編號： 194

國立成功大學 105 學年度碩士班招生考試試題

系　　所：電腦與通信工程研究所

考試科目：電磁學及電磁波

考試日期：0228，節次：2

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

For your reference: $\varepsilon_0 = 10^{-9}/36\pi$ (F/m); $\mu_0 = 4\pi\times10^{-7}$ (H/m); $\eta_0 = 120\pi$ (Ω); $c = 3\times10^8$ (m/s)

Permitivity ε ($=\varepsilon_r\varepsilon_0$); Permeability μ ($=\mu_r\mu_0$); Conductivity σ

1. Let $\vec{D}=\varepsilon\vec{E}$ and $\vec{B}=\mu\vec{H}$, please state the boundary conditions for the tangential components of $\vec{E}$ and $\vec{H}$ as well as the normal components of $\vec{D}$ and $\vec{B}$. (10%)

2. A constant voltage V_0 is applied to a partially filled parallel-plate capacitor shown in **Fig. 1**. The permitivity of the dielectric is ε, and the area of the plates is **A**. Find the force on the upper plate. (15%)

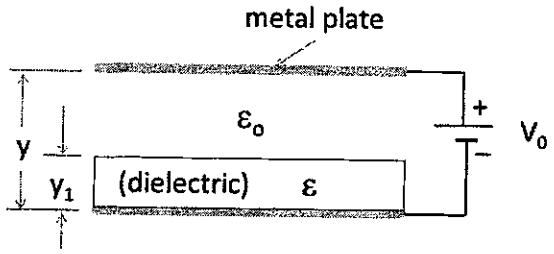

Fig. 1

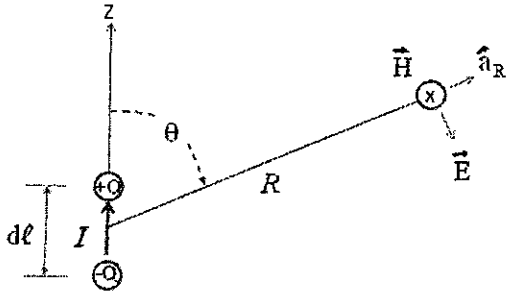

Fig. 2 A Hertzian dipole

3. (a) Express the magnetic energy density w_m in a dielectric (with μ) when $\vec{H}$ is applied. (5%)
   (b) By using the stored magnetic energy, determine the inductance per unit length of an air coaxial transmission line that has a solid inner conductor of radius ***a*** and a very thin outer conductor of inner radius ***b***. (10%)

4. (a) Given the electric field intensity $\vec{E}$, the magnetic field intensity $\vec{H}$, the volume charge density ρ, and the volume current density $\vec{J}$ in free space, please write out the set of Maxwell's equations in the differential form. (8%)

   (b) In the source free condition (that is, $\rho = 0$ and $\vec{J} = 0$), please derive the wave equations for $\vec{E}$ and $\vec{H}$ from the Maxwell's equations. (7%)

5. (a) Find the current required to radiate a power of 50W at 100 MHz from a 0.01 (m) Hertzian dipole. (10 %)
   (b) Find the magnitudes of $\vec{E}$ and $\vec{H}$ at R = 100 (m) and θ = 90° as **Fig. 2** shown. (10%)

6. A C-band air-filled waveguide for use between 3.95 and 5.85 GHz with a cross-section area of 4.755 (cm) × 2.215 (cm). Calculate the dominant mode cutoff frequency and the guided wavelength when the operation frequency is 4.2 GHz. (10%)

7. Given that $\vec{H}=\hat{a}_y\cdot 2\cos(15\pi x)\sin(8\pi\times10^9\,t-\beta z)$ (A/m) in air, please find $\vec{E}$ and **β**. (15%)