PRACTICE QUESTIONS

for SSC-JE : CBT-2

Transformers + DC Machines

Electrical Engineering

03 Transformers + DC Machines

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 In an auto-transformer, power is transferred, through
(a) Conduction process only
(b) Induction process only
(c) Both conduction and induction processes
(d) Mutual coupling

Q.4 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.5 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.6 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.7 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.8 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.9 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.10 The inrush current of transformer at no load is maximum if supply voltage is switched on
(a) at zero voltage
(b) at maximum voltage value
(c) at 0.66 times voltage value
(d) at half voltage value

Q.11 The efficiency of transformer during no load and short-circuit test is
(a) maximum
(b) 50%
(c) zero
(d) none of the above

Q.12 During open-circuit test in a transformer the wattmeter used is of
(a) low p.f. wattmeter type
(b) high p.f. wattmeter type
(c) medium p.f. wattmeter type
(d) very high p.f. wattmeter type

Q.13 Short circuit current in an auto transformer is
(a) greater than that in a two winding transformer
(b) lower than that in a two winding transformer
(c) equal to that in a two winding transformer
(d) twice the no load current in a two winding transformer

Q.14 Sumpner's test on two identical transformers yields information about
(a) core loss only
(b) full-load copper loss only
(c) both core loss and full-loss copper loss
(d) it yields no information on losses

Q.15 No load current in a transformer
(a) lags the applied voltage by 90°
(b) lags the applied voltage by somewhat less than 90°
(c) leads the applied voltage by 90°
(d) leads the applied voltages by somewhat less than 90°

Q.16 In the core-type two winding transformer, the low voltage winding is placed adjacent to the steel core, in order to
(a) facilitate dissipation of heat during the operation of the transformer.
(b) minimize the amount of insulation required.
(c) reduce the chances of axial displacement with respect to the high voltage winding placed outside.
(d) reduce the mutual radial stress between the two windings.

Q.17 Equalizer rings are required in a lap wound dc machines
(a) to improve commutation
(b) to filter out harmonics
(c) to prevent the flow of circulating currents through brushes
(d) to reduce armature reaction

Q.18 During plugging in dc motors, the effective voltage across the armature is
(a) E_b (b) $E_b + V$
(c) $V - E_b$ (d) $E_b + \frac{V}{2}$

Q.19 When is the mechanical power developed by a d.c. motor maximum?
(a) Back e.m.f. is equal to applied voltage
(b) Back e.m.f. is equal to zero
(c) Back e.m.f. is equal to half the applied voltage
(d) None of the above

Q.20 A DC series motor has linear magnetization and negligible armature resistance. The motor speed is
(a) directly proportional to $\sqrt{T}$
(b) inversely proportional to T
(c) directly proportion to T
(d) inversely proportional to $\sqrt{T}$

Q.21 The direction of rotation of a d.c. series motor can be reversed
(a) By interchanging supply terminals
(b) By interchanging field terminals
(c) Either by interchanging supply terminals or by interchanging field terminals
(d) By interchanging supply terminals as well as field terminals

Q.22 A 4-pole lap wound dc shunt motor rotates at a speed of 750 rpm, has a flux of 0.6 m Wb and the total no. of conductors are 2000. The back emf generated is
(a) 20 V (b) 15 V
(c) 80 V (d) 10 V

Q.23 Which one of the following is the correct statement?
Field control of dc shunt motor gives
(a) constant kW drive
(b) constant torque drive
(c) constant speed drive
(d) variable load speed drive

Q.24 The dc motor, which can provide zero speed regulation at full load without any controller is
(a) series
(b) shunt
(c) cumulative compound
(d) differential compound

Q.25 The critical resistance in a dc shunt generator is
(a) the resistance of the field circuit.
(b) the value of field circuit resistance above which the generator would fail to excite.
(c) the value of field circuit resistance below which the generator would fail to excite.
(d) the value of field circuit resistance for which the generator no-load voltage equals the rated voltage.

