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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2010

Fourth Semester

Electrical and Electronics Engineering

EE 2251 — ELECTRICAL MACHINES – I

(Regulation 2008)

Time : Three hours　　　　Maximum : 100 Marks

Answer ALL questions

PART A — (10 × 2 = 20 Marks)

1. Give the analogy between electric circuit and magnetic circuit.

2. Distinguish between statically and dynamically induced electromotive force.

3. What are the no load losses in a two winding transformer and state the reasons for such losses.

4. Mention the conditions to be satisfied for parallel operation of two winding transformers.

5. Draw the power low diagram for motor and generator operation.

6. In a magnetic circuit with a small air gap, in which part the maximum energy is stored and why?

7. Explain the concept of electrical degree. How is the electrical angle of the voltage in a rotor conductor related to the mechanical angle of the machines shaft?

8. Why does curving the pole faces in a D.C. machine contribute to a smoother D.C. output voltage from it?

9. State the conditions under which a D.C. shunt generator fails to excite.

10. What is the precaution to be taken during starting of a D.C. series motor? Why?

PART B — (5 × 16 = 80 Marks)

11. (a) (i) Define inductance of a coil. (4)

(ii) For the magnetic circuit shown in Fig. 11.a (ii) determine the current required to establish a flux density of 0.5 T in the air gap. (12)

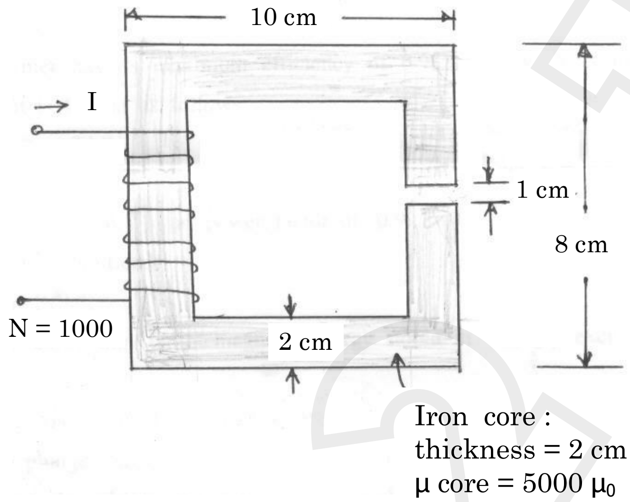

Fig. 11 (a) (ii)

Or

(b) (i) Define permeability of a magnetic material and the factors on which it depends. (4)

(ii) Explain the operation of a magnetic circuit when A.C. current is applied to the coil wound on iron core. Draw the B-H curve and obtain an expression for hysteresis loss. (12)

12. (a) (i) Define "Voltage Regulation" of a two winding transformer and explain its significance. (4)

(ii) A 100 kVA, 6600 V/ 330 V, 50 Hz single phase transformer took 10 A and 436 W at 100 V in a short circuit test, the figures referring to the high voltage side. Calculate the voltage to be applied to the high voltage side on full load at power factor 0.8 lagging when the secondary terminal voltage is 330 V. (12)

Or

(b) (i) Explain the reasons for 'tap changing' in transformers. State on which winding the taps are provided and why? (4)

(ii) A transformer has its maximum efficiency of 0.98 at 15 kVA at unity power factor. During the day it is loaded as follows :

12 Hours	2 kW	at power factor of 0.5
6 Hours	12 kW	at power factor of 0.8
4 Hours	18 kW	at power factor of 0.9
2 Hours	No load	

Find the 'All Day Efficiency'? (12)

13. (a) (i) Derive an expression for the magnetic energy stored in a singly excited electromagnetic relay. (8)

(ii) The relay shown in Fig. Q.13.a (ii) is made from infinitely permeable magnetic material with a movable plunger also of infinitely permeable material. The height of the plunger is much greater than the air gap length (h >> g). Calculate the magnetic energy stored as a function of plunger position (0 < x < d) for N=1000 turns, g = 2.0 mm, d=0. 5 m, l = 0.1 m and I = 10 A. (8)

