3 Induction Machine

✓ **Multiple Choice Questions**

1. Match **List-I** with **List-II** and select the correct answer using the codes given below the lists:

List-I	List-II
A. Motoring	1. $0 < s < 1$
B. Generating	2. $-1 < s < 0$
C. Plugging	3. $-2 < s < -1$
	4. $1 < s < 2$

   Codes:

	A	B	C
(a)	1	2	3
(b)	1	2	4
(c)	2	3	4
(d)	2	3	1

   [IAS-1994]

2. In a normal 3-phase slip-ring induction motor, the developed starting torque will
   - (a) increase with the increase in the value of the rotor resistance
   - (b) decrease with the increase in the value of the rotor resistance
   - (c) not depend upon the value of the rotor resistance
   - (d) increase with increase in the value of the rotor resistance upto a certain value and then decrease with further increase in rotor resistance

   [IAS-1994]

3. A 3-phase induction machine operates on 3-phase fixed frequency ac mains at a per unit slip of 1.5. Consider the following statements regarding the operating condition of the machine

   1. It draws electrical power from the mains.
   2. It draws mechanical power through the shaft.
   3. It delivers electrical power to the mains.
   4. It delivers mechanical power through the shaft.

   On these statements:
   - (a) 1 and 2 are correct
   - (b) 1 and 4 are correct
   - (c) 2 and 3 are correct
   - (d) 3 and 4 are correct

   [IAS-1994]

4. The magnetising current component of the no-load current of an induction motor is much larger than a corresponding transformer because of
   - (a) additional friction and windage loss in motor
   - (b) different winding configurations on stator and rotor
   - (c) increased flux requirement
   - (d) an air-gap in the magnetic circuit

   [IAS-1994]

5. If the load on a squirrel-cage induction motor, operating on a constant voltage, constant frequency ac supply is increased, then
   - (a) power factor angle will increase and slip will decrease.
   - (b) power factor angle will decrease and slip will increase.
   - (c) both power factor angle and slip will decrease.
   - (d) both power factor angle and slip will increase.

   [IAS-1994]

6. The rotor of a 4-pole 3-phase cage induction motor is replaced by a 3-phase, 4-pole wound rotor. When fed with normal supply, the machine will
(a) not run
(b) run at very low speed
(c) run at slightly lower than normal speed
(d) run at slightly higher than normal speed
[IAS-1994]

7. Consider the following statements:
The steady-state speed of a 3-phase cage induction motor delivering a load torque depends upon
1. supply voltage
2. supply frequency
3. load torque-speed characteristic
On these statements:
(a) 1, 2 and 3 are correct
(b) 1 and 2 are correct
(c) 2 and 3 are correct
(d) 1 and 3 are correct
[IAS-1994]

8. Assertion (A): Under normal operating conditions, major portion of iron losses of an induction motor occurs in the stator.
Reason (R): The frequency of the rotor currents under normal operating conditions is very small.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is NOT the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.
[IAS-1994]

9. An induction generator
(a) takes reactive power from the mains and supplies active power to mains
(b) takes active power from the mains and gives reactive power to the mains
(c) supplies both active and reactive powers to the mains
(d) consumes both active and reactive powers from the mains
[IAS-1995]

10. The approximate value of efficiency of a three-phase induction motor running at a slip 's' is given by
(a) $\dfrac{1}{1+s}$ (b) $\dfrac{s}{1+s}$

(c) $\dfrac{1-s}{1+s}$ (d) $\dfrac{s}{1-s}$
[IAS-1995]

11. Consider the following statements:
The emf induced in the rotor of a 3-phase induction motor is proportional to the
1. relative velocity between stator field and rotor conductors.
2. voltage applied to the stator.
3. slip.
On these statements
(a) 1, 2 and 3 are correct
(b) 1 and 2 are correct
(c) 2 and 3 are correct
(d) 1 and 3 are correct
[IAS-1995]

12. A polyphase slip-ring induction machine has the stator and rotor windings wound for
(a) the same number of phase but different number of pairs of poles
(b) the same number of pairs of poles but different number of phases
(c) the same number of phases with number of pairs of poles either equal or different
(d) the same number of pairs of poles with number of phases either equal or different
[IAS-1995]

13. While plugging a 3-phase induction motor, if one supply terminal gets disconnected, then the motor will
(a) continue to run in the same direction
(b) stop
(c) start rotating in the opposite direction at the same speed
(d) start rotating in the opposite direction at reduced speed
[IAS-1995]

14. The chart given below indicates four different conditions under which an induction motor may be called upon to operate, with a constant shaft load.

