

Q.1 is compulsory.

Solve ANY THREE questions out of remaining.

ASSUME SUITABLE DATA wherever necessary.

Q.1)

(20Marks)

- List down advantages of modeling of electrical machines.
- Draw phasor diagram for salient pole alternator for leading power factor.
- Derive the condition for maximum output power in case of an alternator.
- Why short circuit characteristics for an alternator is a straight line?

Q.2)

(20Marks)

- Write a short note on 'Synchronising Power'.
- A 3 phase; star connected;  $11kV$  12pole  $50Hz$  synchronous motor has d-axis and q-axis reactances as  $5\Omega$  and  $3\Omega$  per phase respectively. At certain load the motor draws  $20MW$  at unity power factor. Compute (i) Excitation e.m.f. (ii) Synchronising power coefficient in watts per  $^{\circ}E$  and (iii) Synchronising power coefficient in watts per  $^{\circ}M$ . Neglect armature resistance.

Q.3)

(20Marks)

- Write a short note on 'Synchronous Impedance'.
- A 3 phase;  $440V$ ;  $50Hz$  delta connected alternator with negligible armature resistance has d-axis synchronous reactance as  $0.12\Omega$  and q-axis reactance as  $0.09\Omega$  per phase. If the alternator supplies  $900A$  at  $0.8$  lagging power factor calculate (i) Excitation e.m.f. neglecting effect of saliency, assuming  $X_s = X_d$  and (ii) Excitation e.m.f. considering saliency.

Q.4)

(20Marks)

- Derive the conditions for maximum power input and maximum power output of synchronous generator.
- A 3 phase; delta connected synchronous motor takes  $50kW$  at  $0.8$  power factor lagging from a  $415V$  bus bar. The induced e.m.f. is increased by  $40\%$ , the real power taken remaining the same. Find new current and power factor if synchronous impedance is  $(0.2 + j3)\Omega$  per phase.

Q.5)

(20Marks)

- Explain the effect of change in excitation on two alternators connected in parallel operating under loaded condition.
- Two identical  $3000KVA$  alternators operate in parallel. The governors of alternator 1 is so adjusted that its frequency drops uniformly from  $50Hz$  at no load to  $48Hz$  at full load while the change in frequencies for alternator 2 is from  $50Hz$  to  $47.5Hz$ . Determine the maximum load that can be shared at unity p.f. without overloading either machine.

Q.6) Write short note on

(20Marks)

- Derive basic machine relation in 'd-q' variables for an induction machine.
- Explain the concept of 'power circle' for synchronous motor and prove that efficiency at maximum output is  $50\%$ .