Experiment 5:

To determine the wavelength of sodium light using Newton's ring set or Fresnel biprism set.

Equipment Required: Newton ring apparatus, sodium lamp, eye-piece, spherometer, traveling microscope etc.

Learning Objectives:

1. Formation of interference pattern (~1-2 mm) on the lens-glass plate assembly.
2. Measure the diameter of bright/dark fringes using micrometer attached in the traveling microscope.
2. Calculate the wavelength of light.

Theory :

Circular interference fringes produced by enclosing a thin air film of varying thickness between the surface of a convex lens of large radius of curvature and a plane glass plate are known as Newton's rings. The wavelength of monochromatic light which produces these rings is given by

$$\lambda = (D_n^{\,2} - D_m^{\,2})/4(n-m)R$$

where R is the radius of curvature of the surface of the lens in contact with the glass plate and Dn and Dm the diameters of the n^{th} and m^{th} dark or bright fringes.

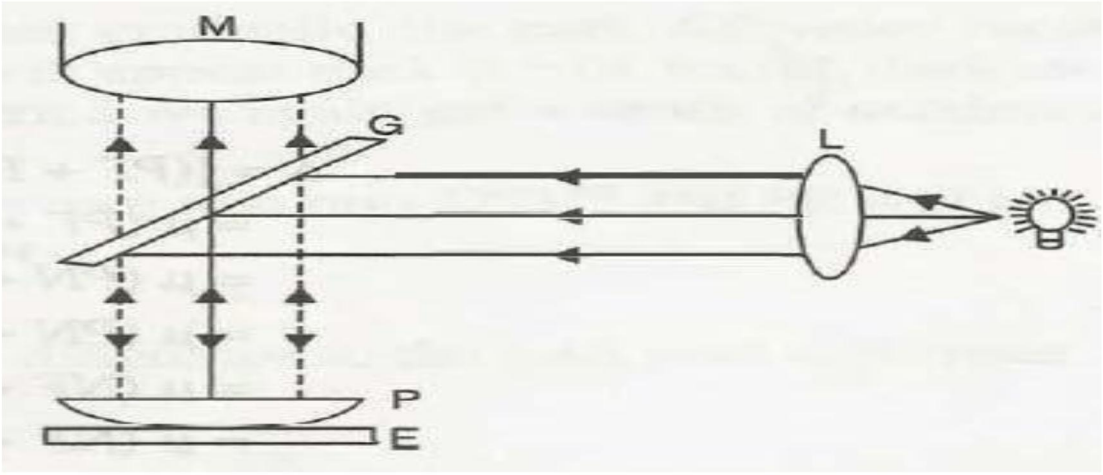

Fig.4. Ray diagram of experimental setup of Newton's ring experiment.

Fig. 5. Newoton's rings with dark center.

Outline of Procedure:

1. Clean the glass and lens surfaces. Place the curved side of the lens on the glass plate. Place this assembly in the frame supplied and slightly tighten the screws provided in the frame.

2. Hold the lens- glass plate assembly horizontal while standing below any light source and observe the formation of very small (~1-2 mm) interference pattern formation. Try to bring the pattern at the center of the glass plate-lens assembly by rotating the screws of the frame.

3. Place the lens-glass plate assembly in the Newton's ring apparatus so that the interference pattern is placed just below the microscope. Fringes are then focused by using microscope. The central fringe should be dark and to obtain the maximum contrast, move the entire apparatus in front of the lamp till the complete pattern is observed.

4. Use the micrometer attached in the apparatus to move the microscope in the horizontal direction and check that whether more than 25 dark fringes on either sides from the center can be marked over cross-wire.

5. Counting carefully from the center move out till the cross-wire reaches 21st dark fringe or 22nd bright fringe. Now rotate the micrometer to note the position of 19th dark fringe or 20th bright fringe. Repeat this for 18th, 16th, 14th etc. bright fringe or otherwise for dark fringes. It is important to use micrometer in one direction for taking micrometer reading, to avoid any backlash error.

