



**San José State**  
UNIVERSITY

Name (Print): \_\_\_\_\_

Physics 208  
Introduction to Electro-Optics

Practice Midterm 1  
Fall 2007

Date of Exam:	<i>Fall 2007</i>
Duration of Exam:	<i>75 minutes</i>
Number of Exam Pages:	<i>2</i>
(including this cover sheet)	
Exam Type:	<i>Open book</i>

1. Consider a uniaxial crystal with an optical axis at  $\theta_o$  from the z-axis in the x-z plane.
  - (a) Write an expression for  $n_x$  in this crystal in terms of  $n_y$ ,  $n_z$  and  $\theta_o$ ?
  - (b) What would be the possible range for the index of refraction seen by a wave propagating along the optical axis? What polarization direction is required for the max and min values?
  - (c) What would be the possible range for the index of refraction seen by a wave propagating in a direction orthogonal to the optical axis in the x-z plane? What polarization direction is required for the max and min values?
  
2. A high reflective dielectric stack mirror designed for operation at 1064 nm at normal incidence has 20 alternating  $\lambda/4$  layers of high index ( $n_h = 2.8$ ) and low index ( $n_l = 1.4$ ) material (10 layers of each material). This optic is used in an experiment that employs frequency doubling, such that there is also a wave at 532 nm incident on the optic. You may find the fourier series for a square wave with wavelength  $2L$  with  $f(0 < x < l) = 1$  and  $f(l < x < 2) = -1$  useful it is  $f(x) = \frac{4}{\pi} \sum_{n=1,3,5,\dots}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi x}{L}\right)$ 
  - (a) What are the matrix elements for the unit cell of this structure as seen by the 532 nm wave?
  - (b) Sketch  $\omega$  vs.  $K$  and identify the portions of the graph relevant to the 1064 nm beam and the 532 nm beam, and describe in words what this graph says about the behavior of the optic for each of these beams.
  - (c) What is the reflectivity of the structure at 532 nm?