Test #1

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Optoelectronics
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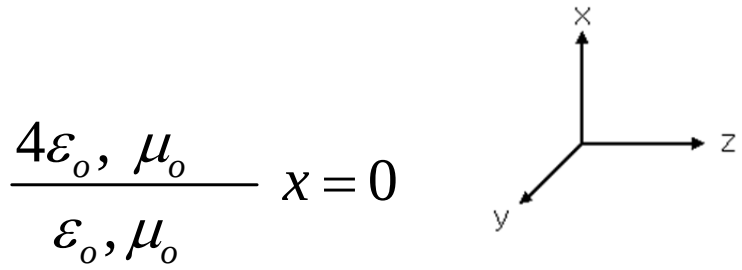
Prob. 1(30)

A plane EM wave is propagating in a medium having $\varepsilon=4\varepsilon_0$, $\mu=\mu_0$ and its H-field is given as $\bar{H}=\bar{y}\exp\left[j(x-z)\right]$.

(a)(10) What is the E-field of this EM wave? Express your answer in terms of parameters given in the problem.

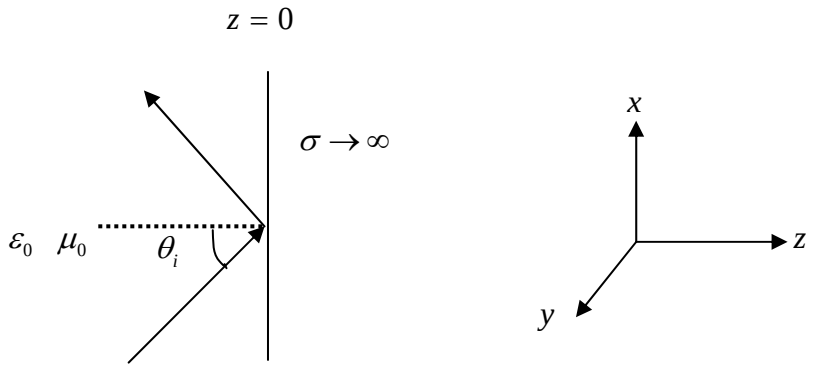
(b)(10) This wave is now incident on a dielectric/vacuum interface at x=0 as shown below. Assuming the power of the incident EM wave is 1mW, what is the amount of the transmitted power into the vacuum?

(c)(10) For the case described in (b), determine the wave vector of the transmitted EM wave in the vacuum.



Prob. 2(25)

A plane EM wave is obliquely incident from on a perfect conductor as shown below and has its E-field given as $\overline{E_{in}} = (\overline{x} - \overline{z})E_0 \exp(-jx - jz)$.



(a)(5) What type of polarization (perpendicular or parallel) does the incident EM wave has?

(b)(10) Determine the expression for the reflected electric field?

(c)(10) Determine the expression for the surface charge density at z=0?

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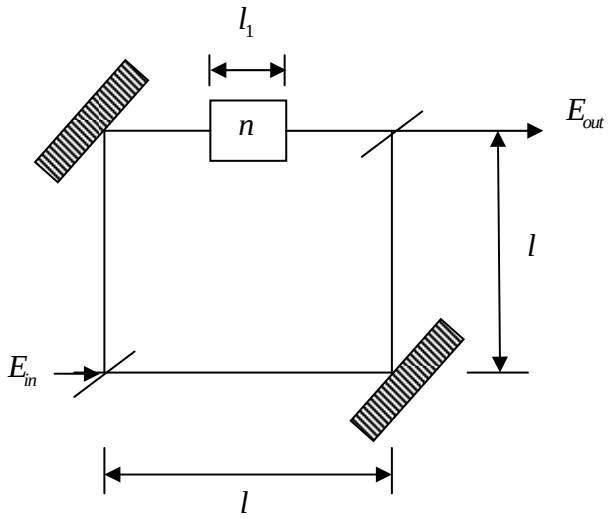
Prob. 3(20)

Consider an interferometer made up of two beam splitters and two mirrors in a vacuum. A dielectric material having reflective index n and length l_1 is placed in one arm as shown below. Assume there is no reflection between this material and the vacuum. The beam splitter has $r = 1/\sqrt{2}$, $t = j/\sqrt{2}$ and both mirrors have $r = -1$.



(a)(10) Determine the expression for I_{out} / I_{in} , the intensity ratio for input and output light.

(b)(10) Assuming λ= 1μm, l_1 = 1mm, l = 1cm, determine the smallest numerical value for n which gives the minimum output intensity.

Prob. 4(25)

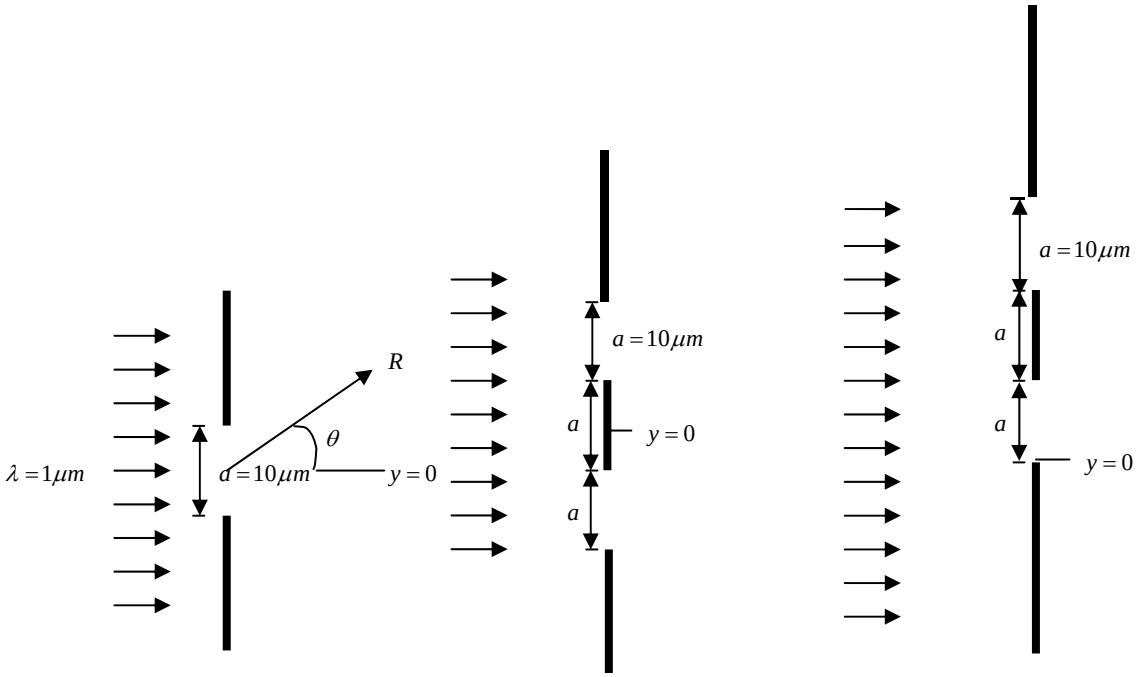


Fig. 4−1 *Fig.* 4−2 *Fig.* 4−3

(a)(10) For the opening shown in Fig. 4-1, what is the smallest angle θ, for which the far-field diffracted intensity is zero? Give a numerical value in degrees.

(b)(10) For the opening shown in Fig. 4-2, what is the smallest angle θ, for which the far-field diffracted intensity is zero? Give a numerical value in degrees.

(c)(5) For the opening shown in Fig. 4-3, what is the smallest angle θ, for which the far-field diffracted intensity is the largest? Give a numerical value in degrees.