



RN-6807

B. E. III (Sem. V) (Elect.) Examination

May / June - 2010

Electrical Machines - III

Time : 3 Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दृशाविल निशानीवाणी विगतो उत्तरवडी पर अवश्य लभवी.
Fillup strictly the details of signs on your answer book.

Name of the Examination :
B. E. 3 (Sem. 5) (Elect.)

Name of the Subject :
Electrical Machines - 3

Subject Code No. : **6 8 0 7** Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

- (2) Attempt **all** questions.
- (3) Answer to the **two** sections must be written in **separate** answer books.
- (4) Figures to the extreme right indicate marks.
- (5) Make suitable assumption wherever necessary.
- (6) Use of calculator model Fx 100 W or equivalent is permissible.

- 1 (a) Fill in the blanks: 6
- (i) A current of 1A flowing in winding produces a flux of 1 Wb. If the circuit reluctance is doubled, the exciting current should be _____.
 - (ii) The shape of the developed mmf wave of DC machine is _____.
 - (iii) In an electromagnetic relay force acts in the direction to _____ reluctance (maximize/minimize) and _____ inductance (maximize/minimize).
 - (iv) Relation between electrical degrees and mechanical degrees is given by _____.
- (b) Match the following : 4
- | | |
|-------------------------------|--------------------------------|
| (i) Flux linkage | a: AT/m |
| (ii) Flux density | b : Wb T |
| (iii) Magnetic field strength | c: H/m |
| (iv) Permeability | d : Wb/m ² or Tesla |
- (c) Define field energy and coenergy and prove that in a linear magnetic system both are having same numeric value. 7
- (d) Compare electromagnet and permanent magnet material. 3

- 2 (a) An inductor has an inductor which is found experimentally to be of the form. $L = 2L_0/(1+x/x_0)$ where $L_0 = 10 \text{ mH}$, $x_0 = 0.04 \text{ cm}$ and x is the displacement of a movable element. Its winding resistance is measured and found equal to $125 \text{ m}\Omega$.
- (i) The displacement x is held constant at 0.06 cm and current is increased from 0 to 2.5 A . Find resultant magnetic stored energy in inductor. 6
- (ii) The current is then held constant at 2.5 A and displacement is increased to 0.12 cm . Find corresponding change in magnetic stored energy. 6
- (b) Differentiate between leakage flux and fringing flux. 3

OR

- 2 (a) Derive the expression for force and torque in system with permanent magnets. 8
- (b) A ring of magnetic material has a rectangular cross section. The inner diameter of the ring is 20 cm and outer diameter is 25 cm , its thickness being 2 cm (figure 1). An air gap of 1 mm length is cut across the ring. The ring is wound with 500 turns and when carrying a current of 3 amp produces a flux density of 1.2 T in the air gap. Find
- (i) Magnetic field intensity in the material and in the air gap
- (ii) Relative permeability of the magnetic material
- (iii) Total Reluctance. 7

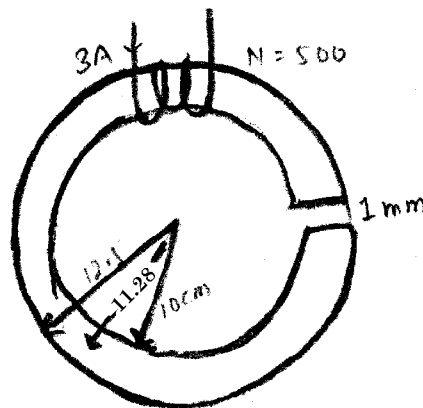


Fig. 1

- 3 (a) A three phase linear ac motor has a winding with a wavelength of $\beta = 0.5 \text{ m}$ and a winding factor $k_w = 0.92$. The air gap is 1.0 cm long, and a total of 45 turns are distributed over a total winding length of $3\beta = 1.5 \text{ m}$. Assume the windings to be excited with balanced three-phase currents of amplitude 700 A and frequency 25 Hz .

Calculate

- (i) The amplitude of the resultant mmf wave 4
 - (ii) The corresponding peak air-gap flux density 4
 - (iii) The velocity of this traveling mmf wave. 4
- (b) Explain recoil line for permanent magnets. 3

OR

- 3 (a) Derive an expression for the voltage induced in the distributed windings of AC machine in terms of flux, no. of series turns/phase, winding factor and frequency. 8
- (b) A steel ring has mean diameter of 20 cm, a cross section area of 25 cm² and a radial gap of 0.8 mm across it. When excited by a current of 1A through a coil of 1000 turns wound on the ring core, it produces an air gap flux of 1mWb. Neglecting leakage and fringing, calculate relative permeability of steel and total reluctance of the magnetic circuit. 7

SECTION - II

- 4 (a) Fill in the blanks with appropriate words : 6
- (i) In capacitor start and run motors, the function of capacitor is _____.
 - (ii) In a single phase induction motor, the starting torque is _____.
 - (iii) Armature reaction causes _____ in the speed of an ac series motor.
 - (iv) A centrifugal switch is placed in a 1- ϕ motors in series with _____.
 - (v) The hysteresis motor rotor is made of magnetic material having _____ hysteresis loop area.
 - (vi) Performance characteristics of 1- ϕ induction motors (less satisfactory than/more satisfactory than).
- (b) Say Yes or No : 4
- (i) The wattage rating for a ceiling fan motor varies from 50 to 150 W.
 - (ii) A reluctance motor is preferred for signalling and timing devices.
 - (iii) A hysteresis motor works on the principle of eddy current loss.
 - (iv) In a shaded pole 1- ϕ motor, the revolving field is produced by the use of capacitor.
- (c) Compare 3- ϕ induction motor with 1- ϕ induction motor. 5

- (d) List three applications for
 - (i) A resistance start-induction-run motor
 - (ii) A capacitor start induction-run motor.

5 Attempt any **three** from the following : **15**

- (a) A 2.5 kW, 120 V, 60 Hz capacitor-start motor has the following impedances for the main and auxiliary winding at starting.

$$Z_{\text{main}} = 4.5 + j3.7 \Omega \text{ main winding}$$

$$Z_{\text{aux}} = 9.5 + j3.5 \Omega \text{ Auxiliary winding.}$$

Find the value of starting capacitance that will place the main and auxiliary winding currents in quadrature at starting.

- (b) A single phase series motor has total resistance of 1Ω and total inductance of 0.05H . When connected to 220V DC, the motor draws 10A and runs at 1400 r.p.m. Calculate the speed and power factor when the motor draws the same current from 220V , 50 Hz source.
- (c) Write short note on Hysteresis motor.
- (d) Explain various starting methods used for starting of $1-\phi$ induction motor.
- (e) What is a stepper motor? Enumerate its advantages and applications.

6 Attempt any **two** from the following :

- (a) Explain double revolving field theory with diagram in connection with single phase induction motor.
- (b) Explain working principle and working of repulsion induction motor with the help of neat diagram, also state its applications.
- (c) Suggest modification in dc series motor to operate on $1-\phi$ ac supply.