Exp 2B **Group 24**

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## Intro

Flatness is a measure of how well a certain surface constitutes an ideal plane. Optical flat is an optical measurment device used to measure the precision of flat surface using the property of interference of light (wave nature)

## Aim

To determine the type of sample based on flatness give the fringe pattern obtained using interference of monochromatic light from a sodium vapour bulb.

## Experimental setup

- → optical flat (gluss & quartz)
- → Monochromatic light source
- → Slip gauges (samples)
- → lint free cloth for polishing and preparing Optical flats and specimens

## Principle of working:

The interference effect is used to determine flatness. When we place an optical flat over a sample with zero kinetic energy, a film of air forms between them. Thus, there is a non-zero angle between the sample and the optical flat. If the surface is perfectly flat, straight parallel fringies will be formed. If the surface is not flat, some deviation from ideal fringies is observed in the form of curved fringes. If a tangent is drawn from any curve, it will meet the next fringe at some distance. Hence, the flatness error in that region is $\lambda/2$ for the length at which the fringe intersects with the tangent.

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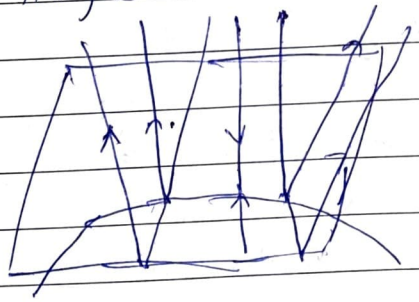
Questions:

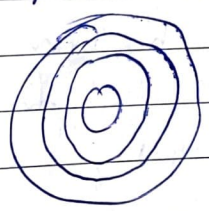
1. Wringing is the process of joining 2 distinct blocks together so that their surfaces bond. This happens when there is virtually no air between the surfaces, and the two surfaces are nearly ~~flat~~ flat. The more a surface is curved, the lesser is the extent of wringing.

2. Flatness error is measured by the amount by which the bands ~~are~~ curve. If a surface is completely flat, we will observe straight parallel fringes. If the surface is curved, then we get curved fringes. Now on drawing tangent lines to any curve and observing where this tangent intersects the next fringe, we can get the flatness error. The distance along the tangent between the two fringes signifies the flatness.

3. For a convex surface, the ends of the surface are further away from the optical flat as we move outwards from the centre. Hence these outer fringes will be spaced closely together.



thus observed fringes are like:



When viewed from above!

4. Wavelength is increasing as light becomes saturated from yellow to yellowish-orange. Thus, spacing b/w fringes increases.

