[redacted]

D 70291 (Pages : 3)

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

Reg. No..............................

FIFTH SEMESTER B.TECH. (ENGINEERING) [09 SCHEME] DEGREE EXAMINATION, NOVEMBER 2014

EE/PTEE 09 501—SYNCHRONOUS AND INDUCTION MACHINES

Time : Three Hours   Maximum : 70 Marks

Part A

All questions *are* **compulsory.**

1. Define Chording factor.
2. What is meant by 'synchronous reactance, X_s' of an alternator.
3. Why synchronous motor is not self starting ?
4. A 12 pole, three phase alternator driven at a speed of 500 r.p.m. supplies power to an 8 pole, three-phase induction motor. If the slip of the motor at full-load is 0.03, calculate the full-load speed of the motor.
5. A 230 V, 50 Hz, single-phase induction motor has the following impedances for the main and auxiliary windings : $Z_m = 28\angle 70^\circ\ \Omega$, and $Z_a = 42\angle 45^\circ\ \Omega$ respectively. Compute the input current at starting.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

1. A three-phase, 16 pole synchronous generator has a resultant air gap flux of 0.06 Wb per pole. The flux is distributed sinusoidally over the pole. The stator has 2 slots per pole per phase and 4 conductors per slot are accommodated in two layers. The coil span is 150° electrical. Calculate the phase and line induced voltages when the machine runs at 375 r.p.m.
2. Using Blondel's two reaction theory, develop and explain the phasor diagram of a salient pole alternator for lagging power factor loads.
3. Explain the principle of operation of a three-phase synchronous motor.

Turn over

[redacted]

[redacted]

4. For a three phase induction motor, show that

$$P_{ir} : W_{cu2} : P_d = 1 : s : (1-s). \text{ where}$$

P_{ir} = rotor power input

W_{cu2} = rotor copper or ohmic losses

P_d = mechanical power developed

s = operating slip

5. Explain how the speed of a polyphase induction motor can be controlled by injecting a voltage in the rotor circuit of a polyphase induction motor.

6. Explain the double revolving field theory as applied to a single-phase induction motor.

(4 × 5 = 20 marks)

Part C

1. A 3.3 kV, three-phase star connected alternator has a full-load current of 100 A. Under short circuit condition, it takes 5 A field current to produce full-load short circuit current. The e.m.f. of open circuit for the same excitation is 700 V (line to line). The armature resistance is 1 Ω per phase. Determine synchronous reactance per phase and regulation for (a) 0.8 p.f. lagging ; and (b) 0.9 p.f. leading.

Or

2. A 10 kVA, 440 V, 50 Hz, 3-phase star connected alternator has the open circuit characteristics as given below :

I_f (A)	1.5	3	5	8	11	15
V_{oc} (V)	150	300	440	550	600	635

With full-load zero p.f. the applied excitation is 14 A to produce 500 V of terminal voltage. On short circuit, 4 A excitation is required to give full-load current. Determine the voltage regulation for full-load, 0.8 p.f. lagging and leading.

3. Show that the parallel operation of two alternators is affected by a) alteration in prime mover input of one of the alternator ; and b) alteration in the excitation of one of the alternator.

Or

4. Draw the phasor diagrams a for synchronous motor at different excitations and thereby explain the influence of excitation on power factor, when the mechanical output is kept constant.

[redacted]

[redacted]

5. Sketch a typical torque-slip curve of a three-phase induction motor. How is this curve modified,

   (a) If the rotor circuit resistance is increased ?

   (b) If the rotor-circuit reactance is increased ?

Or

6. Explain briefly, the phenomenon of cogging and crawling in a three-phase induction motor.

7. Discuss briefly, with neat sketches, the various methods of speed control of three-phase induction motors.

Or

8. Draw the equivalent circuit for a single-phase induction motor based on the two revolving field theory and identify the various parameters involved in it. With this equivalent circuit, prove that forward flux wave is several times greater than the backward flux at normal rotor speed.

(4 × 10 = 40 marks)

[redacted]