Q.26 A series motor is drawing a load current of 1 A from the supply lines. If now the load is reduced such that the current drawn is halved, the speed of the machine (neglecting the saturation and armature resistance) would be
(a) unchanged
(b) reduced by 100%
(c) increased by 100%
(d) reduced by 50%

Q.27 For a dc shunt machine given stray loss = 150 W, full load Copper loss = 400 W, Brush loss = 50 W, field loss = 200 W. To get the maximum efficeincy at full load the Iron loss is
(a) 40 W (b) 50 W
(c) 60 W (d) 70 W

Q.28 The armature MMF waveform of a dc machine is
(a) Pulsating (b) Rectangular
(c) Triangular (d) Sinusoidal

Q.29 For a given torque, reducing the diverter-resistance of a d.c. series motor
(a) increases its speed but armature current remains the same
(b) increases its speed demanding more armature current
(c) decreases its speed demanding less armature current
(d) decreases its speed but armature current remains the same

Q.30 In Hopkinson's test on two identical dc shunt motors
(a) iron losses in both machines are equal.
(b) iron loss in the generating machine is more than that in the motoring machine.
(c) iron loss in the motoring machine is more than that in the generating machine.
(d) only stray-load components of iron loss in both machines are equal.

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Answer Keys

1.	(b)	**2.**	(c)	**3.**	(c)	**4.**	(d)	**5.**	(d)	**6.**	(c)	**7.**	(b)
8.	(c)	**9.**	(c)	**10.**	(a)	**11.**	(c)	**12.**	(a)	**13.**	(a)	**14.**	(c)
15.	(b)	**16.**	(b)	**17.**	(c)	**18.**	(b)	**19.**	(c)	**20.**	(d)	**21.**	(c)
22.	(b)	**23.**	(a)	**24.**	(d)	**25.**	(b)	**26.**	(c)	**27.**	(b)	**28.**	(c)
29.	(b)	**30.**	(b)										

Detailed Solutions

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 $\frac{P_i}{P_c} = 1$

3. (c)

In transformer there is no direct connection between primary and secondary. So the power only transferred through induction. But in Auto transformer there is a conductive path between primary and secondary. So power transferred through both conduction and induction.

4. (d)

At η_{max},

$$\text{Copper loss} = \text{Iron loss}$$

or, $I_m^2 r_e = P_c$

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

5. (d)

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

6. (c)

For maximum efficiency at full load

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

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

$$= 150 + 150$$

$$= 300 \text{ W}$$

7. (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

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

8. (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.

9. (c)

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

10. (a)

The inrush current of the transformer at no load is maximum when the supply voltage is switched on at the instant of zero crossing and going to positive peak.

11. (c)

SC test is carried out to determine the full load copper loss and OC test or NL test to determine core loss. During these tests, power required is used to determine the losses and efficiency will be zero.

12. (a)

During open circuit test or no load test, it is recommended to use low power factor wattmeter. This is because NL power factor is very low and thus less deflecting torque ($T_d \propto I_1 I_2 \cos\phi$) will be there. Hence LPF wattmeters employed for OC test. On the other hand, for short circuit test, high pf wattmeters are employed.

13. (a)

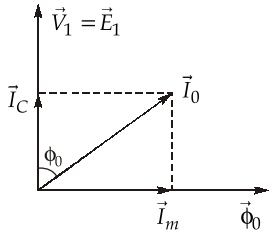
This is one of the disadvantages of an auto transformer. The short circuit current in an auto transformer is higher than that in a corresponding two winding transformer.

14. (c)

Sumpner's test (or back to back test) on two identical transformer's yields information about the iron loss, copper loss and heat run or temperature rise test can be performed.

15. (b)

No load phasor diagram:



Here, no load current (I_0) cannot lag $\vec{V}_1$ by 90° because of core loss. In practical transformer,

$$\theta_0 = 80° - 85°$$

16. (b)

The leakage in the flux is reduced by bringing the two coils closer. In a core type transformer this is achieved by winding half low voltage (LV) and half high voltage (HV) winding on each limb of the core. The LV winding is wound on the inside and HV on the outside to reduce the amount of insulation needed. Insulation between the core and the inner winding is then stressed to low voltage.

17. (c)

Equalizer rings are required in a lap wound dc machines in order to prevent the flow of circulating currents though brushes, commutator or armature windings.

18. (b)

In this method of braking, the armature terminals of a separately excited (or shunt) motor are reversed. Thus during braking, effective voltage across the armature will be $(V + E_b)$, which is almost twice the supply voltage.

