EXPERIMENT 7 (a)

AIM :

To find refractive index of any liquid (water) using a concave mirror.

APPARATUS :

A concave spherical mirror, water, an optical needle, a clamp stand, one meter scale, plumb line, etc.

THEORY:

If the tip of object needle O be at the centre of curvature C, tip of image will exactly coincide with it. (Principle axis is verticle to the plane).

When water is filled in concave mirror, object needle is again replaced to move to C′ to remove parallax between tips of object needle and its image.

A ray starting from C will reach at E without deviation because it is along radius of curvature. Due to water in the concave mirror the position of object and image shifts to C′ i.e., now ray starting from C′ after refraction moves along ED and then DC to make apparent image of centre of curtature.

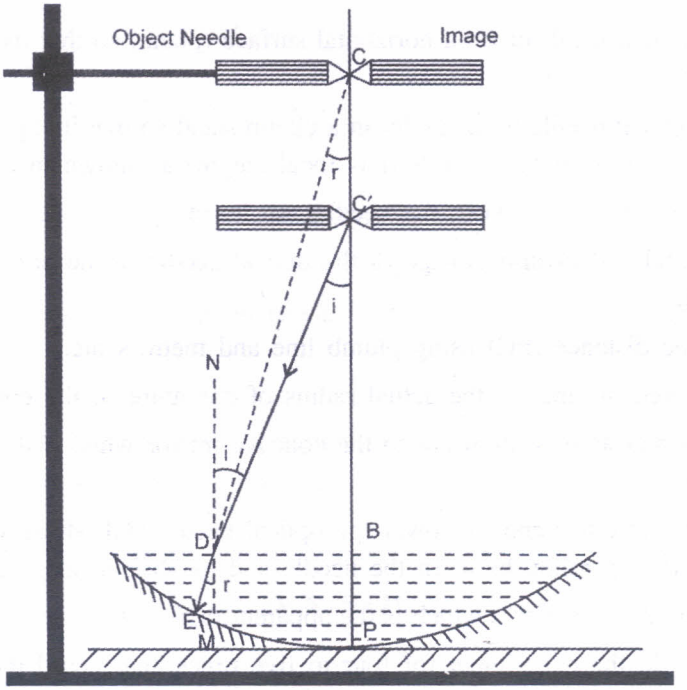

Fig. 1 : Refractive index of liquid

$\therefore \angle NDC' = i$ (angel of incidence) $= \angle BC'D$

$\angle MDE = r$ (angel of refraction) $= \angle BCD$

$$\therefore \quad {}_a\mu_w = \frac{\sin i}{\sin r} = \frac{DB/DC'}{DB/DC} = \frac{DC}{DC'}$$

In $\Delta BC'D$, $\sin i = \dfrac{DB}{DC'}$

$$\Delta BCD \ \sin r = \frac{DB}{DC}$$

For normal view, D will be near B.

therefore ${}_a\mu_w = \dfrac{BC}{BC'}$

If small quantity of water in concave mirror B will be very near to P i.e.,

$BC \simeq PC$ and $BC' \simeq PC'$

$$\therefore \quad {}_a\mu_w = \frac{PC}{PC'} = \frac{\text{Real radius of curvature of mirror}}{\text{Apparent radius of curvature of mirror}}$$

PROCEDURE :

(i) Place the concave mirror on a horizontal surface (plane) so that its principle axis is along vertical.

(ii) Hold the optical needle horizontally in a clamp stand so that its tip lies just above the pole 'P' and at a distance equal to 2f (f is focal length) as shown in figure 1.

(iii) Remove the parallex between the needle and its image.

(iv) Mark the real and inverted image of the optical needle in the mirror. Note the reading of this image.

(v) Measure the distance (PC) using plumb line and metre scale.

(vi) This measured distance is the actual radius of curvature of the concave mirror.

(vii) Now add small amount of water to the concave mirror which will change the position of image needle.

(viii) Adjust the screw to upper or lower the optical needle and adjust its position from 'C' to 'C′' to remove parallex between the needle and its shifted image is seen.

(ix) Measure the distance (PC′) which is the apparent radius of curvature of the concave mirror.

(x) Repeatedly do the experiment for four to five times and record the readings.

OBSERVATIONS :

Rought focal length of the concave mirror, f = ... cm.

Table for refractive index (μ)

S. No.	Actual radius of curvature (R) (in cm)	Apparent radius of curvature (R′) (in cm)	$\mu = \frac{R}{R'}$	Mean μ =
1				
2				
3				
4				

CALCULATIONS :

Putting the observed values of actual radius R and apparent radius R′ in

$\mu = \frac{R}{R'}$ and calculate the value of refractive index of the given medium.

RESULT :

The refractive index of water, μ = ...

PRECAUTIONS :

(i) The mirror and surface of the water should be very clean.

(ii) The needle should be clamped properly in horizontal position.

(iii) The parallex between the optical needle and its image should be removed properly.

SOURCES OF ERROR :

(i) The needle may not be proper horizontal.

(ii) Parallex may not be removed properly.