BYJU'S EXAM PREP

AE/JE Foundation

Electrical Engineering

Electrical Machines

100 Most Important Questions

1. The internal characteristics of a dc generator is plotted between the

A. armature current and voltage generated after armature reaction

B. field current and voltage generated at no load

C. field current and voltage generated on load

D. armature current and voltage generated at the output terminals

Ans. A

Sol. Internal characteristic of a dc generator is plotted between the armature current and voltage generated after armature reaction.

2. In a dc machines the field flux axis and armature mmf axis are respectively along.

A. Direct axis and indirect axis

B. Direct axis and interpolar axis

C. Quadrature axis and direct axis

D. Quadrature axis and interpolar axis.

Ans. B

Sol.

The field flux axis lies along d- axis and armature mmf axis lies along q-axis/ interpolar axis.

3. Which of the following DC generator is not suitable for parallel operation.

A. Shunt generator

B. Over compound generator

C. Under compound generator

D. All of the above are suitable

Ans. B

Sol.

For parallel operation, Voltage characteristics of the generator should be drooping in nature. Over compound generator has rising characteristics, so not suitable for parallel operation.

4. The circuit element which is determined by conducting DC test on stator side of induction machine.

A. Magnetizing reactance.

B. Rotor resistance.

C. Stator resistance.

D. Stator reactance.

Ans. C

Sol.

The circuit element which is determined by conducting DC test on induction machine is stator resistance.

5. The slip of an induction motor while conducting blocked rotor test will be:

A. s = 0

B. s = 1

C. s = 0.2

D. Cannot be determined

Ans. B

Sol.

At blocked rotor test, speed of motor; N = 0

$$s = \frac{N_s - N}{N_s} = \frac{N_s - 0}{N_s} = 1$$

6. In 3Φ phase Y connected structure with frequency 60 Hz and 2 pole is required for starting torque is 1.6 times the full load torque and maximum torque is 2 times the full load torque. The slip at maximum torque will be:

A. 0.5

B. 0.7

C. 0.9

D. 1.01

Ans. A

Sol. From the question:

$T_{start} = 1.6(T_d)$

$T_{dmax} = 2(T_d)$

So, $0.8(s_{Tmax}^2) - 2(s_{Tmax}) + 1 = 0$

$S_{Tmax} = 2$ or 0.5

It is noted that as slip for normal motor ranges between 0 and 1, $s_{Tmax} = 0.5$

7. In which of the following motors diverters are uses?

A. Series motor

B. Shunt motor

C. Compound motor

D. All the above

Ans. A

Sol. In series motor for controlling speed we use diverters. These are not used in shunt motors if we connect the total current will flow through the diverter and almost short circuit and shunt field winding and leads to high speed. So, we use it in series motor.

8. A Doubly excited salient pole motor will have

A. reluctance torque

B. mutual torque

C. reluctance torque followed by mutual torque

D. reluctance torque & mutual torque at the same instant.

Ans. D

Sol.

\# Salient pole synchronous motor

⇒ In salient pole synchronous motor armature is excited with A.C source & field is excited with DC. Hence it is also called doubly excited machine.

⇒ mutual torque or Electromagnetic torque, the torque which is produced by electric & magnetic field mutually is called mutual torque.

\# Reluctance torque

When the motor is rotating and A.C. excitation is cut-off then reluctance torque will come into actions

⇒ The reluctance torque will be in the same direction of rotor rotation

9. In transformer, which of the following statements is valid?

A. In an open circuit test, copper losses are onbtained while in short circuit test, core losses are obtained

B. In an open circuit test, current is drawn at high power factor

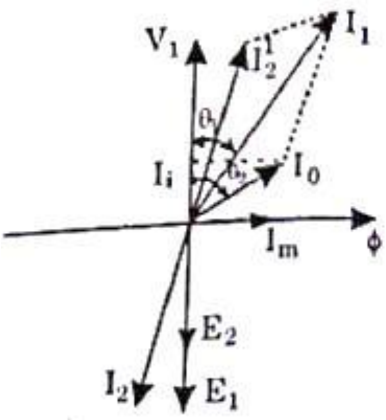
C. In a short circuit test, current is drawn at zero power factor

D. In an open circuit test, current is drawn at low power factor

Ans. D

Sol. In SC test, I_1 (FLC) is drawn at angle θ_1

In OC test, only I_0 (NLC) is drawn at angle θ_2



$\theta_2 > \theta_1$

So, $\cos\theta_2 < \cos\theta_1$

So current is drawn a low power factor.

10. The applied voltage of a certain transformer is increased by 75%, while the frequency of the applied voltage is reduced by 25%. The maximum core flux density will

A. Increase by 2 times

B. Increase by 2.33 times

C. Reduce to 3 quarter

D. Remain the same

Ans. B

Sol. $E = 4.44\, f\, N\phi_{max}$ ....(1)

applied voltage of a certain transformer is increased by 75% so E_{new} = 1.75 E

frequency of the applied voltage is reduced by 25% So f_{new} = 0.75f

Since the magnetic Flux density directly proportional to magnetic flux so **B α Φ**.

Φ α E/f

So B_{new} **α E_{new}/f_{new} = 1.75 E / 0.75f = 2.33 times of B.**

Hence, option (B) is correct.

11. The speed of a dc shunt motor may be varied be varying

1) Field current

2) Armature voltage control

3) Armature circuit resistance

Select the correct statements :

A. 1, 2 and 3

B. 1 and 2 only

C. 1 and 3 only

D. 2 and 3 only

Ans. A

Sol.

Speed of a de shunt motor may be varied by flux control, armature voltage control and armature-resistance control.

12. Stepped core is used in transformers in order to reduce.

A. volume of iron

B. Volume of copper

C. iron loss

D. reluctance of core

Ans. B

Sol. Stepped core reduces the area of the core and more of the limb can be utilized for placing the windings. Thus lesser copper (mean turn wise) will be used and cost will reduce.

The core area also can be better utilized for cooling purposes and mechanically the core structure will be stable with stackings intact.

13. A coil of 160° pitch has 5th harmonic pitch factor

A. 0.984

B. 0.642

C. 0.173

D. 0.787

Ans. B

Sol.

Coil span = 160°

Short pitch by = 180 – 160° = 20°

Pitch factor of 5th harmonic

$$K_{P_5} = \cos\frac{5\alpha}{2} = \cos\frac{5\times 20}{2}$$

$$K_{P_5} = \cos 50^{\circ} = 0.642$$

14. Induction motor can be self starting, if it uses:

A. capacitor in series with auxiliary winding and it is in parallel with main winding

B. auxiliary winding in parallel with main winding

C. auxiliary winding in series with capacitor and main winding

D. none of above

Ans. A

Sol. In single phase induction motor, there is no self-starting quality since initial torque is zero. it can be make self starting by auxiliary winding in series with capacitor and whole combination in parallel with main winding

15. The full-load copper losses and iron losses of a single phase transformer are 3200 W and 800 W respectively. find the copper loss and iron loss at one-fourth load will be

A. 200 W , 50 W

B. 200 W , 800 W

C. 800 W , 800 W

D. 800 W , 200 W

Ans. B

Sol. Iron loss does not depend upon the load and it remains constant so, iron losses at one-fourth load = 800 W

full load copper losses = 3200 W

copper losses at one-fourth load = $\left(\frac{1}{4}\right)^2 P_{cufl} = 200\ W$

16. The primary and secondary windings of an Auto transformer are

A. magnetically coupled

B. electrically coupled

C. both magnetically and electrically coupled

D. None of these

Ans. C

Sol.

The primary and secondary winding of an autotransformer are both magnetically and electrically coupled.

