Short questions and answers

EE1251 Electrical Machines II

1. Why almost all large size Synchronous machines are constructed with rotating field system type?

   The following are the principal advantages of the rotating field system type construction of Synchronous machines:

   - The relatively small amount of power, about 2%, required for field system via slip-rings and brushes.
   - For the same air gap dimensions, which is normally decided by the kVA rating, more space is available in the stator part of the machine for providing more insulation to the system of conductors, especially for machines rated for 11kV or above.
   - Insulation to stationary system of conductors is not subjected to mechanical stresses due to centrifugal action.
   - Stationary system of conductors can easily be braced to prevent deformation.
   - It is easy to provide cooling arrangement for a stationary system of conductors.
   - Firm stationary connection between external circuit and system of conductors enable he machine to handle large amount of volt-ampere as high as 500MVA.

2. Write down the equation for frequency of emf induced in an Altenator.

   Frequency of emf induced in an Alternator,f ,expressed in cycles per second or Hz, is given by the following equation

   $F = (PN)/120$ Hz,

   Where P- Number of poles

   N-Speed in rpm

3. How are alternators classified?

   According to type of field system

   - Stationary field system type
   - Rotating field system type

   According to shape of field system

   - Salient pole type
   - Smooth cylindrical type

4. Name the types of Alternator based on their rotor construction.

   Alternators can be classified into the following two types according to its rotor construction

   - Smooth cylindrical type alternator
   - Salient pole alternator

5. Why do cylindrical Alternators operate with steam turbines?

Steam turbines are found to operate at fairly good efficiency only at high speeds. The high speed operation of rotors tends to increase mechanical losses and so the rotors should have a smooth external surface. Hence, smooth cylindrical type rotors with less diameter and large axial length are used for Synchronous generators driven by steam turbines with either 2 or 4 poles.

6. Which type of Synchronous generators are used in Hydro-electric plants and why?

As the speed of operation is low for hydro turbines use din Hydro-electric plants, salient pole type Synchronous generators are used. These allow better ventilation and also have other advantages over smooth cylindrical type rotor.

7. What are the advantages of salient pole type construction used for Synchronous machines?

Advantages of salient-pole type construction are :

- They allow better ventilation
- The pole faces are so shaped that the radial air gap length increases from the pole center to the pole tips so that the flux distribution in the air-gap is sinusoidal in shape which will help the machine to generate sinusoidal emf
- Due to the variable reluctance the machine develops additional reluctance power which is independent of excitation

8. Why is the stator core of Alternator laminated?

The stator core of Alternator is laminated to reduce eddy current loss.

9. How does electrical degree differ from mechanical degree?

Mechanical degree is the unit for accounting the angle between two points based on their mechanical or physical placement.

Electrical degree is used to account the angle between two points in rotating electrical machines. Since all electrical machines operate with the help of magnetic fields, the electrical degree is accounted with reference to the magnetic field. 180 electrical degree is accounted as the angle between adjacent North and South poles.

10. What is the relation between electrical degree and mechanical degree?

(OHFWULFDO GHJUHH H DQG PHFKDQLFDO GHJUHH P DUH UHODWHG WR RQH DQRWKHU E the number of poles P, the electrical machine has, as given by the following equation

H 3P

11. What is distributed winding?

When coil-sides belonging to each phase are housed or distributed in more than one slot under each pole region then the winding is called distributed winding

A :KHUH fullpitch coil has width of coil otherwise called coil-span as 180º - angle between adjacent slots in electrical degree and x= 1,2,3…

12. Why is short pitch winding preferred over full-pitch winding ?

Advantages

- Waveform of the emf can be approximately made to a sine wave and distorting harmonics can be reduced or totally eliminated.
- Conductor material , copper , is saved in the back and front end connections due to less coil-span.
- Fractional slot winding with fractional number of slots/phase can be used which in turn reduces the tooth ripples.
- Mechanical strength of the coil is increased.

