

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

Problem 1 [共 31 分]

Answer the following questions.

- (a) [4 分] What are the definitions for perfect dielectrics, imperfect dielectric, imperfect conductor and perfect dconductors?
- (b) [6 分] What are the units of electric field intensity, displacement flux density, magnetic flux density, magnetic field intensity, permittivity, and permeability?
- (c) [7 分] State Poynting's theorem for a material medium.
- (d) [4 分] Discuss the reason and principle for transmission-line matching.
- (e) [5 分] Dicsuss the phenomenon of dispersion and explain how the phase and group velocities can be determined from a dispersion diagram.
- (f) [5 分] Discuss the radiation principles of linear antennas and apertual antennas.

Problem 2 [10 分]

For an anisotropic dielectric material characterized by the \mathbf{D} and \mathbf{E} relationship

$$\begin{bmatrix} D_x \\ D_y \\ D_z \end{bmatrix} = \epsilon_0 \begin{bmatrix} 8 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & 9 \end{bmatrix} \begin{bmatrix} E_x \\ E_y \\ E_z \end{bmatrix}$$

find the values of the effective relative permittivity and corresponding characteristic polarizations.

Problem 3 [20 分]

A volume charge distribution is given in spherical coordinates by

$$\rho = \begin{cases} \rho_0 (r/a)^2 & \text{for } r < a \\ 0 & \text{for } r > a \end{cases}$$

- (a) Find the energy stored in the electric field of the charge distribution. (b) Find the work required to rearrange the charge distribution with uniform density in the region $r < a$.

Problem 4 [16 分]

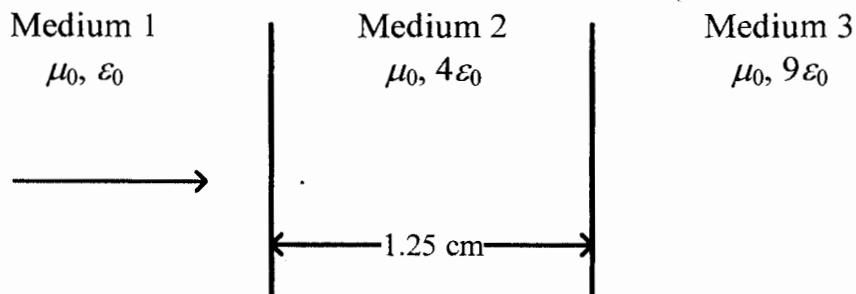
Find the numerical number(s) of k and corresponding magnetic field(s) for the electric field in free space given by

$$\mathbf{E} = E_0 \sin 6x \sin (3 \times 10^9 t - kz) \hat{\mathbf{a}}_y.$$

Note: $c = 1/\sqrt{\mu_0 \epsilon_0} = 3 \times 10^8 \text{ m/s}$

Problem 5 [10 分]

For uniform plane waves of frequency f incident normally onto the interface from medium 1 in the system shown below, find the fraction of the incident power transmitted into medium 3 for 3000 MHz.

**Problem 6** [13 分]

The dimension a of a parallel-plate waveguide with a dielectric of $\epsilon = 4\epsilon_0$ and $\mu = \mu_0$ is 3 cm.

Determine the propagating modes for a wave of frequency 6000 MHz. For each propagating mode, find the cut-off frequency and the guide wavelength.