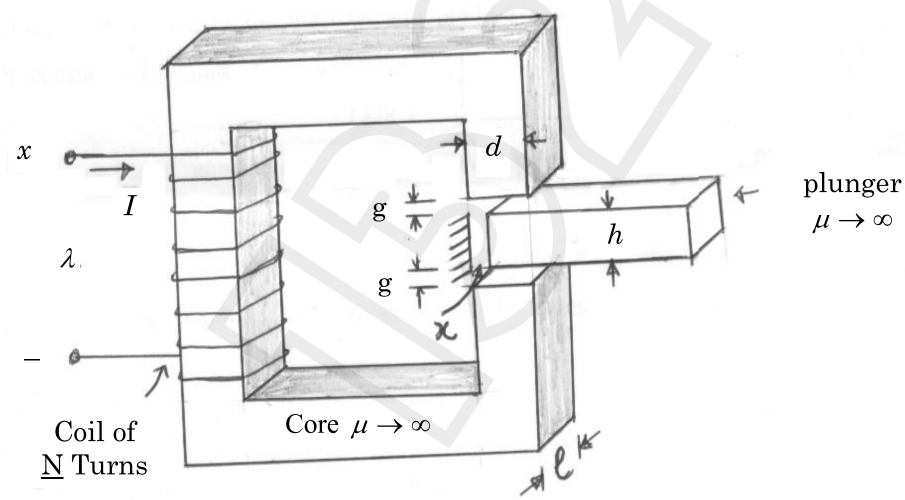

Fig. Q. 13. (a) (ii)

Or

(b) Two windings one mounted on the stator and the other mounted on a rotor have self and mutual inductances of, L11 = 4.5 H, L 22 = 2.5 H and L12 = 2.8 cos θ H, where 'θ' is the angle between the axes of the windings. The resistances of the windings may be neglected. Winding 2 is short circuited and the current in Winding 1 as a function of time is i_1 = 10sin wt A. Derive an expression for the numerical value of the instantaneous torque on the rotor in N-m in terms of the angle θ. (16)

14. (a) (i) Show the arrangement of a distributed stator winding with appropriate number of conductors in the slots designed to produce a sinusoidally varying air gap flux density. (6)

(ii) Prove that a three phase set of currents, each of equal magnitude and differing in space by 120° applied to a three phase winding spaced 120 electrical degrees apart around the surface of the machine will produce a rotating magnetic field of constant magnitude. (10)

Or

(b) (i) A D.C. machine has 'P' number of poles with curved pole faces having 'Z' number of conductors around the rotor armature of radius 'r' and the flux per pole is given as, φ . The rotor rotates at a speed of 'n' rpm. Obtain the induced e.m.f. of the D.C. machine assuming a number of parallel paths. (8)

(ii) A 12 pole D.C. generator has a simplex wave wound armature containing l44 coils of 10 turns each. The resistance of each turn is $0.011\,\Omega$. Its flux per pole is 0.05 Wb and it is running at a speed of 200 rpm. Obtain the induced armature voltage and the effective armature resistance. (8)

15. (a) (i) Draw the load characteristics of D.C. shunt and compound (cumulative and differential) generators and explain. (6)

(ii) In a 110 V, compound generator the resistances of the armature shunt and series field windings are $0.06\,\Omega$, $25\,\Omega$ and $0.04\,\Omega$ respectively. The load consists of 200 lamps each rated at 55 W, 110 V. Find the total electro motive force and armature current when the machine is connected long shunt and short shunt. (10)

Or

(b) (i) Give the reasons for using 'starters' to start D.C. motors. (3)

(ii) Draw the circuit of any one type of starter and explain its operation. (5)

(iii) A series motor of resistance $1\,\Omega$ between terminals runs at 800 rpm at 200 V with a current of 15 A. Find the speed at which it will run when connected in series with a $5\,\Omega$ resistance and taking the same current at the same supply voltage. (8)

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