	Applied voltage	Frequency	Rotor Resistance
1.	Normal	Normal	Normal
2.	80%	Normal	Normal
3.	80%	80%	Normal
4.	Normal	Normal	80%

The operating conditions which lead to increasing values of running slips will be in the sequence
(a) 1, 4, 3, 2   (b) 1, 4, 2, 3
(c) 4, 1, 3, 2   (d) 4, 1, 2, 3
[IAS-1996]

15. Consider the following statements about the operation of a three-phase induction motor running at full load:
If one of the supply line fuse blows off, the motor will
1. stall.
2. continue to run with increased slip.
3. continue to run with normal supply current.
4. continue to run with excessive supply current.
Of these statements
(a) 1 alone is correct
(b) 3 alone is correct
(c) 2 and 3 are correct
(d) 2 and 4 are correct   **[IAS-1996]**

16. The phenomenon of crawling is usually not formed in slip-ring motors because these motors have
(a) no space harmonics
(b) high resistance rotor windings
(c) no zig-zag leakage
(d) comparatively large air-gap   **[IAS-1996]**

17. Consider the following statements:
As a 3-phase induction motor is loaded from no-load to rated load.
1. There is an improvement in the power factor.
2. The torque increase almost in proportion to slip.
3. The air-gap flux falls sharply.

Of these statements:
(a) 1, 2 and 3 are correct
(b) 1 and 2 are correct
(c) 2 and 3 are correct
(d) 1 and 3 are correct   **[IAS-1997]**

18. In a 3-phase induction motor, if the angular speed of the stator field is ω and, the actual angular speed of the rotor is ω_r and the stator induced emf is given by $e_s = N_1\,\omega\,K_{ws}\,\phi\,\sin\omega t$, ($N_1$ being the stator turns/phase), then the rotor emf with N_2 as the rotor/turns phase will be (K_{ws} = stator winding factor and K_{wr} = rotor winding factor)
(a) $e_r = N_2\,\omega\,K_{wr}\,\phi\,\sin\omega t$
(b) $e_r = N_2\,\omega\,K_{wr}\,\phi\,\sin\omega_r t$
(c) $e_r = N_2\,(\omega - \omega_r)\,K_{wr}\,\phi\,\sin(\omega - \omega_r)\,t$
(d) $e_r = N_2\,(\omega + \omega_r)\,K_{wr}\,\phi\,\sin(\omega + \omega_r)\,t$
[IAS-1997]

19. A 3-phase induction motor requires a starter
(a) because there is no back emf induced in the stator winding during starting
(b) because the motor does not posses in inherent starting torque
(c) because the induced secondary voltage and hence the currents in the windings are abnormally high during starting
(d) to increase the starting torque
[IAS-1997]

20. For a rotor-fed 3-phase induction motor, the absolute speed of the rotating magnetic field in space is
(a) the synchronous speed
(b) the difference between the synchronous speed and the rotor speed
(c) the rotor speed
(d) zero
[IAS-1997]

21. A 3-phase induction motor has a full-load slip of 3 per cent at normal voltage. Which one of the following will be the value of the slip of motor if it develops the same torque theoretically while operating at 110 per cent of its normal voltage?
(a) 2.48%   (b) 0.248%
(c) 0.483%   (d) 4.83%
[IAS-1998]

22. A 6-pole, 3-phase, 60 Hz induction motor runs at 1000 rpm developing maximum starting torque. Rotor resistance per phase is 1.2 ohms. Neglecting stator impedance, then for developing maximum starting torque, the external resistance to be connected in series with each rotor phase will be
(a) 7.2 ohms   (b) 6 ohms
(c) 1.44 ohms   (d) 1.2 ohms
[IAS-1998]

