

國立中央大學104學年度碩士班考試入學試題

所別：機械工程學系光機電工程碩士班 乙組(光機)(一般生) 科目：電磁學 共 1 頁 第 1 頁

本科考試可使用計算器，廠牌、功能不拘

\*請在答案卷(卡)內作答

- Fig. 1 shows a ring of charge  $q$  and of radius  $a$ . A charge  $-q$  with mass  $m$  is constrained to move along the  $x$  axis of the ring. The charge  $-q$  can perform oscillations. Considering the small oscillations, find the frequency of the oscillations. (25%)

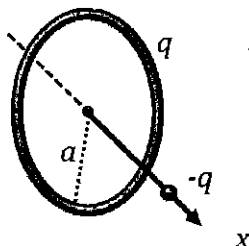


Fig. 1

- An electric field  $E$  exists at any point in space. Find the stored energy density  $u$  at the point in term of the electric field  $E$ . (15%)
- Describe the law of conservation of magnetic flux and its mathematic expression. (10%)
- A toroidal coil with an air core and a rectangular cross section has  $N$  turns of coil and carries a current  $I$ . The dimensions of the toroid are shown in Fig. 2. Find the magnetic flux density inside the toroid ( $r < R_2$ ), the flux linkage, and the self-inductance of the toroidal coil. (30%)

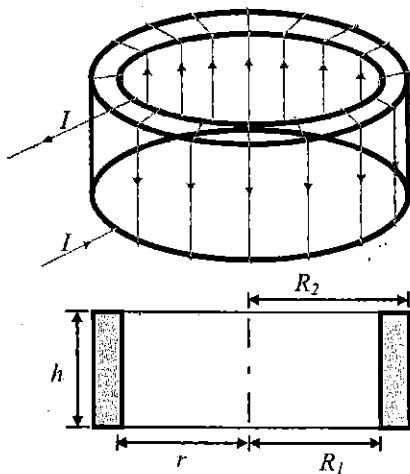


Fig. 2

- A linearly polarized uniform plane wave propagates in the  $+x$ -direction in seawater (constitutive parameters:  $\epsilon_r = 80$ ,  $\mu_r = 1$ , and  $\sigma = 4$  S/m). The electric field intensity is  $\vec{E} = \hat{x} \times 200 \times \cos(7.2 \times 10^6 \times \pi \times t)$  V/m at  $z=0$ .
  - Determine the attenuation constant  $\alpha$ , intrinsic impedance  $\eta_c$ , and skin depth  $\delta$ . (9%)
  - Determine the phase velocity of this plane wave in this seawater. (4%)
  - Write the expressions for  $\vec{E}(z, t)$  at  $z=0.5$  m as functions of  $t$ . (7%)

參考用