D 20911 (Pages : 3) Name.....

Reg. No.....

FIFTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, OCTOBER 2011

EE/PTEE 09 501—SYNCHRONOUS AND INDUCTION MACHINES

(2009 Admissions)

Time : Three Hours Maximum : 70 Marks

Part A

All *questions are* compulsory.

1. A 6-pole alternator rotates at 1000 rpm. What is the frequency of the generated voltage ?
2. Define voltage regulation of a synchronous generator.
3. A synchronous machine is connected to an infinite bus. Its excitation voltage E_f leads the applied voltage V, but E_f is less than V. Phase resistance is negligible, a) Is the machine working as a generator or motor?; and b) Is the machine working at a leading or lagging power factor?
4. Sketch a typical torque-slip curve of a three phase slip ring induction motor. How is this curve modified if the rotor-circuit resistance is increased?
5. A three phase delta connected cage type induction motor when connected directly to 400 V, 50 Hz supply takes a starting current of 100 A in each stator phase. Calculate the line and phase starting currents for star-delta starting.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*

1. A three phase, 6-pole, star-connected alternator revolves at 1000 r.p.m. The stator has 90 slots and 8 conductors per slot. The flux per pole is 0.05 Wb (sinusoidally distributed). Calculate the voltage generated by the machine if the winding factor is 0.96.
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. Explain hunting of a synchronous machine. Also explain the need for damper windings in synchronous machines.
4. 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.
5. A three-phase squirrel cage induction motor, when started from rest, does not accelerate to normal speed but to speed approximately 1/7 of synchronous speed. Explain the causes.
6. Draw the equivalent circuit of single-phase induction motor and obtain therefrom its approximate equivalent circuit stating the various assumptions made.

(4 × 5 = 20 marks)

Turn over

Part C

1. A 11 kV, 1000 kVA, 3-phase, star connected alternator has a resistance of 2 Ω per phase. The open circuit and full load zero power factor characteristics are given below. Find the voltage regulation of the alternator for full load current at 0.8 p.f. lagging by using Potier method.

Current (A)	40	50	110	140	180
O.C, line voltage (V)	5800	7500	12500	13750	15000
Zero p.f. line volts (V)	0	1500	8500	10500	12500

Or

2. Write short notes on

   (a) Symmetrical short circuit transient.

   (b) Trasient and substransient reactances.

3. (a) Describe any one method of synchronizing alternators.

   (b) Derive expressions for current shared by two alternators operating in parallel.

Or

4. A 2.2 kV, three phase synchronous motor has an effective resistance and synchronous reactance of 0.2 Ω and 2.2 Ω respectively. The active power input is 900 kW at normal voltage. Calculate the line current, power factor, and reactive power drawn when the induced e.m.f is (a) 2.6 kV, and (b) 1.8 kV.

5. A 415 V, 11 kW, 50 Hz, delta connected, threephase energy efficient induction motor gave the following test results:

   No-load test : 415 V; 5.8 A; 488 W

   Blocked rotor test : 40 V; 18.4 A; 510 W

   Stator resistance per phase = 0.7 Ω

   For full load condition, find (i) line current, ii) power factor, (iii). input power, iv) slip, and (v) efficiency.

Or

6. (a) Explain the principle of operation of an Induction generator.

   (b) Explain how an Induction Generator can be self-excited.

7. Explain with neat sketches, the technique of varying the speed of a three-phase induction motor by static frequency conversion.

Or

8. A 230 V, 4-pole, 50 Hz, single-phase induction motor has the following constant and losses:

$r_1 = 2.3\ \Omega$; $x_1 = 3.2\ \Omega$; $r_2 = 4.2\ \Omega$; $x_2 = 3.2\ \Omega$; and $X_m = 74\ \Omega$.

Core loss = 98 W; friction and windage loss = 30 W.

If the motor is running with a slip of 0.05 at rated voltage and frequency, then compute the stator current* power factor, power output, torque and efficiency with its auxiliary winding open.

(4 × 10 = 40 marks)