PH481 Homework 9

Due: Friday, 17th of March 2023

8.38* Draw a quartz Wollaston prism, showing all pertinent rays and their polarization states.

8.55* Take two ideal Polaroids (the first with its axis vertical and the second, horizontal) and insert between them a stack of 10 half-wave plates, the first with its fast axis rotated $\pi/40$ rad from the vertical, and each subsequent one rotated $\pi/40$ rad from the previous one. Determine the ratio of the emerging to incident irradiance, showing your logic clearly.

8.71* The specific rotatory power for sucrose dissolved in water at 20°C ($\lambda_0 = 589.3$ nm) is +66.45° per 10 cm of path traversed through a solution containing 1 g of active substance (sugar) per cm^3 of solution. A vertical $\mathcal{P}$-state (sodium light) enters at one end of a 1.0-m tube containing 1000 cm^3 of solution, of which 10 g is sucrose. At what orientation will the $\mathcal{P}$-state emerge?

13.45 A diffraction grating having a mere 50 grooves per cm is the object in the optical computer shown in Fig. 13.36. If it is coherently illuminated by plane waves of green light (543.5 nm) from a He-Ne laser and each lens has a 100-cm focal length, what will be the spacing of the diffraction spots on the transform plane?

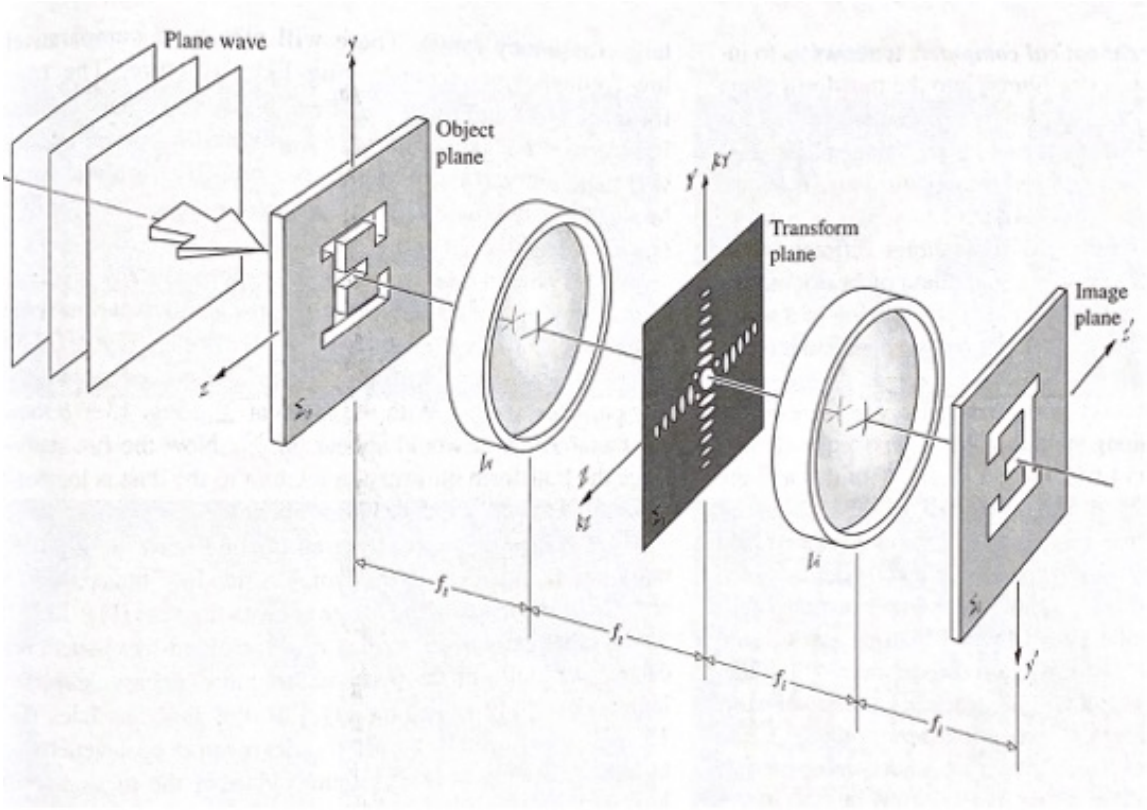

Fig. 13.36 Optical Computer

13.46* Imagine that you have a cosine grating (i.e., a transparency whose *amplitude* transmission profile is cosinusoidal varying between 0 and 1) with a spatial period of 0.01 mm. The grating is illuminated by quasimonochromatic plane waves of $\lambda = 500$ nm, and the setup is the same as that of Fig. 13.36, where the focal lengths of the transform and imaging lenses are 2.0 m and 1.0 m, respectively.

a) Discuss the resulting pattern and design a filter that will pass *only* the first-order terms. Describe it in detail.

b) What will the image look like on $\sum_i$ with that filter in place?

c) How might you pass only the *DC* term, and what would the image look like then?