13. Write down the formula for distribution factor.

K_d = sin(m **P VLQ RU .** $_{dn}$ **= sin(mn P sin(n**

m= **DQJOH** number **EHWZHHQ** ofslots/ **DGMDFHQW** pole/phase **VORWV**

LQ HOHFWULFDO GHJUHH n = order of harmonic

14. Define winding factor.

The winding factor K_d is defined as the ratio of phasor addition of emf induced in all the coils belonging to each phase winding to their arithmetic addition.

15. Why are Alternators rated in kVA and not in kW?

The continuous power rating of any machine is generally defined as the power the machine or apparatus can deliver for a continuous period so that the losses incurred in the machine gives rise to a steady temperature rise not exceeding the limit prescribed by the insulation class.

Apart from the constant loss incurred in Alternators is the copper loss, occurring in the 3 –phase winding which depends on I^2 R, the square of the current delivered by the generator. As the current is directly related to apparent – power delivered by the generator , the Alternators have only their apparent power in VA/kVA/MVA as their power rating.

16. What are the causes of changes in voltage in Alternators when loaded?

Variations in terminal voltage in Alternators on load condition are due to the following three causes:

- Voltage variation due to the resistance of the winding, R

- Voltage variation due to the leakage reactance of the winding, X_t
- Voltage variation due to the armature reaction effect, X_a

17. What is meant by armature reaction in Alternators?

The interaction between flux set up by the current carrying armature

FRQGXFWRUV $_a$ and the main fieOG IOX[$_m$ is defined as the armature reaction.

18. What do you mean by synchronous reactance?

Synchronous reactance $X_s = (X_l + X_a)$

The value of leakage reactance X_l is constant for a machine based on its construction. X_a depends on saturating condition of the machine. It is the addition of X_a , which represent the armature reaction effect between two synchronously acting magnetic fields that makes the total reactance X_a to be called syncheornous reactance.

19. What is meant by synchronous impedance of an Alternator?

The complex addition of resistance, R and synchronous reactance , jX_s can be represented together by a single complex impedance Z_s called synchronous impedance.

In complex form $Z_s = (R + jX_s)$

In polar form $Z_s = | Z_s | <$

Where $| Z_s | =$ ¥ 5^2 + X^2_s)

And WDQ^{-1} (X_s /R)

20. What is meant by load angle of an Alternator?

The phase angle introduced between the induced emf phasor, E and terminal voltage phasor , U during the load condition of an Alternator is called load angle.

22. An Alternator is found to have its terminal voltage on load condition more than that on no load. What is the nature of the load connected?

The nature of the load is of leading power factor , load consisting of resistance and capacitive reactance.

23. Define the term voltage regulation of Alternator.

The voltage regulation of an Alternator is defined as the change in terminal voltage from no-load to load condition expressed as a fraction or percentage of terminal voltage at load condition ; the speed and excitation conditions remaining same.

Voltage regulation in percentage , $U_{RP} = [(|E|-|U|)/|U|]x\ 100$

24. What is the necessity for predetermination of voltage regulation?

Most of the Alternators are manufactured with large power rating , hundreds of kW or MW, and also with large voltage rating upto 33kV. For Alternators of such power and voltage ratings conducting load test is not possible. Hence other indirect methods of testing are used and the performance like voltage regulation then can be predetermined at any desired load currents and power factors.

25. Name the various methods for predetermining the voltage regulation of 3-phase Alternator.

The following are the three methods which are used to predetermine the voltage regulation of smooth cylindrical type Alternators

- Synchronous impedance / EMF method
- Ampere-turn / MMF method
- Potier / ZPF method

26. How synchronous impedance is calculated from OCC and SCC?

Synchronous impedance is calculated from OCC and SCC as

$|Z_s| = E_0/I_{sc}$(for same I_f)

A compromised value of Z_s is normally estimated by taking the ratio of (E_0/I_{sc}) at normal field current I_{fn}. A normal field current I_{fn} is one which gives rated voltage U_r on open circuit.

