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

$$\mathbf{E} = 5(\mathbf{a}_x + j0.4\mathbf{a}_y + j0.3\mathbf{a}_z)e^{j(0.3y-0.4z)}$$

   (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 $\mathbf{E}$, 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_l delivered to the load in terms of V_g and the absolute value of the reflection coefficient Γ.

   (d) (5%) Express the ratio P_l / P_{inc} in terms of voltage standing-wave ratio VSWR.

注意：背面有試題

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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).