

PHYSICS 386 EXAM II

04/04/01

Duration - 250PM to 410PM. This is an open book but closed notes exam. You are allowed to bring one handwritten cheatsheet. Total credit is 20 points. You must write out all the steps and supply explicit reasoning. There are no extended calculations in this exam, so beware if you find yourself doing any. All sub-questions carry EQUAL credit regardless of their difficulty, so consider solving the simple ones first.

1(a). Write down the fields for a monochromatic plane wave having electric field amplitude E_0 and frequency ω that is travelling along the line from (0,0,0) to (1,1,0), with polarization in the yz plane.

1(b). Find the E and B amplitudes for a plane light wave with intensity I . This light is incident on a horizontal reflective plate at an angle θ with respect to the vertical. Compute the pressure on the plate.

1(c). The dispersion relation for a medium is given by $\omega^2 = a^2 + c^2k^2$. What is the cutoff frequency ω_c ? For frequencies below the cutoff frequency, calculate the skin depth (or rather, the penetration depth). Also calculate the phase velocity and group velocity as a function of the wavenumber k . Comment on the high frequency limit, and also on the limiting case of small a .

1(d). Airplanes are detected by Radar. Why not submarines, too?

1(e). Hollow waveguides are often used to transport the microwave radiation inside the conventional (kitchen) microwave ovens. Use common sense and your knowledge of waveguide transmission properties to estimate the operating frequency of these microwave ovens.

2 (a). Write down the electric and magnetic fields for a monochromatic **cosine** plane wave in vacuum with amplitude E_0 , frequency ω , propagation along the z -direction, and polarization along the x -direction.

(b). Now do the same for a similar **sine** wave with polarization along the y -direction.

(c). What are the intensities of these waves?

(d). Now write down the fields for the combined (superposed) wave, i.e., add the fields.

(e). Describe/sketch the electric field **vector** at the origin as a function of time.

(f). What is the intensity of the superposed wave?

(g). What would the intensity of the superposed wave be if the two waves were polarized along the same direction (say x)?

(h). What would the intensity of the superposed wave be if the two waves had identical phase and polarization? (say both were **cosine** waves polarized along x)

=====