Experimental Physics - II
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Lecture – 12
Determination of Focal Length of Concave Mirror

Today I will discuss how to measure the focal length of mirror: concave mirror and convex mirror. If I give you a mirror, how you will identify whether it is concave mirror or convex mirror.

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I have a mirrors here you can see I have a mirror. this mirrors this face is this it has. in both face mirror both face mirror. which type of mirror it is either concave or convex how you will identify say you know that convex mirrors all the time always it will give virtual image and erect straight erect and concave mirror it will give inverted image as well as erect image inverted real image as well as virtual erect image. that depends on the distance of the object from the mirror.

You know that if the object is at the focal point of the concave mirrors then image will be at infinity. Now if you increase now if the image if the object is object distance from the mirror is less than focal length f then we will get the virtual image and erect image. when object distance is less than f, we will get virtual image and erect image, when the object distance is greater than f, we will get real image and inverted image.

That is for the concave lengths and convex lengths all the time for all distance of the object you will get the erect image virtual and erect image means virtual image all the time it is erect image and real image is the is the inverted image.

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Say I have a needle here see if I see the image of the needle in the mirror then we can identify whether it is concave or convex.

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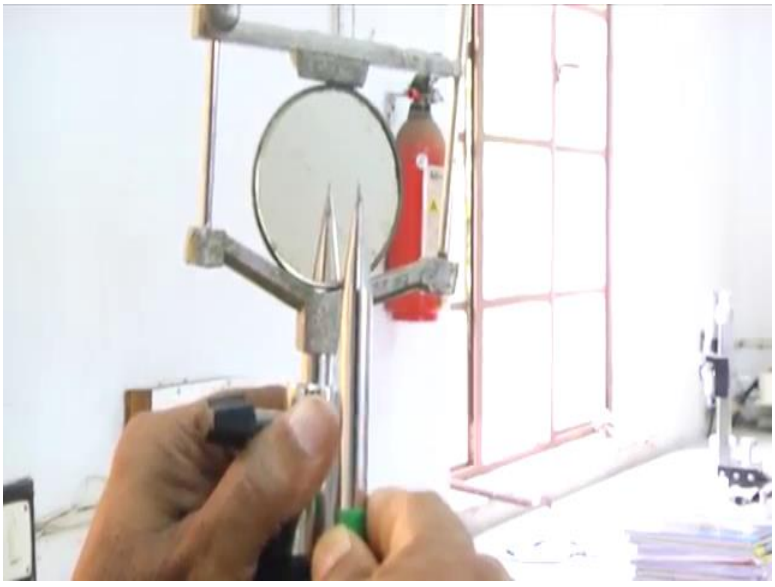

This one let me show you; let me show you this I can see the image, but I can see the image of the mirrors image of the object in the mirror now if I change the distance of the object from the mirror. whether it remains the image remains all the time it is erect.

Then we will say that is the concave convex mirrors if when it is very close to the mirror if it is erect and when will take away from the mirror; we will take away from the mirror then at a after particular distance of the object from the mirror we will see that is the images its inverted. I will show you; I will show you to show you I have to just look at the mirror and the object; look at the mirror and object.

Look; can you see. now, it is very close to the mirrors. we are seeing the erect image now I am changing the distance; I am changing the distance. it is still erect all the time it is erect right all the time it is for all distance it is erect so; that means, this mirror is convex mirror. Now other side two mirror is attached to the two mirrors are there.

If I see the other side of this mirror. that is now you see that you can see the; you can see the erect image now I am changing the distance; I am changing the distance. it is becoming diffused it is becoming diffuse. can you see inverted one now it's clear? this the erect image now I am changing the distance; now I am changing the distance; I am changing the distance now it should be inverted. Yes inverted.

Now, it is becoming inverted; that means, when this object at close to the mirror. image was erect. virtual image now when distance is higher; that means, distance will be greater than the f basically. I am changing distance and if erect image becoming the inverted image. then you can conclude that this mirror is the concave mirror. that way I can identify the whether it is concave mirror or convex mirror. this these way one can identify the mirror whether it is concave or convex that is what I showed you.

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Now, I will demonstrate one experiment here today this how to measure the focal length of a concave mirror of a concave mirror. these the concave mirror this is another concave mirror. this concave mirror we fixed on the on a frame and this we tell generally is a upright its fixed with them upright.

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This mirror is fixed with this frame and this we tell this upright. Now this mirror that is a there is a index line; there is a index line here that I kept it at 0. it should not be parallax error I kept it at 0. here this is the optical bench it has scale; it has scale and it has upright

different upright. this is the one upright where index line is there. that will be used for the taking the position of this upright.

In this upright we have fixed the mirror. this mirror is concave mirror. Now let me tell you how to measure the; how to measure the focal length of a concave mirror; how to measure the focal length of a concave mirror.

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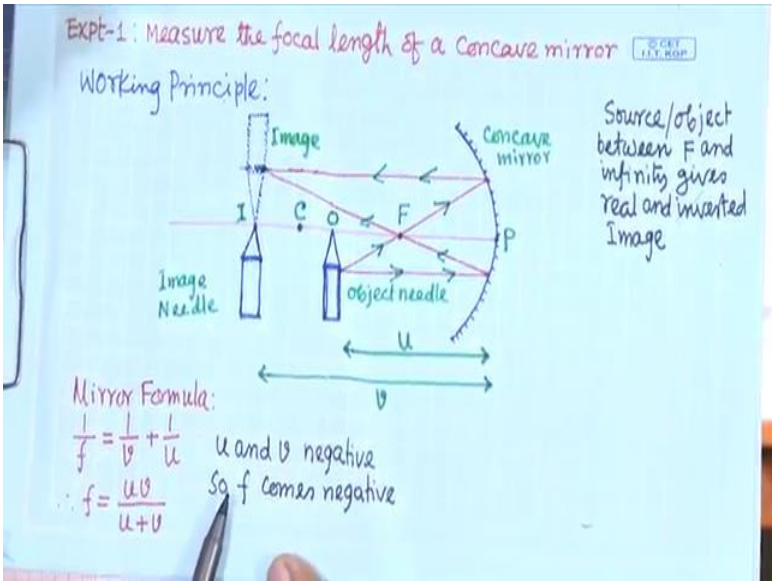

