Assignment # 10

Optics IV

Chapter 36: Diffraction

Important Concepts and Formulas

Condition for dark fringe: $\sin\theta = \frac{m\lambda}{a}$ (m = ±1, ±2, ...)

Bragg's condition for constructive interference from an array $2d\sin\theta = m\lambda$ (m = 1,2,3,4,.....)

Question 1: (10 Points)

The laser used to read a DVD has a wavelength of 650 nm, while the laser used to read a Blu-ray disc has a shorter 405-nm wavelength. How does this make it possible for a Blu-ray disc to hold more information than a DVD?

Question 2: (20 Points)

(a) You pass 633-nm laser light through a narrow slit and observe the diffraction pattern on a screen 6.0m away. The distance on the screen between the centers of the first minima on either side of the central bright fringe is 32 mm . How wide is the slit?
(b) After solving part (a) fraw its proper labeled diagram and show the bright and dark spots accordingly.

Question 3: (30 Points)

Light waves, for which the electric field is given by;

$$E_y(x,t) = E_{max}\sin[(1.20 \times 10^7\ m^{-1})x - \omega t]$$

pass through a slit and produce the first dark bands at ±28.6° from the center of the diffraction pattern.

(a) What is the frequency of this light?
(b) How wide is the slit?
(c) At which angles will other dark bands occur?

Question 4: (40 Points)

Monochromatic light of wavelength λ = 620 nm from a distant source passes through a slit 0.450 mm wide. The diffraction pattern is observed on a screen 3.00 m from the slit. In terms of the intensity I_o at the peak of the central maximum, what is the intensity of the light at the screen the following distances from the center of the central maximum:

(a) 1.00 mm
(b) 3.00 mm
(c) 5.00 mm?