23. **Assertion (A)** : In a 3-phase induction motor, the stator is to be wound for 4 poles but by mistake, the rotor is wound for 2 poles only. When the stator is fed from a 50 Hz, 3-phase supply with rotor winding shorted, the motor does not start up. When, however, the wound rotor is replaced by a squirrel-cage rotor, the machine operates without any problem.
Reason (R) : Rotor of an induction motor should not have any poles.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true
[IAS-1998]

24. The rotor of a three-phase induction machine is replaced by a rotor with a commutator type winding having no external connection between the brushes. The stator is supplied from a balanced three-phase source and the rotor is driven at twice the synchronous speed in the direction opposite to the stator mmf. The frequency of the emf induced between consecutive brushes will be (f is the supply frequency)
(a) zero   (b) f
(c) 2f (d) 3f
[IAS-1999]

25. Two separate induction motors having 6 poles and 4 poles are cascade. 3-phase 400 V, 60 Hz is the supply to the motors.
The synchronous speeds (in rpm) of cascaded set will be

(a) 720, 1200, 1800 and 2400
(b) 600, 1000, 1500 and 3000
(c) 720, 1200, 1800 and 3600
(d) 600, 1200, 1800 and 2400
[IAS-1999]

26. If a 3-phase induction motor and a I-phase induction motor of the same kW rating and same winding voltage are compared, then
(a) both will be of same size and efficiency
(b) the 3-phase induction motor will be bigger in size and less efficient
(c) the 3-phase induction motor will be smaller in size and more efficient
(d) the 3-phase induction motor will be bigger in size and more efficient
[IAS-2000]

27. The given figure shows the equivalent circuit of 3-phase induction motor with deep-bar rotor. The sequence of the magnitudes of the parameters of resistance and reactances in the ascending order is
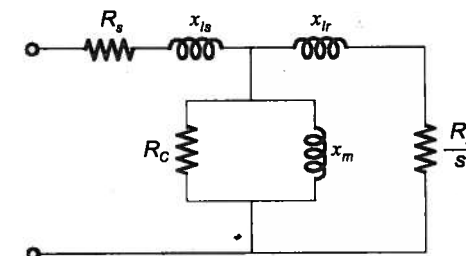
(a) R_s, R_r, x_{ls}, x_{lr}, R_c, x_m
(b) x_{ls}, x_{lr}, R_r, R_s, x_m, R_c
(c) R_r, R_s, x_{ls}, x_{lr}, R_c, x_m
(d) R_s, R_r, x_{ls}, x_{lr}, x_m, R_c [IAS-2001]

28. In a 3-phase induction motor, the rotor impedance angle at standstill is θ. The load angle δ will be
(a) π + θ   (b) π − θ
(c) π/2 + θ   (d) π / 2
[IAS-2001]

29. A 3-phase induction motor develops a torque 'T' when driven from a balanced 3-phase supply. The terminal voltage and frequency are halved so that the air-gap flux remains the same while the load torque is kept constant. Then the slip

(a) is reduced to half
(b) remains same as the previous value
(c) speed is reduced to half
(d) speed remains the same
[IAS-2001]

30. The following performance characteristic are attributed to a 3-phase cage induction motor without skew:
1. lower magnetizing current compared to a slip ring motor
2. lower efficiency
3. high p.f.
4. possible cogging and crawling
Which of these statements are correct?
(a) 1, 2 and 3   (b) 2, 3 and 4
(c) 1, 3 and 4   (d) 1, 2 and 4
[IAS-2002]

31. The power input to an induction motor is 50 kW when it is running at 4% slip. If the stator resistance and core losses are neglected, the rotor copper loss is equal to
(a) 38 kW   (b) 20 kW
(c) 4 kW   (d) 2 kW
[IAS-2002]

32. In order to control the speed of a slip ring 3-phase induction motor through injected voltage in its rotor circuit, this voltage and the rotor voltage should essentially be
(a) in same phase
(b) in quadrature
(c) in phase opposition
(d) of same frequency
[IAS-2002]

33. Under variable frequency operation of 3-phase induction motor, air-gap flux is kept constant by adjusting the motor voltage. For constant air-gap flux, machine develops the same torque when the
(a) slip is kept constant
(b) slip speed is kept constant
(c) power flow across the air-gap is kept constant
(d) power input to the stator is kept constant
[IAS-2003]

