國立臺北科技大學

100學年度研究所碩士在職專班入學考試

電腦與通訊研究所

丙組：電磁學試題

填准考證號碼

注意事項：

1. 本試題共【七】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。

1. A coaxial transmission line consists of an inner conductor of radius a and an outer conductor whose inner radius is b. The space between the two conductors is filled with a dielectric material characterized by permittivity ε, permeability μ, and conductivity σ. Determine the line capacitance (capacitance per unit length), line inductance, and line conductance of the transmission line. (15%)

2. Consider a lossy coaxial transmission line with both conductor loss and dielectric loss.
   - Develop the equivalent circuit of a differential length Δz of the lossy transmission line. (4%)
   - Use this equivalent circuit to derive the time-harmonic transmission-line equations for the phasors $V(z)$, voltage distribution along the line, and $I(z)$, current distribution along the line. (8%)
   - Then, use the equations to solve the two phasors $V(z)$ and $I(z)$. (6%)

3. Draw the variations of a standing wave and a traveling wave in time domain. (10%)

4. What are a *TEM* wave, a TE wave, and a TM wave? (10%)

5. Determine the polarizations of the following uniform plane waves: (15%)
   - $\mathbf{E} = 1\cos(\omega t + \beta z)\hat{x} + 1\sin(\omega t + \beta z)\hat{y}$,
   - $\mathbf{E} = 1\sin(\omega t + \beta z)\hat{x} + 1\sin(\omega t + \beta z)\hat{y}$,
   - $\mathbf{E} = 1\cos(\omega t - \beta z)\hat{x} - 1\sin(\omega t - \beta z)\hat{y}$,
   - $\mathbf{E} = 1\cos(\omega t - \beta z)\hat{x} - 1\cos(\omega t - \beta z)\hat{y}$,
   - $\mathbf{E} = 1\cos(\omega t + \beta z)\hat{x} - 2\sin(\omega t + \beta z - 45°)\hat{y}$

6. Derive the non-homogeneous wave equations for vector potential $\mathbf{A}$ and scalar potential V in a homogeneous medium. (20%)

7. A positive point charge Q is located at distance d_1 and d_2, respectively, from two grounded perpendicular conducting half-planes, as shown in Figure 1. Use the *method of images* to determine the force on Q caused by the charges induced on the planes. (12%)

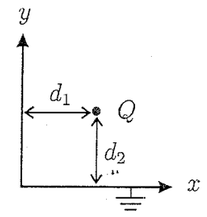

Figure 1.