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Problem 1 (20 Points)

The electric field component of an electromagnetic wave in free space is given by $\bar{E}(y,z,t) = \hat{x}E_0 \cos(ay)\cos(\omega t - bz)$. Note that this is not a uniform plane wave! From Maxwell's equations, (a) find the corresponding magnetic field $\bar{H}(y,z,t)$, (b) find the relationship between the constant a, b, and ω. (c) Assume that this wave may be regarded as a sum of two uniform plane waves, determine the direction of propagation of the two component waves.

Problem 2 (20 Points)

A lossy dielectric has an intrinsic impedance of $200\angle 30°\Omega$ at a particular frequency. If, at that frequency, the plane wave propagating through the dielectric has the magnetic field component $\bar{H} = 10e^{-\alpha x}\cos(\omega t - 0.5x)\bar{a}_y\, A/m$. Find $\bar{E}$ and α. Determine the skin depth and wave polarization.

Problem 3 (20 Points)

Show that the attenuation constants due to conductor and dielectric losses of a low-loss transmission line are given by $\alpha_c \approx R/(2Z_0)$ and $\alpha_d \approx Z_0 G/2$, where R, L, C, and G are the resistance, inductance, capacitance, and conductance per unit length of the line and $Z_0 \equiv \sqrt{L/C}$.

Problem 4 (20 Points)

(a) What are the boundary conditions for the longitudinal fields of TE and TM modes in a uniform metallic waveguide? (b) Prove that a TEM mode can not propagate inside this kind of waveguides.

(背面仍有題目,請繼續作答)

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Problem 5 (20 Points)

An antenna has an input impedance of *75+j25* ohms. (a) Locate this antenna load on Smith chart. (b) Find the admittance directly from Smith chart. (c) An engineer plans to match this antenna to a 50-ohm source by using a transmission-line section *A* and a short-circuited stub *B*. Assume that the characteristic impedance of all the transmission lines is *50* ohms. Find the required lengths of *A* and *B*. (d) What are the VSWR on the matching line *A* and stub *B*? *Remember*: Write down every step of your reasoning and the result on a simplified Smith chart sketched on your answer sheet. Otherwise it can not be graded.