This working principle for this experiment; working principle for this experiment is this you have a mirror concave mirror. Now, you have a object; you have a object. needle object needle object. it is sharp tip is there. now, this from the from this position of the object. this we will see the image of this object in the mirror, how this image is found where will see the image whether it is virtual image or real image, whether it is inverted image or erect image. that will depend on the distance of the object needle from the mirror. here object needle if we put between F and the two F distance between F and two F distance.

Then for this position object position say O now light use the ray diagram. light is coming from; light is coming from this point. it is going this way. this light is passing through the focal length F; passing through the focal length F it is falling on the mirror say you know light passing through the focal length. that will fall on the mirror and it will be reflected, that reflected ray will be parallel to the principal axis these the principle

axis. that I earlier I have discussed importance of three rays. if rays passing through the focal length reflected one will be the parallel to the principal axis.

That way we have drawn. Second this light from the same point if it is parallel if parallel light to the optic principal axis following on the mirror then it will be reflected ray will pass through the focal length pass through the focus. it will pass through the focus. these two reflected rays where they will meet where they will cross there at that point, we will get the image; we will get the image of the point corresponding point of the object. these point will be the image of the object point here. similarly, from all points of the object light will fall on the mirror and we will get we will get the image.

That image since distance is greater than F, we will get the inverted image and real image. image we will see through the we will see if we look at the mirror will see image is like this; image is like this. Now this is the object; object distance from the mirror is u right and now we must find out; we must find out the position of the; position of the image.

So, to find out the position of the image. we will take another needle and that needle will move this; will move this needle and we must find out; we must find out the position of these image needle these we tell image needle and this object needle. position of this image needle will be such that when will look ; when will look and shift our I; shift our I left and right then the tip of the image and the image needle we will move together; will move together they will not be detach. So, but for other position you will see when you are moving your; when you are moving your eyes left and. you will see that this tip their tip position, they will be they will detach from each other. that position we will see this there they will move this image tip and the image needle tip will move; will move together. that is the parallax so method. this way one can find out the position of the image.

When we find the position of the image. on the optical table you have to you need to fix the mirror and optical bench note down the reading of the mirror and then you fix the object needle. how you will know that where you will fixed how will know this it is greater than F this value is greater than F. that we can find out as I told this take the needle object needle very close the mirror then you will see that is you will see the erect image.

Now when you are moving you will see a point where you will see this image is very heavy it cannot see this image. and move further then we will see this erect images convert converting towards the; towards the inverted image. approximately you can find out that these the focal point of the of this mirror.

You should take; you should take; you should take a distance from these distance from the mirror where. starting from the; starting from the mirror starting from the near to the mirror erect image you will see now you are moving. Now it is heavy now after that. your causing the focal length then you will get the; you will get the clear inverted image.

Keep this object needle at this point; at this point. Now that is the distance reading you can take from optical table and then you must find out the image position using the image needle. you will get then reading of this optical image needle from the optical bench. you know the reading difference between these two reading will be the u and difference between the these to mirror and these image needle so that will be the v.

If you find out the u and v. you can calculate the focal length of this. u and v as for the sign convention they are negative. you will get the value of f also negative and; obviously, you can see this these the focal length these the focal length and it is whatever the direction the light.

Focal length is home mirror. you must go against the direction of the incident light. that is why it should be it is expected that it will be negative. that is what it is a f is negative. it is concave mirror.

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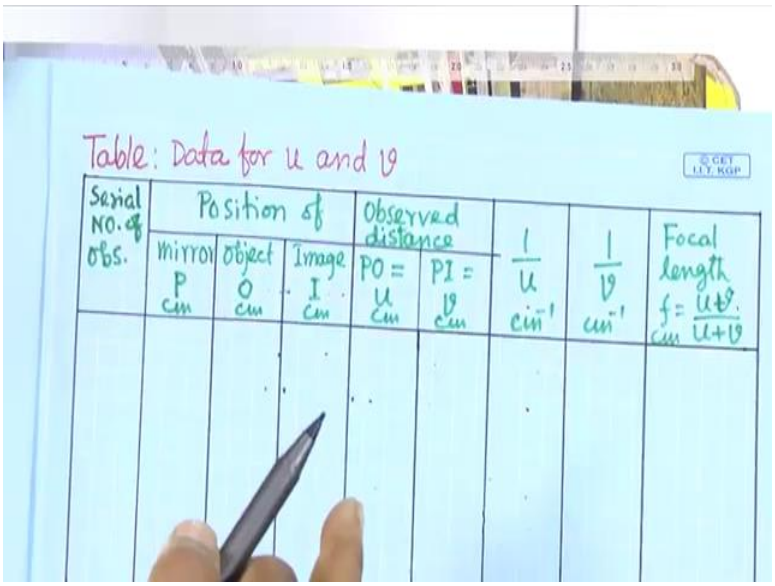

Now I will demonstrate the experiment and you must; you must. these the data table for u and v. that experiment to we will do for different position of the object means for different u value object distance and corresponding image distance we will find out and you will get u and v. one can calculate 1 by u and 1 by v also. one can calculate focal length when you know the u, also one can use the graphical method to find out the focal length. I will show, I will demonstrate in next class. I will stop here.

Thank you for your attention.