1. a. Consider Young’s double slit experiment. Calculate the location of maxima and minima in the far-field. 
b. Now consider the extension to a periodic array of infinitely narrow slits (Fig. 1). Assume that \( d >> \lambda \) where \( d \) is the period of the slits and \( \lambda \) is the wavelength of the illumination. Calculate the intensity pattern in the far-field and the location of its maxima.

![Figure 1](image1.png)

2. Consider two beams propagating in orthogonal directions from air into a rectangular medium of index 2.2. Give an expression that describes the intensity of the interference pattern inside the medium in the following cases:
   a. Normal incidence, orthogonal faces, s-polarized (⊥)
   b. Normal incidence, orthogonal faces, p-polarized (||)
   c. ± 45° incidence, same face, s-polarized
   d. ± 45° incidence, same face, p-polarized

![Figure 2](image2.png)

3. Laser sources of different wavelength are used in a Michelson interferometer. Explain how you would use this feature to reduce the ambiguity in distance measurements.

4. Consider the resonator depicted in Figure 3, composed of two planar mirrors of reflectivity \( r \) separated a distance \( L \) in air, and a transparent plate of thickness \( d \) and refractive index \( n \). Assume that the reflections from the plate can be neglected.
   a. What is the spacing among the resonance frequencies of the resonator?
   b. Assume \( r < 1 \). How would you measure \( L \) and \( r \) without disassembling the resonator? Justify.

![Figure 3](image3.png)