34. A 3-phase induction motor operates at constant slip frequency while the stator frequency is varied from 0 to rated value. Which one of the following statements is correct?
The torque developed by the motor is
(a) proportional to speed
(b) proportional to square of speed
(c) inversely proportional to speed
(d) constant in the complete range up to base speed
[IAS-2003]

35. The speed of a 4-pole induction motor is controlled by varying the supply frequency while maintaining the ratio of supply voltage to supply frequency (V/f) constant. At rated frequency of 50 Hz and rated voltage of 400 V its speed is 1440 rpm. Find the speed at 30 Hz, if the load torque is constant
(a) 882 rpm   (b) 864 rpm
(c) 840 rpm   (d) 828 rpm
[GATE-2006]

36. A 400 V, 50 Hz, 30 hp, three-phase induction motor is drawing 50 A current at 0.8 power factor lagging. The stator and rotor copper losses are 1.5 kW and 900 W respectively. The friction and windage losses are 1050 W and the core losses are 1200 W. The air-gap power of the motor will be
(a) 23.06 kW   (b) 24.11 kW
(c) 25.01 kW   (d) 26.21 kW
[GATE-2008]

Common Data Questions for (37 and 38):
A 3-phase, 440 V, 50 Hz, 4-pole, slip ring induction motor is fed from the rotor side through an auto transformer and the stator is connected to a variable resistance as shown in the figure.
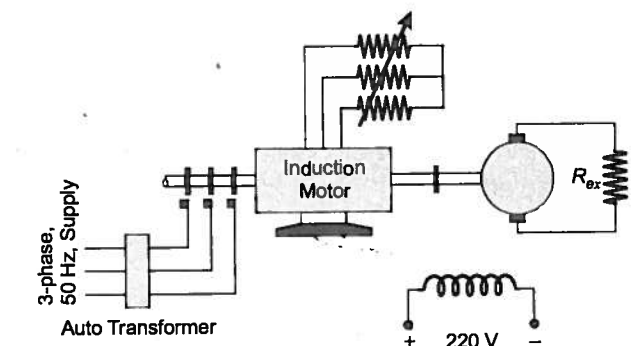
The motor is coupled to a 220 V, separately excited, d.c. generator feeding power to fixed resistance of 10 Ω. Two-wattmeter method is used to measure the input power to induction motor. The variable resistance is adjusted such that the motor runs at 1410 rpm and the following readings were recorded $W_1 = 1800$ W, $W_2 = 200$ W.

37. The speed of rotation of stator magnetic field with respect to rotor structure will be
(a) 90 rpm in the direction of rotation
(b) 90 rpm in the opposite direction of rotation
(c) 1500 rpm in the direction of rotation
(d) 1500 rpm in the opposite direction of rotation
[GATE-2008]

38. Neglecting all losses of both the machines, the dc generator power output and the current through resistance (R_{ex}) will respectively be
(a) 96 W, 3.10 A   (b) 120 W, 3.46 A
(c) 1504 W, 12.26 A (d) 1880 W, 13.71 A
[GATE-2008]

39. A 3-phase, 4-pole, 400 V, 50 Hz, star connected induction motor has following circuit parameters:
$r_1 = 1.0$ Ω $r_2' = 0.5$ Ω $x_1 = x_2' = 1.2$ Ω
$x_m = 35$ Ω
The starting torque when the motor is started direct-on-line is (use approximate equivalent circuit model)
(a) 63.6 Nm   (b) 74.3 Nm
(c) 190.8 Nm   (d) 222.9 Nm
[GATE-2006]

40. A 3-phase, 10 kW, 400 V, 4-pole, 50 Hz, star connected induction motor draws 20 A on full load. Its no load and blocked rotor test data are given below:

No Load test:	400 V	6 A	1002 W
Blocked Rotor test:	90 V	15 A	762 W

Neglecting copper loss in No Load test and core loss in Blocked Rotor test, estimate motor's full load efficiency.
(a) 76%   (b) 81%
(c) 82.4%   (d) 85%
[GATE-2006]

41. A 3-phase squirrel cage induction motor has a starting torque of 150% and a maximum torque of 300% with respect to rated torque at rated voltage and rated frequency. Neglect the stator resistance and rotational losses. The value of slip for maximum torque is
(a) 13.48%   (b) 16.24%
(c) 18.92%   (d) 26.79%
[GATE-2007]

