編號： 195

國立成功大學 107 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：0205，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。

(試卷 6 題共計 100 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)

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

1. (a) Please give the Maxwell's equations in differential form. [10%]

(b) Assuming under the source-free conditions, given the electric field $\vec{E}$, prove that [10%]

$$\nabla^2\vec{E} = \mu\sigma\frac{\partial\vec{E}}{\partial t}\ .$$

2. As shown in **Fig. A**, the volume in Cylindrical coordinates between r = 3 m and r = 5 m contains a uniform charge density $\rho = 100$ (C/m^3). Use the Gauss's law to find the electric flux density $\vec{D}$ in all regions. [10%]

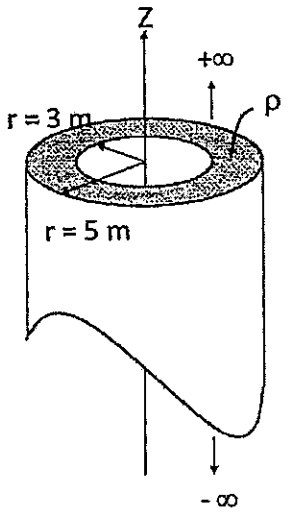

Fig. A

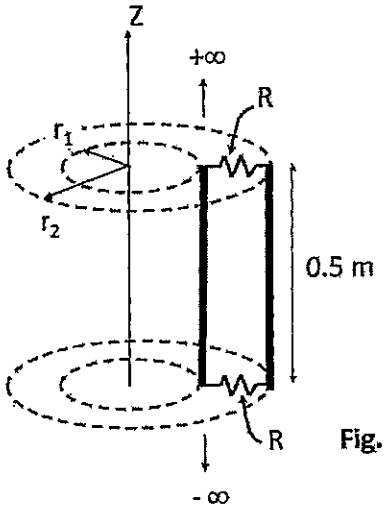

Fig. B

3. As shown in **Fig. B**, a rectangular conducting loop with resistance R = 0.1 Ω turns around the z-axis at a frequency of 100 Hz. The vertical conductors with a length of 0.5 m locate at r_1 = 0.03 m and r_2 = 0.05 m, respectively. The magnetic flux density $\vec{B}(r) = \hat{a}_r\frac{0.075}{r}$ (Wb/m^2). Find the magnitude of induced current in the loop. [10%]

4. Consider an air-filled rectangular waveguide having dimensions of a = 2.286 cm and b=1.016 cm.

(a) Supposed only the dominant mode should be transmitted. What is the range of frequency that can be used. [10%]

(b) When the operation frequency is 15 GHz, which TE and TM modes can propagate in the waveguide? [10%]

(背面仍有題目，請翻頁繼續作答)

5. A 600-Ω transmission line is 150 m long, as shown in **Fig. C**, operates at a frequency of 400 kHz with an attenuation constant α of 2.4×10^{-3} Np/m and a phase constant β of 0.0212 rad/m. This transmission line is terminated with a load of $Z_L = 300\sqrt{2}\angle 45^\circ\ \Omega$.

(a) Find the length of line in wavelength, the reflection coefficient Γ_L at the load end, the reflection coefficient Γ_S at the source end, and the input impedance Z_S at the source end. [10%]

(b) For a received voltage $V_L = 50\angle 0^\circ$ V at the load end, find the voltage V_S at the source end. [10%]

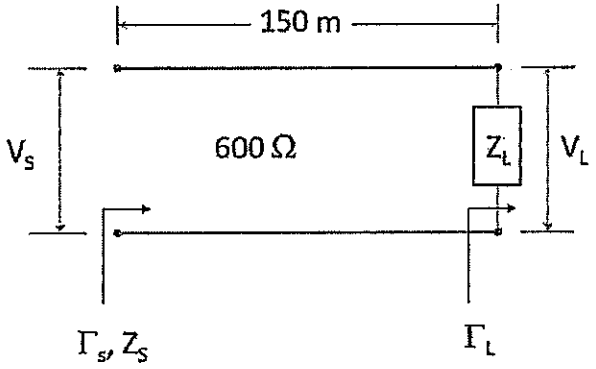

Fig. C

6. (a) Determine the magnitude of electric field intensity at a distance 2 km from an antenna having a directive gain of 10 dB and radiating a total power of 5 kW. [10%]

(b) A Hertzian dipole of length L = 2 m and radius a = 2 mm. Find the radiation efficiency if the copper conductor has $\sigma_c = 58\times10^6$ S/m. [10%]