1- A 100 MHz uniform plane wave is traveling in the y direction in a lossless unbounded medium ($\varepsilon_r = 4$ and $\mu_r = 1$). If the $\overline{E}$ field has only x component and its amplitude is 500 V/m when $t = 0$ and $y = 0$ determine (a) the phase velocity, (b) the phase constant, (c) the $\overline{H}$ field, (d) the wavelength, and (e) the average power flow through a cross-sectional area of 16 cm^2.

2- The $\overline{E}$ field of a plane monochromatic wave traveling in a uniform medium is given as

$$\overline{E} = E_m \cos(\beta z - \omega t)\,\hat{a}_x + E_m \sin(\beta z - \omega t)\,\hat{a}_y$$

where $\beta = \omega\sqrt{\mu\varepsilon}$ and E_m is a constant. Find the corresponding $\overline{H}$ field.

3- A uniform plane wave at a frequency of 50 MHz is transmitted in moist soil ($\varepsilon_r = 16$, $\mu_r = 1$, and $\sigma = 0.02$ S/m). If the amplitude of the tangential component of the $\overline{E}$ field just beneath the surface is 120 V/m. determine (a) the propagation, attenuation, and phase constant, (b) the phase velocity, (c) the wavelength, (d) the intrinsic impedance, (e) the skin depth, and (f) the average power density. If the range is to be taken as a distance at which 90% of the wave amplitude is attenuated, find the range of the signal being transmitted.

4- A uniform plane wave at a frequency of 10 kHz propagates in ferrite ($\varepsilon_r = 9$, $\mu_r = 4$ and $\sigma = 0.01$ S/m). If the amplitude of the tangential component of the $\overline{E}$ field just beneath the surface is 100 V/m, determine (a) the propagation, attenuation, and phase constants. (b)the phase velocity, (c) the wavelength, (d) the intrinsic impedance, (e) the skin depth, and (f) the average power density.

5- The magnetic field intensity in a medium is given by

$$\overline{H} = 0.1\,e^{-77.485y}\cos(2\pi \times 10^9 t - 203.8y)\,\hat{a}_x \text{ A/m}$$

If the medium is characterized by the free space permeability, determine the dielectric constant and the conductivity of the medium. Obtain the associated component of the $\overline{E}$ field. Compute the average power density.

6- A 500 kHz uniform plane wave propagates beneath the earth's surface. The amplitude of the $\overline{E}$ field just beneath the surface is 120 V/m. If the relative permeability, the dielectric constant, and the conductivity of the earth are taken as 1, 16 and 0.02 S/m, respectively, determine (a) the propagation, attenuation, and phase constants, (b) the phase velocity (c) the wavelength, (d) the intrinsic impedance, (e) the skin depth, and (f) the average power density. If the range is considered to be the distance at which 90% of the wave is attenuated, find the range of the signal being transmitted.

7- Find the polarization of the following waves:

(a) $\overline{E} = 100\,e^{-j300x}\,\hat{a}_y + 100\,e^{-j300x}\,\hat{a}_z$ V/m

(b) $\overline{E} = 16\,e^{j\pi/4}\,e^{-j100z}\,\hat{a}_x - 9\,e^{-j\pi/4}\,e^{-j100z}\,\hat{a}_y$ V/m

(c) $\overline{E} = 3\cos(t - 0.5y)\,\hat{a}_x - 4\sin(t - 0.5y)\,\hat{a}_z$ V/m

8- Show that a linearly polarized plane wave $E_o\cos(\omega t - \beta z)\,\hat{a}_x + E_o\cos(\omega t - \beta z)\,\hat{a}_y$ can be expressed as a sum of left and right handed circularly polarized waves of equal amplitudes.

9- A 100 MHz uniform plane wave traveling in a conducting medium ($\varepsilon_r = 2.25$, $\mu_r = 2$ and $\sigma = 2$ S/m) strikes normally on the surface of another conducting medium ($\varepsilon_r = 1$, $\mu_r = 1$ and $\sigma = 20$ S/m). If the amplitude of the incident wave is maximum at the interface and has a value of 10 V/m, determine the average power densities of the incident, reflected and transmitted waves. How far will the transmitted wave travel before its amplitude becomes vanishingly small?

10- A 200 MHz uniform wave is a conducting medium ($\varepsilon_r = 1$, $\mu_r = 1$ and $\sigma = 0.04$ S/m) impinges normally on a conducting medium ($\varepsilon_r = 1$, $\mu_r = 1$ and $\sigma = 4$ S/m). The incident electric field has a maximum value of 50 V/m at the interface. Determine the average power densities of the incident, reflected, and transmitted waves. What is the depth of penetration of the transmitted wave?

11- A uniform plane wave propagating in free space incident on the plane of a dielectric ($\varepsilon_r = 2.25$, $\mu_r = 1$) at an angle θ with respect to the normal. If the interface is at $z = 0$, and the electric field intensity of the incident wave is $\overline{E} = 50\cos(3\times10^6 t - 0.766z + 0.643y)\,\hat{a}_x$ V/m. Determine :

   (a) θ and the phase velocity,
   (b) expressions for the $\overline{E}$ and $\overline{H}$ fields in both media,
   (c) the average power density of the wave in the dielectric medium.

12- If the incident wave in problem 3 strikes at an angle θ on the surface of a perfect conductor at $z = 0$, write expressions for the incident, reflected and total fields. What is the surface current density on the surface of the conductor?