17. The reluctance torque of a 3-φ salient pole synchronous motor with excitation voltage E, terminal voltage V, load angle δ synchronous speed ω_s, quadrature axis reactance, x_q, direct axis reactance x_d is

A. $\frac{v^2}{\omega_s}\left[\frac{1}{x_a} - \frac{1}{x_q}\right] sin\ 2\ \delta$

B. $\frac{V^2}{2\omega_s}\left[\frac{1}{x_a}-\frac{1}{x_q}\right]\sin\delta$

C. $\frac{V^2}{2\omega_s}\left[\frac{1}{x_q}-\frac{1}{x_d}\right]\sin 2\delta$

D. $\frac{V^2}{2\omega_s}\left[\frac{1}{x_q}-\frac{1}{x_d}\right]\sin\quad\delta$

Ans. C

Sol.

The torque equation of the salient pole synchronous machine

$$T=\frac{E_V}{x_d\omega_s}\sin\delta+\frac{V^2}{2\omega_s}\left[\frac{1}{x_q}-\frac{1}{x_d}\right]\sin\quad 2\delta$$

$\Downarrow$ $\Downarrow$

$Electromagneticr\ \ eluc\ tan\, c\ etorque$

$torque(T_{em})$ (T_{rel})

18. In order to build up residual magnetism of self-excited DC generator ___

A. Field winding need to be replaced

B. Reverse the armature connections

C. Reverse the field winding connections

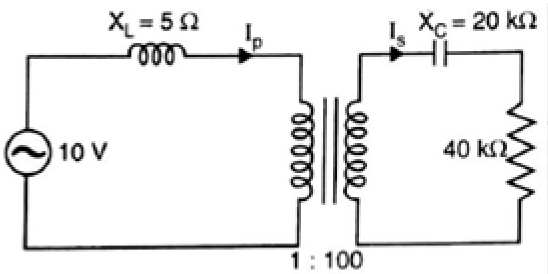
D. Field winding must be excited by low voltage DC supply

Ans. D

Sol.

In DC generator, in order to build up residual magnetism, Field winding must be excited by low voltage DC supply.

19. The impedance seen by the primary in Fig. is......................



A. $5\ \Omega$

B. $25\ \Omega$

C. $625\ \Omega$

D. None of the above

Ans. A

Sol. Let us shift all the impedances to the primary side. Since $N_1/N_2 = 1/100,$ the impedance value are divided by 100^2. Value of resistance when transferred to primary is

$$R' = \frac{40\times10^3}{(100)^2} = 4\ \Omega$$

Value of capacitive reactance when transferred to primary is

$$X'_c = \frac{20\times10^3}{(100)^2} = 2\ \Omega$$

$$\therefore \quad Z = \sqrt{(R')^2 + (X_L + X_C')^2}$$

$$= \sqrt{(4)^2 + (5-2)^2} = 5\ \Omega$$

20. How many segments will be there for the commutator of a 6 pole d.c. machine having a simple wave wound armature with 72 slots?

A. 73

B. 72

C. 71

D. 70

Ans. B

Sol. Number of commutator segments = Number of coils.

Hence, option B is correct.

21. The function of dummy coils in DC machine is-

A. To amplify voltage

B. To reduce eddy current losses

C. To enhance flux density

D. To provide mechanical balance to the rotor.

Ans. D

Sol.

Dummy coils are not electrically connected. The purpose of using it to provide mechanical balance.

22. Consider the following statements regarding transformers:

1) The function of the magnetizing component of no load current is to sustain the alternating flux in the core.

2) Short circuit test is performed to find core losses only.

3) The function of the breather in transformer is to arrest flow of moisture when outside air enters the transformer.

Which of these statements are correct?

A. 1 and 2

B. 1 and 3

C. 2 and 3

D. 1, 2 and 3

Ans. B

Sol. Short circuit test is performed to find copper losses not core losses.

23. In case of Hunting, when there is super synchronous speed, Damper Bar develops

A. Reactance torque

B. Induction motor torque

C. Eddy current torque

D. Induction generator torque

Ans. D

Sol.

In case of rotor speed larger than synchronous speed, induction generator torque is developed in the opposite direction of rotor rotation. In this case rotor decelerate to reach synchronous speed.

24. In case of dc motor, maximum mechanical power is developed when back emf equals

A. the applied voltage

B. half the applied voltage

C. one third of the applied voltage

D. double the applied voltage

Ans. B

Sol.

$$P = EI = E\left(\frac{V - E}{R}\right)$$

$$P = \frac{EV}{R} - \frac{E^2}{R}$$

$$\frac{dP}{dE} = \frac{V}{R} - \frac{2E}{R}$$

Maxima condition for P will be,

$$\frac{dP}{dE} = 0$$

i.e. $E = \frac{V}{2}$

25. Consider the following statements:

1) Salient pole alternators have small diameters and large axial lengths.

2) Cylindrical rotor alternators have a distributed winding.

3) Cylindrical rotor alternators are wound for large number of poles.

4) Salinet pole alternators run at speeds slower than cylindrical rotor machines.

Which of the above statements rotor machines.

A. 1 and 3 only

B. 2 and 4 only

C. 1 and 4 only

D. 2 and 3 only

Ans. B

Sol. 1. Salient pole alternators have large diameters and small axial lengths.

2. Cylindrical rotor alternators have a distributed winding.

3. Number of poles is usually 2 or 4 in Cylindrical rotor alternators. They are smaller in diameter but having longer axial length.

4. Salient pole alternators run at speeds slower than cylindrical rotor machines.

26. For a purely inductive rotor of a 3 – phase induction machine, if rotor power factor angle is 90°, then electromagnetic torque becomes

A. 0

B. Maximum

C. In between minimum to maximum

D. None of the above

Ans. A

Sol.

$$T_e = \frac{\pi}{8} P^2 \phi F_2 \sin(90° + \theta_2)$$

Where θ_2 = Rotor power factor angle = 90° (Given)

So, $Te = \frac{\pi}{8} P^2 \phi F_2 \sin(90° + 90°)$

$$Te = \frac{\pi}{8} P^2 \phi F_2 \sin 1\,80^\circ$$

= 0

27. The number of conductors on each pole piece required in a compensated winding which carries full armature current for an 8-pole lap wound DC armature containing 360 conductors will be ______. (Assume ratio of pole arc to pole pitch = 0.88).

A. 4

B. 5

C. 6

D. 8

Ans. B

Sol.

$$AT/Pole_{(CompensatingWinding)} = \frac{I_a Z}{2AP}\left(\frac{Polearc}{PolePitch}\right)$$

$$Turns/Pole = \frac{Z}{2AP}\left(\frac{Polearc}{PolePitch}\right)$$

$$= \frac{360}{2 \times 8 \times 8} \times 0.88 = 2.5$$

∴ Compensating conductor/pole

= 2 × 2.5 = 5

28. In a single layer, 3-phase winding having 4 slots/pole/phase, the phase spread is

A. π/3

B. π/6

C. 2π/3

D. π/4

Ans. A

Sol.

As we known,

Phase spread = mβ

Where,

m is slots/pole/phase

m = 4

β = slot angle

$$\beta = \frac{180^o}{slots/pale} = \frac{180^o}{4 \times 3} = 15^6$$

Phase spread = 4 × 15 = 60°

In radian, = $60 \times \frac{\pi}{180} = \frac{\pi}{3}$

29. The speed of repulsion motor at no load will be:

A. fairly low

B. low

C. fairly high

D. very high

Ans. D

Sol. Repulsive motor is ideally suited for applications where low voltage is a problem or where high starting torque is needed.

30. Two induction motors of equal number of poles are differentially cascaded and supplied with 50 Hz supply frequency, then speed of cascaded system is ______rpm

A. 0

B. 1000

C. 3000

D. 5000

Ans. A

Sol.

Since $P_1 = P_2$ in differentially cascaded

↓

Output = 0

↓

No Rotation takes place.

