## 國立中央大學95學年度碩士班考試入學試題卷 #\_2 頁 第\_/ 頁

## 所別:電機工程學系碩士班丁組科目:電磁學

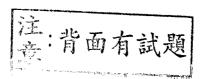
- 1. An air-filled rectangular cavity resonator is bounded by x=0, a; y=0, b; and z=0, d.
  - (a). (8%) Find the expression of time-harmonic field components for the  $TM_{mnp}$  and  $TE_{mnp}$  modes.

Then, determine the dominant modes, the lowest resonant frequency, and the energy storage of dominant mode for following cases:

- (b). (6%) For a > b > d
- (c). (6%) For a > d > b
- 2. The electric field of a uniform plane wave propagating in free space is given in phasor form by

$$E = 5(a_x + j0.4a_y + j0.3a_z)e^{j(0.3y-0.4z)}$$

- (a) (3%) Determine the frequency of the wave.
- (b) (3%) What is the direction of propagation?
- (c) (3%) Obtain the associated magnetic field in phasor form.
- (d) (3%) Discuss the polarization of the wave.
- (e) (4%) Write the instantaneous (time-domain) expression for E, using a cosine reference.
- (f) (4%) Find the time-average power flow per unit area normal to the direction of propagation.
- 3. Consider a lossless transmission line of a characteristic impedance  $R_0$ . A time-harmonic voltage source of an amplitude  $V_g$  and an internal impedance  $R_g = R_0$  is connected to the input terminals of the line, which is terminated with a load impedance  $Z_l = R_l + jX_l$ . Let  $P_{inc}$  be the average incident power associated with the wave traveling in the +z direction.
  - (a) (5%) Write the line voltage and current phasor expressions V(z) and I(z).
  - (b) (5%) Find the expression for  $P_{inc}$  in terms of  $V_g$  and  $R_0$ .
  - (c) (5%) Find the expression for the average power  $P_I$  delivered to the load in terms of  $V_g$  and the absolute value of the reflection coefficient  $\Gamma$ .
  - (d) (5%) Express the ratio  $P_l/P_{inc}$  in terms of voltage standing-wave ratio VSWR.



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- 4. Consider an electric dipole, consisting of +q and -q with a separation d, located above a large grounded conducting plane. The dipole is in x-direction and at (0,0,h), and the conducting plane is on x-y plane.
  - (a) (10%) Obtain the expression for the electric field intensity at (0,0,0).
  - (b) (10%) Obtain the expression for the charge density on the conducting plane.
- 5. Consider a magnetic dipole with dipole moment  $\overline{\mathbf{m}} = \hat{\mathbf{z}} I \pi b^2$ , in which  $\hat{\mathbf{z}}$  is a unit vector in z-direction, I is the current, and b is the radius of the current loop. There is also a large grounded conducting plane on the z=0 plane. The dipole is located at (0, 0, h).
  - (a) (7%) Apply the method of images and obtain the dipole moment of the image dipole.
  - (b) (7%) Obtain the expression for the vector magnetic potential at (0,0,0).
  - (c) (6%) Obtain the expression for the magnetic flux density at (0,0,0).