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Name..............................

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FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE [REGULAR/SUPPLEMENTARY] EXAMINATION, NOVEMBER 2013

EE 09 501—SYNCHRONOUS AND INDUCTION MACHINES

Time : Three Hours Maximum : 70 Marks

Part A

All questions are **compulsory.**

1. Define Distribution factor.
2. A 500 V, 50 kVA single-phase alternator has an effective armature resistance of 0.2 Ω. An excitation current of 10 A produces 200 A armature current on short circuit and an e.m.f. of 450 V on open circuit. Calculate the synchronous reactance.
3. What are the conditions to be satisfied for paralleling alternators ?
4. If an 8 pole Induction motor running from a supply of 50 Hz has an e.m.f. in the rotor of frequency of 1.5 Hz, determine the slip and the speed of the motor.
5. Is it possible to change the direction of rotation of a shaded pole type induction motor ? Justify your answer.

(5 × 2 =10 marks)

Part B

Answer any **four** *questions.*

1. A three-phase, 50 Hz, 8-pole alternator has a star-connected winding with 120 slots and 8 conductors per slot. The flux per pole is 0.05 Wb, sinusoidally distributed. Determine the phase and line voltages.
2. A 3 phase salient pole synchronous generator is rated at 3.5 MVA, 6.6 kV. Its direct and quadrature axis reactance are 9.6 Ω and 6 Ω per phase respectively. The winding is star connected and resistance is negligible. If the generator is supplying 2.5 MW at rated voltage and at 0.8 p.f., find the voltage regulation.
3. Describe briefly the effect of varying excitation upon the armature current and power factor of a synchronous when the input active power to the motor is maintained constant.
4. Explain how the rotor of an Induction motor rotates.
5. Discuss the phenomenon of 'single phasing' when applied to the three-phase induction motors, designed for continuous working.
6. Explain the basic principle of induction motor speed control by pole changing.

(4 × 5 = 20 marks)

Turn over

Part C

1. Explain with neat sketches, the mmf method of predetermining regulation of an alternator. Why the results obtained by this method differ from those obtained by synchronous impedance method ?

Or

2. Derive an expression for the excitation e.m.f., E_f, of a salient pole alternator using two reaction theory. Draw its phasor diagram.

3. Discuss in brief, the operations necessary to start up and synchronize a three-phase alternator to the bus bars in a generating station. Explain how the power factor and active power delivered by the generator are adjusted.

Or

4. (a) Explain the principle of operation of synchronous motor and hence develop its phasor diagram.

   (b) Explain the phenomena of hunting in synchronous motor and the methods adopted to minimize the effect of hunting.

5. (a) Describe with neat sketches, the construction of a three-phase squirrel cage induction motor.

   (b) Explain clearly with neat sketches, how a 2 pole magnetic field is created by a three-phase winding when a three-phase supply is given to it.

Or

6. (a) For a three-phase induction motor, show that :

$$P_{ir} : W_{cu2} : P_d = 1 : s : (1 - S)$$

   where P_{ir} = rotor power input

   W_{cu2} = rotor copper or ohmic losses

   P_d = mechanical power developed

   s = operating slip

   (b) Discuss the relative merits and demerits of single cage and double cage induction motors.

7. (a) Describe with construction diagram, the working of an autotransformer starter.

   (b) Explain the slip power recovery scheme for the speed control of a wound rotor induction motor.

Or

8. (a) With neat sketches, using the double field revolving field theory, explain why a single-phase induction motor is not self-starting.

   (b) The following data pertains to a 230 V, 50 Hz, capacitor start single-phase induction motor at standstill.

   Main Winding excited alone : 100 V, 2 A, 40 W

   Auxiliary winding excited alone : 80 V, 1 A, 50 W

   Determine the value of capacitance for obtaining the maximum starting torque.

(4 × 10 = 40 marks)