D 4048

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Third Semester

(Regulation 2004)

Electrical and Electronics Engineering

EE 1202 — ELECTRICAL MACHINES – I

(Common to B.E. (Part Time) Second Semester Regulation – 2005)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Why do all practical energy conversion devices make use of the magnetic field as a coupling medium rather than an electric field?

2. State the necessary conditions for production of steady torque by the interaction of stator and rotor fields in an electric machine.

3. The series field winding has low resistance while the shunt field winding has high resistance. Why?

4. What are the arrangements to be done for satisfactory parallel operation of DC series generators?

5. Draw the mechanical characteristics of all types of DC motors in the same diagram.

6. How does 4-point starter differ from 3-point starter?

7. Under what value of power factor a Transformer gives zero voltage regulation?

8. Why is the Auto-Transformer not used as Distribution Transformer?

9. At what load does the efficiency is maximum in DC shunt machines?

10. Why is the short-circuit test on a Transformer performed on HV (High voltage) side?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Explain why distributed field winding is employed in cylindrical rotor synchronous machine. (6)

(ii) With neat sketch, explain the multiple-excited magnetic field systems in electromechanical energy conversion system. Also obtain the expression for field energy in the system. (10)

OR

(b) (i) Explain clearly how a rotating magnetic field is setup around the 3-phase AC winding having 120° (electrical) phase displacement each when 3-phase balanced supply is given to it. (8)

(ii) Obtain the torque equation for round rotor machine having p number of poles. State the assumptions made. (8)

12. (a) (i) Briefly explain the load characteristics of different types of compound generators. (8)

(ii) A 4-pole, lap connected DC machine has 540 armature conductors. If the flux per pole is 0.03 Wb and runs at 1500 rpm, determine the emf generated. If this machine is driven as a shunt generator with the same field flux and speed, calculate the terminal voltage when it supplies a load resistance of $40\,\Omega$. Given armature resistance as $2\,\Omega$ and shunt field circuit resistance as $450\,\Omega$. Also find the load current. (8)

Or

(b) (i) Two separately excited dc generators are connected in parallel. Discuss in detail how they share a load. (8)

(ii) The brushes of a 400 kW, 500 V, 6-pole DC generator are given a lead of 12° electrical. Calculate (1) the demagnetising ampere-turns, (2) the cross-magnetizing ampere-turns and (3) series turns required to balance the demagnetising component. The machine has 1000 conductors and the leakage co-efficient is 1.4. (8)

13. (a) (i) Derive from the first principle an expression for the torque developed in a DC motor. (8)

(ii) A 220 V DC shunt motor takes 5 A on no-load and runs at 750 rpm. The resistances of the armature and shunt field windings are 0.2 Ω and 110 Ω respectively. Calculate the speed when motor is loaded and taking a current of 50 A. Assume that armature reaction weakens the field by 3%. (8)

Or

(b) A 220 V, DC shunt motor with an armature resistance of 0.4 Ω and a field resistance of 110 Ω drives a load, the torque of which remains constant. The motor draws from the supply, a line current of 32 A when the speed is 450 rpm. If the speed is to be raised to 700 rpm what change must be effected in the value of the shunt field circuit resistance? Assume that the magnetization characteristic of the motor is a straight line. (16)

14. (a) (i) A 100 kVA, 6.6 kV/415 V single-phase Transformer has an effective impedance of (3+j8) Ω referred to HV side. Estimate the full-load voltage regulation at 0.8 pf lagging and 0.8 pf leading. (10)

(ii) Explain the need for parallel operation of single-phase Transformers Give the conditions to be satisfied for their successful operation. (6)

Or

(b) (i) The emf per turn of a single-phase, 6.6 kV, 440 V 50 Hz transformer is approximately 12 V. Calculate number of turns in the HV and LV windings and the net cross-sectional area of the core for a maximum flux density of 1.5 T. (6)

(ii) Explain the Open Delta connection to carry out 3-phase operation with the help of two transformers. State the disadvantage also. (10)

15. (a) The Hopkinson's test on two identical shunt machines gave the following results. Line voltage 230 V; line current excluding field current is 50 A; motor armature current is 380 A; generator and motor field currents are 5 A and 4.2 A respectively; armature resistance of each machine is 0.025 Ω. Calculate the efficiency of each machine at this load condition. (16)

Or

(b) (i) Show that the maximum efficiency in a transformer occurs when its variable loss is equal to constant loss. (6)

(ii) Find the all-day efficiency of a 500 kVA distribution Transformer whose iron loss and full–load copper loss are 1.5 kW and 6 kW respectively. In a day, it is loaded as follows. (10)

Duration (H_i)	Output (P_{oi}) in kW	Power factor ($\cos\phi_2$)
6	400	0.8
10	300	0.75
4	100	0.8
4	0	–

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