42. A three phase squirrel cage induction motor has a starting current of seven times the full load current and full load slip of 5%. If an autotransformer is used for reduced voltage starting to provide 1.5 per unit starting torque, the autotransformer ratio (%) should be
(a) 57.77%   (b) 72.56%
(c) 78.25%   (d) 81.33%
[GATE-2007]

43. If a star-delta starter is used to start this induction motor, the per unit starting torque will be
(a) 0.607   (b) 0.816
(c) 1.225   (d) 1.616
[GATE-2007]

44. If a starting torque of 0.5 per unit is required then the per unit starting current should be
(a) 4.65   (b) 3.75
(c) 3.16   (d) 2.13
[GATE-2007]

45. Which one of the following statements is correct? A smaller air-gap in a polyphase induction motor helps to
(a) reduce the chances of crawling
(b) increase the starting torque
(c) reduce the chance of cogging
(d) reduce the magnetising current
[ESE-2004]

46. Which one of the following statements is correct?
In an induction motor, if the air-gap is increased,
(a) its speed will reduce
(b) its efficiency will improve
(c) its power factor will reduce
(d) its breakdown torque will reduce
[ESE-2004]

47. Which one of the following statements is correct?
In a 3-phase induction motor, the torque developed is maximum when the rotor circuit resistance per phase is equal to
(a) rotor leakage reactance per phase at standstill
(b) slip times the rotor leakage reactances per phase at standstill
(c) stator resistance per phase
(d) stator leakage reactance per phase
[ESE-2004]

48. The supply voltage to an induction motor is reduced by 10%. By what percentage approximately, will he maximum torque decrease?
(a) 5%   (b) 10%
(c) 20%   (d) 40%
[ESE-2004]

49. What is the shunt resistance component in equivalent circuit obtained by no load test of an induction motor representative of?
(a) Windage and frictional losses only
(b) Core losses only
(c) Core, windage and frictional losses
(d) Copper, losses
[ESE-2005]

50. A wound rotor induction motor runs with a slip of 0.03 when developing full load torque. Its rotor resistance is 0.25 ohm per phase. If an external resistance of 0.50 ohm per phase is connected across the slip rings, what is the slip for full load torque?
(a) 0.03   (b) 0.06
(c) 0.09   (d) 0.1   **[ESE-2005]**

51. A starting torque of 80 Nm is developed in an induction motor by an auto-transformer starter with a tapping of 30%. If the tapping of auto-transformer starter is 60%, then what is the starting torque?
(a) 40 Nm   (b) 100 Nm
(c) 240 Nm   (d) 320 Nm
[ESE-2005]

52. Assertion (A): Under V/f control of induction motor, the maximum value of the developed torque remains constant over a wide range of speed in the sub-synchronous region.
Reason (R): The magnetic flux is maintained almost constant at the rated value by keeping the ratio V/f constant over the considered speed range.
(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true
[ESE-2006]

53. The voltage actually used for setting up the useful flux in the air-gap of a 3-phase induction motor is
(a) = Applied voltage
(b) > Applied voltage
(c) < Applied voltage
(d) = Rotor induced emf
[ESE-2006]

54. Which of the points on the torque-speed curve of the induction motor represents operation at a slip greater than 1?
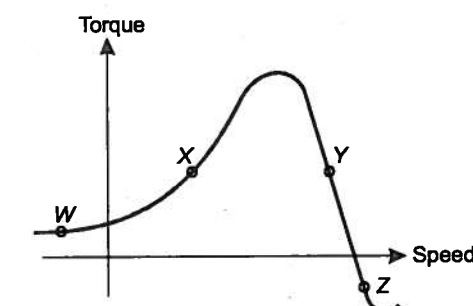
(a) *W*   (b) *X*
(c) *Y*   (d) *Z*   **[ESE-2006]**

