TRANSFORMERS

1. Two windings of a transformer are designated as
   (*a*) primary and secondary windings
   (*b*) primary and h.v. windings
   (c) secondary and l.v. windings or primary and l.v. windings
   (*d*) h.v. and l.v. windings

2. Two transformers *A* and *B*, having identical ratings, are to be designed with flux densities of 1.2 *T* and 1.4 *T* respectively. The weight of transformer *A* per kVA would be
   (*a*) less than that of transformer *B*
   (*b*) more than that of transformer *B*
   (*c*) equal to that of transformer *B*
   (*d*) may be less or more than that of transformer *B* depending upon other parameters

3. In power transformers, core is made up of
   (*a*) cast iron (*b*) silicon steel (c) ferrite (*d*) powdered alloy

4. Consider the following statements :
   1. Air-core transformers are used in gate-triggering circuits of thyristors
   2. Cores made of soft-ferrite are used in pulse transformers
   3. Air-core transformers are used in radio devices
   4. Cores of powdered alloy are used in isolation transformers

   From above, the correct answer is
   (*a*) 2, 3, 4 (*b*) 2, 3 (c) 1, 3, 4 (*d*) 2, 4

5. For a given cross-sectional area of transformer core, stepped cores are used
   (*a*) to reduce the core loss
   (*b*) to provide more mechanical strength to the core
   (c) to reduce the conductor material and therefore I^2R loss
   (*d*) to reduce the magnetizing current

6. In single-phase core-type transformers, LV and HV windings are arranged as under
   (*a*) L.V. on one core-limb, H.V. on the other core-limb
   (*b*) half H.V. near the core and half L.V. outside the H.V. on each limb
   (c) L.V. and H.V. winding sections are sandwiched
   (*d*) half L.V. near the core and half H.V. outside the L.V. on each limb

7. A 400/200 V, 50 Hz transformer operates at a flux density of 1.2 T when energised from its H.V. side. For this transformer, linear dimensions of core are doubled while the number of turns are halved on both its H.V. and L.V. sides. If this transformer is now connected to 800 V, 50 Hz on its H.V. side, then its flux density would be
   (*a*) 0.6 T (*b*) 1.2 T (c) 3.6 T (*d*) 4.8 T

8. For core-type power transformers, both primary and secondary windings have circular coil sections, because this section
   (*a*) is easier to wind
   (*b*) requires minimum conductor material and, therefore, less I^2R loss
   (c) has the strongest mechanical shape
   (*d*) results in less core material and, therefore, less core loss

9. Transformer action requires a
   (*a*) constant magnetic flux (*b*) increasing magnetic flux
   (c) alternating magnetic flux (*d*) alternating electric flux

10. In a single-phase transformer, with subscripts 1 and 2 for primary and secondary windings,
   (*a*) $E_1 N_2 = E_2 N_1$ and $I_1 N_1 = I_2 N_2$ (*b*) $E_1 N_1 = E_2 N_2$ and $I_1 N_1 = I_2 N_2$
   (c) $E_1 N_2 = E_2 N_1$ and $I_1 N_2 = I_2 N_1$ (*d*) $E_1 N_1 = E_2 N_2$ and $I_1 N_2 = I_2 N_1$

11. The flux involved in the emf equation of a transformer has
   (*a*) rms value (*b*) average value(c) total value (*d*) maximum value

1→d 2→b 3→b 4→b 5→c 6→d
7→b 8→c 9→c 10→a 11→d

12. For understanding the behaviour of a transformer, the following laws may be called for
1. Lenz's law
2. Newton's second law
3. Faraday's law of electromagnetic induction
4. Ohm's law
5. Fleming's right-hand rule
6. Right-hand grip rule

From these, the correct answer is
(*a*) 1, 3, 4 (*b*) 2, 3, 4, 5 (*c*) 1, 3, 4, 5, 6 (*d*) 1, 3, 4, 6

13. In an ideal transformer, if K is some constant, then the supply voltage V, in terms of its magnetizing current I_m can be expressed as
(*a*) $jKf\,I_m$ (*b*) $\frac{jK \cdot f}{I_m}$ (*c*) $-jKf\,I_m$ (*d*) $-\frac{jK \cdot f}{I_m}$

14. In an ideal transformer, the impedance can be transformed from one side to the other
(*a*) in direct proportion to square of turns-ratio
(*b*) in direct proportion to turns-ratio
(*c*) in inverse proportion to square of turns-ratio
(*d*) in inverse proportion to turns-ratio

15. Distribution transformers are designed to have
(*a*) core loss $P_c >$ full-load ohmic loss P_{oh}
(*b*) $P_c < P_{oh}$
(*c*) $P_c = P_{oh}$
(*d*) P_c negligible as compared to P_{oh}

16. A transformer has sometimes two or more ratings depending upon the use of
(*a*) the cooling techniques
(*b*) the type of windings
(*c*) the type of core
(*d*) the type of insulation

17. In a transformer, exciting current is made up of two components ; namely magnetizing current I_m and core-loss current I_c. With negligible leakage impedance drop,
(*a*) both I_m and I_c lag supply voltage V_1 by 90°
(*b*) both I_m and I_c are in phase with V_1
(*c*) I_m lags V_1 by 90° whereas I_c is in phase with V_1
(*d*) I_m is in phase with V_1 but I_c lags V_1 by 90°.

18. A transformer at no load is excited at rated voltage. Now a cut is made in the transformer yoke thus creating a small air gap. With this, the transformer core flux
(*a*) will decrease and magnetizing current I_m will increase
(*b*) will remain constant and I_m will increase
(*c*) as well as I_m both will increase
(*d*) as well as I_m both will decrease

19. If the secondary winding of the ideal transformer shown in the circuit of Fig. C.42 has 40 turns, the number of turns in the primary winding for maximum power transfer to the 2 Ω resistor will be
(*a*) 20 (*b*) 40 (*c*) 80 (*d*) 160

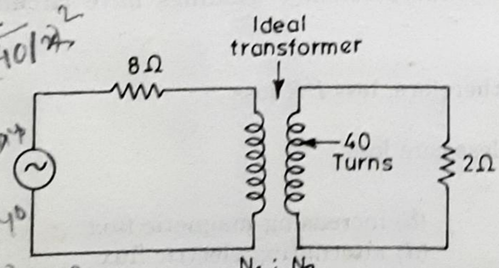


Fig. C.42.

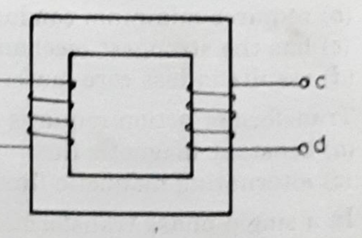


Fig. C.43.