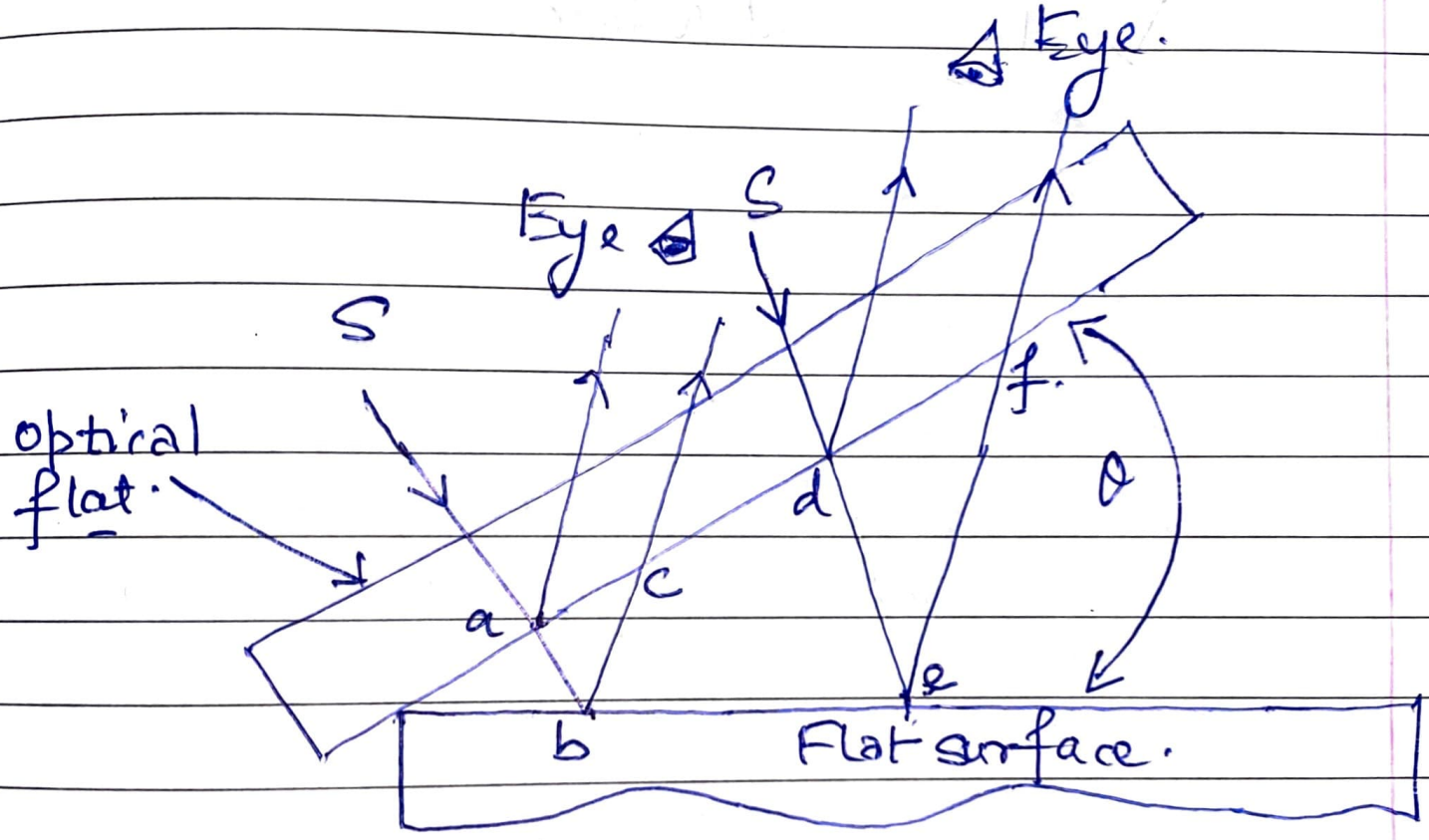
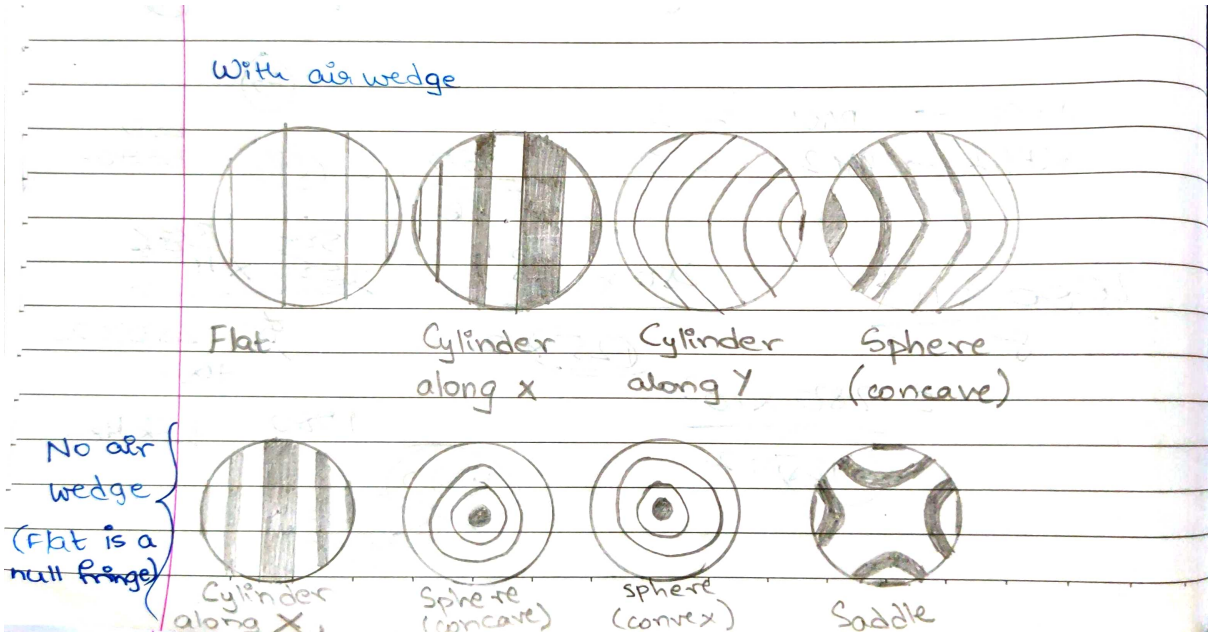