55. The required load torque line intersects the resultant torque–speed characteristic of a 3-phase squirrel cage induction motor at points *P, Q* and *R* as shown in the figure below. Which is/are the stable opening point(s)?
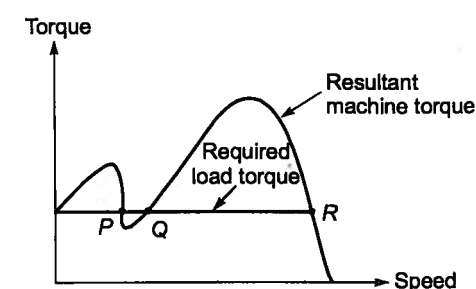
(a) P and Q (b) Q and R
(c) P and R (d) Only R

[ESE-2006]

56. When the applied rated voltage per phase is reduced to one-half, the starting torque of a 3-phase squirrel cage induction motor becomes
(a) 1/2 of the initial value
(b) 1/4 of the initial value
(c) Twice of the initial
(d) 4 times of the initial value   [ESE-2006]

57. If the full-load speed of a 3-phase, 50 Hz induction motor is 950 rpm, what is its half-load speed nearly equal to?
(a) 1000 rpm   (b) 450 rpm
(c) 1900 rpm   (d) 975 rpm

[ESE-2007]

58. Breakdown torque in a 3-phase induction motor of negligible stator impedance is
(a) directly proportional to rotor resistance
(b) inversely proportional to rotor resistance
(c) directly proportional to rotor leakage reactance
(d) inversely proportional to rotor leakage reactance

[ESE-2008]

59. The stator of a 3-phase, 6-pole a.c. machine has 45 slots. The stator winding has 45 coils with a coil span of 6 slots. What type of winding will be selected for this machine?
(a) Double-layer, fractional slot, short-pitched winding
(b) Single-layer, fractional slot, short-pitched winding
(c) Single-layer, integral slot, full-pitch winding

(d) Double-layer, fractional slot, full-pitch winding

[ESE-2008]

60. A three-phase 400 V, 6 pole, 50 Hz, squirrel cage induction motor is running at a slip of 5%. The speed of stator magnetic field with respect to rotor magnetic field and speed of rotor with respect to stator magnetic field are
(a) zero, −50 rpm
(b) zero, 950 rpm
(c) 1000 rpm, −50 rpm
(d) 1000 rpm, 950 rpm

[GATE-2011]

61. A separately excited dc machine is coupled to a 50 Hz, three-phase, 4-pole induction machine as shown in the figure. The dc machine is energized first and the machines rotate at 1600 rpm. Subsequently the induction machine is also connected to a 50 Hz, three-phase source, the phase sequence being consistent with the direction of rotation. In steady state,
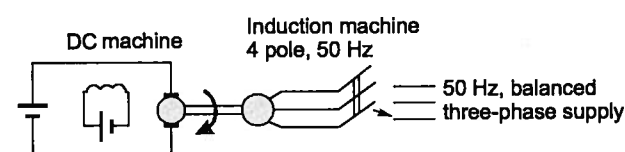

(a) both machines act as generators
(b) the dc machine acts as a generator, and the induction machine acts as a motor
(c) the dc machine acts as a motor, and the induction machine acts as a generator
(d) both machines act as motors

[GATE-2010]

62. A 4-pole induction motor, supplied by a slightly unbalanced three-phase 50 Hz source, is rotating at 1440 rpm. The electrical frequency in Hz of the induced negative sequence current in the rotor is
(a) 100   (b) 98
(c) 52   (d) 48

[GATE-2013]

63. A three-phase slip-ring induction motor, provided with a commutator winding, is shown in the figure. The motor rotates in clockwise direction when the rotor windings are closed.
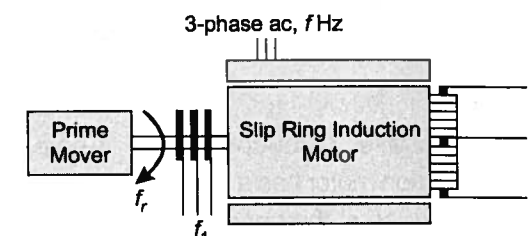

If the rotor winding is open-circuited and the system is made to run at rotational speed f_r with the help of prime-mover in anti-clockwise direction, then the frequency of voltage across slip rings is f_1 and frequency of voltage across commutator brushes is f_2. The values of f_1 and f_2 respectively are

(a) $f + f_r$ and f (b) $f - f_r$ and f
(c) $f - f_r$ and $f + f_r$ (d) $f + f_r$ and $f - f_r$

[GATE-2014]

64. The torque-speed characteristics of motor (T_M) and load (T_L) for two cases are shown in the figures (a) and (b). The load torque is equal to motor torque at points P, Q, R and S.