20. In a single-phase transformer, polarities of terminals *a* and *b* at any instant are shown in the Fig. C.43. At the same instant,
(*a*) *c* is positive, *d* is positive and flux is clock-wise (*cw*)
(*b*) *c* is negative, *d* positive and flux is counterclock-wise
(*c*) *c* is negative, *d* is positive and flux is *cw*

(*d*) c is positive, *d* is negative and flux is *ccw*.

21. In an oil-filled transformer, oil is provided for
(*a*) cooling (*b*) insulation
(*c*) both cooling and insulation (*d*) preventing the accumulation of dust

22. Transformers cores are laminated to reduce
(*a*) eddy-current loss (*b*) hysteresis loss
(*c*) both eddy-current and hysteresis loss (*d*) ohmic loss

23. CRGO laminations in a transformer are used to minimise
(*a*) eddy-current loss (*b*) hysteresis loss
(*c*) both eddy-current and hysteresis losses (*d*) ohmic loss

24. In case of a power transformer, the no-load current in terms of rated current is
(*a*) 10 to 20% (*b*) 2 to 6% (*c*) 15 to 30% (*d*) 30 to 50%

25. If a transformer primary is energised from a square-wave voltage source, then its output voltage will be
(*a*) zero (*b*) a sine wave
(*c*) a triangular wave (*d*) a pulsed wave

26. The primary (220 V side) of a 220/6 V, 50 Hz transformer is connected to 110 V, 60 Hz source. The secondary output voltage will be
(*a*) 3.6 V (*b*) 3.0 V (*c*) 2.5 V (*d*) 1.667 V

27. The no-load current in a transformer lags the applied voltage by
(*a*) 90° (*b*) about 75° (*c*) 0° (*d*) about 110°

28. A transformer has N_1 and N_2 turns in primary and secondary windings respectively. Its secondary-winding reactance x_2 Ω, when referred to primary, is
(*a*) $x_2\left(\frac{N_2}{N_1}\right)^2$ (*b*) $x_2\frac{N_2}{N_1}$
(*c*) $x_2\left(\frac{N_1}{N_2}\right)^2$ (*d*) $x_2\frac{N_1}{N_2}$

29. A 400/200 V transformer has total resistance of 0.02 pu on its l.v. side. This resistance when referred to h.v. side would be
(*a*) 0.02 (*b*) 0.04 (*c*) 0.01 (*d*) 0.08

30. The leakage flux in a transformer depends upon
(*a*) the applied voltage (*b*) the frequency
(*c*) the load current (*d*) the mutual flux

31. The useful flux of a transformer is 1 Wb. When it is loaded at 0.8 pf lag, then its mutual flux
(*a*) may decrease to 0.8 Wb (*b*) may increase to 1.01 Wb
(*c*) remains constant (*d*) may decrease to 0.99 Wb

32. If, in a transformer P_c = core loss and P_{sc} = full-load ohmic loss, then maximum kVA delivered to the load at maximum efficiency is equal to rated kVA multiplied by
(*a*) $\frac{P_c}{P_{sc}}$ (*b*) $\left(\frac{P_c}{P_{sc}}\right)^2$ (*c*) $\sqrt{\frac{P_c}{P_{sc}}}$ (*d*) $\sqrt{\frac{P_{sc}}{P_c}}$

33. Two transformers of the same type, using the same grade of iron and conductor materials are designed to work at the same flux and current densities ; but the linear dimensions of one are two times those of the other in all respects. The ratio of kVA ratings of the two transformer closely equals
(*a*) 16 (*b*) 8 (*c*) 4 (*d*) 2

34. A 3 : 1 transformer has impedance of (1 + *j* 5) Ω on the l.v. side and (9 + *j* 45) Ω on the h.v. side. The total equivalent impedance at the h.v. terminals is
(*a*) 18 + *j* 90 Ω (*b*) 2 + *j* 10 Ω
(*c*) 10 + *j* 50 Ω (*d*) 8 + *j* 40 Ω

35. A 220/440 V, 50 Hz, 5 kVA, single-phase transformer operates on 220 V, 40 Hz supply with secondary winding open-circuited. Then
(*a*) both eddy-current and hysteresis losses decrease
(*b*) both eddy-current and hysteresis losses increase
(*c*) eddy-current loss remains the same but hysteresis loss increases
(*d*) eddy-current loss increases but hysteresis loss remains the same

36. The hysteresis and eddy-current losses of a single-phase transformer working on 200 V, 50 Hz supply are P_h and P_e respectively. The percentage decrease in these, when operated on a 160 V, 40 Hz supply are
(*a*) 32, 36 (*b*) 20, 36
(*c*) 25, 50 (*d*) 40, 80

37. 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*) $\sqrt{\frac{P_c}{r_e}}$ (*b*) $\sqrt{\frac{P_c}{x_e}}$
(*c*) $\frac{P_c}{r_e}$ (*d*) $\frac{P_c}{x_e}$

38. The maximum efficiency for a transformer occurs at 80% of full load. Its core loss is P_c and ohmic loss is P_{oh}. For this transformer, the ratio $\frac{P_c}{P_{oh}}$ is
(*a*) 0.8 (*b*) 1.25 (*c*) 0.64 (*d*) 0.8944

39. Frequency of the supply voltage to a transformer at no load is increased but the supply voltage is held fixed. With this
(1) eddy-current loss remains constant but hysteresis loss increases
(2) eddy-current loss remains constant but hysteresis loss decreases
(3) magnetizing current increases but core-loss current decreases
(4) both magnetizing and core-loss currents decrease.
From these, the correct answer is
(*a*) 2, 3 (*b*) 2, 4 (*c*) 1, 3 (*d*) 1, 4

40. The voltage applied to a transformer primary is increased keeping $\frac{V}{f}$ constant. With this, the core loss will
(*a*) decrease and magnetizing current I_m will increase
(*b*) increase and I_m will also increase
(*c*) remain constant and I_m will also remain constant
(*d*) increase and I_m will remain constant

41. A 4 kVA, 400/200 V, 1-phase transformer has leakage impedance of 0.02 + *j* 0.04 per unit. This leakage impedance in ohms, when referred to h.v. side is
(*a*) 0.8 + *j* 1.6 Ω (*b*) 0.2 + *j* 0.4 Ω
(*c*) 0.08 + *j* 0.16 Ω (*d*) 1 + *j* 2 Ω

42. As the load on a transformer is increased, the core losses
(*a*) decrease slightly
(*b*) increase slightly
(*c*) remain constant
(*d*) may decrease or increase slightly depending upon the nature of load.

