THE UNIVERSITY OF BRITISH COLUMBIA
Department of Electrical and Computer Engineering

ELEC 311 – Electromagnetic Fields & Waves
2025 W1

Drill Problems for
Chapter 12 – Plane Wave Reflection and Dispersion

The purpose of the six drill problems from Chapter 12 is to help you master fundamental techniques used to analyze plane wave reflection and dispersion.

Answers should be short and to the point. It is especially critical to use sketches to explain your solution here. Clarity, conciseness, and presentation all count. Solution = Intuition (strategy) + Execution (calculation). Make both explicit.

The numerical answers below are from the text. Do you agree with them?

D12.1 A 1-MHz uniform plane wave with amplitude 1 V/m is normally incident onto a fresh water lake ($\epsilon_r'=78$, $\epsilon_r''=0$, $\mu_r = 1$). Determine the fraction of the incident power that is (*a*) reflected and (*b*) transmitted. (*c*) Determine the amplitude of the electric field that is transmitted into the lake.

Answers: (*a*) 0.63; (*b*) 0.37; (*c*) 0.20 V/m

D12.2 What value of *s* results when $\Gamma = \pm 1/2$

Answer: 3

D12.3 A uniform plane wave in air is normally incident on a dielectric slab of thickness $\lambda_2/4$ and intrinsic impedance $\eta_2 = 260\ \Omega$. Determine the magnitude and phase of the reflection coefficient.

Answers: 0.356; 180°

D12.4 Consider a 50-MHz uniform plane wave having electric field amplitude 10 V/m. The medium is lossless, having $\epsilon_r = \epsilon_r' = 9.0$ and $\mu_r = 1.0$. The wave propagates in the x, y plane at a 30° angle to the x axis and is linearly polarized along z. Calculate λ_x, λ_y, v_{px}, and v_{py}.

Answers: 2.2 m; 3.9 m; 1.1×10^8 m/s; 2.0×10^8 m/s

D12.5 Light is incident from air to glass (refractive index = 1.45) at Brewster's angle. Determine the incident and transmitted angles. Calculate the reflection coefficient for s-polarized light.

Answers: 55.4°, 34.6°, -0.355

D12.6 An optical fiber link is known to have dispersion $\beta_2 = 20$ ps^2/km. A Gaussian light pulse at the input of the fiber is of initial width $T = 20$ ps. Determine the width of the pulse at the fiber output if the fiber is 15 km long.

Answers: 25 ps