EE 481/581 Microwave Engineering (Fall 2025)

Homework 5

Wednesday, October 8, 2025

1) A 3" × 1.2" brass ($\sigma = 2.5 \times 10^7$ S/m) rectangular waveguide is filled with ABS plastic ($\varepsilon_r = 2$, $\tan\delta = 0.005$). In order, find the cutoff frequency of the: a) lowest four TE modes and b) lowest two TM modes. Neglect loss tangent.
2) For a 3" × 1.2" brass ($\sigma = 2.5 \times 10^7$ S/m) rectangular waveguide filled with ABS plastic ($\varepsilon_r = 2$, $\tan\delta = 0.005$) operating at 2 GHz in the TE_{10} mode, find: a) k, b) k_c, c) β, d) λ_g, e) v_p, and f) Z_{TE}. Neglect loss tangent.
3) For a 3" × 1.2" brass ($\sigma = 2.5 \times 10^7$ S/m) rectangular waveguide filled with ABS plastic ($\varepsilon_r = 2$, $\tan\delta = 0.005$), find the dielectric, conductor, and overall attenuation constants (Np/m and dB/m) for the TE_{10} mode at 2 GHz.
4) Design a 75 Ω stripline using a ground plane separation of 1.5 mm with an ABS dielectric ($\varepsilon_r = 2$, $\tan\delta = 0.005$). Assume the ground planes and land are made with 2 oz. copper (ε_0, μ_0, $\sigma = 5.7 \times 10^8$ S/m). Draw a fully-labeled sketch of the design. At 2 GHz, find: a) the phase velocity, b) guided wavelength, c) phase constant, d) dielectric attenuation constant (Np/m & dB/m), e) conductor attenuation constant (Np/m & dB/m), and f) overall attenuation constant (Np/m & dB/m).
5) Design a 75 Ω microstrip TL using a 2 oz. copper clad (ε_0, μ_0, $\sigma = 5.7 \times 10^8$ S/m) ABS substrate ($\varepsilon_r = 2$, $\tan\delta = 0.005$) that is 0.75 mm thick for use at 2 GHz. Draw a full-labeled sketch of your design. Compute: a) the effective relative permittivity, b) phase velocity, c) phase constant, d) dielectric attenuation constant (Np/m & dB/m), e) conductor attenuation constant (Np/m & dB/m), and f) overall attenuation constant (Np/m & dB/m).
6) **EE 581 only:** For a microstrip TL made using a 2 oz. copper clad (ε_0, μ_0, $\sigma = 5.7 \times 10^8$ S/m) ABS substrate ($\varepsilon_r = 2$, $\tan\delta = 0.005$) that is 0.75 mm thick for use at 2 GHz, calculate the threshold frequencies. Is the operating frequency of 2 GHz lower than these threshold frequencies?

Due Wednesday, October 15, 2025.