43. For the system shown in Fig. C.44, the phase relation of current *I* with respect to the voltage V_{AB} is
(*a*) zero (*b*) 90° lead
(*c*) 90° lag (*d*) 180°

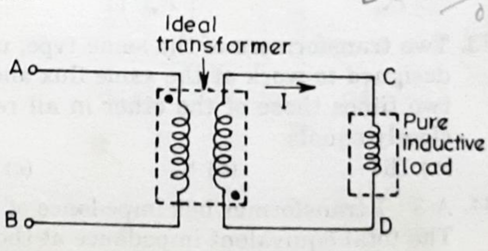


Fig. C.44.

35→c 36→b 37→a 38→c 39→b 40→d
41→a 42→d 43→b

44. Two transformers X and Y with identical ratings and dimensions have 0.8 mm and 1.2 mm thick laminations respectively. If R_c and X_m are the magnetizing branch parameters in the equivalent circuit, then
(*a*) R_c values in both are likely to be equal, but X_m of X is likely to be higher than X_m of Y
(*b*) X_m values in both are likely to be equal, but R_c of X is likely to be higher than R_c of Y
(*c*) X_m values in both are likely to be equal, but R_c of X is likely to be lower than R_c of Y
(*d*) R_c values in both are likely to be equal, but X_m of X is likely to be lower than X_m of Y

45. If the applied voltage of a certain transformer is increased by 50% and the frequency is reduced to 50% (assuming that magnetic circuit remains unsaturated), the maximum core flux density will
(*a*) change to three times the original value
(*b*) change to 1.5 times the original value
(*c*) change to 0.5 times the original value
(*d*) remains the same as the original value

46. In a transformer, low-voltage winding is placed near the core in case of concentric windings so as to
1. reduce the leakage flux
2. reduce the insulation requirement
3. reduce the risk of voltage shock in case of insulation breakdown
4. reduce the core loss
5. reduce the total conductor material

From these, the correct answer is
(*a*) 1, 2, 3, 5 (*b*) 2, 3, 4, 5 (*c*) 1, 2, 3, 4, 5 (*d*) 2, 3, 5

47. Can a 50 Hz transformer be used for 25 Hz, if the input voltage is maintained constant at the rated value corresponding to 50 Hz?
(*a*) Yes. Since the voltage is constant, current levels will not change
(*b*) No. Flux will be doubled which will drive the core to excessive saturation
(*c*) No. Owing to decreased reactance of transformer, input current will be doubled at load
(*d*) Yes. At constant voltage, insulation will not be overstressed.

48. Voltage applied to the primary of a transformer is kept constant but its frequency is decreased. Under this operation,
(*a*) magnetizing current increases but core-loss current decreases
(*b*) magnetizing current decreases but core-loss current increases
(*c*) magnetizing current and core-loss current both decrease
(*d*) magnetizing current and core-loss current both increase

49. In a transformer, if primary leakage impedance is neglected, then
1. magnetizing current lags the applied voltage V_1 by 90°
2. core-loss current lags V_1 by 90°
3. exciting current lags V_1 by 90°
4. core-loss current is in phase with V_1
5. exciting current lags V_1 by about 80°
6. magnetizing current lags V_1 by about 80°

From these, the correct statements are
(*a*) 1, 4, 5 (*b*) 3, 4, 6 (*c*) 1, 4 (*d*) 1, 2, 6

50. A transformer secondary is connected to pure resistive load. The power factor on the primary side will be
(*a*) near about 0.95 lead (*b*) near about 0.95 lag
(*c*) zero (*d*) unity

51. If supply frequency in a transformer is doubled
(*a*) hysteresis loss also doubles
(*b*) eddy-current loss doubles
(*c*) iron-losses double
(*d*) hysteresis loss decreases

52. A 50 Hz transformer having equal hysteresis and eddy-current losses at rated excitation is operated at 45 Hz at 90% of rated voltage compared to rated operating point, the core loss under this condition
(*a*) reduces by 10%
(*b*) reduces by 19%
(*c*) reduces by 14.5%
(*d*) remains unchanged [*GATE, 1998*]

53. For the purpose of analysis, exact equivalent circuit of a transformer is usually replaced by an approximate equivalent circuit. In doing so, errors introduced due to winding ohmic loss and core loss are of differential nature. Due to this, the analysis by approximate equivalent circuit gives fairly satisfactory results. Under the circumstances, which one of the following statements is correct in respect of losses referred to approximate equivalent circuit as compared to exact equivalent circuit ?
(*a*) This accounts for somewhat greater primary winding ohmic loss and less core loss.
(*b*) This accounts for somewhat less primary-winding ohmic loss and more core loss.
(*c*) This accounts for somewhat greater secondary-winding ohmic loss and less core loss.
(*d*) This accounts for somewhat less secondary-winding ohmic loss and more core loss.

54. In a 1-phase transformer, the magnitude of leakage reactance is twice that of resistance of both primary and secondary. With secondary short-circuited, the input pf is
(*a*) $\frac{1}{\sqrt{2}}$
(*b*) $\frac{1}{\sqrt{5}}$
(*c*) $\frac{2}{\sqrt{5}}$
(*d*) $\frac{1}{3}$

55. High leakage-impedance transformers are used for applications such as
(*a*) power distribution
(*b*) electric toys
(*c*) fluorescent lamps
(*d*) arc welding

56. In an ideal transformer shown in Fig. C.45,
(*a*) $V_1 = a\,V_2, \bar{I}_2 = -\,a\,\bar{I}_1$
(*b*) $V_2 = a\,V_1, \bar{I}_2 = -\,a\,\bar{I}_1$
(*c*) $V_1 = a\,V_2, \bar{I}_2 = \frac{1}{a}\bar{I}_1$
(*d*) $V_1 = a\,V_2, \bar{I}_2 = -\frac{1}{a}\bar{I}_1$

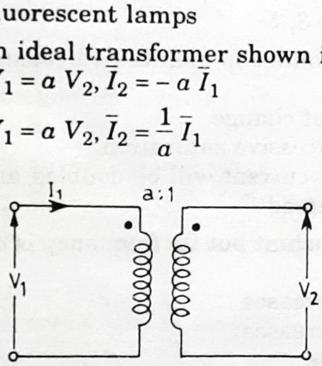


Fig. C.45.

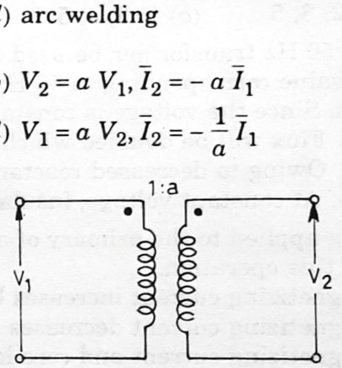


Fig. C.46.

