
B.E. / B.Tech. (Full Time) DEGREE EXAMINATIONS, NOV/DEC 2011

ELECTRICAL AND ELECTRONICS ENGINEERING BRANCH

FIFTH SEMESTER

EE 9304 – ELECTRICAL MACHINES II

(REGULATIONS 2008)

PART – A (10 x 2 = 20 Marks)

1. A three-phase, 4 kW, 400V, 50 Hz, 4 P slip ring induction motor develops a maximum torque of 100 Nm. It has rotor resistance = 0.5 Ω/phase and rotor leakage reactance = 1.0 Ω/phase. If the rotor resistance is doubled then what will be the new value of maximum torque.
2. A three phase, 400V, 50 Hz, 4 P induction motor is connected to a three phase 400V, 50 Hz power supply and runs at no-load condition. The number of poles is suddenly changed to 6 P. Comment on the machines performance.
3. A 50 Hz, three phase induction motor with synchronous speed of 100 rad/sec develops a shaft torque of 150 Nm when the rotor emf makes 120 complete cycles per minute. Compute the shaft power output for this motor.
4. Draw the speed (vs.) torque curves of slip ring induction motor whose rotor resistance is externally changed such that $R'_2 > R''_2 > R'''_2$.
5. In a synchronous machine the armature reaction produces magnetizing effect under favourable conditions. Justify using the necessary phasor diagram.
6. State whether a synchronous motor can be started with a low frequency power supply (say 5 Hz). Justify your answer.
7. What is called torque angle of a synchronous machine?
8. Does the terminal voltage of an alternator increase or decrease when the load across it is thrown open for a positive voltage regulation? Justify your answer.
9. Why a single phase induction motor is not self starting?
10. Why is a capacitor start capacitor run motor better than a permanent split capacitor motor?

PART – B (5 x 16 = 80 Marks)

11 a) i). Graphically show that a rotating magnetic field is created in the air gap of a three-phase induction machine when its windings are excited with three phase balanced power supply. [8]

11 a) ii). A three phase 4 kW, 400V, 50 Hz, 4 P induction motor runs at 1440 RPM at rated load condition. Compute its efficiency at rated load condition, where the rotational losses are 400 W and stator copper loss is equal to rotor copper loss. [8]

12 a). The test data on a 208 V, 60 Hz, 4 pole, star connected three-phase induction motor rated at 1710 rpm are as follows: the stator resistance between any two terminals = 2.4 Ω. *No load test: 450 W, 1.562 A, 208 V. Blocked rotor test: 59.4 W, 2.77 A, 27 V.* Friction and windage loss = 18 W. Compute the stator current, power factor and efficiency at 75% full load. [16]

(or)

12 b). (i) Compare and contrast the construction and performance of deep bar rotor and double cage rotor of three phase induction motors. Draw necessary diagrams. [8]

(ii) Describe the functional features of a starter of three-phase induction motor that can provide one third of the starting torque at standstill condition. [8]

13 a). (i) From first principles derive the EMF equation of a three-phase alternator. [8]

(ii) The short circuit, open circuit and DC test data for a three-phase, star connected, 50 kVA, 240 V, 60 Hz synchronous alternator are V_{oc} = 240 V; $I_{sc,line}$ = 115.65 A, V_{dc} = 10.35 V, I_{dc} = 52.80 A. Compute the short circuit ratio. [8]

(or)

13. b). Explain in detail the construction and theory of salient pole synchronous machines. Suggest a suitable method to determine the direct axis and quadrature axis reactance components and hence load angle δ. [16]

14. a). A 9 kVA, 208 V, three-phase star connected synchronous generator has a winding resistance of 0.1 Ω/phase and a synchronous reactance of 5.6 Ω/phase. Determine its voltage regulation at full load and the power factor of the load is (a) 80% lagging, (b) unity and (c) 80% leading. [16]

(or)

14. b). (i) How damper windings are used in both alternators and synchronous motors. [8]

(ii) Explain the application of synchronous motor as synchronous condenser in power system. [8]

15. a). (i) The main and auxiliary windings of a 120 V, 60 Hz, split phase motor have the following locked rotor parameters: R_{main} = 2.0 Ω, X_{main} = 3.5Ω, R_{aux} = 9.15Ω and X_{aux} = 8.4 Ω. If the motor is connected to a 120 V and 60 Hz power supply then determine the locked rotor current in each winding and the phase displacement angle. [8]

(ii). Write short notes on shaded pole motor. [8]

(or)

15. b). With neat sketches explain the principle of operation of universal motor. [16]