Tutorial-7 (Coherence and Wavefront division interferometers)

1. Consider a two-slit Young's interference experiment with λ= 500 nm where fringes are generated on a screen N placed 1 meter apart from the slits.

(a) The fringe width decreases 1.2 times when the slit width is increased by 0.2 mm. Calculate the original fringe width.

(b) When a thin film of a transparent material is put behind one of the slits, the zero order fringe moves to the position previously occupied by the 4^{th} order bright fringe. The index of refraction of the film is n= 1.2. Calculate the thickness of the film.

2. In a Lloyd's mirror experiment (see Figure 1), a bright wave emitted directly by the source S interferes with the wave reflected by the mirror M. As a result, an interference fringe pattern is formed on the screen N. The source and the screen is separated by a distance l = 1 m. At a certain position of the source the fringe width on the screen is equals to Δx = 0.25 mm. After the source is moved away from the plane of mirror by Δh= 0.60 mm, the fringe width decreases by a factor η= 1.5. Find the wavelength of the light

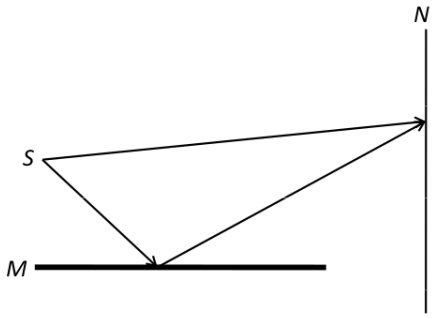

Figure 1: Lloyd's Mirror

3. A plane light wave falls on a Fresnel mirrors with an angle $\alpha = 2.0'$ between them. Determine the wavelength of light if the fringe-width on the screen is 0.55 mm.

4. A lens of diameter 5 cm and focal length 25 cm is cut along its diameter into two identical halves. A layer of the lens a= 1 mm in thickness is removed and the two remaining halves of the lens are cemented together to form a composite lens. A slit is placed in the focal plane emitting monochromatic light of wavelength 0.60 μm. A screen is located behind the lens at a distance 50 cm from the lens.

(a) Find the fringe width on the screen and the number of possible maximum

(b) Find the maximum width of the slit at which the fringes on the screen will still be visible sufficiently sharp

5. Calculate frequency bandwidth for white light (frequency range $4\times10^{14}\,Hz$ to $7.5\times10^{14}\,Hz$). Find coherence time and coherence length of white light.

6. A quasi-monochromatic source emits radiation of mean wavelength 532 nm and has a frequency bandwidth of 10^9 Hz. Calculate the coherence time, coherence length and degree of monochromaticity.