57. In an ideal transformer shown in Fig. C.46
(*a*) $V_1 = a\,V_2, \bar{I}_2 = -\,a\,\bar{I}_1$
(*b*) $V_2 = a\,V_1, \bar{I}_2 = -\,a\,\bar{I}_1$
(*c*) $V_1 = a\,V_2, \bar{I}_2 = \frac{1}{a}\bar{I}_1$
(*d*) $V_2 = a\,V_1, \bar{I}_2 = -\frac{1}{a}\bar{I}_1$

58. When compared with power transformer, a distribution transformer has
(*a*) low %age impedance and high I^2R loss to core-loss ratio
(*b*) high %age impedance and high I^2R loss to core-loss ratio
(*c*) high %age impedance and low I^2R loss to core-loss ratio
(*d*) low %age impedance and low I^2R loss to core-loss ratio

59. Following statements are made regarding the open-circuit test on a 1-phase transformer :
1. It is performed on l.v. side
2. It is performed at rated current
3. It helps in the calculation of equivalent leakage impedance

4. It is performed on h.v. side
5. It is performed at rated voltage
6. It gives magnetizing current and core loss
7. It helps in the determination of voltage regulation
8. It gives turns ratio

From these, the correct answer is
(*a*) 1, 5, 6, 8 (*b*) 2, 4, 6, 8 (*c*) 3, 4, 5, 6, 8 (*d*) 1, 5, 7, 8

60. Following statements are made regarding the short-circuit test on a 1-phase transformer :
1. H.V. side is short circuited
2. It is performed at rated current
3. It gives the core loss
4. L.V. side is short-circuited
5. It is performed at rated voltage
6. It gives ohmic loss on the side instruments are connected
7. It helps in the calculation of voltage regulation

From these, the correct answer is
(*a*) 1, 2, 6, 7 (*b*) 2, 3, 4, 7 (*c*) 4, 5, 6, 7 (*d*) 2, 4, 7

61. A 10 kVA, 400/200 V, single-phase transformer with 10% leakage impedance draws a steady short-circuit line current of
(*a*) 50 A (*b*) 150 A (*c*) 250 A (*d*) 350 A

62. While performing the open-circuit and short-circuit tests on a transformer to determine its parameters, the status of the low-voltage (L.V.) and high-voltage (H.V.) windings will be such that
(*a*) in O.C., L.V. is open and in S.C., H.V. is shorted
(*b*) in O.C., H.V. is open and in S.C., L.V. is shorted
(*c*) in O.C., L.V. is open and in S.C., L.V. is shorted
(*d*) in O.C., H.V. is open and in S.C., H.V. is shorted

63. A multimeter, for measuring resistance, is connected to one terminal of primary and the other terminal of secondary. The multimeter reading would be
(*a*) zero (*b*) infinity
(*c*) zero or infinity (*d*) equal to the resistance of the windings

64. For given base voltage and base volt-amperes, the per unit leakage impedance of a transformer is x. What will be the per unit leakage impedance of this transformer when the voltage and volt-ampere bases are both doubled ?
(*a*) $0.5\,x$ (*b*) $2\,x$ (*c*) $4\,x$ (*d*) x

65. At 50 Hz operation, a single-phase transformer has hysteresis loss of 200 W and eddy-current loss of 100 W. Its core loss at 60 Hz operation will be
(*a*) 432 W (*b*) 408 W (*c*) 384 W (*d*) 360 W [*I.E.S., 1995*]

66. The hysteresis and eddy-current losses of 1-phase transformer working on 200 V, 50 Hz supply are P_h and P_e respectively. The percentage decrease in these losses when operated on a 160 V, 40 Hz supply would respectively be
(*a*) 32, 36 (*b*) 20, 36 (*c*) 25, 50 (*d*) 40, 80 [*I.E.S., 2001*]

67. In a transformer, eddy-current loss is 100 watts which is half of the total core loss. If both the thickness of laminations and frequency are increased by 10%, the new core-loss would be
(*a*) 256.41 W (*b*) 231 W (*c*) 267.41 W (*d*) 242 W

68. A 220/115 V, 25 Hz, 1-phase transformer has eddy-current loss of 100 W which is half of the no-load loss at rated applied voltage. If this transformer is used with primary connected to 440 V, 50 Hz mains, the total no-load loss would be
(*a*) 300 W (*b*) 600 W (*c*) 1000 W (*d*) 400 W

69. A 220 V, 50 Hz transformer with 0.35 mm thick laminations has eddy-current loss of 120 watts which is two-third of the total loss at no-load. If this transformer is built with 0.7 mm thick laminations and is worked from 110 V, 25 Hz, then total no-load loss would be
(*a*) 150 W (*b*) 510 W (*c*) 200 W (*d*) 45 W

70. A transformer, fed from an alternator at 230 V, 50 Hz, has eddy-current loss of 50 W and hysteresis loss of 100 W. If the speed of the prime-mover driving the alternator drops to 80% of its previous speed, then eddy-current and hysteresis losses in the transformer would respectively be
(*a*) 40 W, 80 W (*b*) 32 W, 80 W (*c*) 32 W, 64 W (*d*) 40 W, 64 W

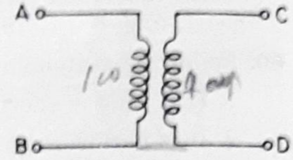


Fig. C.47.

71. Two windings of a transformer are indicated by terminals *AB* and *CD* as shown in Fig. C.47. When a voltage of 100 V is applied across *AB* with *BD* short-circuited, a voltage of 200 V appears across *AC*. The turns ratio from *CD* to *AB* is
(*a*) 3 (*b*) 1 (*c*) 3 or 1 (*d*) 2 or 1

72. In question 71, if voltage appearing across terminals *AC* is 100 V with input to *AB* as 100 V, then the turns ratio from *CD* to *AB* is
(*a*) 2 (*b*) 1
(*c*) 2 or 1 (*d*) 3 or 1

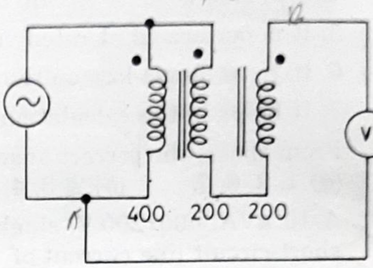


Fig. C.48.