31. For an induction machine, acting as a motor, rotor rotates in clockwise direction. If same machine rotates in clockwise direction but at super synchronous speed, then,

1) Slip > 1

2) Machine delivers active power towards supply

3) Theoretical super synchronous speed is Infinite

Choose the correct option

A. 1 only

B. 1 and only

C. 2 and 3 only

D. 1, 2 and 3

Ans. C

Sol.

$$s = \frac{\omega_s - \omega_r}{\omega_s}$$

Since ω_s and ω_r are in same direction (Clockwise) and $\omega_r > \omega_s$; So, s = Negative

So, 1 is incorrect

Under the given conditions, active power delivered to rotor by prime mover is transferred across the air gaps to the stator and from there to supply. So, 2 is correct

3 is correct, since from circle diagram we can see that slip can be ($-\infty$) which indicates that $\omega_r = \infty$.

32. The effect of armature reaction in motors and generators is that:

A. induced emf in coils under the pole tips increases when a pole tip has higher flux density

B. induced emf in coils under the pole tips decreases when a pole tip has higher flux density

C. induced emf in coils under the pole tips increases when a pole tip has lower flux density

D. induced emf in coils under the pole tips decreases when a pole tip has lower flux density

Ans. B

Sol. Interpoles are main field poles and located on yoke between the main field poles. They have windings in series with the armature winding. They reduce the armature reaction effect in commutating zone.

33. The generator efficiency of a shunt generator will be maximum when its variable loss is equal to

A. Constant loss

B. Stray loss

C. Iron loss

D. Friction and windage loss

Ans. A

Sol.

Shunt generator, efficiency.

$$\eta = \frac{VIL}{VIL + I_a^2 R_a + P_c}$$

Pe → constant losses

$\therefore I_L \simeq I_a$

$$\eta = \frac{V}{V + I_L R_a + \frac{P_e}{I_L}}$$

For η_{max}, $f(I_L) = V + I_L r_a + \frac{P_e}{I_L}$ should be minimum.

$$f'(I_L) = R_a - \frac{P_e}{I_L^2} = 0$$

$P_e = I_L^2 R_a$ constant losses = variable losses

34. Consider the following statements:

1) A synchronous motor has no starting torque but when started it always runs at a fixed speed.

2) A single-phase reluctance motor is not self-starting even if paths for eddy currents are provided in the rotor.

3) A single-phase hysteresis motor is self-starting.

Which of these statement(s) is/are correct?

A. 1, 2 and 3

B. 1 only

C. 1 and 2 only

D. 2 and 3 only

Ans. A

35. A dc motor develops an electromagnetic torque of 150 N-m in a certain operating condition. From this operating condition, a 10% reduction in field flux and 50% increase in armature current is made. What will be new value of electromagnetic torque?

A. 225 N-m

B. 202.5 N-m

C. 22.5 N-m

D. 20.25 N-m

Ans. B

Sol.

Torque in D.C. machine $T \propto \phi I_a$

$\phi \rightarrow$ field flux

$I_a \rightarrow$ Armature current

So $T_1 \propto \phi I_a$

$\phi_2 = 0.9\ \phi_1;\ I_{a2} = 1.5\ I_{a1}$

$T_2 \propto (0.9)\,\phi_1\,(1.5)\,I_{a1}$

So $\frac{T_2}{T_1} = 1.35$

$T_2 = 1.35\ T_1 = (1.35)(150)$

$T_2 = 202.5\ \text{N-m}$

36. The air-gap between the yoke and armature in a dc motor is kept small

A. to achieve a stronger magnetic field.

B. to avoid overheating of the machine.

C. to avoid locking of the armature.

D. to avoid transverse motion.

Ans. A

Sol. To achieve a stronger magnetic field, the air gap between the yoke and armature is kept small in rotating machines.

37. What does the SCR (short circuit ratio) of a synchronous machine yield?

A. $\frac{1}{X_s(\text{unsaturated})\text{p.u.}}$

B. $\frac{1}{X_s(\text{unsaturated})\text{in ohm}}$

C. $\frac{1}{X_s(\text{adjusted})\text{p.u.}}$

D. $\frac{1}{X_s(\text{adjusted})\text{in Ohm}}$

Ans. C

Sol. By definition SCR

$$= \frac{(\text{For } V_t \text{ rated on O.C.})\, I_{f_1}}{(\text{For } I_a \text{ rated on O.C.})\, I_{f_2}}$$

$$= \frac{1}{X_s\,(\text{adjusted})\text{ in p.u.}}$$

Using O.C.C. and S.C.C.

$$I_{f_1} = \frac{V_t \text{ rated}}{k_1}; \quad I_{f_2} = \frac{I_a \text{ rated}}{k_2}$$

where, k_1 and k_2 are constants.

X_s adjusted is for I_f at rated V_t

X_s unsaturated is for $I_f =$ const. and

X_s adjusted $< X_s$ unsaturated

38. A 6 pole, 50 Hz 3- φ induction motor has negligible stator impedance. The rotor resistance and reactance are 0.5 Ω and 20 Ω respectively. The speed at which it will develop maximum torque.

A. 1000 RPM

B. 25 RPM

C. 975 RPM

D. 950 RPM

Ans. C

Sol.

Synchronous speed, $N_s = \frac{120 \times f}{P} = \frac{120 \times 50}{6}$

N_s = 1000 RPM

Slip at maximum torque,

$$s_m = \frac{R_2}{X_2}$$

$$s_m = \frac{0.5}{20} = 0.025$$

$$s_m = \frac{N_s - N}{N_s}$$

$N = N_s - sN_s$

= 1000 – 1000 × 0.025

N = 975 RPM

39. A compensated DC generator has 15000 ampere turn/pole, $\frac{Pole arc}{Pole pitch} = 0.7,$ l_{inter} = 1.25 cm, and B = 0.8 T. Find the AT/Pole for the compensating winding and for interpole winding.

A. 12057.7 AT/pole

B. 12787.7 AT/pole

C. 12457.7 AT/pole

D. 12243.7 AT/pole

Ans. C

Sol.

$F_{compensating}$ = 15000 × 0.7 = 10500 AT/pole

$F_{interpole}$ = 15000 × (1 – 0.7) + $\frac{0.8}{4\pi\times10^{-7}} \times 1.25 \times 10^{-2}$ = 12457.7 AT/Pole

40. A three-point starter is suitable for

A. Series Motor

B. Shunt motor

C. Shunt & Compound motor

D. Series, Shunt and Compound motor

Ans. C

Sol.

A three-point starter is used in order to reduce the high initial current.

The 3-point starter is useful for the type of motor which will have shunt field winding i.e., Shunt & Compound motor

It also provides protection to motor from over-Voltage & under-voltage conditions.

41. A capacitor-start single-phase induction motor is used for:

A. Easy to start loads

B. Medium start loads

C. Hard to start loads

D. Any type of start loads

Ans. C

Sol. A capacitor-start single-phase induction motor is used for: Hard to start loads due to high starting torque.

42. Cogging in an induction motor is caused

A. if the number of stator slots are unequal to number of rotor slots.

B. if the number of stator slots are an integral multiple of rotor slots.

C. if the motor is running at fraction of its rated speed.

D. due to 5^{th} harmonic.

Ans. B

Sol. Sometimes, it happens because of low voltage supply. But the main reason for starting problem in motor is because of cogging in which the slots of the stator get locked up with the rotor slots and it is sometimes called magnetic locking of the induction motor.

43. If the wave form of the voltage impressed on the primary of a $Y-\Delta$ bank contains 5^{th} harmonics, what are the wave forms of the resultant voltages of the primary and the secondary?

A. Peaked Peaked

B. Peaked Flat-topped

C. Flat-topped Peaked

D. Flat-topped Flat-topped

Ans. D

Sol. As the applied voltage contains 5^{th} harmonic and the 3^{rd} harmonic is absent in the magnetizing current wave and the flux wave becomes flat topped and hence emf wave also flat topped wave on both the sides.

44. Which of the following statements of the following statements is/are correct.

1) Ward- Leonard method is suitable for constant torque drive.