$|Zs| = U_r/I_{scn}$

27. What are the advantages and disadvantages of estimating the voltage regulation of an Alternator by EMF method?

Advantages:

- Simple no load tests (for obtaining OCC and SCC) are to be conducted
- Calculation procedure is much simpler

Disadvantages:

- The value of voltage regulation obtained by this method is always higher than the actual value

28. Why is the synchronous impedance method of estimating voltage regulation considered as pessimistic method?

Compared to other methods, the value of voltage regulation obtained by the synchronous impedance method is always higher than the actual value and therefore this method is called the pessimistic method.

29. In what way does the ampere-turn method differ from synchronous impedance method?

The ampere-turn /MMF method is the converse of the EMF method in the sense that instead of having the phasor addition of various voltage drops/EMFs, here the phasor addition of MMF required for the voltage drops are carried out. Further the effect of saturation is also taken care of.

30. What are the test data required for predetermining the voltage regulation of an Alternator by MMF method?

Data required for MMF method are :

- Effective resistance per phase of the 3-phase winding R
- Open circuit characteristic (OCC) at rated speed/frequency
- Short circuit characteristic (SCC) at rated speed/frequency

31. Why is the MMF method of estimating the voltage regulation considered as the optimistic method?

Compared to the EMF method, MMF method, involves more number of complex calculation steps. Further the OCC is referred twice and SCC is referred once while predetermining the voltage regulation for each load condition. Reference of OCC takes care of saturation effect. As this method require more effort, the final result is very close to the actual value. Hence this method is called optimistic method.

32. State the condition to be satisfied before connecting two alternators in parallel

The following are the three conditions to be satisfied by synchronizing the additional Alternator with the existing one or the common bus-bars.

- The terminal voltage magnitude of the incoming Alternator must be made equal to the existing Alternator or the bus-bar voltage magnitude.
- The phase sequence of the incoming Alternator voltage must be similar to the bus-bar voltage.
- The frequency of the incoming Alternator voltage must be the same as the bus-bar voltage.

33. How do the synchronizing lamps indicate the correctness of phase sequence between existing and incoming Alternators?

The correctness of the phase sequence can be checked by looking at the three sets of lamps connected across the 3-pole of the synchronizing switch. If the lamps grow bright and dark in unison it is an indication of the correctness of the phase sequence. If on the other hand, they become bright and dark one after the other, connections to any two machine terminals have to be interchanged after shutting down the machine.

34. What are the advantages and disadvantages of three dark lamps method of synchronizing?

Advantages:

- The synchronous switch using lamps is inexpensive

- Checking for correctness of the phase sequence can be obtained in a simple manner which is essential especially when the Alternator is connected for the first time or for fresh operation after disconnection

Disadvantages:

- The rate of flickering of the lamps only indicates the frequency difference between the bus-bar and the incoming Alternator. The frequency of the incoming Alternator in relation to the bus-bar frequency is not available.

35. How synchronoscope is used for synchronizing Alternators?

Synchronoscope can be used for permanently connected Alternators where the correctness of phase sequence is already checked by other means. Synchronoscope is capable of rotating in both directions. The rate of rotation of the pointer indicates the amount of frequency difference between the Alternators. The direction of rotation indicates whether incoming Alternator frequency is higher or lower than the existing Alternator. The TPST switch is closed to synchronise the incoming Alternator when the pointer faces the top thick line marking.

36. Why synchronous generators are to be constructed with more synchronous reactance and negligible resistance?

The presence of more resistance in the Synchronous generators will resist or oppose their synchronous operation. More reactance in the generators can cause good reaction between the two and help the generators to remain in synchronism in spite of any disturbance occurring in any one of the generators.

37. List the factors that affect the load sharing in parallel operating generators?

The total active and reactive power delivered to the load, connected across the common bus-bars, are shared among Synchronous generators, operating in parallel, based on the following three factors

- Prime-mover characteristic/input
- Excitation level and
- Percentage synchronous impedance and its R/X ratio

38. How does the change in prime mover input affect the load sharing?

An increase in prime-mover input to a particular generator causes the active-power shared by it to increase and a corresponding decrease in active-power shared by other generators. The change in reactive power sharing is less appreciable. The frequency of the bus-bar voltage will also subjected to slight increase in value.

