = 1$

**3. (d)**

At $\eta_{max}$,

Copper loss = Iron loss

or, $I_m^2 r_e = P_c$

or, $I_m = \sqrt{\dfrac{P_c}{r_e}}$

**4. (d)**

Air-core means non-iron core so there will be no hysteresis losses.

**5. (c)**

For maximum efficiency at full load

$$P_{cu} = P_i = 150 \text{ W}$$

$$\text{Total loss} = P_i + P_{cu} = 150 + 150 = 300 \text{ W}$$

**6. (b)**

Given: $V_{NL} = 250$ V ; $I_{NL} = 1$ A ; $P_{NL} = 80$ W

For OC test: $P_{NL} = V_{NL} I_{NL} \cdot \cos\phi$

$\cos\phi$ = pf on LV side

$$= \frac{80}{250 \times 1} = 0.32$$

**7. (c)**

In an ideal transformer there is no-loss (either in winding or core). The leakage reactance is also zero (as no-voltage drop).

Magnetizing current is zero due to infinite permeability of core.

**8. (c)**

$$\text{kVA shared} \propto \frac{1}{\text{leakage impedance}}$$

**9. (c)**

Given, $\dfrac{Z_{HV(\Omega)} I_{HV(rated)}}{V_{HV(rated)}} = 0.08$

$$Z_{HV(\Omega)} \cdot I_{HV(rated)} = 0.08\, V_{HV\,(rated)}$$

$$V_{SC} = 0.08 \times 2000 = 160 \text{ V}$$

**10. (b)**

In an ideal transformer,

$$Z \propto N^2$$

Given, on port 2:

$$Z_2 = \omega L \text{ i.e. } Z_2 \propto L$$

$$\frac{N_1}{N_2} = n : 1 = n$$