73. A 400 V/200 V/200 V, 50 Hz, three-winding transformer is connected as shown in Fig. C.48. The reading of the voltmeter *V* will be
(*a*) 0 V (*b*) 400 V
(*c*) 600 V (*d*) 800 V

74. A transformer has leakage impedance of $z_e = r_e + jx_e$. Its maximum voltage regulation occurs at a power factor of
(*a*) $\frac{r_e}{x_e}$ leading (*b*) $\frac{r_e}{z_e}$ lagging (*c*) $\frac{x_e}{z_e}$ leading (*d*) $\frac{r_e}{z_e}$ leading

75. A transformer has leakage impedance of $z_e = r_e + j\,x_e$. Zero voltage regulation for this transformer occurs at a pf of
(*a*) $\frac{r_e}{x_e}$ leading (*b*) $\frac{r_3}{z_e}$ lagging (*c*) $\frac{x_e}{z_e}$ leading (*d*) $\frac{r_e}{z_e}$ leading

76. A 1-phase transformer has p.u. leakage impedance of $0.02 + j\,0.04$. Its regulation at pf 0.8 lagging and 0.8 leading are respectively
(*a*) 4%, 0.8% (*b*) 4%, – 0.8% (*c*) 2.4%, – 0.8% (*d*) 4%, – 1%

77. A 10 kVA, 400 V/200 V, 1-phase transformer with a percentage resistance of 3% and percentage reactance of 6% is supplying a current of 50 A to a resistive load. The value of the load voltage is
(*a*) 194 V (*b*) 390 V (*c*) 192 V (*d*) 196 V

78. In a transformer, $r_{e2} + j\,x_{e2}$ = equivalent leakage impedance z_{e2}. Its maximum voltage regulation is equal to
(*a*) r_{e2} at $\frac{r_{e2}}{z_{e2}}$ lagging pf (*b*) x_{e2} at $\frac{x_{e2}}{z_{e2}}$ lagging pf
(*c*) z_{e2} at $\frac{r_{e2}}{z_{e2}}$ leading pf (*d*) z_{e2} at $\frac{r_{e2}}{z_{e2}}$ lagging pf

79. Full-load voltage regulation of a power transformer is zero when power factor of the load is near
(*a*) unity and leading (*b*) zero and leading
(*c*) zero and lagging (*d*) unity and lagging

80. A 5 kVA, 250/125 V, 1-phase transformer has leakage impedance of $(0.02 + j\,0.8)$ p.u.. Its value in ohm referred to h.v. side is
(a) $0.2 + j\,0.8$ (b) $0.25 + j\,1$ (c) $0.02 + j\,0.08$ (d) $0.0625 + j\,0.25$

81. The voltage regulation of a transformer is given by
(a) $\frac{E_2 - V_2}{V_2}$ (b) $\frac{E_2 - V_2}{E_2}$ (c) $\frac{V_2 - E_2}{V_2}$ (d) $\frac{V_2 - E_2}{E_2}$

82. The voltage regulation of a transformer at full-load 0.8 pf lagging is 4%. Its voltage regulation at full-load 0.8 pf leading
(a) will be positive (b) will be negative
(c) may be positive (d) may be negative

83. The voltage regulation of a transformer depends on its
1. equivalent reactance 2. equivalent resistance 3. load power factor
4. transformer size 5. load current
From these, the correct answer is
(a) 1, 2, 3, 5 (b) 1, 2, 3, 4, 5 (c) 1, 2, 4, 5 (d) 1, 2, 3, 4

84. The voltage regulation of a transformer at full load and 0.8 pf lagging is 2.5%. The voltage regulation at full load 0.8 pf leading will be
(a) – 2.5% (b) zero (c) – 0.9% (d) 2.5%

85. In Sumpner's test on two identical transformers having rated frequency f,
(a) both the primaries and the regulating transformer should be fed from voltage sources of frequency f
(b) both the primaries and the regulating transformer may be fed from voltage sources at frequencies different from f
(c) both the primaries should be fed from voltage source at frequency f but regulating transformer may be fed at a frequency different from f
(d) both the primaries may be fed from voltage source at a frequency different from f but regulating transformer should be fed at f

86. The efficiency of a transformer at full load 0.8 pf lag is 90%. Its efficiency at full load 0.8 pf lead will be
(a) somewhat less than 90% (b) somewhat more than 90%
(c) 90% (d) 91%

87. Transformer maximum efficiency, for a constant load current, occurs at
(a) at any pf (b) zero pf leading
(c) zero pf lagging (d) unity pf

88. One transformer has leakage impedance of $1 + j\,4\ \Omega$ and $3 + j\,11\ \Omega$ for its primary and secondary windings respectively. This transformer has
(a) h.v. primary (b) medium voltage primary
(c) l.v. primary (d) l.v. secondary

89. Transformer at no-load behaves like
(a) a resistor, pf = 0 (b) an inductive reactor, pf = 0.2 lagging
(c) a capacitive reactor, pf = 0.2 leading (d) an inductive reactor, pf = 0.8 lagging

90. In a transformer, the tappings are provided on
(a) h.v. side at one end of the winding (b) l.v. side at one end of the winding
(c) h.v. side at the middle (d) l.v. side at the middle

91. In transformers, the windings are tapped in the middle
(a) to avoid the radial forces on the windings
(b) to eliminate the axial forces on the windings
(c) to reduce the insulation level of the windings
(d) to provide a mechanical balance to the windings

92. In transformers, tappings are provided on the h.v. side because
1. it has larger number of turns which allow smoother control of output voltage

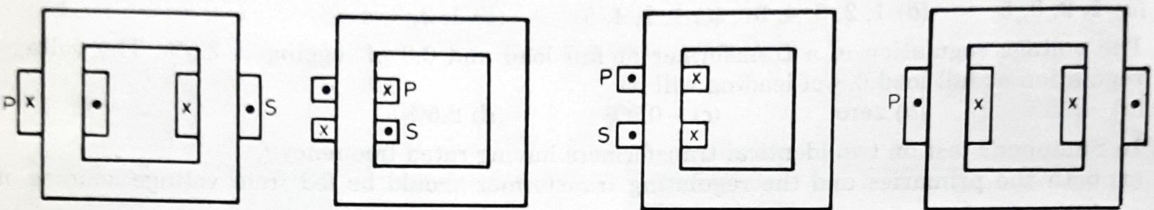
2. it has to handle low value of currents
3. it is easily accessible for repairs
4. it requires less insulation

From these, the correct answer is

(a) 1, 2, 3, 4 (b) 2, 3, 4 (c) 1, 2, 4 (d) 1, 2, 3

93. When a transformer winding suffers a short circuit, the adjoining turns of the same winding experience
(a) an attractive force
(b) a repulsive force
(c) no force
(d) may be attractive or repulsive depending upon the current directions

94. The relative current directions through the primary (P) and secondary (S) of a 1-phase transformer connected to a resistive load on the secondary side, are indicated in the various cross-sectional views given in Fig. C.49. Which of these are correct representations ?



(a) (b) (c) (d)

Fig. C.49.