39. How does change in excitation affects the load sharing?

The decrease in excitation in one generator causes the reactive power shared by it to decrease and a corresponding increase in reactive-power shared by other generators. The change in active-power sharing is less appreciable. There will be a slight decrease in terminal voltage magnitude also.

40. What steps are to be taken before disconnecting one Alternator from parallel operation?

The following steps are to be taken before disconnecting one Alternator from parallel operation

- The prime-mover input of the outgoing generator has to be decreased and that of other generators has to be increased and by this the entire active-power delivered by the outgoing generator is transferred to other generators.
- The excitation of the outgoing generator has to be decreased and that of other generators have to be increased and by this the entire reactive-power delivered by the outgoing generator is transferred to other generators.
- After ensuring the current delivered by the outgoing generator is zero, it has to be disconnected from parallel operation.

41. What is meant by infinite bus-bars?

The source or supply lines with non-variable voltage and frequency are called infinite bus-bars. The source lines are said to have zero source impedance and infinite rotational inertia.

42. How does increase in excitation of the Alternator connected to infinite bus-bars affect this operation?

Increase in excitation level of the synchronous generator will effectively increase the reactive component of the current supplied by the generator and hence the active power delivered.

43. In what respect does a 1-phase Induction motor differ from a 3-phase Induction motor?

Construction wise a plain 1-phase Induction motor is more or less similar to a 3-phase squirrel-cage Induction motor except that its stator is provided with only 1-phase winding.

44. What are the inherent characteristics of plain 1-phase Induction motor ?

A plain 1-phase Induction motor is not used in practice due to the following inherent characteristics

- A plain 1-phase Induction motor does not have any starting torque
- However, if the rotor is initially given a starting torque, by some means, the motor can pick up its speed in a direction at which the initial torque is given and deliver the required output.

45. Name the two different theories with which principle of 1-phase induction motors are explained.

The two different theories are

- Double revolving field theory
- Cross field theory

46. State double revolving field theory.

Double PDJQHWLF revolving ILHOGP theory, DVLWVPD[LPXP formulated YDOXH by Ferrari, FDQEH states UHVROYHG that LQWR a single WZR URWDWLQJ pulsating

PDJQHWLF ILHOGV RI P DV WKHLU PDJQLWXGH URWDWLQJ LQ RSSRVLWH

GLUHFWLRQ DW synchronous speed proportional to the frequency of the pulsating field.

47. Name any four types of 1-phase induction motors.

Based on the method of starting arrangement provided, the 1-phase Induction motors are classified as follows

(i) Split-phase motor
(ii) Capacitor start motor
(iii) Capacitor start and run motor
(iv) Shaded pole motor
(v) Repulsion start Induction run motor

48. Why are centrifugal switches provided on many 1-phase Induction motors?

Centrifugal switches are provided on many 1-phase Induction motors to disconnect the starting / auxiliary winding from the supply when the motor reaches about 70% of its synchronous speed.

49. How is the direction of a capacitor start Induction motor be reversed?

The direction of rotation can be reversed by interchanging the terminals of either the main winding or the starting winding.

50. State the principle of 3 phase IM?

While starting, rotor conductors are stationary and they cut the revolving magnetic field and so an emf is induced in them by electromagnetic induction. This induced emf produces a current if the circuit is closed. This current opposes the cause by Lenz's law and hence the rotor starts revolving in the same direction as that of the magnetic field.

51. Induction motor can run at synchronous speed ? True or false? Explain .

No, if the speed of induction motor is Ns then the relative speed between the rotating flux and the rotor will be zero and so no torque is produced.

52. An induction motor is generally analogous to ?

It is analogous to a winding rotating transformer with its secondary circuit closed'

.

53. Can the starting torque of of a slip ring induction motor being

increased? Yes. It can be increased by adding resistances to the rotor.

54. What would happen if a 3 phase induction motor is switched on with one phase disconnected?

The motor is likely to burn .