2) Ward-Leonard method is not suitable for constant power drive.

A. 1 only

B. 2 only

C. 1 and 2 both

D. Neither 1 nor 2

Ans. A

Sol.

Ward-Leonard method is a wide speed control method that control speed above base speed as well as below base speed.

So, It works both as constant torque drive and constant power drive.

45. Two transformers when operating in parallel will share the load depending upon which of the following?

A. Magnetizing current

B. Leakage reactance

C. Per unit impedance

D. Efficiency

Ans. C

Sol. Load sharing not depend on η and magnetizing current. Equivalent impedance also have resistance so option B. Leakage reactance is also not correct.

46. In a DC machine, the yoke carries the flux-

A. φ

B. φ /2

C. 2 φ

D. φ /4

Ans. B

Sol.

The Yoke carries φ/2 flux in DC machine.

47. Which one of the following statements is **not** correct regarding lap and wave winding ?

A. Lap-winding is suitable for high-voltage but low-current generators.

B. Lap-winding is suitable for low-voltage but high-current generators.

C. Wave-winding is used for high-voltage, low-current machines.

D. When large currents are required, it is necessary to use lap-winding.

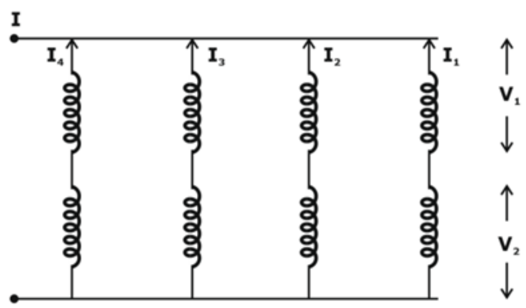
Ans. A

Sol.

Lap winding use for high current and low voltage. In lap winding no. of parallel path are more (A = P). So its current rating is high.

Lap winding → $I = I_1 + I_2 + I_3 + I_4$

$V = V_1 + V_2$

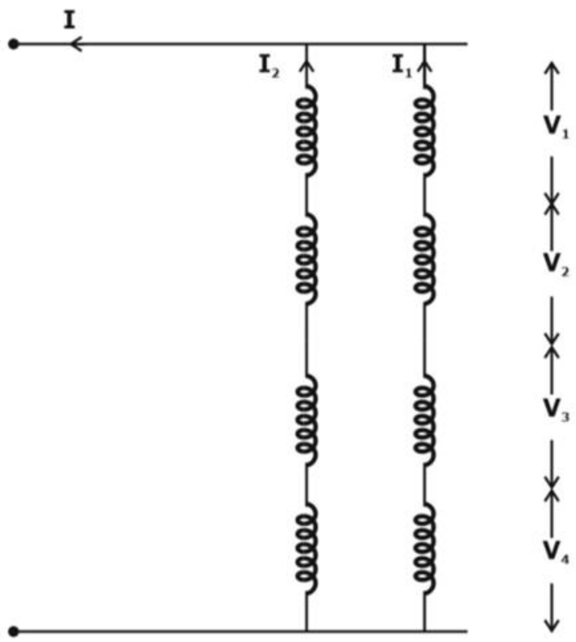


Wave winding use for low current and high voltage. Wave winding has only two parallel path so its current rating is low, its is suitable for low current and high voltage requirement.

A = 2

Wave winding → $V = V_1 + V_2 + V_3 + V_4$

$I = I_1 + I_2$



48. A single phase transformer has a resistance drop of 3% and reactance drop of 4.8%. Determine the voltage regulation at 75% load at 0.866 power factor lag.

A. 4.89%

B. 6.66%

C. 3.82%

D. 1.87%

Ans. B

Sol.

For lagging power factor,

Voltage regulation (V. R) = $\frac{1}{n}\left[R_{pu}\cos\phi + X_{pu}\sin\phi\right]$

% Load, n = 75 % = 0.75

Given, $X_{pu} = \frac{4.8}{100} = 0.048\text{pu}$

$R_{pu} = \frac{3}{100} = 0.03\text{pu}$

$\cos\varphi = 0.866$

$\Rightarrow \varphi = 30°$

$\sin \varphi = 0.5$

$\therefore \text{ V.R} = \frac{1}{0.75}[0.03 \times 0.866 + 0.048 \times 0.5]$

V. R = 0.06664 pu = 6.66%

49. For V-curves for a synchronous motor the graph is drawn between

A. Terminal voltage and load factor

B. Power factor and field current

C. Field current and armature current

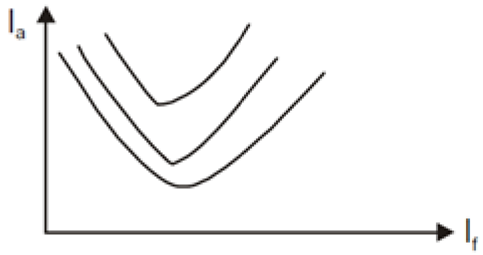
D. Armature current and power factor

Ans. C

Sol.

X – axis → Field Current

Y – axiz → Armature current



50. The rotating magnetic field in Induction machine,

A. has constant magnitude and flows from leading to lagging phase.

B. has constant magnitude and flows from lagging to leading phase.

C. has variable value and flows from leading to lagging phase.

D. has variable value and flows from lagging to leading phase.

Ans. A

Sol.

Rotating magnetic field has a constant magnitude of $1.5\varphi_m$ (φ_{max} is maximum valve of flux) and its direction is from leading to lagging phase.

51. The armature MMF waveform of a dc machine is

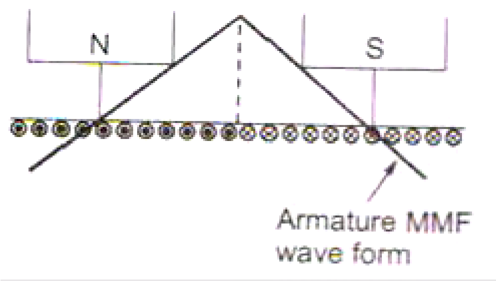
A. Pulsating

B. Rectangular

C. Triangular

D. Sinusoidal

Ans. C

Sol. 

52. A 100 KVA, 11500/2300 V, 1-φ transformer having iron loss 2 KW and full load copper loss 16 kW. The transformer is reconnected as autotransformer to maximize its kVA ratings and operating at half load and 0.8 p.f. lagging. Find the % efficiency of autotransformer.

Sol.

Primary current

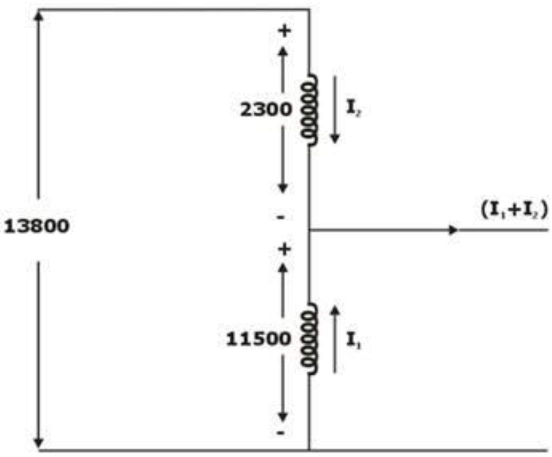
$$I_1 = \frac{100\times10^3}{11500} = 8.695\,\text{A}$$

Secondary Current

$$I_2 = \frac{100\times10^3}{2300} = 43.47\,\text{A}$$

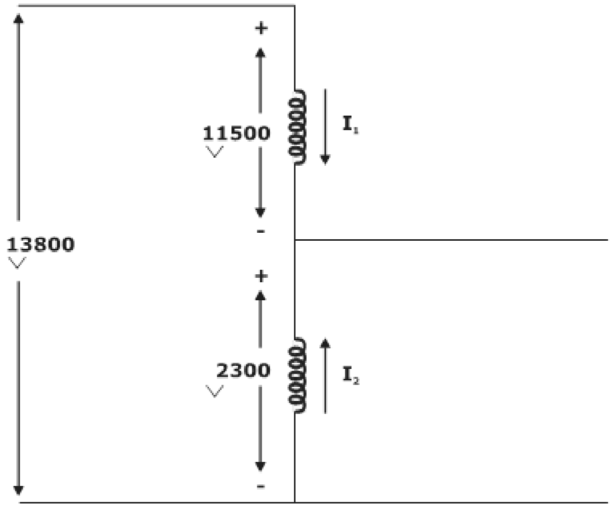
Two auto-transformers connection is possible.

