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Question Paper Code : 50528

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Third Semester

Electrical and Electronics Engineering

EE 8301 – ELECTRICAL MACHINES – I

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Faraday's law of electromagnetic induction.
2. Write the relation between constant losses and frequency of power supply.
3. Define efficiency and regulation for a transformer.
4. Mention the conditions for proper parallel operation of transformers.
5. Give examples for singly excited systems.
6. Write the condition for generating a rotating magnetic field.
7. What are the applications of DC series generators?
8. Define critical resistance.
9. Mention the different speed control methods for DC shunt motor.
10. Why DC series motor cannot be started under no-load conditions?

PART B — (5 × 13 = 65 marks)

11. (a) In the magnetic circuit of Figure. 1, the relative permeability of the ferromagnetic material is 1200. Neglect magnetic leakage and fringing. All dimensions are in centimeters, and the magnetic material has a square cross-sectional area. Determine the air gap flux, the air gap flux density, and the magnetic field intensity in the air gap. (7+3+3)

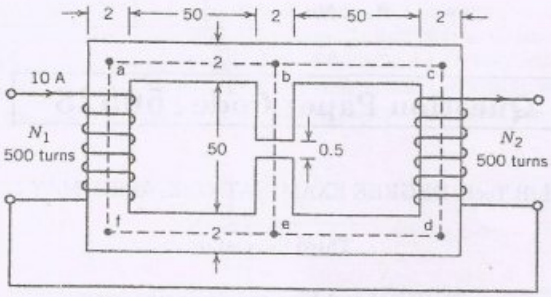

Figure 1

Or

(b) A square-wave voltage of amplitude E=100 V and frequency 60 Hz is applied on a coil wound on a closed iron core. The coil has 500 turns, and the cross-sectional area of the core is 0:001m². Assume that the coil has no resistance.

(i) Find the maximum value of the flux and sketch the waveforms of voltage and flux as a function of time.

(ii) Find the maximum value of E if the maximum flux density is not to exceed 1.2 Tesla. (6+7)

12. (a) A 40 kVA, single phase transformer has an iron loss of 300 W and full load copper loss 600 W.

(i) Find the load at which maximum efficiency occurs and the value of maximum efficiency.

(ii) If the maximum efficiency occurs at 80% full-load, find the new core loss and full-load copper loss assuming that full-load loss is a constant. (7+6)

Or

(b) Explain the procedure to obtain equivalent circuit of a single phase transformer. (13)

13. (a) Find energy and force for a system in which $\lambda = xi^2$. (9+4)

Or

(b) Find co-energy and force for $\lambda_1 - x^2 i_1^2 + xi_2; \lambda_2 - x^2 i_2^2 + xi_1$. (9+4)

14. (a) The induced emf in a dc machine while running at 750 rpm is 220 V. Calculate (i) assuming constant flux the speed at which the induced emf will be 250 V; and (ii) the percentage increase in the field flux for an induced emf of 250 V and speed of 700 rpm. (7+6)

Or

(b) Calculate the ampere-turns for each commutating pole of an 8-pole generator with 107 slots, each containing 1000 ampere conductors. The interpole air-gap is 1.2 cm. The gap flux density is to be 0.32 Wb/m². Neglect the effect of iron parts of the circuit and of leakage. (13)

15. (a) A 240 V dc shunt motor runs on no-load at 800 rpm with no extra resistance in the field or armature circuit, the armature current being 2 A. Calculate the resistance required in series with the shunt winding so that the motor may run at 950 rpm when taking a line current of 30 A. Shunt winding resistance is 160 Ω and armature resistance is 0.4 Ω. Assume that flux is proportional to field current. (13)

Or

(b) A 100 kW, 500 V shunt generator was run as a motor (Figure 2) on no load at its rated voltage and speed. The total current taken was 9.5 A, including a shunt-field current of 2.5 A. The resistance of the armature circuit at normal working temperature is 0.1 Ω. Calculate the efficiency of the generator at full-load and at half-load. (13)

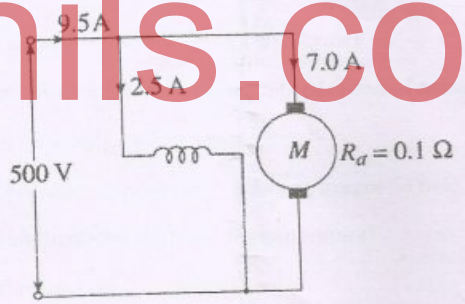

Figure 2

PART C — (1 × 15 = 15 marks)

16. (a) A DC shunt generator delivers 50 kW at 250 V and 400 rpm. The armature resistance is 0.02 W and field resistance is 50 W. Calculate the speed of the machine when running as a shunt motor and taking 50 kW input at 250 V. (15)

Or

(b) Two transformers are connected in parallel to supply a common load of 125 kVA at 0.8 power-factor lagging. Rating of transformer A is 100 kVA and has resistance and reactance of 0.9% and 10% respectively. Rating of transformer B is 50 kVA and has resistance and reactance of 1.0 % and 5% respectively. How will the two transformers share the common load? (15)