Date - 13/2/25

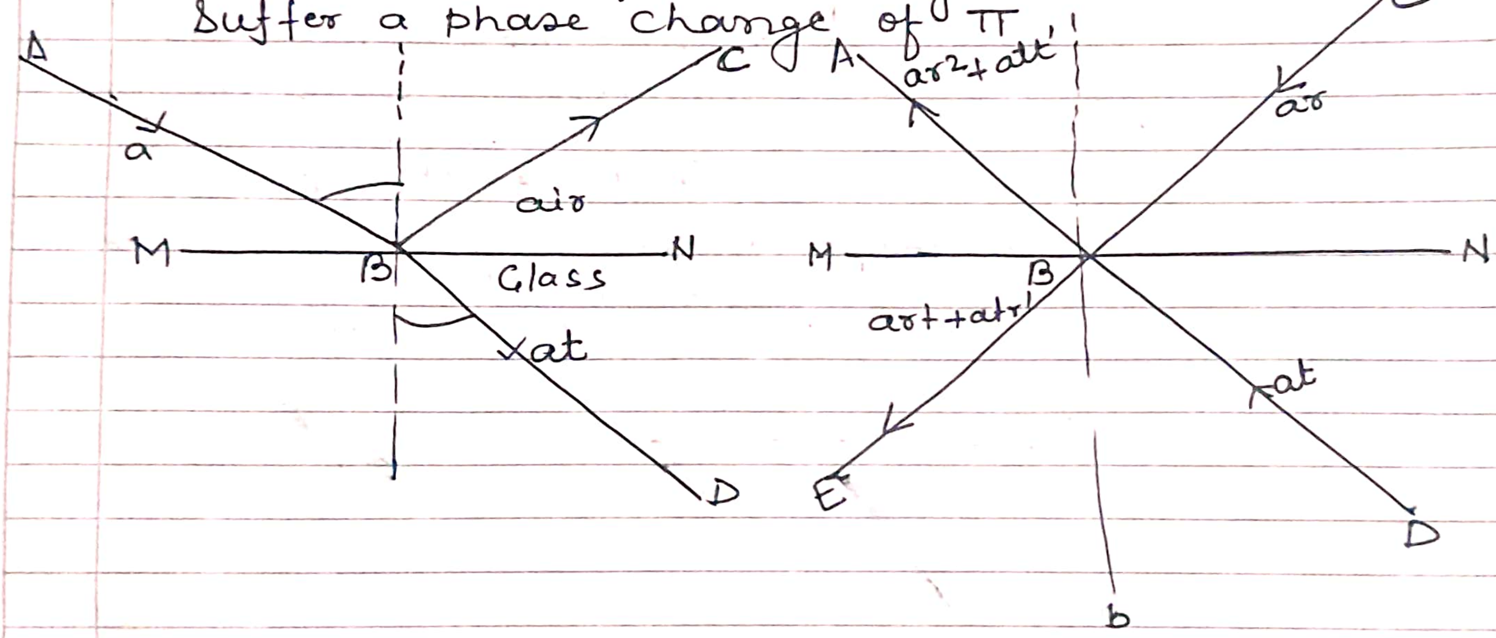
B.SC (Sem - IV)

PHYSICS (Optics)

UNIT - I

TITLE :- STOKE'S THEOREM FOR DIVISION OF AMPLITUDE OF LIGHT

STOKE'S THEOREM :- When a light wave is reflected at the surface of an optically denser medium, it suffer a phase change of π



NO such change is introduced when the reflection takes place at the surface of a rare medium.

Let MN be the surface of separation of two media, the lower one being denser. An incident light wave AB is partly reflected along BC and partly transmitted along BD. Let r be the reflected fraction of amplitude reflected and t the fraction transmitted when the wave is travelling from rarer to denser medium. Then the amplitude transmitted along BC and BD are ar and at respectively

Now. Let us suppose that the direction of the reflected and transmitted waves are reversed. The wave BC on reversal, gives a reflected wave of amplitude ar^2 along BA, and a transmitted wave of amplitude art along BE as shown in fig 1B. Let r' and t' be the fractional of amplitude reflected and transmitted when the wave is travelling from denser medium to rarer medium. Then the wave BD, on reversal, gives a transmitted wave of amplitude att' along BA and a reflected wave of amplitude atr' along BE. But according to the principle of reversibity of light, the reflected and transmitted wave BC and BD, when reversed should give the original ray of amplitude a along BA only. Hence the component along BE should be zero and that along BA should be equal to a

$$art + atr' = 0 \quad \text{——(1)}$$

and $$ar^2 + att' = a \quad \text{——(2)}$$

From eqn (1), we get

$$r + r' = 0$$

Or $$r = -r' \quad \text{————(3)}$$

Again from eqn (2), we get

$$a(r^2 + tt') = a$$

Or $$r^2 + tt' = 1$$

$$\therefore \quad tt' = 1 - r^2 \quad \text{————(4)}$$

The negative sign in (3) indicates displacements in opposite directions. i.e. a phase change of π either at reflection from rarer to denser medium or at reflection from denser to rarer medium.