PHY F214 PHYSICS LAB-10 REPORT SEM-1 2017-2018

EXP NO. -12 EXP. NAME- FRESNEL'S ZONE PLATE

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ID NO. – 2016B5A30750G

DATE OF PERFORMING – 26-10.2017

DATE OF SUBMISSION – 31-10-2017

AIM:

1. To measure the focal points of several orders of the zone plate and plot it's graph with respect to the inverse of the order and analyse the relation.
2. Calculate the radii of the zone plate.

EQUIPMENT USED:

Laser He-Ne ,zone plate,lens holder ,ground glass screen,polarising filter ,slide mount, 3 convex and 1 concave lenses of focal lengths +20, +50, +100, -50 mm respectively.

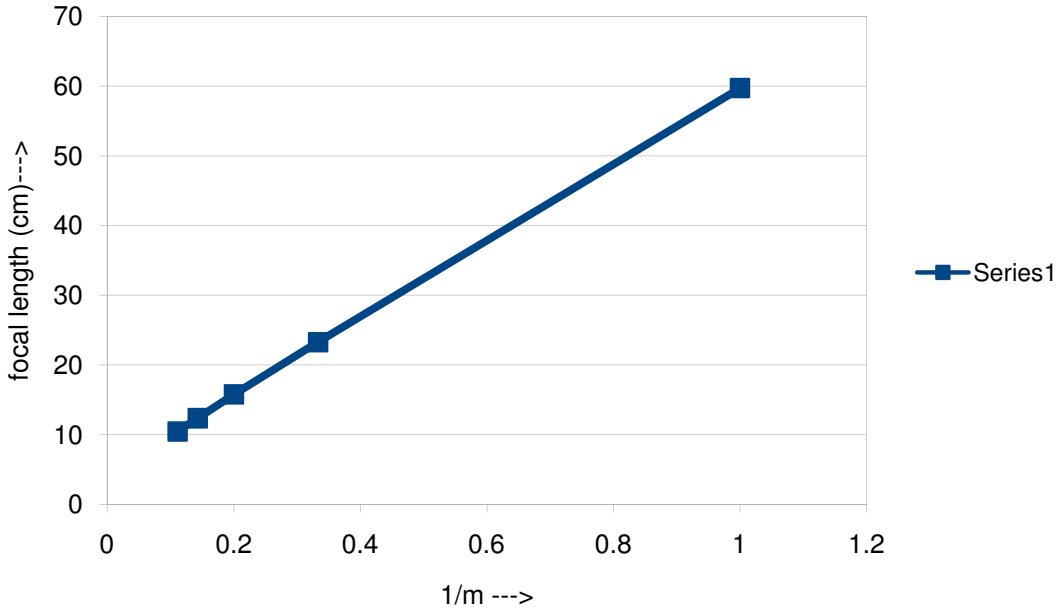
PRINCIPLE USED:

A zone plate is illuminated with parallel laser light.The focal points of several orders of the zone plate are projected on a ground glass screen the zone plate consists of a number of alternating transparent and opaque circles which act as a barrier and the light incident gets diffracted from it and interferes on the other side .The interference of waves diffracted may be treated by splitting the primary wave front into zones .Secondary waves originating from neighbouring zones meet in P with opposed phases .It is possible to either let the odd or even zones exert an influence at a point of observation P.

OBSERVATION AND PROCEDURE:

First of all the laser beam is widened so that the zone plate is well illuminated. It must be assured that the laser light beam runs parallel over several meters this can be checked by keeping a paper in the laser's way and when you move it away if the radius is not changing much then the rays are parallel. To do so we adjust the lenses in front next we start moving the lens from the farthest end and note the distances between the zone plate and the lens whenever we see a bright spot at the center and that is the focal length of first order and like that we keep it moving closer and closer to the zone plate until the bright point is visible and note the focal lengths of different order

m (order)	1/m	Focal length(cm)
1	1	59.7
3	0.3333	23.3
5	0.2000	15.8
7	0.1428	12.4
9	0.1111	10.5



Graph of focal length vs the inverse of order

It comes out to be a straight line .We can also see that $f_m=f_1/m$

There is some fluctuation from the theoretical value because of the human errors or because the rays are not perfectly parallel .

If the number of zones is 2k then the amplitude at point P is kA .

If the point of observation P is shifted along the zone plate we observe alternating brightness and darkness which means that the zone plate has several focal points.

These higher order focal points exist because of optical path differences of the zone rays of $(2n+1)\lambda/2$.

INFERENCE:

We can see the wave nature of light through this experiment and this is another technique that can be used to focus parallel rays at a point using the concept of diffraction and interference of light . Laser beams are used so that the light remains coherent over a long range of distance as only then will the interference take place. We are also

able to see how the focal lengths of higher orders of the zone plate is inversely proportional to the order of the focal length or directly proportional to the inverse of the order of the focal length.

POSSIBLE ERRORS:

1. There can be human error while noticing the meter scale reading or judging when the bright spot has come or not .
2. The rays striking the zone plate may not be perfectly parallel .
3. The laser beam is not perfectly coherent source hence this also can cause errors .
4. The lens and the equipments are not perfect hence a small error can also be attributed to the imperfectness of the equipments be it uneven curvature of lens or other things.