[06 – 3221]

III/IV B.E. DEGREE EXAMINATION.

Second Semester

Electrical and Electronics Engineering

PERFORMANCE AND DESIGN OF ELECTRICAL MACHINES – III

(Effective from the admitted batch of 2006–2007)

Time : Three hours Maximum : 70 marks

Question 1 is compulsory.

Answer any FOUR from the remaining.

All questions carry equal marks.

1. (a) In an alternator, explain why short - circuit characteristic is a straight line whereas open circuit characteristic is a curve.

(b) Define voltage regulation of an alternator. Is it possible to have the full-load terminal voltage greater than the no-load terminal voltage in an alternator?

(c) An alternator connected to an infinite bus, is supplying some power. For constant power input from the prime mover, if the field current is increased, explain what happens to the load angle.

6. (a) Explain how the excitation and power circles can be superimposed to obtain 'V'-curves of a cylindrical rotor synchronous motor.

(b) A 2000 volts, 3-phase, star connected synchronous motor has synchronous reactance of 5 ohms per phase. For an excitation voltage of 3000 volts, the motor takes an input of 900 kW at rated voltage. Find the line current and power factor.

7. (a) Explain how does the air gap length of an induction motor effect the power factor, overload capacity and tooth pulsation losses.

(b) Determine the main dimensions of a 25 MVA, 50 Hz, 3-phase turbo alternator given mean gap density = 0.5 Tesla, specific electric loading of 550 ampere conductors per cm. of armature periphery; peripheral speed not to exceed 145 m/s; Air gap is 3 cm.

8. (a) Derive the output equation of 3-phase induction motor from fundamentals.

(b) Determine the pole phase group sequences and distribution of slots for a 3-phase, 72 slots, 20 poles with 2 coil sides per slot. Assume the phase sequence as RYB.

(d) A synchronous motor is supplying a certain load. In order to stop the motor, it is essential to switch off first the A.C supply and then its field current. Explain the reason.

(e) Draw the phasor diagram of synchronous motor of salient pole type.

(f) What is the difference between single layer and double-layer windings?

(g) What are the specific electric and magnetic loadings? Give their range of values for salient pole synchronous machines.

2. (a) Explain how the Potier Triangle can be drawn with the help of O.C.C and any two points on the Z.P.F. characteristic.

(b) A 15 MVA, 6.6 kV, 3-phase star connected synchronous generator with armature resistance of 0.4 ohm/phase and synchronous reactance of 6 ohms/phase delivers full-load current at 0.8 p.f. lagging with rated voltage. Estimate the terminal voltage for the same excitation and load current at 0.8 p.f. leading.

3. (a) Describe how is slip test conducted in the laboratory with a neat circuit diagram. Explain why the pointers of ammeter and voltmeter swing during the slip test.

(b) Calculate the value of the synchronizing power in kW for one mechanical degree of displacement at 0.8 p.f. lagging for a 3-phase, 2000 kVA, 6600 volts, 50 Hz, 12 pole machine having a synchronous reactance of 25% and negligible resistance.

4. (a) Discuss the effect of changing excitation of a synchronous machine connected to an infinite bus under load.

(b) A 3-phase, 8 pole alternator has a star connected winding with 72 slots and 6 conductors per slot. The flux per pole is 30 mWb sinusoidally distributed and the speed is 750 rpm. Find the frequency and the line e.m.f. under open circuit conditions.

5. (a) With the help of phasor diagram, explain the working of a synchronous motor for constant power and varying excitation.

(b) A 6.6 KV, 3-phase star connected synchronous motor takes a line current of 50 Amps. The synchronous impedance per phase is (1.5 + j8) ohms. Determine

(i) the power supplied to the motor and

(ii) the induced e.m.f. for a power factor of 0.8 lagging.