(a)

(b)
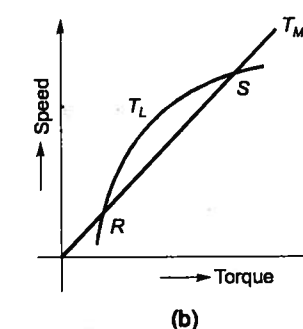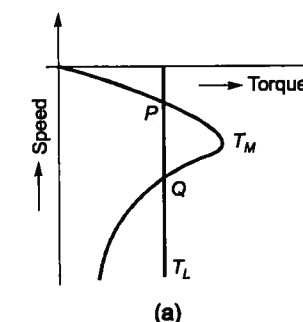
The stable operating points are
(a) P and R   (b) P and S
(c) Q and R   (d) Q and S

[GATE-2014]

65. A 3-ϕ induction machine has air gap of 2.2 mm. If its air gap is increased to 2.5. What will be the effect on X_m, X_2, X_1 and r_1, r_2?
(i) all will increase
(ii) X_m, will decrease
(iii) X_2, X_1, will increase
(iv) r_1, r_2 will remain same
Correct options are
(a) (i) and (ii)   (b) (iii) and (iv)
(c) (ii), (iii) and (iv)   (d) only (iv)

66. In a constant V/f induction motor drive, the slip at the maximum torque
(a) is directly proportional to the synchronous speed.
(b) remains constant with respect to the synchronous speed.
(c) has an inverse relation with the synchronous speed.
(d) has no relation with the synchronous speed.

[GATE-2016]

 Numerical Data Type Questions

67. A 10 kW, 50 Hz, 0.8 power factor, 3-ϕ, 6 pole induction motor runs at 980 rpm at no-load and at 940 rpm at full load. Windage and friction losses are 400 W and rotor resistance is 1.2 Ω/phase. If efficiency is 85%, ___ W is rotor copper loss at full load. (neglect stator loss)

68. A 3-ϕ I.M has an η = 0.9, when the load is 37 kW at this load stator copper loss and rotor copper loss each equals iron loss. The mechanical losses are 1/3 of no load loss, _____ is the slip.

69. The starting line current of a 415 V, 3-phase, delta connected induction motor is 120 A, when the rated voltage is applied to its stator winding. The starting line current at a reduced voltage of 110 V, in ampere, is _____.

[GATE-2016]

Try Yourself

T1. The rotor of a 3-ϕ induction motor has resistance per phase as 0.04 Ω. This motor has 0.2 Ω standstill reactance per phase. Neglect stator resistance.

What is the value of external resistance required in the rotor circuit to get half of the maximum torque at the starting and if this external resistance is added to the circuit then what is the percentage improvement in p.f. during starting?

[Ans. : 33.16]

T2. A 3 hp induction motor with full-load efficiency and power factor of 0.83 and 0.8 respectively, has a short circuit current of 3.5 times full load current. _____ is the line current at the instant of starting the motor from a 500 V supply by means of a star-delta switch. Ignore the magnetizing current.

[Ans. : 4.54 A]

T3. A 6-pole, 50 Hz, 3-phase induction motor has a rotor resistance of 0.2 Ω per phase and a maximum torque of 160 Nm at 875 rpm. _____ Nm will be the torque for a full-load slip of 4%. Rotational losses and stator impedance are neglected.

[Ans. : 92.89]

T4. A 3-phase, delta-connected, 4-pole, 50 Hz induction motor has a stator resistance of 0.4 Ω per phase at the operating temperature. For a line current of 20 A, the total stator input is 4000 watts. For negligible stator core losses, the internal torque will be _____ Nm.

[Ans. : 24.45]

T5. A 4-pole, 8 kW, 50 Hz, 3-phase induction motor develops rated torque at 1440 rpm. In case load torque is reduced to one-fourth, the power output will be _____ kW. Assume linear-torque-slip characteristics near the operating range.

[Ans. : 2.062]

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