

元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別： 光電工程學系碩
士班

組別： 不分組

科目： 電磁學

用紙第 / 頁共 / 頁

●不可使用電子計算機

1. Given an electric field $\vec{E} = (y+1)\hat{a}_x + (x-1)\hat{a}_y + 2\hat{a}_z$, find the electrical potential at the point P_2 with respect to the point P_1 , in which
 - (a) $P_2 : (2, -2, -1)$ and $P_1 : (0, 0, 0)$; (10%)
 - (b) $P_2 : (3, 2, -1)$ and $P_1 : (-2, -3, 4)$. (10%)

2. Considering a coaxial cable with outer radius a and inner radius b , find the magnetic field energy per unit length between the inner conductor and outer conductor if the current in the inner conductor is I . The dielectric material between the inner conductor and outer conductor is non-magnetic. (20%)

3. Prove that the ratio of conducting current and displacement current in a parallel conducting plate capacitor is $\sigma/\omega\epsilon$, in which σ and ϵ are the conducting coefficient and permittivity of the material between the plates, respectively, and ω is the angular frequency of the electric field between the plates. (10%)

Hint: Assume the electric field to be $E = E_m \cos(\omega t)$.

4. (a) Write down the Maxwell equations in a source free and homogeneous medium. (10%)

- (b) Derive the following wave equations from the Maxwell equations in (a). (10%)

$$\nabla^2 \vec{E} - \mu\epsilon \frac{\partial^2 \vec{E}}{\partial t^2} = 0, \quad \nabla^2 \vec{H} - \mu\epsilon \frac{\partial^2 \vec{H}}{\partial t^2} = 0$$

Hint: $\nabla \times \nabla \times \vec{A} = \nabla(\nabla \cdot \vec{A}) - \nabla^2 \vec{A}$

- (c) Drive the x-polarized electric field of a plane wave propagating in z direction from (b). (10%)

- (d) Derive the magnetic field corresponding to the electric field in (c). (10%)

- (e) Write down the electric and magnetic fields in (c) and (d) for a 10.0 GHz plane wave with relativity permittivity $\epsilon_r = 8$ and relativity permeability $\mu_r = 1$. The peak amplitude of the electric field is 0.1 V/m. (10%)

Hint: The wave impedance in free space is 377 Ω . The units of the fields must be indicated.

103051