55. What happens if the air gap flux density in an induction motor increases?

The increase in air gap flux increases iron loss and hence efficiency decreases.

56. State the advantages of skewing?

It reduces humming and hence quite running of motor is achieved. It reduces magnetic locking of the stator and rotor.

67 State the condition at which the starting torque developed in a slip-ring induction motor is maximum.

When R2=X2

68 What are the effects of increasing rotor resistance on starting current and starting torque?

The additional external resistance reduces the rotor current and hence the current drawn from the supply.
It improves the starting torque developed by improving the power factor in high proportion to the decrease in rotor current.

68 What is slip of an induction motor?

The slip speed expressed as the ratio of synchronous speed is defined as slip. Percentage slip S=Ns-N/Ns*100

69 How the magnitude of rotor emf is related to the slip in an I M?

Rotor circuit emf per phase E2r=SE2

70 How the frequency of rotor emf is related to the slip in an I M?

Frequency of rotor emf/current fr=Sfs

71 What is the normal value of slip of an I M operating at full load? 3 - 5%

72 Why is not possible for the rotor speed of an I M to be equal to the speed of its rotating magnetic field?

The machine will not be able to develop any mechanical torque to run as a motor.

73 State the condition at which the torque developed in a 3 phase induction motor is maximum.

When R2=SX2

74. What are the advantages of slip-ring I M over cage I M?

(i) Rotor circuit is accessible for external connection.

(ii) By adding external resistance to the rotor circuit the starting current is reduced with the added advantage of improving starting torque.

(iii) Additional speed control methods can be employed with the accessibility in the rotor circuit.

75. What are the losses occurring in an I M and on what factors do they depend?

Magnetic losses Wi
Electrical losses Wcu
Mechanical losses Wm

For I M operating in normal condition (with constant voltage and frequency) magnetic and mechanical losses remain constant whereas electrical losses vary in square proportion to the current.

76. What care should be taken at the time of construction to reduce eddy current losses in I M?

Make the resistance of the core body as large as possible.This is achieved by laminating the stator core,stacked and revetted at right angles to the path of eddy current.The laminations are insulated from each other by thin coat of varnish.

77. Why is there not appreciable magnetic losses in the rotor core of Induction motors?

Although the rotor core is also subjected to magnetic flux reversals and since the frequency of flux reversals in the rotor, $f_r = Sf_s$, is very small, the iron loss incurred in the rotor core is negligibly small.

78. What is meant by synchronous watt?

With the power input to the motor P_i, after the losses in the stator winding. W_{cu1} and stator core, W_i, are met with, the remaining power is transferred to the rotor by the rotating magnetic field as power input to the rotor P_{ir}

$$P_{ir} = P_i - w_{au1} - W_i$$

The power input to the rotor P_{ir} is transferred from the stator to the rotor by rotating magnetic field which rotates at synchronous speed N_s. Torque T_d is developed in the rotor as a result of P_{ir} and the equation for P_{ir} can alternatively be expressed **1** as

P_{ir} $s/60).\ T_d$ W

Or $T_d = P_{ir}$ Syn. W

79. How does the shaft torque differ from the torque developed in 3-phase Induction motor?

The mechanical power developed Pd causes the rotor to rotate at a speed N_r due to the torque T_d developed in the rotor . Therefore, equation for P_r can be written as P_d **1** $T_d / 60$

The remaining power, after the mechanical losses Wm are met with, available in the shaft as mechanical power output P_o

$P_o = P_d - W_m$

The mechanical power output P_o, which is less than P_d is available in the shaft running at a speed of N_r and with a shaft torque T. Therefore the shaft torque (T) is slightly less than **1** the torque developed T_d,

P_d $_rT / 60$ **> 1**

$W_m = P_d - P_o$ $_r(T_d - T)] / 60$

80. Name the tests to be conducted for predetermining the performance of 3-phase induction machine.

(a) No load test
(b) Blocked rotor test

81. What are the informations obtained from no-load test in a 3-phase I M?

(i) No –load input current per phase,Io
(ii) No load powerfactor and hence no load phase angle
(iii) Iron and mechanical losses together
(iv) elements of equivalent circuit shunt branch

82What are the informations obtained from blocked rotor test in a 3-phase I M? (i)Blocked rotor input current per phase at normal voltage
(ii) Blocked rotor power factor and hence phase angle
(iii) Total resistance and leakage reactance per phase of the motor as refered to the stator

83 What is circle diagram of an I M?

When an I M operates on constant voltage and constant frequency source,the loci of stator current phasor is found to fall on a circle.This circle diagram is used to predict the performance of the machine at different loading conditions as well as mode of operation.

