Department of Electrical Engineering
Indian Institute of Technology Delhi

EEL203 - Electromechanics

Name: .....Entry No. .....

Minor-I: Part – II (5-2-2013) **Total Marks: 40** **Time: 40 minutes**

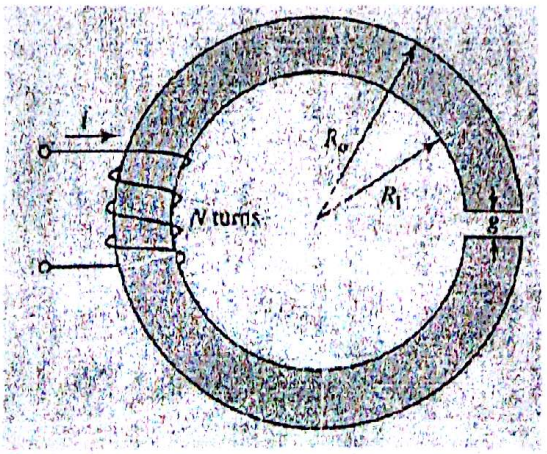
Note:
(i) Answer all questions in brief and specific to the points asked for.
(ii) Make proper assumptions in case of insufficient data. Indicate the assumptions made, if any.
(iii) No clarifications on questions except for printing mistakes, if any.
(iv) No negative marks.

1) Specify the important characteristics and properties required for a good soft magnetic material used for the stator and rotor of electrical machines. Discuss the effect of each of these parameters on the performance of these machines. List down the names of three soft magnetic materials in the order of these parameters in each case. **[8 marks]**

2) The magnetic circuit given in the following figure consists of rings of magnetic material in a stack of height h. The rings have inner radius R_i and outer radius R_o. Assume that the relative permeability of iron is 700, and neglect the effects of magnetic leakage and fringing.

For: $R_i = 3.6$ cm, $R_o = 4.2$ cm, $h = 2.2$ cm, $g = 0.18$ cm, $N = 75$ turns, calculate:

(a) the inductance,
(b) the current required to operate at an airgap flux density of 1.25 T, and
(c) the corresponding flux linkage of the coil. **[9 marks]**



3) It is decided to achieve a time-varying magnetic flux density in the airgap of the magnetic circuit given in the following figure of the form:

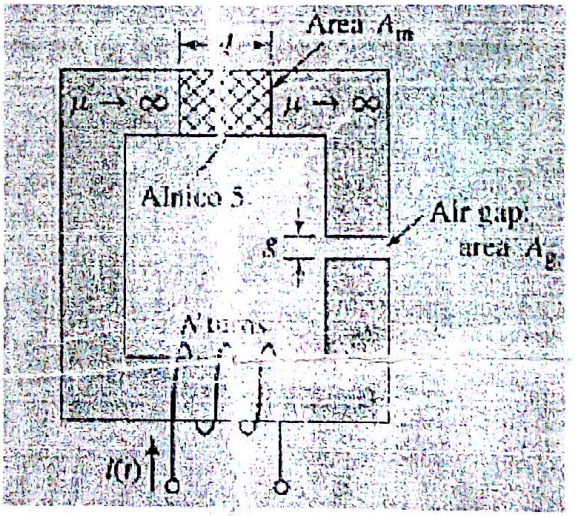
$$B_g = B_0 + B_1 \sin \omega t$$

where, $B_0 = 0.6$ T, $B_1 = 0.3$ T. The dc field B_0 is to be created by a Neodymium-Iron-Boron magnet, whereas the tme-varying field is to be created by a time varying current.

For: $A_g = 7\ cm^2$, $g = 0.18$ cm, $N = 220$ turns, find:

(a) the magnet length d and the magnet area A_m that will achieve the desired dc airgap flux density and minimize the magnet volume.

(b) the minimum and maximum values of the time-varying current required to achieve the desired time-varying airgap flux density. Will this current vary sinusoidally in time? **[10 marks]**



4) (a) What are the applications of transformers?
(b) Will the flux in a transformer core vary when the load connected to the secondary side is varying? Briefly explain. **[5 marks]**

5) A single-phase 100 kVA, 1000/100 V transformer gave the following test results:

Open-circuit test with HV side open: 100 V, 6 A, 400 W
Short-circuit test: 50 V, 100 A, 1800 W

(a) Derive an approximate equivalent circuit referred to HV side.
(b) Determine the efficiency of the transformer when it is delivering the rated current at a power factor of 0.8 lagging. **[8 marks]**