6. Remove the plano-convex lens and plate from the frame and lay the lens with the flat surface pointing downwards. Raise the central screw of the spherometer and place the spherometer on the convex surface of the lens. Rotate the screw till the tip just touch

the lens surface and note the reading. Now without disturbing the reading lift the spherometer and place it on the glass plate. Again lower the screw till it touches the plate and note the new reading. Repeat this 2-3 times to obtain the mean value of the difference in the two reading.

7. In order to measure the distance between any two legs of the spherometer, press the spherometer down on the plain paper, so that the three legs make mark on it and the distance between the two legs can be calculated.

Observations:

Vernier constant = ……cm

Ring No.	Microscope reading						D	Microscope reading						D	Mean D	
	Left			Right				Right			Left				cm	m
	MS	VS	T	MS	VS	T		MS	VS	T	MS	VS	T			
20																
16																
12																
8																
4																

Pitch of the spherometer screw = …… mm Number of divisions on circular scale = …….

Least count = …… mm

Distance between the two legs = 1…….= 2…….. = 3…… Mean l = …….cm

No.	Spherometer reading on		h
	Convex surface	Plane surface	
1			
2			
3			

Mean h = …….cm

Radius of curvature of convex surface R = $(l^2/6h) + (h/2)$ = ……cm = …….m

Wavelength $\lambda = (D_n^{\ 2} - D_m^{\ 2})/4(n-m)R$

Find the value of λ By taking the various combinations of n and m as for example, (20,12),

(16,8),(12,4). λ = ……...1. ……2. ……..3.

mean wavelength of sodium light λ= …… m

Scope of results:

Least count of micrometer on microscope =

Pitch (least count of main scale) of spherometer =

Least count of vernier (circular) scale of spherometer =

The wavelength of the light comes out to be = Å

Cautions:

1. Make sure that the glass plate and lens are properly cleaned and free from any greasy material.
2. Micrometer reading should be taken in one direction to avoid any backlash error.

3. Spherometer should be used only by touch-rotate method or by shadow method only.
4. The contrast of light used for the illumination of the interferences pattern should be used accurately.

References:

1. B.Sc. Practical Physics by C. L. Arora S.Chand Publication, 20 th edition(2015).

Weblinks:

http://vlab.amrita.edu/?sub=1&brch=281

Worksheet of the student:

Date of Performance: **Registration number:**

Experiment: To determine the wavelength of sodium light using Newton's ring set or Fresnel biprism set..

Observations:

Vernier constant of microscope =

Observations:

Vernier constant = ……cm

Ring No.	Microscope reading						Dia-meter	Microscope reading						Dia-meter	Mean diameter	
	Left			Right				Right			Left				cm	m
	MS	VS	T	MS	VS	T		MS	VS	T	MS	VS	T			
20																
16																
12																
8																
4																

Pitch of the spherometer screw = ……mm

Number of divisions on circular scale = …….

Least count =…… mm

Distance between the two legs = 1……..= 2…….. = 3.....

Mean l = ……..cm

No.	Spherometer reading on		h
	Convex surface	Plane surface	
1			
2			
3			

Mean h = ……..cm

Radius of curvature of convex surface R = $(l^2/6h) + (h/2)$

= ……cm = ……..m

Wavelength $\lambda = (D_n^{\ 2} - D_m^{\ 2})/4(n-m)R$

by taking the various combinations of n and m as for example, (20,12), (16,8),(12,4).

λ1 = ……

λ2 = ……

λ3 = ...

mean wavelength of sodium light λ= …… m

Scope of results:

Least count of micrometer on microscope =

Pitch (least count of main scale) of spherometer =

Least count of vernier (circular) scale of spherometer =

The wavelength of the light comes out to be = λ

Learning Outcomes (what I have learnt):

To be filled in by faculty:

S.No.	Parameter	Marks obtained	Max marks
1	Understanding of the student about the procedure/apparatus		20
2	Observations and analysis including learning outcomes		20
3	Completion of experiment , discipline and cleanliness		10
	Signature of faculty	Total marks obtained	