國立臺灣科技大學

九十一學年度碩士班招生考試試題

系所組別： 電子工程系乙三組、電子工程系丙組

科　目： 電磁學

(本 科 總 分 100 分)

1) A line charge of uniform charge density ρ (c/m) forms a circle of radius b (m) that lies in the xy-plane in air with its center at the origin.

(a) Find the electric potential V and the electric field intensity **E** at the point (0,0,h). (7%)

(b) At what value of h will **E** in part (a) be a maximum ? What is this maximum ? (8%)

2) Calculate the internal and external inductances per unit length of a transmission line consisting of two long parallel conducting wires of radius a (m) that carry currents in opposite directions. The axes of the wires are separated by a distance d (m), which is larger than a (m). (15%)

3) A 60-(MHz) electromagnetic wave exists in an air-dielectric coaxial cable having an inner conductor with radius a (m) and an outer conductor with inner radius b (m). Assuming perfect conductors, and the phasor form of the electric field intensity to be

$$\mathbf{E} = \mathbf{a}_r (E_0 / r)\, \exp(-j k z) \quad (\text{v/m}), \qquad a < r < b,$$

(a) find k, (5 %)

(b) find the corresponding phasor form of magnetic field intensity **H** , (5%)

(c) fnd the surface current densities on the inner and outer conductors. (5%)

4) A long, round wire of radius a (m) and conductivity σ (s/m) is coated with a material of conductivity 0.1σ (s/m).

(a) What must be the thickness of the coating so that the resistance per unit length of the uncoated wire is reduced by 50 % ? (7%)

(b) Assuming a total current I (A) in the coated wire, find the current densities and electric field densities in both the core and the coating material. (8 %)

5) Given that the skin depth for graphite at 100 (MHz) is 0.16 (mm) and the permeability of graphite is $4\pi \times 10^{-7}$ (H/m). determine

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(a) the conductivity of graphite, (8 %) and
(b) the distance that a 1 (GHz) wave travels in graphite such that its field intensity is reduced by 30 (dB) (7%)

6) The open-circuit and short-circuit impedance measured at the input terminals of a lossless transmission line of length 1.5 (m), which is less than a quarter wavelength, are -j54.6 (Ω) and j103 (Ω), respectively.
(a) Find the characteristic impedance and propagation constant of this transmission line. (5%)
(b) Without changing the operating frequency, find the input impedance of a shorted line that is twice the given length. (5%)
(c) How long should the short-circuited line be in order for it to appear as an open circuit at the input terminals ? (5%)

7) (a) Define electric displacement vector, What is its SI unit ? (3%)
(b) What is the relation between vector magnetic potential **A** and the magnetic flux of **B** through a given area S ? (3%)
(c) Define Brewster angle. Why is a Brewster angle also called a polarizing angle ? (4%)

參 考 公 式

$$\nabla\times\mathbf{A}\,(r,\phi,z) = \mathbf{a}_r[\partial A_z/(r\partial\phi) - \partial A_\phi/\partial z] + \mathbf{a}_\phi\,[\partial A_r/\partial z - \partial A_z/\partial r] + \mathbf{a}_z\,(1/r)[\partial\,(rA_\phi)/\partial r - \partial A_r/\partial\phi]$$

$\log_{10}(e) = 0.434$. Permeability in free space $\mu_0 = 4\pi \times 10^{-7}$ (H/m).