95. Short-circuit test on a single-phase transformer gave the following data :

30 V at 50 Hz, 20 A, $pf = 0.2$ lag

If s.c. test is performed on 30 V, 25 Hz, then short-circuit current
(a) decreases at a pf < 0.2
(b) increases at a pf < 0.2
(c) increases at a pf > 0.2
(d) decreases at a pf > 0.2

96. Open-circuit test on a single-phase transformer gave the following data :

230 V at 50 Hz, 2 A, pf = 0.2 lag

If open-circuit test is performed on 230 V, 45 Hz, then no-load current
(a) decreases at a pf > 0.2
(b) decreases at a pf < 0.2
(c) increases at a pf > 0.2
(d) increases at a pf < 0.2

97. When short-circuit test on a transformer is performed at 25 V, 50 Hz ; then drawn current 'I_1' is at a lagging pf-angle of ϕ_1. If the test is performed at 25 V, 25 Hz and the drawn current 'I_2' is at a lagging pf-angle of ϕ_2, then
(a) $I_2 > I_1$ and $\phi_2 < \phi_1$
(b) $I_2 < I_1$ and $\phi_2 < \phi_1$
(c) $I_2 > I_1$ and $\phi_2 > \phi_1$
(d) $I_2 < I_1$ and $\phi_2 > \phi_1$

98. Two transformers to be operated in parallel have their secondary no-load emfs E_a for transformer A and E_b for transformer B. As E_a is somewhat more than E_b, a circulating current I_c is established at no load which tends to

(a) boost both E_a and E_b with $I_c = \dfrac{\overline{E}_a - \overline{E}_b}{z_{ea} + z_{eb}}$

(b) boost E_a and buck E_b with $I_c = \dfrac{\overline{E}_a - \overline{E}_b}{z_{ea} + z_{eb}}$

(c) buck E_a and boost E_b with $I_c = \dfrac{\overline{E}_a - \overline{E}_b}{z_{ea} + z_{eb}}$

(d) buck both E_a and E_b with $I_c = \dfrac{\overline{E}_b - \overline{E}_a}{z_{ea} + z_{eb}}$

99 → c 100 → b 101 → c 102 → d 103 → c
104 → d 105 → c 106 → a

99. Two transformers of identical voltages but of different capacities are operating in parallel. For satisfactory load sharing,
(*a*) impedances must be equal
(*b*) per-unit impedances must be equal
(*c*) per-unit impedances and $\frac{X}{R}$ ratios must be equal
(*d*) impedances and $\frac{X}{R}$ ratios must be equal

100. Two transformers of different kVA ratings working in parallel share the load in proportion to their ratings when their
1. per unit leakage impedances on the same kVA base are equal
2. per unit leakage impedances based on their respective kVA ratings are equal
3. ohmic values of the leakage impedances are inversely proportional to their ratings
4. ohmic values of the magnetizing reactances are the same.

From these, the correct answer is
(*a*) 1, 3, 4 (*b*) 2, 3 (*c*) 2, 3, 4 (*d*) 1, 4 [*GATE, 1992*]

101. Transformer operating in parallel will share a common load in the best possible manner if
(*a*) the leakage impedances are proportional to their respective kVA ratings
(*b*) the leakage impedances are equal
(*c*) per unit leakage impedances are equal
(*d*) per unit leakage impedances are proportional to their respective kVA ratings

102. The necessary conditions for parallel operation of two 1-phase transformers is that these should have the same
1. polarity 2. kVA rating 3. voltage regulation
4. efficiencies 5. voltage ratio 6. $\frac{X}{R}$ ratio

From these, the correct answer is
(*a*) 1, 2, 3, 4, 5, 6 (*b*) 1, 2, 5, 6
(*c*) 1, 5, 6 (*d*) 1, 3, 5, 6

103. For successful parallel operation of two single-phase transformers, the essential condition is that their
(*a*) percentage impedances should be equal (*b*) turns ratio should be exactly equal
(*c*) polarities must be properly connected (*d*) kVA ratings should be equal

104. Two transformers operating in parallel have different quality of their leakage impedances. For a load pf of 0.8,
(*a*) both would operate at pfs less than 0.8
(*b*) both would operate at pfs more than 0.8
(*c*) both would operate at the same pfs
(*d*) one would operate at pf > 0.8 and the other at pf < 0.8

105. Two 1-phase transformers with equal turns ratio have impedances of $(0.5 + j\,3)\ \Omega$ and $(0.6 + j\,10)\ \Omega$ with respect to the secondary. If they operate in parallel, how will they share a load of 100 kW at 0.8 pf lagging ?
(*a*) 50 kW, 50 kW (*b*) 62 kW, 38 kW
(*c*) 78.2 kW, 21.8 kW (*d*) 85.5 kW, 14.5 kW [*I.E.S., 1992*]

106. A single-phase transformer, with kVA rating K, has voltage rating of V_1/V_2. This transformer can be connected as an autotransformer to get two possible voltage ratings of $\frac{V_1 + V_2}{V_2}$ and $\frac{V_1 + V_2}{V_1}$. The respective kVA ratings as an autotransformer are
(*a*) $\frac{V_1 + V_2}{V_1}K,\ \frac{V_1 + V_2}{V_2}K$ (*b*) $\frac{V_1 + V_2}{V_2}K,\ \frac{V_1 + V_2}{V_1}K$

(c) $\frac{V_1 - V_2}{V_1} K, \frac{V_1 - V_2}{V_2} K$ (d) $\frac{V_1 + V_2}{V_2 \cdot K}, \frac{V_1 + V_2}{V_2 \cdot K}$

107. A 400 V/100 V, 10 kVA, two-winding transformer is reconnected as an autotransformer across a suitable voltage. The maximum rating of such a transformer could be
(a) 50 kVA (b) 15 kVA (c) 12.5 kVA (d) 8.75 kVA

108. An autotransformer having a transformation ratio of 0.8 supplies a load of 10 kW. The power transferred inductively from the primary to the secondary is
(a) 10 kW (b) 8 kW (c) 2 kW (d) zero

109. A single-phase transformer has a rating of 15 kVA, 600 V/120 V. It is reconnected as an autotransformer to supply at 720 V from a 600 V primary source. The maximum load it can supply is
(a) 90 kVA (b) 180 kVA (c) 15 kVA (d) 18 kVA

110. In an autotransformer of voltage ratio $\frac{V_1}{V_2}$ and $V_1 > V_2$, the fraction of power transferred inductively is
(a) $\frac{V_1}{V_1 + V_2}$ (b) $\frac{V_2}{V_1}$ (c) $\frac{V_1 - V_2}{V_1 + V_2}$ (d) $\frac{V_1 - V_2}{V_1}$

111. A 10 kVA step down autotransformer has voltage ratio of 0.7. The transformed and conducted kVA can be respectively
(a) 3, 7 (b) 7, 3 (c) 5, 5 (d) 3.5, 6.5