(i)



KVA rating is = 13800 × I_2 = 13800 × 43.47 = 600 KVA

(ii)



The KVA rating of auto transformer = 13800 × 8.695 = 120 KVA

The maximum possible KVA rating of auto-transform is = 600 KVA

Since losses in the two winding transformer and in the autotransformer is same.

So, the required efficiency

$$\eta = \frac{x \times (KVA) \times \cos\phi}{x \times (KVA) \times \cos\phi + P_i + x^2 P_{cufl}}$$

$$\eta = \frac{\frac{1}{2} \times 600 \times 0.8}{\frac{1}{2} \times 600 \times 0.8 + 2 + \frac{1}{4} \times 16}$$

$$\eta = \frac{240}{240+6} = 97.56\%$$

$$\eta = 97.56\%$$

53. When the load on an induction motor is increased from no-load to full load then

A. slip decreases & power factor increases

B. slip increases & power factor decreases.

C. Both slip & power factor decreases

D. Both slip & power factor increases

Ans. D

Sol.

Slip $s = \frac{N_s - N_r}{N_s}$

Where N_S = synchronous speed, N_r = rotor speed

⇒ at no load $N_S = N_r$

So, slip $s = \frac{N_s - N_s}{N_s} = 0$

But at full load $N_r < N_S$

slip $s = \left(\frac{N_s - N_r}{N_s}\right) \Rightarrow s > 0$

⇒ slip increases from no load to full load.

Power factor:

⇒ Because of the airgap the reluctance of the magnetic circuit of the 3-ф I.M. is very high

⇒ p.f. of a lightly loaded 3-ф I.M. is very low.

⇒ The power factor will improve as the motor is loaded from no-load to rated load.

54. The slip at which maximum Power developed for 3-phase IM, If 120V, 60 Hz, 6-Pole, (Δ) 3 phase IM has stator impedance = (0.1 + j0.15) Ω/phase and rotor impedance = (0.1 + j0.25) Ω/phase (at standstill).

A. 0.286

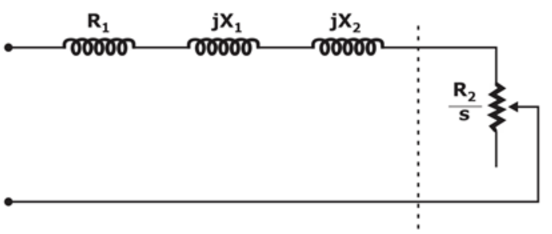
B. 0.386

C. 0.242

D. 0

Ans. C

Sol.



For max power development:

$$\frac{R_2}{s} = Z_{eq} = \sqrt{R_1^2 + (X_1 + X_2)^2}$$

$\because Z_{eq} = R_1 + j(X_1 + X_2)$

Slip: $s = \frac{R_2}{\sqrt{R_1^2 + (X_1 + X_2)^2}}$

$$s = \frac{0 \cdot 1}{\sqrt{(0.1)^2 + (0.25 + 0.15)^2}} = \frac{0.1}{\sqrt{0.1^2 + 0.4^2}}$$

$$s = \frac{0.1}{\sqrt{0.17}} = 0.242$$ Ans.

55. Which of the following is incorrectly method?

A. No load test → Induction machine.

B. Sumpner's test → DC machine.

C. Blocked rotor test → Induction machine.

D. Swinburne's test → DC machine.

Ans. B

Sol.

No load test → I.M

Blocked rotor test → I.M

Swinburne's test → DC

Sumpner's test → transformer

56. A synchronous generator, connected to an infinite bus is working at half load. If an increase in its field current causes a reduction in the armature current, then the generator is ___________.

A. Delivering reactive power to the bus at lead power factor

B. Delivering reactive power to the bus at lag power factor

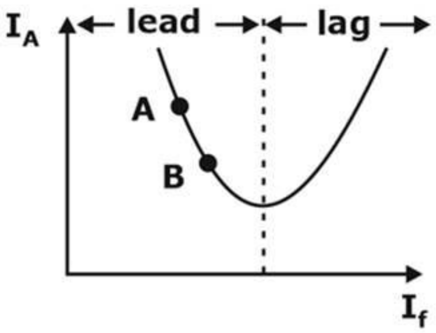
C. absorbing reactive power to the bus at lead power factor

D. absorbing reactive power to the bus at log power factor

Ans. C

Sol.

When machine operating an infinite bus bar with constant power input & excitation changes. From V & inverted V curves of alternator. We can conclude that machine operating in leading pf & it absorbs reactive power.



Suppose alternator operate at point A and field current increase, armature current decreases so machine reaches at point B which is leading

If alternator works on leading pf it means it absorbs reactive power

57. In a DC machine, armature MMF is

A. Stationary in space

B. Having triangular space distribution

C. Both (a) and (b)

D. Neither (a) Nor (b)

Ans. C

Sol.

In a DC machine, armature MMF is stationary in space and has triangular space distribution.

58. A triangular mmf wave is produced in the air-gap of an electric machine. Such a wave is produced by

A. stator of an induction machine

B. rotor of a synchronous machine

C. stator of a dc machine

D. rotor of a dc machine

Ans. D

Sol. In dc machine, armature winding is placed in rotor and it has triangular armature mmf.

59. If the induction motor drive is capable of bidirectional power flow where limited range of speed control is required for large power applications, then this arrangement is called

A. Static conductance drive

B. Static Scherbius drive

C. Static compressive drive

D. Static reluctance drive

Ans. B

Sol.

Power can flow from source to load and vice-versa, when induction motor is operated static Scherbius drive.

60. Which of the following cores have linear characteristics?

A. Steel core

B. CRGO core

C. Air core

D. None of the above

Ans. C

Sol.

Air cores have linear magnetization characteristics i.e., they do not saturate whereas steel core and CRGO core have non-linear magnetization characteristics.

61. In which of the following winding we don’t use equaliser ring?

A. Simplex lap winding

B. Duplex lap winding

C. Simplex wave winding

D. Duplex wave winding

Ans. C

Sol.

For simplex lap winding no. of parallel path, A = P

For duplex lap winding no. of parallel path, A = 2P

For simplex wave winding no. of parallel path, A = 2

For duplex wave winding no. of parallel path, A = 4

Since simplex wave winding has only 2 parallel paths so in this winding, we don't need to provide equaliser ring

62. Cores of large power transformers are made from which one of the following?

A. Hot-rolled steel

B. Cold-rolled non-grain oriented steel

C. Cold-rolled grain oriented steel

D. Ferrite

Ans. C

Sol. Cold-rolled grain oriented steel used to increase μ_r.

63. Which statement is correct in case of Single Phase Transformer?

A. In this a varying current appears in primary winding that creates varying magnetic flux in transformer's core

B. It creates varying magnetic field in secondary winding that induces electromotive force (EMF) or voltage

C. It carries inductive coupled conductors

D. All of above

Ans. D

Sol. Single Phase Transformer has single primary and secondary winding where current will vary which will create varying magnetic flux. Such type of transformers will create varying magnetic field in secondary winding.

