1. (15 Points)

Prove that the four Maxwell's equations are not totally independent.

2. (25 Points)

A uniform plane wave propagating in air has an electric field given by $\bar{E}_i(x,y) = E_0(0.5\hat{x} + 0.5\sqrt{3}\hat{y} - e^{j\pi/2}\hat{z})e^{-j2\sqrt{3}\pi x + j2\pi y}$ V/m, where E_0 is a real constant. The wave is incident on the planar interface (located at $y = 0$) of a dielectric with μ_r=1, ε_r=3.

(a) What are the values of the wave frequency and the angle of incident?

(b) What is the polarization of the incident wave (i.e., linear, circular, elliptical, right-handed or left-handed)?

(c) Write the complex expression for the electric field of the reflected wave

(d) What is the polarization of the reflected wave?

3. (10 Points)

Explain the physical meanings of *Snell's law* and *total reflection*.

4. (15 Points)

An air-filled 5-cm by 2-cm waveguide has $E_z = 20\sin(40\pi x)\sin(50\pi y)e^{-j\beta z}$ V/m at 15 GHz. (a) What mode is being propagated? (b) Find β. (c) Determine the wave impedance of this mode.

5. (15 Points)

The E field radiated by an antenna has only a θ component and is given by $E_\theta = E_o(\pi - \theta)\theta$. Find the beam solid angle, directivity and effective aperture of this antenna.

(背面仍有題目,請繼續作答)

6. (20 Points)

The VSWR on a lossless line is 4. At a certain point on the line, within $\lambda/4$ from the load, the impedance has an angle 45° and has a normalized value greater than 1. The load has a normalized magnitude of 1. Use Smith chart to find how far the point is from the load, and what the actual value of the load is, if Z_0=100Ω. (Note: you may use the Smith chart below, *temporarily*. But don't forget to write down important procedures and results on your answer sheet. Otherwise it will not be graded.)