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Question Paper Code : 40482

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

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. Write the properties of magnetic lines of force.
2. What are the applications of eddy current?
3. What are the properties of an ideal transformer?
4. Mention the necessity for parallel operation of transformers.
5. Draw the characteristics between the flux linkage 'λ' and current of a magnetic circuit involved in electromechanical energy conversion process. Also locate energy and co-energy.
6. For the electromechanical device shown in Figure 6, find the value of mutual inductance between stator and rotor.

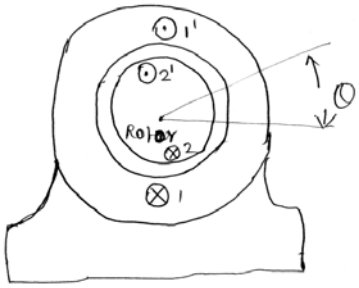

Figure 6. Electromechanical device

7. Write the advantages of wave winding in comparison with lap winding.
8. Define armature reaction.
9. The armature resistance of a DC shunt motor is 0.5 ohm, it draws 20 A from 220 V mains and is running at a speed of 80 radian per second. Determine (i) Induced emf (ii) Electromagnetic torque
10. Why swinburne's test cannot be conducted on DC series motor?

PART B — (5 × 13 = 65 marks)

11. (a) For the magnetic circuit shown in Figure 11 (a), estimate the number of ampere-turns necessary to produce a flux of 100000 lines round an iron ring of 6 cm^2 cross section and 20 cm mean diameter having an air gap 2 mm wide across it. Permeability of the iron may be taken 1200. Neglect the leakage flux outside the 2 mm air gap.

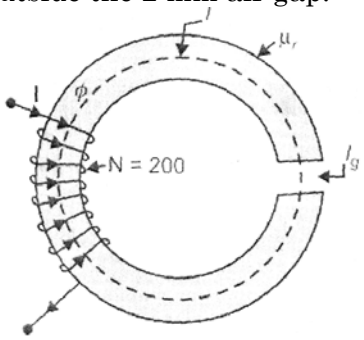

Figure 11 (a) Magnetic circuit I

Or

(b) In the magnetic circuit of Figure 11 (b), 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. (5+4+4)

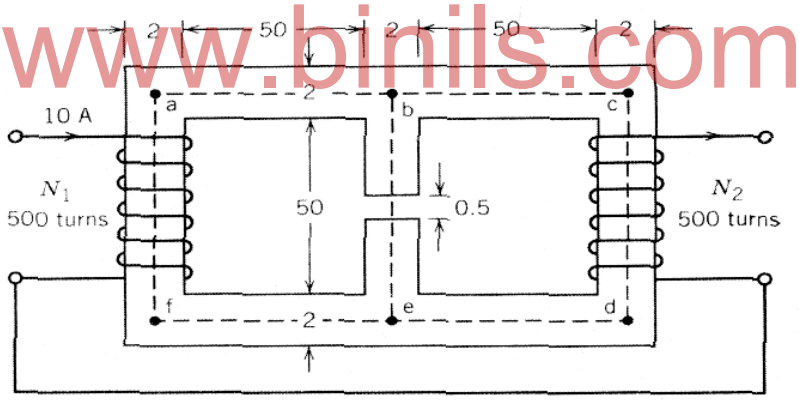

Figure 11 (b) Magnetic circuit II

12. (a) (i) Two transformers of 20 kVA each with turn-ratios respectively of 250 1000 and 250 : 1025 are connected in back-to-back test; the two primaries being fed from a 250 V supply and secondaries being connected in phase opposition. A booster transformer connected on primary side to the same 250 V supply is used to inject voltage in the circuit of secondaries such as to circulate a current of 20 A. The core losses of each transformer are 350 W and each transformer has a reactance of 2.5 times its resistance. Calculate the possible readings of the wattmeter connected to measure the input to the primaries (5)

(ii) A speaker of 9 Ω, resistive impedance is connected to a supply of 10 V with internal resistive impedance of 1 Ω, as shown in Figure.4. Determine the power absorbed by the speaker. To maximize the power transfer to the speaker, a transformer of 1 : 3 turns ratio is used between source and speaker as shown in Figure 12 (a). Determine the power taken by the speaker. (4+4)

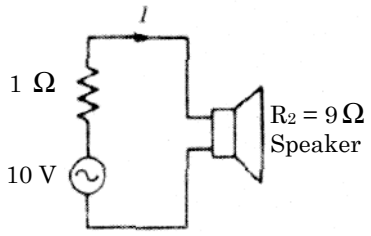

Figure 12 (a) Speaker circuit

Or

(b) Two single-phase transformers connected in parallel supply a load of 1000 A at 0.8 p.f. lagging. For each transformer, the secondary emf on open circuit is 3300 V and the total leakage impedances in terms of the secondary are (0.1 + j0.2) and (0.05 +j0.4) ohm, respectively. Determine the output current for each transformer and the ratio of the kW output of the two transformers. (7+6)

13. (a) Derive an expression for energy, co-energy and force for a singly excited system (5+4+4)

Or

(b) Write technical notes on the following :

(i) Magnetic fields in rotating machines. (6)

(ii) Magnetic saturation and leakage fluxes. (7)

14. (a) A DC machine running at 750 rpm has an induced emf of 200 V. Calculate the speed at which the induced emf will be 250 V The percentage increase in main field flux for an induced emf of 250 V at a speed of 700 rpm. (6+7)

Or

(b) A four-pole lap-wound DC machine has an armature of 20 cm diameter and runs at 1500 rpm. If the armature current is 120 A, thickness of the brush is 10 mm and the self-inductance of each coil is 0.15 mH. determine the average emf induced in each coil during commutation.

15. (a) A 230 V, 1000 rpm DC shunt motor has field resistance of 115 Ω and armature circuit resistance of 0.5 Ω. At no-load, the motor runs at 1000 rpm with armature current of 4 A and with full field flux. Find the speed of the motor and armature current for the developed torque of 80 Nm. Also determine the value of external resistance that must be inserted in series with the field winding to make the motor to develop power of 8 kW at 1250 rpm. (6+7)

Or

(b) Hopkinson's test on two shunt machines gave the following full load results:

Line voltage = 220 V, Line current excluding field currents = 12 A. Motor armature current 72 A, Field currents = 1.5 A and 1 A. Armature resistance of each machine is 0.2 Ω.

Calculate the efficiency of each machine.

PART C — (1 × 15 = 15 marks)

16. (a) A 210 V dc shunt motor develops 18 kW when taking 21 kW. Field and armature resistance values are 60 Ω and 0.05 Ω respectively. What is the efficiency and power input when the output is 8 kW.

Or

(b) The efficiency of a 250 kVA, single phase transformer is 96% when delivering full load at 0.8 power factor lagging and 97.2% when delivering half full-load at unity power factor. Determine the efficiency at 75% of full load at 0.8 power factor lagging.