64. In a round rotor alternator, reactive power is maximum at a load angle of,

A. 90°

B. 180°

C. 0°

D. 45°

Ans. C

Sol.

$$Q = \frac{V}{x_s}[E\cos\delta - v]$$

For Q_{max}

$$\frac{\partial Q}{\partial \delta} = \frac{V}{x_s}[E(-\sin\delta) - 0] = 0$$

But δ ≤ 90° for stability

So, δ = 0°

65. Due to reversal of the direction of power flow, a differentially compound motor becomes

A. A shunt motor

B. A series motor

C. A differentially compound generator

D. A cumulatively compounded generator

Ans. D

Sol.

By reversing the direction of power flow the direction of current through the series winding will be changed. So, the differentially compounded motor will become cumulative compound generator.

66. Match List-I (DC motor) with List-II (Characteristic) and select the correct answer using the code given below the lists :

List-I

A) Cumulatively compound motor

B) Differentially compound motor

C) Series motor

D) Shunt motor

List-II

1) Fairly constant speed irrespective of the load

2) It may start in reverse direction

3) Define no-load speed

4) Is never started without load

A. A-4; B-1; C-3; D-2

B. A-3; B-2; C-4; D-1

C. A-4; B-2; C-3; D-1

D. A-3; B-1; C-4; D-2

Ans. B

Sol. A) Cumulatively compound motor - Define no-load speed

B) Differentially compound motor - It may start in reverse direction

C) Series motor - Is never started without load

D) Shunt motor - Fairly constant speed irrespective of the load

67. 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.

Ans. B

Sol. 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.

68. For 4-Pole wave wound DC generator, generated voltage is _________volts if

(i) Slots = 55

(ii) Conductors = 19 at each slot

(iii) Flux/pole = 1.5 $\times 10^{-3}$ Wb

(iv) Running speed = 1500 rpm

A. 78.9

B. 78.375

C. 156.9

D. 56.375

Ans. B

Sol.

$$E = \frac{\phi ZN}{60}\left(\frac{P}{A}\right)$$

$$= \frac{1.5\times10^{-3}\times55\times19\times1500}{60}\left(\frac{4}{2}\right)$$

= 78.375 V

69. Which of the following motors should not be allowed to run at no-load.

A. Separately excited dc motor

B. Shunt motor

C. Series motor

D. All of the above

Ans. C

Sol.

In series motor at no-load, the motor current and flux per pole tends to zero. Due to this, motor speed tends to infinity which is a dangerous situation.

70. An overexcited synchronous machine stability with respect to under excited synchronous machine-

A. More stable

B. Less stable

C. Equally stable

D. Cannot compare

Ans. A

Sol.

As stability ∝ P_{sy} (synchronizing power) and $P_{sy} \propto E \propto I_f$ (Excitation)

Therefore stability ∝ Excitation

Hence over excited synchronous machine is more stable than an under excited synchronous machine.

71. A 4 pole DC motor is lap wound with 400 conductors. The pole shoe is 40 cm long and B_{avg} over one pole pitch is 0.2 T, the armature diameter being 30 cm. The torque developed when the motor is drawing 10 A and running at 1000 rpm is ______

A. 12 Nm

B. 6 Nm

C. 18 Nm

D. 20 Nm

Ans. A

Sol.

$$\frac{\text{Flux}}{\text{Pole}} = \frac{\pi DL}{P} \times B_{avg}$$

$$= \left(\frac{\pi \times 30 \times 10^{-2} \times 40 \times 10^{-2}}{4}\right) \times 0.2 = 188.5 \times 10^{-4} \text{wb/pole}$$

For lap connection A=P

Induced emf E $= \frac{PN\phi Z}{60A} = \frac{4}{4} \times \frac{1000 \times 400 \times 188.5 \times 10^{-4}}{60}$

$= 125.66V$

$$\text{torque} = \frac{\text{MechanicalPower}}{\omega} = \frac{EI}{\omega} = \frac{125.66 \times 10}{\frac{2\pi}{60} \times 1000} = 12\text{Nm}$$

72. Which of the following statement is true for both transformer and Induction machine.

A. Requires less magnetising current (2 – 6% of rated current)

B. Primary & secondary frequencies are same

C. Converts electrical to mechanical energy.

D. With increase in load, power factor improves.

Ans. D

Sol.

1. Induction motor requires more magnetising current (30 – 50%) of rated current.
2. Stator & rotor frequencies are not same in induction motor.
3. There is no electromechanical conversion in transformer.

73. A squirrel-cage induction motor having a rated slip of 5% on full load has a starting torque twice as that of full-load torque. The starting current is:

A. 2 times of full load current

B. 40 times of full load current

C. 0.1 times of full-load current.

D. 6.32 times of full-load current

Ans. D

Sol.

As we known,

$$\frac{T_{st}}{T_{fl}} = \left(\frac{I_{st}}{I_{fl}}\right)^2 s_f$$

For $T_{st} = 2T_{fl}$

$s_f = 0.05$

$$\frac{2T_{fl}}{T_{fl}} = \left(\frac{I_{st}}{I_{fl}}\right)^2 \times 0.05$$

$$\left(\frac{I_{st}}{I_{fl}}\right)^2 = 40$$

$I_{st} = 6.32\ I_{fl}$

74. The cross-magnetizing effect of the armature reaction can be reduced by

A. making pole shoes flat faced.

B. making the main field ampere-turns larger compared to the armature ampere turns.

C. increasing the flux density under one half of the pole.

D. keeping the direction of rotation of generator in the same direction as motor.

Ans. B

Sol. The cross-magnetizing effect of the armature reaction can be reduced by making the main field ampere-turns larger compared to the armature ampere-turns.

75. What is the effect on breakdown torque when 3-phase Induction motor operates with variable frequency such that V/f is constant.

A. Breakdown torque will increase with increase in frequency.

B. Breakdown torque will decrease with increase in frequency

C. Breakdown torque will not change till rated frequency.

D. Breakdown torque will not change above rated frequency.

Ans. C

Sol.

Breakdown torque remains constant up to rated frequency but above base or rated speed, it will decrease as inversely to the speed to keep constant kW performance.

76. Transformer cooling and insulation oil must be of

A. low viscosity

B. high viscosity

C. low BDV

D. low resistivity

Ans. A

Sol.

the viscosity of transformer oil can be said that viscosity is the resistance of flow, in normal condition. Resistance to flow of transformer oil means obstruction of convection circulation of oil inside the transformer. Good oil should have a low viscosity so that it offers less resistance to the conventional flow of oil thereby not affecting the cooling of a transformer.

77. A DC shunt generator running at 1000 rpm with critical resistance of 80 Ω. It's shunt resistance is 50 Ω then critical speed is-

A. 1000 rpm

B. 1200 rpm

C. 800 rpm

D. 625 rpm

Ans. D

Sol.

Critical resistance α speed

$$\frac{R_{C_1}}{R_{C_2}} = \frac{N_1}{N_2}$$

$$\frac{80}{50} = \frac{1000}{N_2} \Rightarrow N_2 = 625 \text{ rpm}$$

78. The rotor resistance of a 4-pole 50 Hz, 3-φ slip ring induction motor is 0.4 Ω. The motor runs at 1460 rpm at full load. Determine the external resistance required per phase to lower the speed to 1250 rpm with the load torque being constant.

A. 1.7 Ω

B. 1.2 Ω

C. 2.7 Ω

D. 2.1 Ω

Ans. D

Sol.

Synchronous speed, $N_s = \frac{120 \times 50}{4} = 1500 \text{ rpm}$

Full load speed, N_1 = 1460 rpm

Full load slip, $S_1 = \frac{1500 - 1460}{1500} = 0.0266$

When external resistance is inserted, N_2 = 1250 rpm

Slip, $S_2 = \frac{1500 - 1250}{1500} = 0.166$

Since, load torque is constant,

$\therefore T \propto \frac{SV^2}{R_2 f}$ = constant

$$\therefore \frac{S_1}{R_2} = \frac{S_2}{R_2'}$$

$$\Rightarrow R_2' = \frac{S_2}{S_1} \times R_2 = \frac{0.166}{0.0266} \times 0.4 = 2.5\ \Omega$$

$$R_2' = R_2 + R_{ext} = 2.5$$

$$\Rightarrow R_{ext} = 2.5 - 0.4 = 2.1\ \Omega$$

79. In the case of a converter-inverter speed control arrangement for an induction motor operating with V/f constant and with negligible stator impedance.

