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B.TECH. DEGREE EXAMINATION, MAY 2014

Sixth Semester

Branch : Electrical and Electronics Engineering

ELECTRICAL MACHINES—II (E)

(Old Scheme—Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Time : Three Hours

Maximum : 100 Marks

Part A

Answer **all** *questions briefly. Each question carries 4 marks.*

1. Why is a rotating field system used in preference to a stationary field ?
2. Explain the effect of space harmonics.
3. Explain the MMF method of predetermination of the voltage regulation of cylindrical rotor alternator.
4. Draw the phasor diagram of a salient pole synchronous generator supplying a lagging power factor load.
5. What is the necessity of parallel operation of alternators ? Explain.
6. Explain the function of damper winding.
7. What are the conditions to be fulfilled before an alternator can be connected to an infinite bus ?
8. Write a note on transient and sub-transient reactances.
9. Discuss the excitation of any one type suitable for a large alternator.
10. Draw and describe the representation of an induction machine using general equations.

(10 × 4 = 40 marks)

Part B

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

11. (a) Why are salient-pole alternators more suitable for low speed and non-salient pole for high speed operation ? (4 marks)

    (b) A star-connected, 3-phase, 6-pole alternator has a stator with 90 slots and 8 conductors per slot. The rotor revolves at 1000 r.p.m.. The flux per pole is 4×10^{-2} Wb. Calculate the e.m.f. generated if all the conductors in each phase are in series. Assume sinusoidal flux distribution and full pitched coils. (8 marks)

Or

Turn over

12. Find the no-load phase and line voltage of a star-connected, 3-phase, 6-pole alternator which runs at 1200 r.p.m., having flux per pole of 0.1 Wb sinusoidally distributed. Its stator has 54 slots having double layer winding. Each coil has 8 turns and the coil is chorded by 1 slot.

13. A 500 kVA, 1100 V, 50 Hz star-connected, 3-phase alternator has armature resistance per phase of 0.1 Ω and synchronous reactance per phase 1.5 Ω. Find its voltage for (a) unity p.f. ; (b) 0.8 lagging ; and (iii) 0.9 leading p.f. Also calculate the voltage regulation in each case.

Or

14. A 3-phase, star-connected synchronous generator supplies current of 10 A having phase angle of 20° lagging at 400 V. Find the load angle and components of armature current I_d and I_q if $X_d = 10\ \Omega$ and $X_q = 6.5\ \Omega$. Assume armature resistance to be negligible.

15. Two alternators are running in parallel and sharing a load in desired proportion. Explain clearly what will happen if

    (i) The excitations of alternators are changed while their prime-mover inputs are fixed.

    (ii) The prime mover inputs are varied while the excitations are kept fixed.

Or

16. A 3-phase, 415 V, 6 pole, 50 Hz star connected synchronous motor has e.m.f. of 520 V (L-L). The stator winding has a synchronous reactance of 2Ω per phase, and the motor develops a torque of 220 Nm. The motor is operating at 415 V, 50 Hz bus. (a) Calculate the current drawn from the supply and its power factor ; (b) Draw the phasor diagram showing all the relevant quantities.

17. A 3-phase salient pole synchronous motor is connected to an infinite bus. Derive an expression for the electromechanical power developed ? What will happen if the excitation is reduced to zero ? Also comment on the stability of the machine as compared to that of a cylindrical rotor machine.

Or

18. (a) What is a synchronous condenser ? Show the region of operation of the condenser on V-curves. Where are synchronous condensers used ?

    (b) Explain the effects of varying excitation on armature current and power factor in a synchronous motor. Draw the V curves.

19. (a) Explain the generalised machine theory.

    (b) The power input to the rotor of a 440 V, 50 Hz, 3-phase, 6 pole induction motor is 60 kW. It is observed that the roto e.m.f. makes 90 complete cycles per minute. Calculate (i) the slip ; (ii) the rotor speed ; (ii) rotor copper loss ; and (iv) mechanical power developed.

Or

20. A 3-phase, 50 Hz induction motor has a starting torque which is 1.25 times full-load torque and a maximum torque which is 2.5 times full-load torque. Neglecting stator resistance and rotational losses and assuming constant rotor resistance, find (i) the slip at full-load ; (ii) slip at maximum torque ; and (iii) the rotor current at starting in per unit of full-load rotor current.

(5 × 12 = 60 marks)