84 What are the advantages and disadvantages of circle diagram method of predetermining the performance of 3 –phase I M?

The prediction can be carried out when any of the following information is available

The input line current., the input power factor, The active power input, The reactive power input, The apparent power input, The output power , The slip of operation, The torque developed, The equivalent rotor current per phase, Maximum output power, Maximum torque developed.

The only disadvantage is, being a geometrical solution, errors made during measurements will affect the accuracy of the result.

85 What are the advantages and disadvantages of direct load test for 3 –phase I M? Advantages

Direct measurement of input and output parameters yield accurate results

Aside from the usual performance other performances like mechanical vibration, noise etc can be studied.

By operating the motor at full load for a continuous period, the final steady temperature can be measured.

Disadvantages

Testing involves large amount of power and the input energy and the entire energy delivered is wasted

Loading arrangement cannot be provided for motors of large power rating

86 State the characteristic features of synchronous motor.

a. the motor is not inherently self starting
b. The speed of operation is always in synchronous with the supply frequency irrespective of load conditions
c. The motor is capable of operating at any power factor.

87 In what way synchronous motor is different from other motors?

All dc and ac motors work on the same principle. Synchronous motor operates due to magnetic locking taking place between stator and rotor magnetic fields.

88 Name any two methods of starting a synchronous motors

- By an extra 3 phase cage induction motor
- By providing damper winding in pole phases
- By operating the pilot excitor as a dc motor

89 What is the effect on speed if the load is increased on a 3 phase synchronous motor?

The speed of operation remains constant from no load to maximum load in the motor operating at constant frequency bus bars.

90 Why a synchronous motor is a constant speed motor?

Synchronous motor work on the principle of force developed due to the magnetic attraction established between the rotating magnetic field and the main pole feed. Since the speed of rotating magnetic field is directly proportional to frequency the motor operates at constant speed.

91 What is the phasor relation between induced emf and terminal voltage of a 3 phase synchronous motor?

The rotating magnetic field is initially established by the prime source of supply V. The main field then causes an emf e to get induced in the 3 phase winding. Hence when the machine operates as a synchronous motor the **DQJOH** emf phasor always lags the terminal voltage phasor by the load/torque

92 At what load angle is power developed in a synchronous motor becomes its maximum value ?

:KHQ LWV ORDG DQJOH LV HTXDO WR WKH LPSHGDQFH DQJOH

93 What are V and inverted V curves of synchronous motor ?

The variation of magnitude of line current with respect to the field current is called V curve . The variation of power factor with respect to the field current is called inverted V curve.

94 What happens when the field current of a synchronous motor is increased beyond the normal value at constant input?

Increase in emf causes the motor to have reactive current in the leading direction. The additional leading reactive current causes the magnitude of line current, accompanied by the decrease in power factor.

95 Distinguish between synchronous phase modifier and synchronous condenser

A synchronous motor used to change the power factor or power factor in the supply lines is called synchronous phase modifier.
A synchronous motor operated at no load with over excitation condition to draw large leading reactive current and power is called a synchronous condenser.

96 How the synchronous motor can be used as s synchronous condenser?

Synchronous motor is operated on over excitation so as to draw leading reactive current and power from the supply lines. This compensates the lagging current and power requirement of the load making the system power factor to become unity. The motor does the job of capacitors and hence called as synchronous condenser.