A. The maximum torque is independent of frequency.

B. The maximum torque is proportional to frequency.

C. The slip at maximum torque is proportional to frequency.

D. The slip at maximum torque is independent of frequency.

Ans. A

Sol.

As we known:

$$T_{max} = \frac{3 \times 60}{2\pi N_s} \times \frac{V^2}{2X_2}$$

$$T_{max} \propto \frac{V^2}{f^2} \Rightarrow \text{as } \frac{V}{f} \text{ is constant}$$

T_{max} is independent of frequency.

$$s_m = \frac{R_2}{X_2}$$

$$s_m \propto \frac{1}{f}$$

80. Generally full pitch winding is used in DC machines

A. To increase the generated voltage

B. To provide dynamic balance

C. To reduce harmonics

D. To improve the shape of induced emf waveform

Ans. A

Sol.

1. Full pitched produces maximum voltage.

2. Distributed windings are used for improving shape of induced voltage and dynamic balance.

3. Short pitch coils are used to reduce harmonics.

81. Rotor slot of the squirrel cage induction motor are skewed slightly, so as to

A. increase the mechanical strength of rotor

B. eliminate locking tendency of the rotor and to reduce the noise.

C. save the amount of copper

D. make rotor construction simple.

Ans. B

Sol.

⇒ Skewing of squirrel cage induction motor is done for following purpose

⇒ Noise reduction

⇒ eliminate harmonic

⇒ To produce uniform torque

⇒ Reduce the magnetic pulling and eliminate locking tendency of the rotor

⇒ increase resistance of motor to get high starting torque

⇒ The main purpose of skewing is to reduce the magnetic locking (cogging) between stator & rotor.

82. Scott connections are used for

A. single phase to three phase transformation

B. three phase to single phase transformation

C. three phase to two phase transformation

D. any of the above

Ans. C

Sol.

Scott connections are used for three phases to two phase transformation.

83. A single phase transformer has no-load voltage and no-load current as 230 V and 3.623 A respectively. If the core loss is 500 W, then determine the shunt branch parameters R_0 ad X_m.

A. R_0 = 25.73 Ω, X_m = 12.49 Ω

B. R_0 = 105.8 Ω, X_m = 79.35 Ω

C. R_0 = 79.35 Ω, X_m = 105.8 Ω

D. R_0 = 12.49 Ω, X_m = 25.73 Ω

Ans. B

Sol.

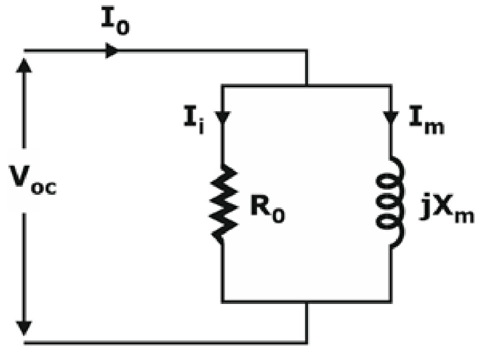
Core loss, $P_i = V_{oc} I_0 \cos \varphi_0$

∴ No load power factor, $\cos\phi_0 = \frac{P_i}{V_{oc}I_0}$

$$\cos\phi_0 = \frac{500}{230 \times 3.623} = 0.6$$

$\Rightarrow \ \phi_0 = \cos^{-1} 0.6 = 53.13°$

$\sin\phi_0 = \sin 53.13° = 0.8$



$I_i = I_0 \cos \varphi_0 = 3.623 \times 0.6 = 2.1738$ A

$I_m = I_0 \sin \varphi_0 = 3.623 \times 0.8 = 2.8984$ A

$$\therefore R_0 = \frac{V_{oc}}{I_i} = \frac{230}{2.1738} = 105.8\ \Omega$$

$$X_m = \frac{V_{oc}}{I_m} = \frac{230}{2.8984} = 79.35\ \Omega$$

84. A 4-pole, 50 Hz, 3-φ induction motor is running at 1250 rpm. The power input to this motor is 30 kW. The stator and rotor copper losses are respectively 200 W and 300 W while the mechanical losses are 600 W. Neglecting the core loss, the output torque of this motor is?

A. 220.78 Nm

B. 467.56Nm

C. 332.58 Nm

D. 157.92 Nm

Ans. A

Sol.

Air gap power, P_g = Stator input power – Stator copper loss – Stator core loss

$\therefore P_g = 30 \times 10^3 - 200 = 29{,}800$ W

Output power, $P_{sh} = P_g$ – Rotor copper loss – Mechanical loss

$\therefore P_{sh} = 29{,}800 - 300 - 600 = 28{,}900$ W

Given, Motor is running at $N_r = 1250$ rpm

$$\therefore \omega_r = \frac{2\pi N_r}{60} = \frac{2\pi \times 1250}{60}$$

$\therefore$ Output torque,

$$T_{sh} = \frac{P_{sh}}{\omega_r} = \frac{28{,}900}{\frac{2\pi \times 1250}{60}} = 220.78 \text{ Nm}$$

85. Two transformers, each rated at 200 kVA, 11kV/400V and 50 Hz are connected in open delta on both the primary and secondary, the load kVA that can be supplied from this transformer connection will be

A. 400 kVA

B. 200 √3 kVA

C. 300 kVA

D. 100 √3 kVA

Ans. B

Sol.

Rated kVA of each transformer = 200 kVA

Rated load in open delta = √3 × Rated kVA of each transformer

= √3 × 200

= 200√3 kVA

86. Which of the following methods of voltage regulation is also known as optimistic method

A. emf method

B. mmf method

C. zpf method

D. synchronous impedance method

Ans. B

Sol.

⇒ Voltage regulation is measured by following method in synchronous machine

⇒ Synchronous impedance method

⇒ emf method (pessimistic method)

⇒ mmf method (optimistic method)

⇒ zpf (or) Potier triangle method

87. What are slot wedges in a dc machine, made of?

A. Mild steel

B. Silicon steel

C. Fibre

D. Cast iron

Ans. B

Sol. Slot wedges are used to reduce the air gap so made of silicon steel.

88. The reversing of a 3φinduction motor is achieved by

A. $Y-\Delta$ starter

B. DOL starter

C. Auto transformer

D. Interchanging any two of the supply line

Ans. D

Sol. By interchanging any two supply terminal, the direction of rotating magnetic field produced by induction motor is reversed. Which in turns reverses the direction of rotation.

89. A stepper motor with a step angel of 15° has a stepping frequency of 15° has a stepping frequency of 300 steps/sec. What is the motor speed?

A. 750 rpm

B. 650 rpm

C. 780 rpm

D. 950 rpm

Ans. A

Sol.

Step angle 15°

Frequency = 300 step/sec

Total angular distance in 1 sec = 300 × 15 = 4500°

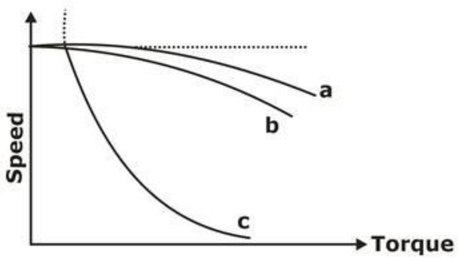
Total revolution in 1 sec = $\frac{4500}{360}$

= 12.5 rps

Motor speed in rpm = 12.5 × 60

= 750 rpm

90. Speed-torque characteristics of a dc series motor is shown by curve:



A. a

B. b

C. c

D. None of these

Ans. C

Sol.

