

(3 Hours)

[Total Marks: 80]

**N.B. 1) Question No. 1 is compulsory****2) Attempt any three of the remaining Questions No. 2 to No. 6.****3) Illustrate answers with diagrams wherever necessary.****4) Assumptions made should be clearly stated.****Q 1.****Solve any four**

- a) Explain the term coil span factor( $K_c$ ) and pitch factor ( $K_d$ ). **05**
- b) Define the term Synchronous impedance and voltage regulation of an alternator. **05**
- c) What do you mean by synchronization of alternators? Describe any one method of synchronizing. **05**
- d) Explain why the synchronous motor is not self-starting. **05**
- e) Write a note on Steady-state analysis of synchronous machines. **05**

**Q 2.**

- a) Derive the E.M.F equation for an alternator. Also, draw the equivalent circuit of the alternator. **10**
- b) A 550 V, 55 KVA, three-phase, star-connected alternator has an effective resistance of 0.2 ohms per phase. A field current of 10 A produces an armature current of 200 A on a short circuit and an emf of 450 V on an open circuit. Calculate the synchronous reactance and voltage regulation at full load power factor 0.8 lagging. **10**

**Q 3.**

- a) Explain the hunting of synchronous machines. What is the purpose of damper winding in the synchronous machine? **10**
- b) Two station generators A and B operate in parallel. Station capacity of A is 50 MW and that of B is 25 MW. The full-load speed regulation of station A is 3% and station B is 3.5%. Calculate the load sharing if the connected load is 50 MW. The no-load frequency is 50 Hz. **10**

**Q 4.**

- a) Explain V-curves and inverted V-curves of synchronous motors. **10**
- b) Describe the slip test method for the measurement of  $X_d$  and  $X_q$  of synchronous machine. **10**

**Q 5.**

- a) Explain Blondel's two-reaction theory of salient-pole synchronous machines. **10**
- b) A 1500 KVA, Star connected, 2300 V, 3 phase, Salient pole synchronous generator has reactances  $X_d = 1.95$  Ohms and  $X_q = 1.40$  ohms per phase. All losses may neglected. Find the excitation voltage for operation at rated KVA and power factor of 0.85 lagging. **10**

**Q 6.**

- Solve any two.** **20**
- a) Explain different starting methods used for synchronous motors.
- b) What is an infinite bus? state the characteristics of an infinite bus.
- c) Derive the basic machine relation in dq0 Variables.