D 30962 (Pages : 2) Name.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION OCTOBER 2012

EE 09 501—SYNCHRONOUS AND INDUCTION MACHINES

(2009 Scheme)

Time : Three Hours Maximum : 70 Marks

Part A

All *questions are* **compulsory.**

1. A water wheel alternator has 20 poles. Calculate the speed for a frequency of 50 Hz.
2. Deduce the expression showing the relationship between speed, frequency and number of poles of a synchronous machine.
3. What is meant by synchronous condenser ?
4. The maximum torque of a three phase squirrel-cage induction motor is 3 times the full-load torque and starting torque is 1.5 times the full-load torque. For negligible stator resistance, compute slip at maximum torque and full load slip.
5. Classify single phase induction motors in accordance with the methods of starting.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

1. A three-phase, 50 Hz, 2 pole, star-connected turbo alternator has 54 slots with 4 conductors per slot. The pitch of the coils is 2 slots less than the pole pitch. If the machine gives 3300 V between lines on open circuit with sinusoidal flux distribution, determine the useful flux per pole.
2. Explain the phenomena of armature reaction when an alternator is delivering a load current at (a) purely leading power factor, and (b) unity power factor.
3. Explain the reason for running the alternaors in parallel.
4. A three phase squirrel-cage induction motor, when started from rest, does not accelerate to normal speed but to a speed approximately $\frac{1}{7}$th of synchronous speed. Give the causes.
5. Compare single-cage and double cage induction motors in so far as their starting performance, full load performance and torque-slip characteristics are concerned.
6. Explain the functions of two stator windings in a single phase induction motor.

(4 × 10 = 40 marks)

Part C

Answer **one** *question from each module.*

1. Explain the effect of armature reaction in Synchronous generator at lagging and leading p.fs.

Or

2. Describe slip test with neat sketches, and explain how reactances are calculated using it.

Turn over

3. Two three phase 6.6 kV star-connected alternators supply a total load of 4000 kW at 0.8 p.f. lagging. The synchronous impedance per phase of alternator 1 is $(0.4 + j7)\ \Omega$ and that of alternator 2 is $(0.3 + j8)\Omega$. The prime movers are so set that the two alternators share the active power output equally. The excitation of alternator 1 is adjusted so that it delivers 200 A at a lagging p.f. Determine the current, p.f., induced e.m.f. and load angle of each alternator.

Or

4. Draw the phasor diagram of synchronous motor when it takes power at (i) lagging, (ii) unity, and (iii) leading power factors and show the e.m.f. induced is greater than the applied voltage when the motor takes power at leading power factor.

5. (a) With neat sketches, explain the principle of operation of a three phase induction motor.

   (b) The maximum torque of a three phase squirrel-cage induction motor is 3 times the full load torque, and starting torque is 1.5 times the full load torque. For negligible stator resistance, compute slip at maximum torque and full load slip.

Or

6. Explain how space harmonics in the airgap flux wave cause the appearance of harmonic synchronous torques in theee phase induction motors. How can these torques be avoided ?

7. (a) Explain the operation of a star-delta starter with a neat sketch showing all protective devices.

   (b) Compare (i) stator resistance, (ii) autotransformer, and (iii) star-delta methods of starting an induction motor with regard to line current, starting torque and field of application.

Or

8. The following data relates to tests on a 110 V, 150 W. 50 Hz, 6 pole, single phase induction motor :

   No load test : 110 V, 63 W, 2.7 A

   Blocked rotor test : 55 V, 212 W, 5.8 A

   The stator winding resistance is 2.5 Ω and during the blocked rotor test, the starting winding is open. Determine the equivalent circuit parameters. Also find the core, friction and windage losses.

$(4 \times 10 = 40$ marks)