19. (c)

$\because$
$$P_{out} = E_b \cdot I_a = (V - I_a R_a)$$
$$= VI_a - I_a^2 R_a$$

For maximum power output,

$$\frac{d}{dI_a}(P_{out}) = 0$$
$$V - 2I_a \cdot R_a = 0$$
$\Rightarrow$
$$I_a = \frac{V}{2R_a}$$
$\because$
$$E_b = V - I_a R_a$$
$$= V - \frac{V}{2} = \frac{V}{2}$$

20. (d)

For series motor, $T \rightarrow$ Torque

$$T \propto I_a^2$$

or, $$I_a \propto \sqrt{T} \quad \text{...(i)}$$

and also, $$E_b \propto N\phi$$

or $$E_b \propto NI_a \quad (\text{as } \phi \propto I_a)$$

$$N \propto \frac{E_b}{I_a}$$

From equation (i),

$$N \propto \frac{E_b}{\sqrt{T}}$$

21. (c)

In general Torque $\propto \phi_1 . \phi_2$ so by changing the direction of any of the two fluxes the direction of rotation of a dc series motor can be reversed.

22. (b)

$$\text{Back emf, } E_b = \frac{P\phi NZ}{60A}$$

($A = P$ for lap winding)

$$= \frac{0.6\times10^{-3}\times750\times2000}{60} = 15 \text{ V}$$

23. (a)

The induced back emf,

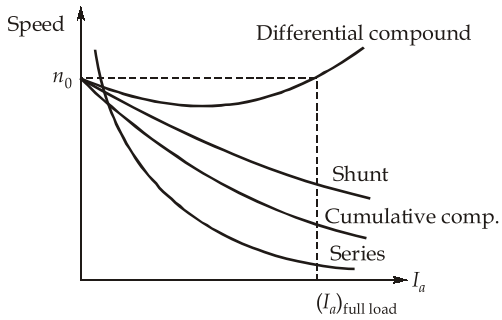
$$E_a = K_a \phi \omega_m$$

For field control, E_a remains constant as a decrease in flux leads to increase in speed. If armature current is kept rated then $E_a I_a \rightarrow$ constant

$E_a I_a \rightarrow$ Power output

24. (d)

Speed-current characteristics of DC motors



It can be seen from the characteristics, speed regulation can be zero at full load in the case of differential compound dc motor.

25. (b)

For $R_F > R_{FC}$, failure of generated voltage. If field resistance will be more than its critical field resistance then failure of voltage building up in shunt generator.

26. (c)

If the armature reaction is ignored then,

$$E_a \approx \text{Constant} \approx V$$

Now, $E_a \propto \phi\ N$

Since saturation is neglected,

therefore $\phi \propto I_a$

and $E_a = \text{Constant}$

$\therefore$ $N_2 I_{a2} = N_1 I_{a1}$

or, $N_2 = N_1 \times \dfrac{I_{a1}}{I_{a2}} = N_1 \times \dfrac{I}{1/2I} = 2N_1$

or, $N_2 = 2N_1$

Hence, speed becomes two times, i.e. increases by 100%.

27. (b)

For maximum efficiency,

Constant loss = losses proportional to square of variable

Cu loss = I^2R

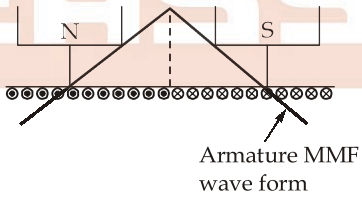
Brush loss $\propto I$ (so it is not included in constant losses)

So, Constant loss = $150 + 200 + P_i$

$150 + 200 + P_i = 400$

$P_i = 50$ W

28. (c)



Armature MMF wave form

29. (b)

$T \propto \phi . I_a$; reducing the diverter-resistance reduces the ϕ, so for a given load torque, I_a would increase. Further, $\omega_m \propto \dfrac{1}{\phi}$ so speed would also increase.

30. (b)

In Hopkinson's method of testing, generator field current is greater than the motor field current. Since both the machines are running at the same speed, the generator iron losses ($\propto$ speed and flux) are more than the motor iron losses.

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