Photonics in Semiconductors, Spring 2017

Exercise 5, 23.2.2017

1. Bragg diffraction

Suppose that parallel grooves are etched on the surface of a semiconductor to act as a reflection grating and that the periodicity (separation) of the grooves is 1 micron. If light of wavelength 1.3 µm is incident at an angle 89° to the normal, find the diffracted beams.

2. Diffraction grating for WDM

Consider a transmission diffraction grating. Suppose that we wish to use this grating to separate out different wavelengths of information in wavelength division multiplexing (WDM) signal at 1550 nm. Suppose that the diffraction grating has a periodicity of 2 µm. The angle of incidence is 0° with respect to the normal to the diffraction grating. What is the angular separation of the two wavelength component s at 1.550 µm and 1.540 µm? How would you increase this separation?

3. Diffraction limit

a) Describe the Rayleigh criterion for microscope's lateral resolution.
b) Calculate the size of the smallest resolvable feature for 50x objective at wavelength 250 nm, 350 nm, and 750 nm. What would you expect to see from a Blue-ray disc?

4. Fabry-Perot optical cavity

Consider an optical cavity formed between two identical mirrors. The cavity length is 50 cm and the refractive index of the medium is 1. The mirror reflectances are 0.97 each. What is the nearest mode number that corresponds to a radiation of wavelength 632.8 nm? What is the actual wavelength of the mode closest to 632.8 nm? What is the mode separation in frequency and wavelength? What are the Finesse F and Q-factors for the cavity.