Torque of dc series motor , $T = k_a \varphi_{se} I_a$

Now = $k_a k_{se} I_a^2$

Here k_a k_{se} = k →constant

T = kI_a^2

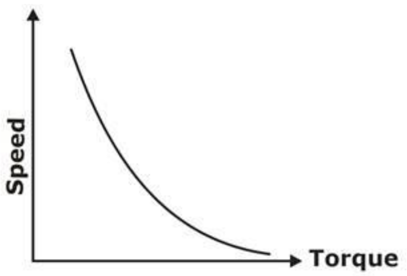
$$I_a = \sqrt{\frac{T}{k}} \qquad ......(1)$$

Now, E = V – I_a (R_a + R_{se}) = $k_n\varphi_{se}$ N

$$\Rightarrow N = \frac{V}{k_n\phi_{se}} - \frac{I_n.R_a}{k_n\phi_{se}} \qquad [R_a = r_a + r_{se}]$$

$$\Rightarrow N = \frac{V}{k_n k_{se}} - \frac{R_a}{k_n k_{se}}$$

There is inverse relation between torque and speed.



91. The full-load copper loss and iron loss of a transformer are 6400 W and 500 W, respectively. The above copper loss and iron loss at half load will be

A. 33200 W and 250 W respectively

B. 3200 W and 500 W respectively

C. 1600 W and 125 W respectively

D. 1600 W and 500 W respectively

Ans. D

Sol. Iron loss does not depend upon the load and it remains constant so, Iron loss at half load = 500 W.

Full-load copper loss $= P_c\left(ft\right) = 6400\,W$

Copper loss at half load =

$$\left(\frac{1}{2}\right)^2 P_c\left(ft\right) = \frac{6400}{4} = 1600\,W$$

Hence, option (D) is correct.

92. A 1:5 step-up transformer has 120V across the primary and 600 ohms resistance across the secondary. Assuming 100% efficiency, the primary current equals

A. 0.2 Amp.

B. 5 Amps.

C. 10 Amps.

D. 20 Amps.

Ans. A

Sol.

$I_1 = V_1 / R_1 = 120/600 = 0.2$

(η = 100%, losses are zero $\therefore V_1 = V_R = I_1 R_1$)

93. When the value of slip of an induction motor approaches zero, the effective resistance

A. is very low and the motor is under no-load

B. of the rotor circuit is very high and the motor is under no-load

C. is zero

D. of the rotor circuit is infinity and the motor is equivalent to short-circuited two-winding transformer

Ans. B

Sol.

For induction motor, Effective resistance of rotor is given as $\frac{R_{20}}{s}$

Where, R_{20} = standstill rotor resistance

s = slip

Under no load, slip ≈ 0

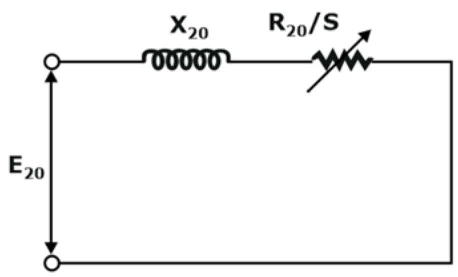
As the load on motor increases, rotor speed decreases, hence slip increases,.

Therefore,

As s approaches to zero, $\frac{R_{20}}{s} \approx \infty$

and motor is under no load

By observing the rotor equivalent circuit at line frequency.



as slip approaches zero, $\frac{R_{20}}{s} \simeq \infty$ and secondary i.e. rotor winding acts as open circuit.

94. Torque developed by the armature of a dc motor is proportional to which one of the following ?

A. (Back emf) × (Armature current)

B. (Magnetic flux per pole) × (Armature current)

C. (Back emf) × (Magnetic flux per pole)

D. (Back emf)/(Magnetic flux per pole)

Ans. B

Sol.

The torque developed in a D.C machine is defined as

$T_e = k\Phi I_a$

where Φ is Magnetic flux per pole.

& I_a is the Armature current.

95. The cross-magnetizing effect of the armature reaction can be reduced by

A. making pole shoes flat faced.

B. making the main field ampere-turns larger compared to the armature ampere turns.

C. increasing the flux density under one half of the pole.

D. keeping the direction of rotation of generator in the same direction as motor.

Ans. B

Sol. The cross-magnetizing effect of the armature reaction can be reduced by making the main field ampere-turns larger compared to the armature ampere-turns.

96. A 400 kVA transformer has 90% efficiency at full load and also at 60% of full load both at unity power factor, the iron loss and full load copper loss occurring in transformer will be respectively (in kW)

A. 27 .77, 16 .66

B. 44.44, 26 .67

C. 26 .67, 44.44

D. 16 .66, 27 .77

Ans. D

Sol.

$$\%\ \text{efficiecny} = \frac{\text{output}}{\text{output} + \text{loss}} \times 100$$

At full load →

$$90 = \frac{400 \times 10^3 \times 1}{400 \times 10^3 \times 1 + P_I + P_{cu}} \times 100$$

$P_I + P_{cu} = 44.444 \times 10^3$ ...(1)

At 60% of full load →

$$90 = \frac{400 \times 10^3 \times 0.6 \times 1}{400 \times 10^3 \times 0.6 \times 1 + P_I + 0.36\ P_{cu}} \times 100$$

$P_I + 0.36\ P_{cu} = 26.667 \times 10^3$ ...(2)

On solving (1) and (2)

$P_I = 27.77$ kW

$P_{cu} = 16.66$ kW

97. Match List-I with List-II and select the correct answer using the code given below the lists:

List-I

A) General purpose split phase FHP motor

B) General purpose capacitor start FHP motor

C) Permanent split capacitor start FHP motor

D) Shaded pole FHP motor

List-II

1) Refrigerators

2) Hair dryers

3) Unit heaters

4) Fans, blowers

A. A-1; B-2; C-4; D-3

B. A-1; B-2; C-3; D-4

C. A-4; B-1; C-2; D-3

D. A-4; B-1; C-3; D-2

Ans. D

Sol. Shaded pole motor. Normally used with hairdryer and small unit heaters, refrigerator uses motor without capacitor.

98. A single phase transformer takes a no-load current of 1.3 A when high voltage winding is kept open. If the iron loss component of no-load current is 0.5 A, the magnetizing component of no-load current will be

A. 2.76 A

B. 1.19 A

C. 0.87 A

D. 3 A

Ans. B

Sol.

No load current $I_o = 1.3A$

Iron loss component I_w = 0.5A

$$\cos\phi_o = \frac{I_w}{I_o} = \frac{0.5}{1.3} = 0.385$$

Magnetizing component of no load current

$$I_m = I_o \sin\phi_o = I_o\sqrt{1-\cos^2\phi_o}$$

= 1.3 × 0.923 = 1.199 A

99. A generator develops 250 V and has an internal resistance of 100 ohm. If the load resistance is 100 ohm, then what is the efficiency of the generator ?

A. 80%

B. 50%

C. 60%

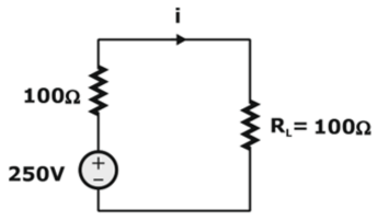
D. 70%

Ans. B

Sol. E_g = 250V

r = 100Ω

R_L = 100Ω



$$i = \frac{250}{200} = 1.25A$$

$$\text{Efficiency} = \frac{P_{out}}{P_{in}} = \frac{(1.25)^2 \times 100}{(1.25)^2 \times 200} = \frac{1}{2}$$

η = 50%

100. Deep bar rotor used in 3 –f induction motor causes

A. More starting torque

B. More pull out torque

C. More efficiency

D. All of the above

Ans. A

Sol. Deep bar rotor is used in 3 –f induction motor increases starting torque.

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