國立中央大學100學年度碩士班考試入學試題卷

所別：電機工程學系碩士班 電波組(一般生)　科目：電磁學　共 1 頁 第 1 頁

本科考試禁用計算器

＊請在試卷答案卷（卡）內作答

1. For a general transmission line, the equivalent resistance, inductance, conductance, and capacitance per unit length are R, L, G, and C, respectively.
   (a) (10%) Determine the characteristic impedance of the transmission line.
   (b) (2%) Is it the pure TEM mode for the wave propagating on the transmission line? Why?
   (c) (3%) What is meant by a "distortionless line"? If the transmission line is distortionless, what relation must the distributed parameters of the line satisfy?
   (d) (10%) If the transmission line is lossless, what is the characteristic impedance? With a length of l, the measured open- and short-circuit impedances at the input terminals are Z_{io} and Z_{is} (Ω), respectively. Assuming the length is less than a quarter wavelength, find the characteristic impedance and propagation constant.

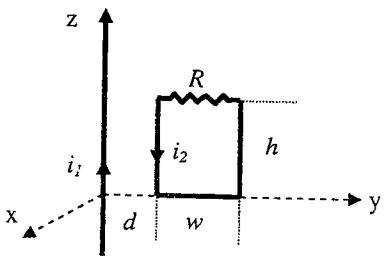
2. In air, the magnetic field of a wave is given by

   $$\overline{H} = \hat{y}\cos(x)\sin(\omega t - \beta z)$$

   (a) (12%) Assuming the wave travels in positive z direction, determine the propagation constant, electric field, and frequency.
   (b) (2%) What is the polarized direction of the wave?
   (c) (2%) Is the wave circularly polarized? Why?
   (d) (6%) State how to generate a linearly or a circularly polarized waves.
   (e) (3%) State the TEM, TE, and TM waves.

3. (15%) The vector magnetic potential can be calculated by using $\mathbf{A} = \frac{\mu_0}{4\pi}\int_{v'}\frac{\mathbf{J}}{R}\,dv'$, and then $\mathbf{B} = \nabla \times \mathbf{A}$. Please derive the Biot-Savart law.

4. (18%) A stationary rectangular conducting loop of width w and height h is situated near very long wire carrying a current i_1 as in the right figure. R is a resistor. Assume $i_1 = I_1\cos\omega t$ and the self-inductance of the rectangular loop to be L. Find the induced current i_2 in the loop.



5. (17%) A line charge with charge density ρ_0 is located inside and at distance a from the center of a cylindrical conducting shell of radius d (where $d > a$). Determine the charge density induced on the inner surface of the shell.