PHYS 3800 "Optics"

Homework #5 (Polarization & Diffraction)

1) Identify the state of polarization corresponding to the Jones vector $\begin{bmatrix} 2 \\ 3\, e^{i\cdot\pi/3} \end{bmatrix}$ and

(a) write it in the standard normalized form for linear, circular, or elliptical polarized light

(b) Let this light be transmitted through an element that rotates linearly polarized light by + 30°. Find the new, normalized form and describe the result.

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2) Show that elliptical polarization can be regarded as combination of circular and linear polarizations.

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3) A collimated beam of mercury green light at 546.1 nm is normally incident on a slit 0.015 cm wide. A lens of a focal length 60 cm is place behind the slit. A diffraction pattern is formed on a screen placed in the focal plane of the lens. Determine the distance between

(a) the central maximum and the first minimum and

(b) the first and second minimum.

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4) The width of a rectangular slit is measured in the laboratory by means of its diffraction pattern at a distance of 2 m from the slit. When illuminated normally with a parallel beam of laser light (632.8nm), the distance between third minima on either side of the principal maximum is measured. An average of several tries gives 5.625 cm.

(a) Assuming Fraunhofer diffraction, what is the slit width?

(b) Is the assumption of far-filed diffraction justified in this case? What is the ratio L/L_{min}?

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5) Consider the far-field diffraction pattern of a single slit of width 2.125 μm, when illuminated normally by a collimated beam of 550nm. Determine

(a) the angular radius of this central peak and

(b) the ratio I/Io at points making an angle of $\Theta = 5°, 10°, 15°$ and 22.5° with the axis.

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6) Assume the range of pupil variation during adaptation of a normal eye is from 2 mm to 7 mm. What is the corresponding range of distances over which it can detect the separation of objects 1 inch apart?

Points: (1) = 20; (2) = 10; (3) = 20; (4) = 20; (5) = 20; (6) = 20;
Grading: A: 86-100, B: 71-85, C: 50-70