112. A supply of 100 V can be obtained from a source of 300 V, by means of a two-winding transformer or an autotransformer. The ratio of weights of conductor material in the autotransformer with respect to two-winding transformer is
(a) 1 : 1.5 (b) 1.5 : 1 (c) 3 : 1 (d) 1 : 3

113. In an autotransformer of voltage ratio V_1/V_2 with $V_1 > V_2$, the conducted power in terms of total power is
(a) $\frac{V_1}{V_2}$ (b) $\frac{V_2}{V_1}$ (c) $\frac{V_1 - V_2}{V_1}$ (d) $\frac{V_1 - V_2}{V_2}$

114. A 20 kVA, 2300 V/230 V, two winding transformer is to be used as an autotransformer to give 2300 V/2530 V. Its rating will be
(a) 200 kVA with conducted kVA = 20 (b) 200 kVA with conducted kVA = 180
(c) 220 kVA with conducted kVA = 20 (d) 220 kVA with conducted kVA = 200

115. Single-phase supply of 220 V, 50 Hz is to be obtained from 400 V, 50 Hz source. The ratio of weight of conductor material in a two-winding transformer to that required in an autotransformer is
(a) $\frac{20}{9}$ (b) $\frac{9}{20}$ (c) $\frac{20}{11}$ (d) 2

116. A 400 V/200 V transformer has a full-load voltage regulation of x p.u. at 0.8 pf lagging. If this transformer is used as an autotransformer with voltage rating 400 V/600 V or 200 V/600 V, then its voltage regulation would be
(a) $\frac{x}{3}, \frac{x}{3}$ (b) $\frac{2x}{3}, \frac{x}{3}$ (c) $\frac{2x}{3}, \frac{2x}{3}$ (d) $\frac{x}{3}, \frac{2x}{3}$

117. An autotransformer has V_1, I_1 as input quantities and V_2, I_2 as output quantities with $V_2 < V_1$. The VA conducted from input to output is
(a) $V_1 I_2$ (b) $V_2 I_1$ (c) $V_1 I_1 - V_2 I_2$ (d) $(V_1 - V_2) I_1$

118. An autotransformer has V_1, I_1 as input quantities and V_2, I_2 as output quantities with $V_2 < V_1$. The VA transformed from primary to secondary is
(a) $V_1 I_2$ (b) $V_2 I_1$ (c) $V_1 I_1 - V_2 I_2$ (d) $(V_1 - V_2) I_1$

119. The efficiency of a 100 kVA transformer is 0.98 at full as well as half load. For this transformer at full load, the ohmic loss
(*a*) is less than core loss
(*b*) is equal to core loss
(*c*) is more than core loss
(*d*) none of the above

120. A 40 kVA transformer has a core loss of 400 W and a full-load copper loss of 800 W. The proportion of full-load at maximum efficiency is
(*a*) 50% (*b*) 62.3% (*c*) 70.7% (*d*) 100%

121. Consider the following statements about induction regulators :
1. Compensating windings are needed in single-phase induction regulators (IR).
2. In single-phase IR, secondary induced voltage E_2 is in phase with the applied voltage V_1.
3. In single-phase IR, magnitude of E_2 remains constant with the rotor movement.
4. In 3-phase IR, magnitude of E_2 varies with rotor position.
5. In 3-phase IR, E_2 is not in phase with V_1 except when $\theta = 0°$ or $180°$.

From these, the correct statements are
(*a*) 1, 3, 5 (*b*) 2, 3, 4 (*c*) 1, 2, 4 (*d*) 1, 2, 5

122. In a tap changer, the voltage at consumers terminals is kept within the prescribed limits by varying the
(*a*) ratio of turns between primary and secondary windings
(*b*) frequency
(*c*) flux density in the core
(*d*) angle between the magnetic axes of the primary and secondary windings

123. A single-phase induction regulator is a constant-voltage input transformer to obtain smooth variation of the output voltage by varying the
(*a*) ratio of turns between primary and secondary windings
(*b*) frequency
(*c*) flux density in the core
(*d*) angle between the magnetic axes of the primary and secondary windings

124. A line voltage regulator is to be used in a 1-phase, 200 V, 5 kVA system to keep the voltage constant for voltage variation within ± 10%. The rating (in kVA) of the voltage regulator is
(*a*) 0.05 (*b*) 0.5 (*c*) 5 (*d*) 50

125. A 3-phase induction voltage regulator needed to regulate 100 kVA between the voltage limits 1200 and 800 V has a rating of
(*a*) 10 kVA (*b*) 20 kVA (*c*) 5 kVA (*d*) 30 kVA

126. A 3-phase delta-star transformer has secondary to primary turns ratio per phase of 5. For a primary voltage of 400 V, the secondary voltage would be
(*a*) 2000 V (*b*) 80 V (*c*) 3464 V (*d*) 80 $\sqrt{3}$ V

127. A 3-phase star-delta transformer has secondary to primary turns ratio per phase of 5. For a primary voltage of 400 V, the secondary voltage would be
(*a*) 3464 V (*b*) 1154.7 V (*c*) 2000 V (*d*) 46.2 V

128. A 3-phase delta-star transformer has secondary to primary turns ratio per phase of 5. For a primary line current of 10 A, the secondary line current would be
(*a*) 2 A (*b*) 3.464 A (*c*) 1.633 A (*d*) 1.155 A

129. A 3-phase star-delta transformer has primary to secondary turns ratio per phase of 5. For a primary line current of 10 A, the secondary line current would be
(*a*) 50 A (*b*) 86.6 A (*c*) 3.464 A (*d*) 150 A

130. In transformers, the noise or hum is produced primarily due to
(*a*) improper tightening of core laminations
(*b*) magnetostriction
(*c*) tank walls
(*d*) loose bolts etc.

131. Match the items on the left-hand side with the most appropriate item on the right-hand side

	Type		*Application*
A.	Power transformer	1.	Thyristor firing circuits
B.	Distribution transformer	2.	Impedance matching
C.	Pulse transformer	3.	At different city localities
D.	Audio-frequency transformer	4.	At generating stations

132. Which of the following statements are incorrect ?

1. Maximum voltage regulation of a transformer occurs at leading power factor
2. Voltage regulation of a transformer is the maximum when load power-factor (lagging) angle has the same value as the angle of equivalent impedance
3. Voltage regulation of a transformer at zero power factor is always zero
4. Voltage regulation of a transformer can be negative at leading power factor

Select the correct answer using the codes given below :

Codes :

(*a*) 1 and 3 (*b*) 2 and 3 (*c*) 2 and 4 (*d*) 1 and 4 [*I.A.S.*, 199

133. When a short-circuit test is conducted on a single-phase transformer, 30% of the rated voltag is required to allow full-load current. The short-circuit power factor is found to be 0.2. Th percentage regulation at UPF is

