

[Answer in Finnish, Swedish or English]

1. Explain **briefly** the following concepts:

- a) Free spectral range
- b) Mie scattering
- c) Free electron laser
- d) Optical coherence tomography (OCT)

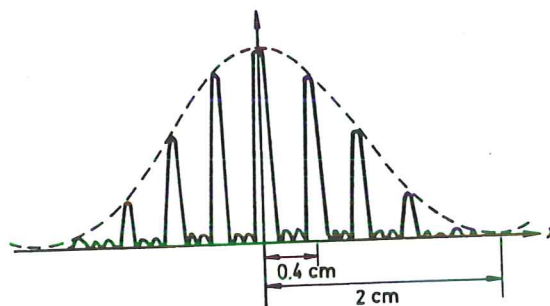
2. An optical cavity formed by two mirrors facing each other is illuminated in the direction normal to the mirror surfaces with completely **incoherent** light of intensity $I_0 = 3 \text{ W/cm}^2$. Calculate the intensity inside the cavity in the space between the two mirrors, and the transmitted and reflected intensities. The reflectivity of the mirrors is $R_1 = R_2 = 0.95$ and their separation is $d = 10 \text{ cm}$.

3. A quarter-wave plate is placed in between a crossed polarizer and an analyzer in such a way that the angle between the polarizer transmission axis and the quarter-wave plate fast axis is θ . How does the emergent light intensity vary as a function of θ ?

4. At a distance of 20 meters N identical, parallel slits produce a diffraction pattern with a measured intensity profile that is given in Fig.1.

- a) Deduce from the measurement result the number, width, and spacing of the slits (N , a , and b , respectively) when the wavelength of the light is 600 nm.
- b) Give an expression for the envelope function of the main maxima (dashed line) and explain its physical origin.

Fig. 1



5. Describe the various ways population inversion can be created in lasers.