Total Pages—6

(Set-K)

B.Tech. - 4th
Electrical Machines - II

Full Marks : 70

Time : 3 hours

Answer any six questions including Q. No. 1

The figures in the right-hand margin indicate marks

1. Answer the following : 2 × 10

   (*i*) Define pitch factor of alternators.

   (*ii*) Compare the rotor construction of a turbo alternator in thermal power plant with that of a hydel generator.

   (*iii*) A 3-phase synchronous motor connected to infinite bus is operating at half load, with normal excitation. What will happen to its speed, when the load is suddenly increased ?

   (*iv*) If a 3-phase slip ring induction motor is fed

from the rotor side with stator winding short circuited, what will be the frequency of the current flowing in the short circuited stator ?

(*v*) How short circuit test is performed on an induction motor ?

(*vi*) What is 'crawling' of induction motor and why is it produced ?

(*vii*) Why damper winding is used in synchronous motors ?

(*viii*) What is synchronous reactance ?

(*ix*) How phase splitting can be accomplished in a single phase induction motor ?

(*x*) Why does the capacitor start single phase Induction motor develop much larger starting torque in comparison with the 'split-phase' motor ?

2. (*a*) A 3-phase, 4 pole alternator has 48 stator slots carrying 3-phase distributed winding. If each coil of the winding is short chorded by one slot pitch, calculate the winding factor. 3

1+1+1

(*b*) List the conditions to be satisfied for parallel operation of alternators. 3

(*c*) Derive and explain the power angle relation of a 3-phase cylindrical rotor alternator. 4

3. (*a*) Explain the ZPF method of determining regulation of an alternator. Define the relevant reactance. 4

(*b*) Explain Blodels two reaction theory of salient pole alternator. 6

4. (*a*) A salient pole alternator with $X_d = 1.2$ pu and $X_q = 0.8$ pu is connected through an external reactance of 0·1 pu to an infinite bus of voltage 1·0 pu. The alternator delivers rated VA at power factor of 0·9 lagging at its terminals. Calculate : 6

(*i*) the alternator terminal voltage and current

(*ii*) the alternator load angle and the excitation voltage.

(*b*) A synchronous motor operates with constant load at 0.8 p.f. lagging. Explain what will happen to armature current and its power factor, if the field current of the motor is continuously increased. Give reasons. 4

5. (*a*) Using the approximate equivalent circuit of 3-phase induction motor, derive the expressions for developed torque without neglecting stator resistance. Also, obtain the condition for torque to be maximum, and the expression for maximum torque. Sketch and explain the torque-speed characteristics with variable rotor resistance. 5

(*b*) Describe the different methods of starting 3-phase induction motors. 5

6. A 15 kW, 400 V, 4-pole, 50 Hz, 3-phase, star connected induction motor gave the following test results :

No load test	: $V_L = 400V$, $I_L = 9A$, 1310W
Blocked rotor test	: $V_L = 200V$, $I_L = 50A$, 7100W

(*Continued*)

Stator and rotor ohmic losses at stand still are equal. Draw the induction motor circle diagram and calculate :

(*i*) line current, power factor, slip, torque and efficiency at full load.

(*ii*) maximum possible power factor and the corresponding line current.

(*iii*) maximum power output and maximum power input.

(*iv*) slip at which maximum torque occurs and the maximum torque.

(*v*) starting torque. 10

7. (*a*) Explain the double revolving field theory and obtain the equivalent circuit for single phase induction motor. 5

(*b*) A 2 MVA, 11 KV, 3-phase, star connected alternator has a resistance of 0·3Ω and reactance of 5Ω per phase. It delivers full load current at power factor 0·8 lagging and

normal rated voltage. Compute the terminal voltage for the same excitation and load current at 0·8 p.f. leading. 5

8. Write notes on any *two* : 5 × 2

(*i*) Principles of ac machines and E.M.F. equation

(*ii*) Universal motor

(*iii*) Speed control of Induction motor.