(*a*) 30 (*b*) 29.5 (*c*) 15 (*d*) 6 [*I.A.S.*, 1993

134. A bank of three identical single-phase 250 kVA, 11 kV/230 V transformer is used to provid 400 V low-tension supply from a 11 kV, 3-phase sub-station. The effective kVA rating of the ban will be

(*a*) 250 (*b*) 250 $\sqrt{3}$ (*c*) 500 (*d*) 750 [*I.A.S.*, 1994

135. A transformer designed for operation of 60 Hz supply is worked on 50 Hz supply system withou changing its voltage and current ratings. When compared with full-load efficiency at 60 Hz, th transformer efficiency on full load at 50 Hz will

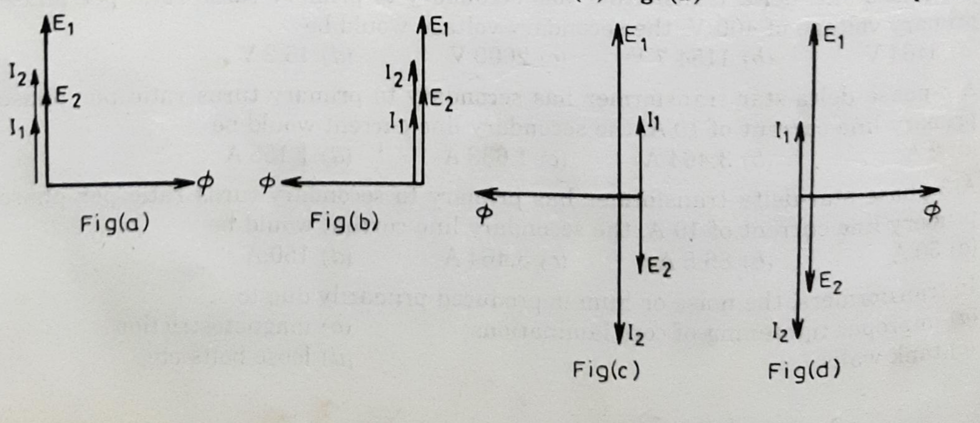
(*a*) increase marginally (*b*) increase by a factor of 1.2
(*c*) remain unaltered (*d*) decrease marginally

136. The voltage regulation of a large transformer is mainly influenced by

(*a*) no-load current and load power factor
(*b*) winding resistances and load power factor
(*c*) leakage fluxes and load power factor
(*d*) winding resistances and core loss

137. Fig. C.50 shows an ideal single-phase transformer. The primary and secondary coils are wounc on the core as shown. Turns ratio $(N_1/N_2) = 2$. The correct phasors of voltages E_1, E_2, currents I_1, I_2 and core flux ϕ are as shown in

(*a*) Fig. (*a*) (*b*) Fig. (*b*) (*c*) Fig. (*c*) (*d*) Fig. (*d*) [*GATE*, 2003



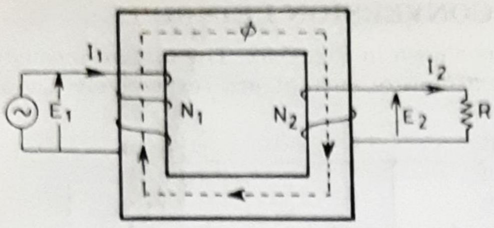


Fig. C.50.

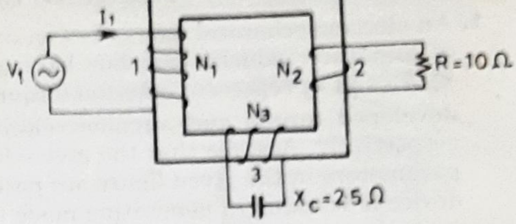


Fig. C.51.

138. Fig. C.51 shows an ideal transformer. The three windings 1, 2, 3 of the transformer are wound on the same core as shown. The turns ratio $N_1 : N_2 : N_3$ is 4 : 2 : 1. A resistor of 10 Ω is connected across winding-2. A capacitor of reactance 2.5 Ω is connected across winding-3. Winding-1 is connected across a 400 V, ac supply. If the supply voltage phasor $V_1 = 400 \angle 0°$, the supply current I_1 is given by

(a) $(-10 + j\,10)\,A$ (b) $(-10 - j\,10)\,A$
(c) $(10 + j\,10)\,A$ (d) $(10 - j\,10)\,A$ [GATE, 2003]

139. A single-phase transformer has a maximum efficiency of 90% at full load and unity power factor. Efficiency at half load at the same power factor is

(a) 86.7% (b) 88.26% (c) 88.9% (d) 87.8% [GATE, 2003]

ANSWERS

1. (d)	2. (b)	3. (b)	4. (b)	5. (c)
6. (d)	7. (b)	8. (c)	9. (c)	10. (a)
11. (d)	12. (d)	13. (a)	14. (a)	15. (b)
16. (a)	17. (c)	18. (b)	19. (c)	20. (c)
21. (c)	22. (a)	23. (c)	24. (b)	25. (d)
26. (b)	27. (b)	28. (c)	29. (a)	30. (c)
31. (d)	32. (c)	33. (a)	34. (a)	35. (c)
36. (b)	37. (a)	38. (c)	39. (b)	40. (d)
41. (a)	42. (d)	43. (b)	44. (c)	45. (a)
46. (d)	47. (b)	48. (d)	49. (a)	50. (b)
51. (d)	52. (c)	53. (b)	54. (b)	55. (d)
56. (a)	57. (d)	58. (a)	59. (a)	60. (d)
61. (c)	62. (b)	63. (b)	64. (a)	65. (c)
66. (b)	67. (a)	68. (b)	69. (a)	70. (b)
71. (c)	72. (a)	73. (a)	74. (b)	75. (c)
76. (b)	77. (a)	78. (d)	79. (a)	80. (b)
81. (b)	82. (d)	83. (a)	84. (c)	85. (c)
86. (a)	87. (d)	88. (c)	89. (b)	90. (c)
91. (b)	92. (d)	93. (a)	94. (a) & (b)	95. (c)
96. (d)	97. (a)	98. (c)	99. (c)	100. (b)
101. (c)	102. (d)	103. (c)	104. (d)	105. (c)
106. (a)	107. (a)	108. (c)	109. (a)	110. (d)
111. (a)	112. (a)	113. (b)	114. (d)	115. (a)
116. (d)	117. (b)	118. (d)	119. (c)	120. (c)
121. (d)	122. (a)	123. (d)	124. (b)	125. (b)
126. (c)	127. (b)	128. (d)	129. (b)	130. (b)
131. $A \rightarrow 4, B \rightarrow 3, C \rightarrow 1, D \rightarrow 2$		132. (a)	133. (d)	134. (d)
135. (d)	136. (c)	137. (d)	138. (d)	139. (d)