

### ENEE 381 Problem Set #3

9/31/04- due 10/12/04

**THE FIRST EXAMINATION IS ON NOVEMBER 2, 2004**

**Questions like (1) - (5) could be on the first examination.**

(1) The electric vector of a wave propagating in the  $z$ -direction varies according to

$$E_y = E_0 \cos(\pi x/2a) e^{j(\omega t - kz)},$$

where  $E_0=1\text{V/m}$ ,  $a=1\text{m}$ . The frequency of the wave is  $\nu=100\text{MHz}$ . How much energy flow per second passes through the region  $-1 \leq x \leq 1$  (m),  $-1 \leq y \leq 1$  (m). Hint: this is not a uniform plane wave.

(2) A point source transmitter at  $(0,0,0)$  emits a total power of  $5\text{W}$ . What is the value of the Poynting vector at the point  $(10,10,10)$ ? What is the total power flux into the surface bounded by the two concentric spheres  $R=5$ , and  $R=7$ ?

(3) A point source transmitter at  $(0,0,0)$  emits a total power of  $5\text{W}$ . What is the total power flux through the surface of a cube centered at  $(0,0,0)$  with sides of length  $1\text{m}$ ?

(4) A plane wave with magnetic field  $H_y = 1\text{A/m}$  and electric field  $E_x$  traveling in the  $z$ -direction through a vacuum strikes an infinite planar copper medium. What is the value of the electric field and magnetic field at the surface of the sheet? What is the value of the surface resistance  $R_s$ ? How much energy is dissipated per unit area of the copper? For copper  $\sigma=5.8 \times 10^7 \text{ S/m}$ .

(5) How are the answers to question (4) modified if the wave is traveling through a dielectric with  $\epsilon_r=30$  when it strikes the copper

(6) RW&vD 4.5a

(7) RW&vD 4.5b

(8) RW&vD 3.17a