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Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, MAY 2016

Seventh Semester

Branch : Electrical and Electronics Engineering

EE 010 702—SYNCHRONOUS MACHINES (EE)

(New Scheme—2010 Admission onwards)

[Improvement/Supplementary]

Time : Three Hours

Maximum : 100 Marks

Part A

Answer **all** *questions.*
Each question carries 3 *marks.*

1. Mention the advantages of fractional slot winding.
2. Write the different effects of armature reaction.
3. Explain the causes of hunting. How they can be reduced ?
4. What are the advantages of installing a synchronous condenser in an electrical system ?
5. Mention the different types of exciter systems.

(5 × 3 = 15 marks)

Part B

Answer **all** *questions.*
Each question carries 5 *marks.*

6. Explain single layer and double layer windings.
7. Explain the differences between cylindrical-rotor theory and two-reaction theory.
8. Discuss any *two* methods of synchronizing an alternator to the mains.
9. Derive an expression for the output power of cylindrical rotor alternator connected to infinite bus in terms of excitation voltage, bus bar voltage and load angle.
10. Discuss any *one* type of excitation method suitable for a large alternator.

(5 × 5 = 25 marks)

Part C

Answer **all** *questions.*
Each full question carries 12 *marks.*

11. Using neat figures, explain the various types of armature windings suitable for a 3-phase synchronous machine.

Or

12. Derive an e.m.f. expression for an alternator from fundamentals showing clearly the expressions for pitch and distribution factors. Determine, therefrom, the ratio of induced e.m.fs of n^{th} harmonic to fundamental. Can we adopt short-chording for single layer winding ?

13. (a) Develop the e.m.f. method of determining the voltage regulation and hence show that the synchronous reactance consists of two components of reactances.

(b) An alternator has a synchronous reactance of 20% and negligible resistance. Calculate its voltage regulation when working at full-load (i) 0.8 p.f. lag ; (ii) 0.8 p.f. lead ; (iii) u.p.f.

Or

14. (a) Explain how the Potier triangle can be drawn with the help of *occ* and any two points on the *zpfc*.

(b) Describe the load magnetisation curve of a synchronous machine. Explain the differences between Potier reactance x_p and armature leakage reactance x_{al}.

15. (a) Explain why synchronous motor is not self-starting ?

(b) A 3-phase, 600 kW, 4 kV, 180 r.p.m., 50 Hz synchronous motor has per phase synchronous reactance of 1.2 Ω. At full-load the torque angle is 20° electrical. If the generated back-e.m.f. per phase is 2.4 kV, calculate the mechanical power developed. What will be the maximum power developed ?

Or

16. Two synchronous generators are connected in parallel. Generator A has induced e.m.f. of $13000 \angle 22.6^\circ$ and reactance of 2 ohms/phase. Generator B has e.m.f. of $12500 \angle 32.5^\circ$ and has a reactance of 3 ohms/phase. Calculate the synchronizing power and torque assuming star connection, 50 Hz and no-load operation. The machines have 6 poles.

17. (a) Compare the performance of a synchronous generator connected to an infinite bus with that of an isolated alternator operating on its own load.

(b) An alternator connected to infinite bus, is operating at unity power factor at half-full load. With the field current remaining constant, steam input is increased till the alternator begins to operate at full-load. Under this condition, what will happen to the power factor and reactive power flow ?

Or

18. A 5 MVA, 10,000 V, 1500 r.p.m., 3 ϕ, 50 Hz alternator is operating on infinite busbar. Calculate the synchronous power per mechanical degree of angular displacement at :

    (a) No-load.

    (b) Full-load at rated voltage and 0.8 p.f. lagging. Also find synchronous torque for a 5^{o} mechanical displacement in each case, X_s is 20%.

19. The excitation of 415 V, 3 ϕ, mesh connected synchronous motor is such that the induced e.m.f. is 520 V. The impedance per phase is $0.5 + j4$ ohms. If the friction and iron losses are constant at 1000 W, calculate the power output, line current, power factor and efficiency for maximum power output.

Or

20. With neat diagrams, explain the constructional details and working principle of brushless alternator. What are its advantages and applications ?

(5 × 12 = 60 marks)