

Fifth Semester B.Tech Degree Examination
13.502 - Synchronous Machines (E)

Max Marks: 100

Duration: 3 hrs

Part A (Answer All Questions)

1. Why are damper windings used in alternators?
2. Explain any one method of cooling of alternators.
3. What is Synchronous Reactance for an alternator? Explain briefly.
4. Draw the Potier Regulation Diagram for an alternator.
5. What do you mean by Short Circuit Ratio of an alternator? Explain briefly.
6. Explain the phenomenon of "Hunting" in alternators.
7. List the requirements to be satisfied for parallel operation of alternator?
8. What do you mean by reluctance power? Explain briefly.
9. What are synchronous condensers? Explain briefly.
10. List down any two advantages and two drawbacks of synchronous motors.

(10 x 2 marks = 20 marks)

Part B

(Answer One Question From Each Module)

Module 1

11. (a) Explain pitch factor and distribution factor. (8 marks)
(b) Derive the EMF equation of alternator. (5 marks)
(c) A 4pole 50Hz star connected alternator has flux per pole of 0.18Wb. It has 5 slots per pole per phase. Conductor per slot being 3. If the coil span is 150° , find the EMF generated. (7 marks)

OR

12. (a) Explain in detail the Short Pitch Winding and Fractional Slot Winding. What are their advantages compared to Full Pitch Winding and Integral Slot Winding respectively? (10 marks)
(b) Calculate the RMS value of the induced EMF (per phase) for a 10 pole, 3 Phase, 50Hz alternator with 2 slots per pole and 4 conductors per slot in two layers. Coil span is 150° . The flux per pole has a fundamental component of 0.12 Wb and 20% third harmonic component. (10marks)

Module 2

13. (a) Compare and contrast the Synchronous Impedance Method and Ampere-Turn Method of calculating the voltage regulation of an alternator. (10 marks)

(b) The data obtained on 100kVA, 1100V, 3Phase alternator is:

DC Resistance Test : Voltage between line = 6V dc, Current in line = 10A dc

Open Circuit Test : Field Current = 12.5A dc, Line Voltage = 420V ac

Short Circuit Test : Field Current = 12.5A. Line Current = rated value

Calculate the voltage regulation of the alternator at 0.8pf lagging (10 marks)

OR

14. (a) Explain Blondel's Two Reactance Theory for Salient Pole Machine with relevant phasor diagram(s). (10 marks)

(b) Derive the expression for the power generated by a salient pole synchronous generator. (10 marks)

Module 3

15. (a) What do you mean by Infinite bus bars? Explain in detail the effect of varying the excitation of a Synchronous Machine connected to Infinite Bus-bars. (10 marks)

(b) Two alternators running in parallel supply a lighting load of 2MW and a motor load of 4MW at pf 0.8 lagging. Once machine is loaded to 2400kVA at pf 0.95 lagging. What is the output and power factor of the second machine? (10 marks)

OR

16. (a) Explain in details the concept of Synchronising Current, Synchronising Power and Synchronising Torque. Derive the expressions for each. (10 marks)

(b) Explain the effect of (i) change in speed and (ii) increasing the driving torque of one of the alternators which is synchronised with another alternator (parallel operation) (10 marks)

Module 4

17. (a) Explain the concept of Stability and Maximum Load Angle. Derive the expression for Power Input and Stability factor of a synchronous motor (10 marks)

(b) A 75kW, 400V, 4 pole, 3Phase, Star connected synchronous motor has a resistance and synchronous reactance per phase of 0.04Ω and 0.4Ω respectively. Assuming an efficiency of 92.5%, calculate the Open Circuit EMF per phase and the gross Mechanical Power developed for full load at 0.8pf lead. (10 marks)

OR

18. (a) What is V and Inverted-V curves of a synchronous motor? Explain in detail. Draw and explain the experimental set-up to obtain the curves. (10 marks)

(b) A 2000V 3 Phase 4 pole star connected synchronous motor runs at 1500rpm. The excitation is constant and corresponds to an open circuit voltage of 2000V. The resistance is negligible compared to the synchronous reactance of 3Ω /phase. Determine the power input, power factor and the torque developed for an armature current of 200A. (10 marks)
