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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 70091

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third Semester

Electrical and Electronics Engineering

EE 3303 – ELECTRICAL MACHINES - I

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define an electromechanical system. Give example of devices which convert electrical to mechanical and mechanical to electrical energy.

2. Describe multiply excited magnetic field system.

3. List the important conditions for exciting a self-excited DC generator.

4. Draw the internal and external load characteristics of a DC shunt generator.

5. A 220V DC shunt machine has a armature resistance of 0.5 Ω. If the full load armature current is 20, calculate the induced emf when the machine acts (a) generator (b) motor.

6. Write the significance and condition for Hopkinson's test.

7. Define all day efficiency of a transformer.

8. Give the mandatory conditions in paralleling transformers.

9. Write the working principle of a step down auto transformer with a single diagram.

10. State the condition for which a 3 phase - 4 wire distribution transformer will give maximum efficiency (η_{max}) and the range of loading for maximum efficiency.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Compare magnetic and electric circuits. (6)

(ii) Derive the expression for the force and torque on a Current Carrying Conductor. (7)

Or

(b) (i) Calculate the force acting on the plunger of a linear actuator. (7)

(ii) Calculate the current requires to produce a flux of 1.75m. wb in the ring if the relative permeability of the iron is 900, number of turns N = 600 and radius of the cross section r = 3.5 cm. (6)

12. (a) (i) Derive the induced E.M.F. equation of a DC generator. (7)

(ii) Define armature reaction in DC generator and discuss its effects on a two pole generator. (6)

Or

(b) State different commutation techniques of DC generator and illustrate resistance commutation. (13)

13. (a) List the different speed control of DC shunt motor and explain the speed control of at following conditions. (13)

(i) speed below rated speed.

(ii) speed above rated speed.

Or

(b) Explain the laboratory experimental procedure for doing Swinburne's test with a circuit and list the calculations to be made to predetermine the efficiency of DC motor and generator by using Swinburne's test results. (13)

14. (a) (i) Derive the induced EMF equation of transformer. (7)

(ii) A transformer has 600 turns of the primary winding and 20 turns of the secondary winding. Determine.

(1) the secondary voltage if the secondary circuit is open and the primary voltage is140 V.

(2) the primary current if the secondary current is 90 A (6)

Or

(b) (i) A 10 kVA single-phase transformer provides a no-load secondary voltage of 110 volts. If the equivalent secondary winding resistance is 0.015 Ω and its total reactance is 0.04 Ω, determine its voltage regulation when supplying a load at 0.85 power factor lagging. (7)

(ii) Explain the construction and working principle of single phase transformer. (6)

15. (a) A 400 kVA transformer has a primary winding resistance of 0.5 ohm and a secondary winding resistance of 0.001 ohm. The iron loss is 2.5 kW and the primary and secondary voltages are 5kV and 320 V respectively. If the power factor of the load is 0.85, determine the efficiency of the transformer (i) on full load and (ii) on half load. (13)

Or

(b) Sketch and explain an electrical circuit connection of transformer that used to get two- phase power supply from three-phase source and write the application. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Derive the expression for copper saving in a step down auto transformer with a circuit. (15)

Or

(b) (i) A 200 k VA single-phase transformer is in circuit throughout 24 hours. For 8 hours in a day, the load is 150 kW at 0.8 power factor lagging and for 7 hours, the load is 90 kW at 0.9 power factor. Remaining time or the rest period, it is at no-load condition. Full-load Cu loss is 4 kW and the iron loss is 1.8 kW. Calculate the all-day efficiency of the transformer. (8)

(ii) Discuss the real time applications of the following electro mechanical energy conversion devices. (7)

(1) DC Shunt generator

(2) DC series generator

(3) DC Shunt motor

(4) DC Series motor

(5) 3 Phase power transformer

(6) 3 Phase distribution transformer

(7) Auto transformer

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