Problem Set 2023-1
Physics 265
First Semester, AY 2023– 2024
Release Date: 22 September 2023
Due: 6 January 2024
Ten points per number

1. Derive explicitly (step-by-step) the wave equations for the electric field vector **E** (Equation5, Section 1.2, Born & Wolf) and the magnetic field vector **H** (Equation 6) from Equations 1 to 11 in Section 1.1.

2. Derive the respective scalar wave equations for the Cartesian components (E_x, E_y and E_z) of **E** in a medium where the dielectric constant is given by $\varepsilon(z)$ and the magnetic permeability $\mu \sim 1$.

3. Derive the respective scalar wave equations for the Cartesian components (E_x, E_y and E_z) of **E** in a medium with $\varepsilon(x, y)$ and $\mu \sim 1$.

4. Derive the respective scalar wave equations for the Cartesian components (E_x, E_y and E_z) of **E** in a medium with $n(x, y) = C_x x + C_y y$ where: $\mu \sim 1$, and C_x and C_y are constants.

5. Show the corresponding form of Equations 5 and 6 in a medium with a nonzero but constant charge density ρ and electric current **j**.

Reference

M Born and E Wolf, Principles of Optics (60th Anniversary of First Edition), Cambridge University Press, UK (2019)

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