Optics, Spring 2024

Submit your answers as a PDF file via Google Classroom before deadline (07.03.2024 at 10.00).
If problems, contact the course assistant joonas.mustonen@helsinki.fi.

Exercise 6 (Max points 6, 2 from each task)

1. Lens systems (Hecht 5th ed., Ch. 5.2)

a) Show that the magnification of a two-lens system is:

$$M_T = \frac{f_1 s_{i2}}{d(s_{o1} - f_1) - s_{01} f_1}.$$

b) A plane wave (object at infinity) is incident at a system of two biconvex lenses of focal lengths f_1 and f_2 separated by a distance of $f_1 + f_2$. How is the waveform altered by the system? Draw a ray diagram.

2. Apertures (Ch. 5.7)

a) A simple digital camera is composed of a thin lens, an aperture and a CCD sensor. A circular aperture of diameter 5 mm is placed in front of a biconvex lens (f = 20 mm) at a distance of 5 mm. Calculate the location and size of entrance and exit pupils. If an object is imaged to a 10 mm wide CCD sensor, describe the location and size of aperture and field stops.
b) A 50 mm camera lens with diameter of 5 cm is marked: "50 mm, f/1.9 - f/16". Calculate the range for the numerical aperture (NA).

3. Lens systems continued (Hecht 5th ed., Ch 5.2)

a) Two biconvex (positive) lenses L_1 and L_2 of focal lengths 10 cm and 20 cm are separated by a distance of 80 cm (See the figure). Calculate the size, location and orientation of the image corresponding to a 5-cm tall object located 15 cm from L_1. Draw a ray diagram.