In His Name

# Physics Extra Sheet
## Ch 13 Diffraction

SY: 2022/2023

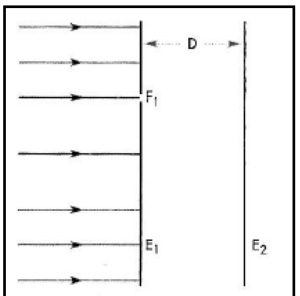
Al-Mahdi Schools – Shahed

**Name: ……** **Grade (section): G 12 LS** **Date: / /**

## Arbitrary questions:

1. We want to observe on the screen the broadest possible pattern. Suggest 3 methods to achieve this.
2. Microwaves of wavelength 3 cm falls normally on a slit of width 5 cm. Determine the angles of diffraction of the centers of the first dark fringes.

## Exercise 1: Determination of the wavelength of a laser light (2001-I)



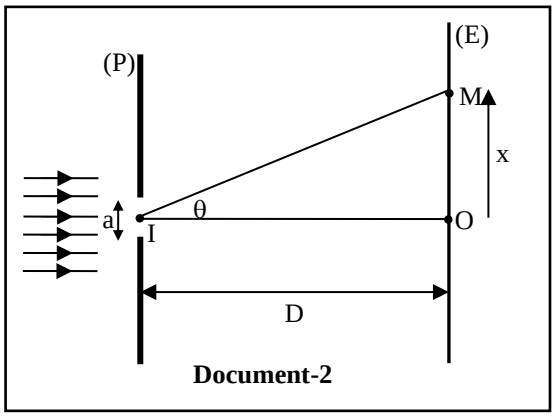
**Document-1**

The monochromatic light emitted by a laser source, of wavelength $\lambda$, illuminates, under normal incidence, a very narrow slit $F_1$ of width $a_1 = 0.1$mm cut in an opaque screen ($E_1$). The phenomenon of diffraction is observed on a screen ($E_2$) parallel to ($E_1$), found at a distance D = 4 m from it (Document-1).

The central bright fringe on ($E_2$) has a linear width = 5cm.

1. Describe the diffraction pattern observed on ($E_2$).
2. The phenomenon of diffraction shows evidence of a certain aspect of light. What is it?
3. Calculate the angular width of the central bright fringe.
4. Calculate the value of λ.

## Exercise 2: Diffraction ~~and interference~~ of light (GS-2012-II modified)



**Document-2**

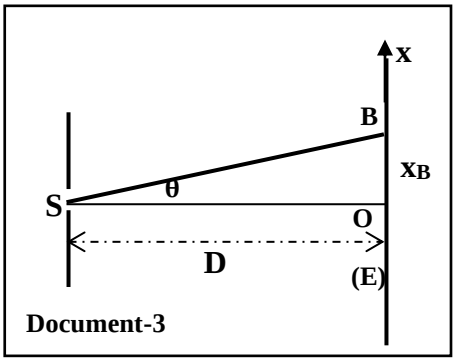
A laser source emits a monochromatic cylindrical beam of light of wavelength λ = 640 nm in air.
This beam falls normally on a vertical screen (P) having a horizontal slit $F_1$ of width a. The phenomenon of diffraction is observed on a screen (E) parallel to (P) and situated at a distance D = 4 m from (P).

Consider on (E) a point M so that M coincides with the second dark fringe counted from O, the center of the central bright fringe. OIM = θ (θ is very small) is the angle of diffraction corresponding to the second dark fringe (Document-2).

1. What does a monochromatic light mean?
2. Write the expression of θ in terms of a and λ.
3. Determine the expression of OM = x in terms of a, D and λ.
4. Determine the value of a if OM = 1.28 cm.
5. We replace the slit $F_1$ by another slit $F_1'$ of width 100 times larger than that of $F_1$. What do we observe on the screen (E)?
6. The whole set up of Document 2 is immersed in water of index of refraction n.
   **6.1.** The value of the wavelength $\lambda$ of a luminous radiation changes when it passes from a transparent medium into another. Why?
   **6.2.** Deduce whether the pattern becomes wider or narrower.

**Exercise 3: (From Everest-modified)**

A white light falls normally on a slit of width $a = 0.3\ mm$. The slit is at a distance $D = 1\ m$ from a vertical screen. A point B belongs to the obtained diffraction pattern and has a position $x_B = 6\ mm$ relative to the origin O of the x-axis. (SO) is horizontal (Document-3). The angular width and the size of the central bright fringe are $\alpha$ and $L$ respectively. The range of wavelength of light in vacuum is: $\lambda$: $(400\ nm \rightarrow 800\ nm)$. $(\lambda_{violet} \rightarrow \lambda_{red})$.



**Document-3**

*The angles of diffraction of the fringes in the following questions are small.*

1. The color at the point O is white. Justify.
2. N is a point on the screen which has an abscissa x ( x = ON). N is the center of a dark fringe of order n of the red color ($\lambda = 800\ nm$) . Also, N is the center of a dark fringe of order (n +1) of a color of wavelength $\lambda' = 640\ nm$. Determine n and **x**.
3. Determine the wavelengths of the missing radiations (dark fringes) at the point B.
4. For $\lambda = 600\ nm$,
   - **4.1.** determine the order of the dark fringe of point B.
   - **4.2.** Deduce the distance $x_F$ of first bright fringes.
   - **4.3.** The screen (E) is approached from the plane of the slit so that the point B becomes the center of **$4^{th}$ dark** fringe on the positive side of O.
     - **4.3.1.** Specify whether the pattern of fringes become wider (broader) or narrower.
     - **4.3.2.** Determine the distance displaced by the screen.
   - **4.4.** The slit is replaced by another one of width a′ so that the distance separating the centers of the $2^{nd}$ dark fringe and the $4^{th}$ dark fringe on opposite sides of the central bright fringe is 10 mm. Determine a′.