

Ollscoil na hÉireann, Gaillimh

National University of Ireland, Galway

SEMESTER I EXAMINATIONS, 2000/2001

THIRD YEAR ELECTRONIC ENGINEERING
THIRD YEAR MECHANICAL ENGINEERING

ELECTRICAL POWER AND MACHINES

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Duration of examination: *One Hour Thirty Minutes*

Instructions: Answer *three* questions

$$\mu_0 = 4\pi \times 10^{-7} \text{ H/m} \quad 1 \text{ hp} = 746 \text{ W}$$

- 1 Write down the expression for the inductance of a toroidal core with circular cross-section. Assume the flux is uniform over the cross-section. Explain the meaning of each term in the expression.

A toroidal core has a circular cross-section with the dimensions shown in Fig. 1(a). It is wound with a coil having 100 turns. The B-H characteristic of the core may be represented by the linearised magnetization curve of Fig. 1(b).

- Determine the inductance of the coil, if the flux density in any part of the core is below 1.0 T.
- Determine the maximum value of current for the condition of part (a).
- Calculate the stored energy in (b).

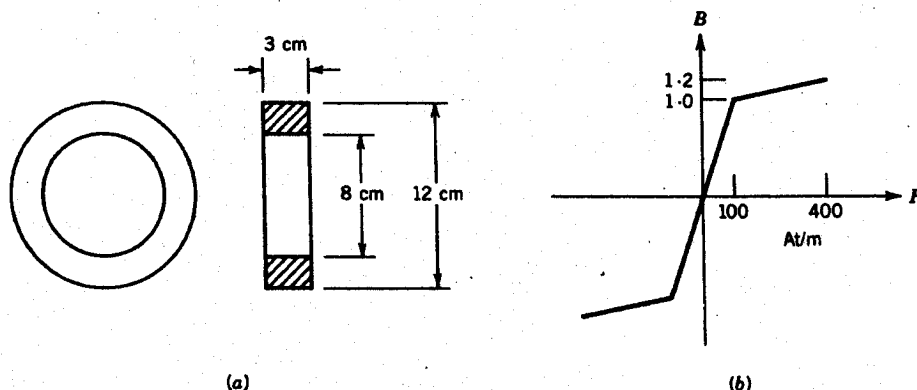


Figure 1.

- 2 Show that for maximum efficiency in a transformer, the iron (core) loss is equal to the copper (winding) loss.

In a 50 kVA transformer the iron loss is 700 W and the full load copper loss is 800 W.

Calculate the efficiency of the transformer under the following conditions.

- (a) full load, unity power factor
- (b) full load, 0.8 power factor
- (c) half-load, 0.8 power factor
- 3 Explain the role of a commutator in a dc machine. A 12 kW, 100V, 1000 rpm dc shunt motor with armature resistance $R_a = 0.1\Omega$ is connected to a 100 V supply. At no-load the motor runs at 1000 rpm and the armature takes 6A.
- Calculate the following when rated current flows in the machine.
- Neglect armature reaction.
- (a) Full load speed
- (b) Torque at full load.
- 4 A phase-controlled full wave bridge rectifier is used to control the speed of a dc motor, as show in Fig. 2. The supply voltage is 120Vrms, the motor current is 15 A and is assumed to be ripple-free. The firing angle of the SCR's is $\alpha = 60^\circ$. For this operating condition.
- (a) Draw the waveforms v , v_0 , i , i_0 .
- (b) Calculate the power drawn by the motor.
- (c) Calculate the power factor of the supply, assume that the converter is lossless.

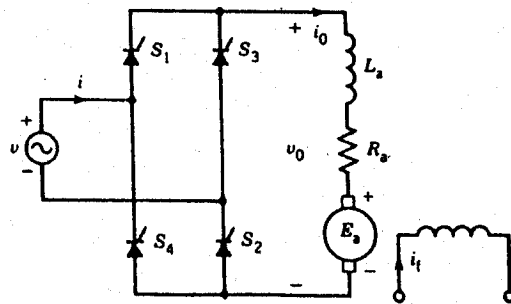


Figure 2.