National University of Singapore

Department of Electrical & Computer Engineering

EE-1102:Introduction to Circuits and Systems

Tutorial - 7 (Magnetic Circuits)

Year 2013-17

Q.1 A 200 turn toroidal coil as shown in Figure. 1 has $r = 1$cm and $R = 10$ cm. When a current of 0.05 sin(200t) A flows through the coil, a voltage of 0.5 cos(200t) V is produced. Determine the flux, ϕ as a function of time, t and the relative permeability of the core material.

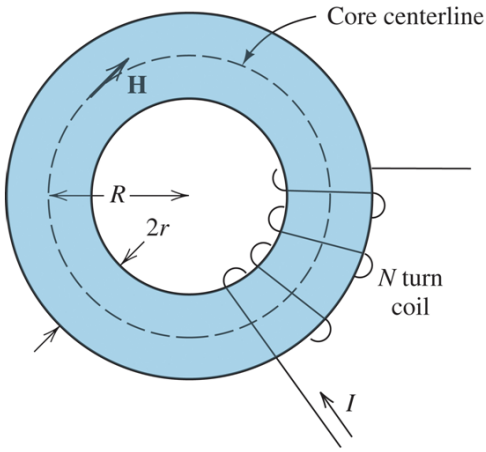

Figure 1: Q.1

(Ans. 0.0125 sin(200t) mWb and 1989)

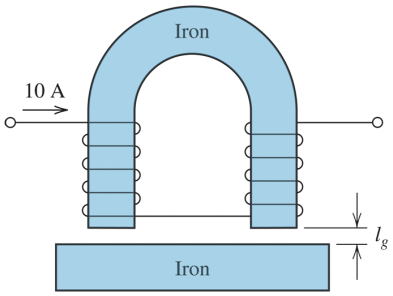

Figure 2:

Q.2 Consider the magnetic circuit as shown in Figure. 2. Assume that the reluctance of the iron path is small and therefore can be neglected. The length of the air-gaps are 0.2 cm, and the effective area of each air-gap is 20 cm^2. Determine the total number of turns needed to produce a flux-density of 0.5 Wb/m^2 in the air-gaps.

(Ans. $\simeq 159$)

Q.3 Two coils wound on a common core have $L_1 = 1\,\text{H}$, $L_2 = 2\,\text{H}$, and $M = 0.5\,\text{H}$. The currents in the coils are $i_1 = 1\,\text{A}$, and $i_2 = 0.5\,\text{A}$. If the current i_1 enters at the dotted terminal while current, i_2 leaves at the dotted terminal, determine the flux-linkages in both the coils.

(Ans. $\lambda_1 = 0.75\,\text{Wb-turns}$ and $\lambda_2 = 0.50\,\text{Wb-turns}$)

Q.4 Consider an electric circuit as shown in Figure. 3 where the secondary side of the coil is left open. The two coils have $L_1 = 0.1\,\text{H}$, $L_2 = 10\,\text{H}$, and $M = 1.0\,\text{H}$. Prior to $t = 0$, the currents in the coils are zero. At $t = 0$, the switch is closed. Determine and sketch $i_1(t)$ and $v_2(t)$ to scale with respect to time.

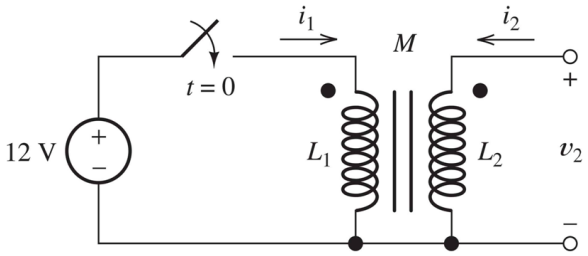

Figure 3:

(Ans. $i_1(t) = 120t\,\text{A}$ and $v_2(t) = 120\,\text{V}$)

— END —