PHYS 1312 EOC - Homework Assignment No. 3

Chapters S3 and Extra Problems, Sept. 21, 2022

Due: Sept. 30, 2022

Problem 1. A Young's double-slit experiment is performed with 589-nm light and a distance of 2.00 m between the slits and the screen. The tenth interference minimum is observed 7.26 mm from the central maximum. Determine the spacing of the slits. (answer: 1.54 mm).

Problem 2. Two narrow, parallel slits separated by 0.850 mm are illuminated by 600-nm light, and the viewing screen is 2.8 m away from the slits. (a) What is the phase difference between the two interfering waves on the screen at a point 2.50 mm from the central bright fringe? (b) What is the ratio of the intensity at this point to the intensity at the center of a bright fringe? (answers: (a) 7.95 rad, (b) 0.453)

Problem 3. The Michelson interferometer can be used to measure the index of refraction of a gas by placing an evacuated transparent tube in the light path along one arm of the device. Fringe shifts occur as the gas is slowly added to the tube. Assume 600-nm light is used, the tube is 5.00 cm long, and 160 bright fringes pass on the screen as the pressure of the gas in the tube increases to atmospheric pressure. What is the index of fraction of the gas? (answer: 1.001)

Problem 4. A screen is placed 50.0 cm from a single slit, which is illuminated with light of wavelength 690 nm. If the distance between the first and third minima in the diffraction pattern is 3.00 mm, what is the width of the slit? (answer: 2.30×10^{-4} m)

Problem 5. Light from an argon laser strikes a diffraction grating that has 5310 grooves per centimeter. The central and first-order principal maxima are separated by 0.488 m on a wall 1.72 m from the grating. Determine the wavelength of the laser light. The angle of the light is normal to the grating surface. (answer: 514 nm)

Extra problem (not required). A student holds a laser that emits light of wavelength 632.8 nm. The laser beam passes through a pair of slits separated by 0.300 mm, in a glass plate attached to the front of the laser. The beam then falls perpendicularly on a screen, creating a typical interference pattern. The student then begins to walk directly toward the screen at a constant speed of 3.00 m/s. The central maximum on the screen is stationary. Find the speed of the 50th-order maxima on the screen. (answer: 0.318 m/s)

Also do, chapter S3: P18, P19, P21, and P25.