國立臺南大學 102 學年度 **電機工程學系碩士班** 招生考試 電磁學 試題卷

每大題 10 分，共 10 題，合計 100 分

1. A vector filed $\vec{D} = \vec{e}_r(\cos^2\phi / r^3)$ exists in the region between two spherical shells defined by r = 2 and r =3. Evaluate $\oint_S \vec{D} \cdot d\vec{a}$.

2. A spherical distribution of charge $\rho = \rho_0$ [1-(r^2/b^2)] exists in the region $1 \le r \le b$. This charge distribution is concentrically surrounded by a conducting shell with inner radius *Ri* (>b) and outer radius *Ro*. Determine $\vec{E}$ everywhere.

3. An air coaxial transmission line has a solid inner conductor of radius *a* and a very thin outer conductor of inner radius *b*. Determine the inductance per unit length of the line.

4. A right-hand circularly polarized plane wave represented by the phasor $\vec{E}(z) = E_0(e_x - je_y)e^{-j\beta z}$ impinges normally on a perfectly conducting wall at z =0.
   (a) Determine the polarization of the reflected wave.
   (b) Obtain the instantaneous expression of the total electric intensity based on a cosine time reference.

5. A sinusoidal voltage generator V_g =100sin(ωt)(V) and internal impedance Z_g =50 Ω is connected to a quarter-wave lossless line having a characteristic impedance R_0 =50 Ω that is terminated in a purely reactive load Z_L = j 50 Ω. Please obtain the instantaneous power and the average power delivered to the load.

6. A spherical capacitor consists of an inner conducting sphere of radius a and an outer conductor with a spherical inner wall of radius b. The space in between is filled with a dielectric of permittivity ε. Determine the capacitance.

7. (a) When does Brewster angle exist at an interface of two nonmagnetic media?
   (b) Why is a Brewster angle also called a polarizing angle?

8. (a) Write the instantaneous field expressions for the TE_{10} mode in a perfectly conducting rectangular waveguide having sides a and b.
   (b) Find the cutoff frequency for the TE_{10} mode.

9. A spherical region carries a uniform charge per unit volume ρ. Let $\mathbf{r}$ be the vector from the center of the sphere to a general point P within the sphere. Please find the electric field at P.

10. A conducting sliding bar oscillates over two parallel conducting rails in a sinusoidally varying magnetic field $\mathbf{B} = \mathbf{a}_z 5\cos(\omega t)$ (mT), as shown in Fig. 1. The position of the sliding bar is given by $x = 0.4[1-\cos(\omega t)]$ (m), and the rails are terminated in a resistance R = 0.2 (Ω). Find i.

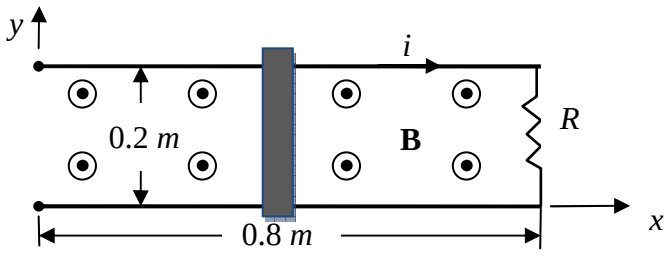

Fig. 1