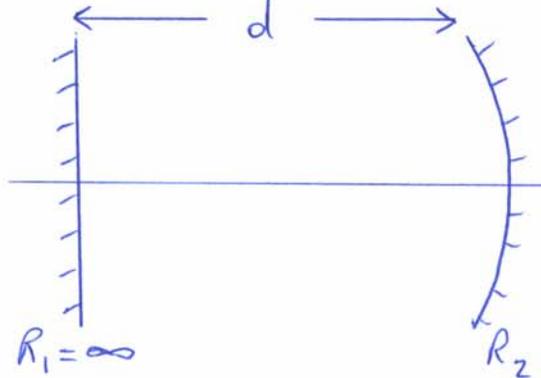
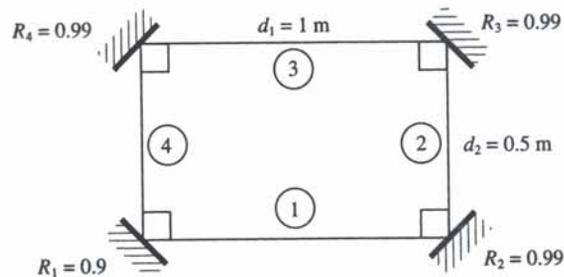


### Assignment 4

1. The following questions refer to the optical cavity shown below with  $d = 0.75 R_2$ ,  $(\Gamma_1)^2 = 0.99$  and  $(\Gamma_2)^2 = 0.97$ .

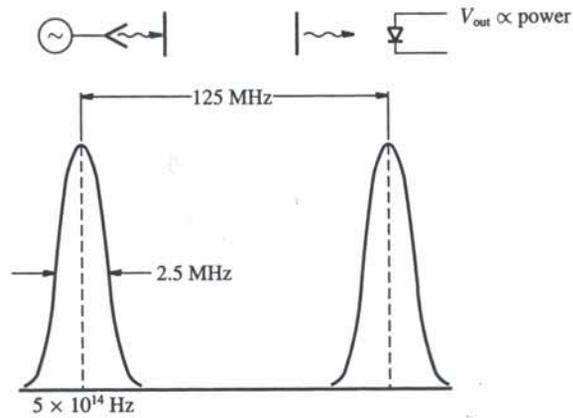


- a) Find an expression for the resonant frequencies of the  $TEM_{00}$  modes of the cavity.
  - b) If the radius of curvature is 2 m and the wavelength region of interest is 500 nm, compute the following quantities:
    - i. Free spectral range in MHz and in nm
    - ii. Cavity Q
    - iii. Photon lifetime in nsec
    - iv. Finesse
2. Consider the optical cavity shown below.



- a) If the optical paths 1 through 4 are lossless, what is the photon lifetime of this cavity?
- b) What is the cavity Q assuming that the wavelength of interest is 500 nm?
- c) Suppose path 1 has a transmission coefficient of 0.85 rather than 1 as in problem 2b. What is the new photon lifetime?

3. A laser cavity was excited by a 0.1 ns pulse from an external source at 558 nm. When the medium was not pumped, the detected transmission was as shown below.



- How long is the cavity?
  - What is the photon lifetime?
  - What is the cavity Q?
  - What is the cavity finesse?
4. Consider a  $TEM_{00}$  mode incident on an aperture of radius  $a$ . Show that the fraction of power transmitted is

$$T = 1 - \exp\left[-2\left(\frac{a}{w}\right)^2\right]$$