97 What type of single phase induction motor would you use for the following applications?
(i) Ceiling fan (ii) Wet grinder

Ceiling fan – capacitor start and run motor

Wet grinder – capacitor start motor

98 After servicing a single phase fan it was found to run in reverse direction. What could be the reason?

The connection to the starting/ auxiliary winding would have reversed.

99 What will be the direction of rotation of a shaded pole single phase induction motor?

The motor rotates in the direction specified by the unshaded to shaded region in the pole phase

100 What is the property of a single phase single winding induction motor?

It has zero starting torque

101 Which winding in a double cage induction motor has high resistance and low inductance?

Outer cage winding

Long answer Questions

1. State the requirements for paralleling of alternators.
2. A two pole,50 Hz, 3-phase, turbo alternator is excited to generate the bus-bar voltage of 11 kV on no load.The machine is star connected and the short circuit current for this excitation is 1000A. Calculate the synchronizing power per degree of mechanical displacement of the rotor and the corresponding synchronizing torque.
3. A 3300V, 3 phase star connected alternator has a full load current of 100A.On short circuit a field current of 5A was necessary to produce full-load current.The e m f on open circuit for the same excitation was 900V.The armature resistance was 0.8 ohm/phase. Determine the full load voltage regulation for (i) 0.8 p f lagging (ii) 0.8 p f leading.
4. Explain the construction and principle of operation of 3-phase alternator
5. Develop the equivalent circuit of three phase I M
6. Explain the various techniques of speed control of 3-phase I M
7. A 3-phase ,star connected, 16 pole alternaror has 192 slots with 8 conductors per slot, coil span=160 electrical degrees, speed of alternator=375 rpm, flux per pole=55mWb.Calculate the line and phase values of EMF generated.
8. The following data refers to a 20pole,460V,60Hz, 3-phase I M :
   R1=2 ohm,X1=1 ohm, R2' =3 ohm, X2' =7 ohm. When the motor is tested on no load, it is observed that it takes 3.9A and the total core loss is 450W.By using an approximate equivalent circuit at 5% slip, calculate
   (i) Rotor current (ii) Supply current and pf (iii) Gross load torque
   (iv) draw the equivalent circuit.

9. Explain about crawling and cogging
10. Describe any two methods of determining the voltage regulation of 3-phase alternator
11. Explain the operation of single phase induction motor on the basis of double field revolving theory.
12. Explain the operation of the types of stepper motors.
13. A 3 MVA , 50Hz, 11 kV, 3-phase star connected alternator supplies 100A at zero p f leading. The line voltage is 12370V.When the load is removed, the line voltage is 1100V.Find the regulation at full load,0.8 pf lagging. Ra=0,4ohm/phase.
14. Bring out the characteristics of two alternators working in parallel. What is the effect of change in excitation on load sharing.
15. Derive the equation for torque developed by an I M. Draw the tipical torque-slip curve and deduce the condition for maximum torque.
16. Write a note on Hysterisis motor
17. Write short notes on (i)A C series motor (ii) Reluctance motor
18. How do you determine the direct axis and quadrature axis reactances of a salient pole alternator?
19. A three phase star connected alternator has direct axis synchronous reactance of 0,7p u and quadrature axis reactance of 0,5 p u,If the generator delivers kVA at rated voltage at full load and lagging, find the percentage regulation.Resistance drop at full load is 0,017 p u.
20. Two alternators are connected in parallel, what happens when we (i) increase the excitation of one machine (ii) increase the steam supply of one machine.
21. Two similar 3000kVA synchronous generators work in parallel.The governor of first machine is such that frequency drops uniformly from 50Hz on no load to 48 Hz on full load.The corresponding speed drop of second machine is from 50Hz to 47.5Hz.determine the following
    (i) How will the two machines share a load 5000kW at full load
    (ii) What is the maximum load at u p f that can be delivered without overloading either of the two machines.
22. Explain why synchronous motor is not self starting.
23. Explain the various schemes of starting of 3 phase I M
24. Describe how 3-phase supply produces a rotating magnetic field of constant value at constant speed with vector diagrams.
25. Derive the EMF Equation of 3 phase alternator .Define distribution factor and coil span factor?