Bachelor of ElectricalEngineering Examination (Old), 2017

(3rdYear, **2nd**Semester)

ELECTRICAL MACHINES - III

Time: Three Hours **Full Marks**: 100

(50 marks for each part)
Use a separate Answer-Script for each Part

PART - I

Answer ***any three*** questions from this part.
Two marks are reserved for neat and well organised answer.

1. a) Starting from basic principle develop the expression for torque produced in a three phase induction motor. Establish the condition for maximum torque developed. Draw torque vs. slip characteristic and also show how torque vs. slip characteristic changes with the variation of rotor resistance and rotor inductance. 10

   b) Derive the relation between output power of the rotor, input power to the rotor and slip of a three phase induction motor. 6

2. a) Develop the equivalent circuit of a three phase induction motor and explain how the mechanical power developed is taken care in the equivalent circuit. 8

   b) Describe no-load and blocked rotor tests of an induction motor and show how to calculate the equivalent circuit parameters from these test results. 8

3. a) Explain how improved starting performance of a three phase squirrel cage motor may be obtained by means of a double cage rotor winding. Draw equivalent circuit of a double cage rotor induction motor.Derive the relationship between the torques developed by outer and inner cages of a double cage induction motor. 10

   b) The resistance and reactance (equivalent) values of a double cage induction motor forthe stator, outer and inner cage are 0.25, 1.0 and 0.15 ohm of resistance while 3.5, zero and 3.0 ohm of reactance respectively. Find the starting torque if the phase voltage is 250 Volt and the synchronous speed is 1000 rpm. 6

[Turn over

4. a) Describe briefly the phenomenon of cogging and crawling. What measures can eliminate these effects? 6

b) A squirrel cage type induction motor when started by means of a star-delta starter takes 180% of full load line current and develops 35% of full load torque at starting. Calculate the starting torque and current in terms of full load values, if an auto-transformer with 75% tapping were employed. 10

5. a) Explain the double revolving field theory for single phase induction motor and also prove that a single phase induction motor cannot produce starting torque. Show that this motor can be forced to run in either direction. 10

b) What are the various methods of starting of single phase induction motor? 2

c) Explain the construction and working of a deep-bar rotor induction motor. 4

PART II

Answer any Three Questions
Two marks are for neat and systematic answers

Q6. Justify the following (any four) 4x4

a) OC test is performed at synchronous speed while SC test can be performed at speeds other than synchronous speed.

b) Slip test is performed at a speed slightly less than the synchronous speed.

c) It is not mandatory to laminate the rotor of a synchronous machine because the excitation is d.c, but the rotor of salient pole machine is always laminated – why?

d) Zero power factor characteristics (ZPFC) of an alternator do not start from origin- why?

e) Cylindrical rotor synchronous machine has long rotor with special cooling arrangement – why?

f) Mmf method to determine voltage regulation of an alternator is optimistic.

Q7. (a) Show that the effect of armature reaction of a three phase synchronous machine is equivalent to reactive voltage drop. Explain with help of diagrams the effect of load power factor on armature reaction . 8

(b) A 100 kVA, 440V, 3 phase, star connected, alternator has the following data: 8

F&W Loss= 340W, Open circuit Core Loss=480W, Field winding resistance at 75^0C=180 ohm, Ra=0.02 ohm/phase 8

The voltage applied to field winding is 220V. Calculate alternator efficiency at 0.8 pf, at half load.

Q8. (a) Develop and explain the phasor diagram of a salient pole alternator both under lagging and leading power factor condition. 8

(b) Develop the power angle characteristics of salient pole alternator. Also determine the synchronizing power coefficient for the same. 4+4

Q9. (a) Show that the synchronous motors do not have inherent starting torque. Discuss different starting techniques of synchronous motors. 4+6

(b) A 20 MVA, 3 phase, star connected, 11kV, 12 pole 50 Hz, salient pole synchronous motor has the following parameters. 6

X_d= 5 ohm, X_q= 3 ohm

At full load unity power factor and rated voltage, compute (a) the excitation voltage (b) Total Power output.

Q10. Write short notes on any Two 8x2

a) Excitation and power circle diagrams of a synchronous motor.
b) Zero power factor method for calculation of voltage regulation
c) Synchronization of alternator