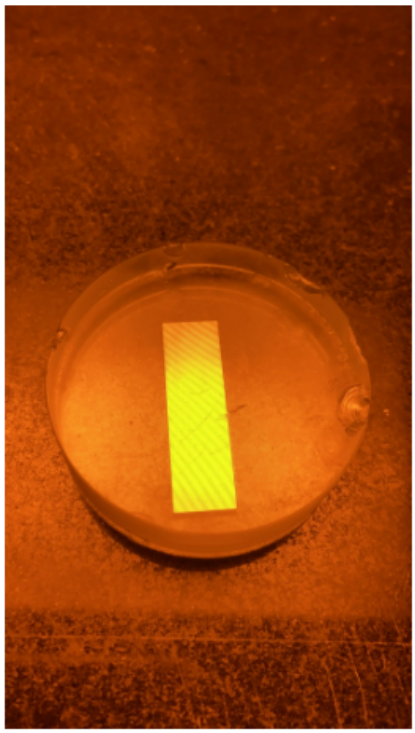

Fig: Principle of Interferometry.

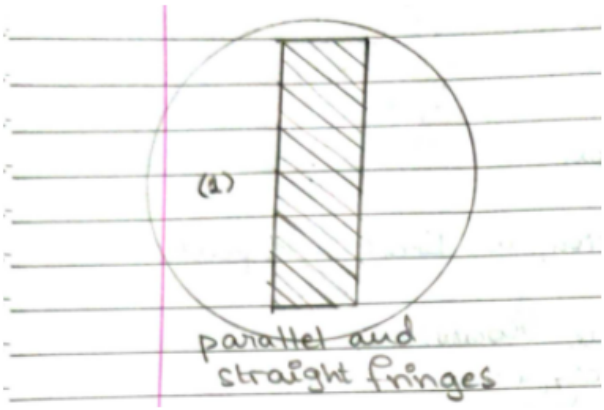
## Sketch different type of patterns possible using optical flat along with their interpretation

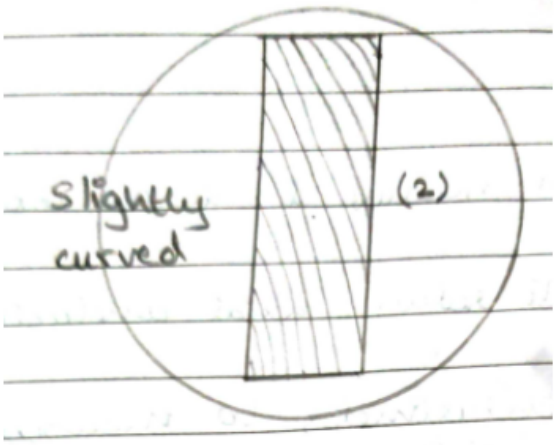


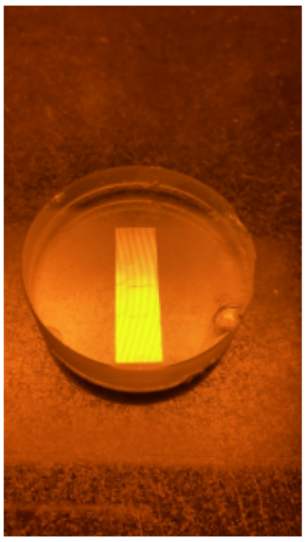

Resources:
https://wp.optics.arizona.edu/jcwyant/wp-content/uploads/sites/13/2016/08/07-Testing-Flat-Surface-Optical-Components.pptx.pdf

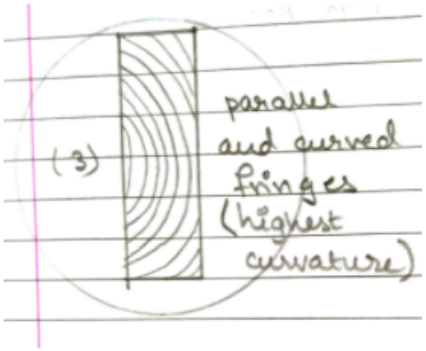
# Results:

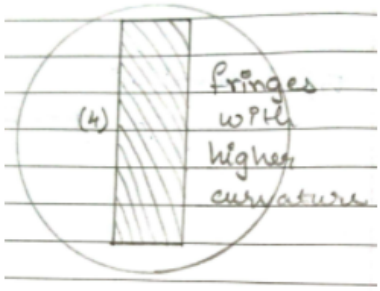


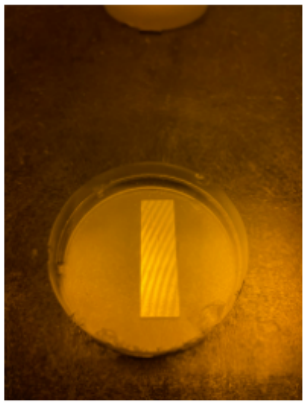


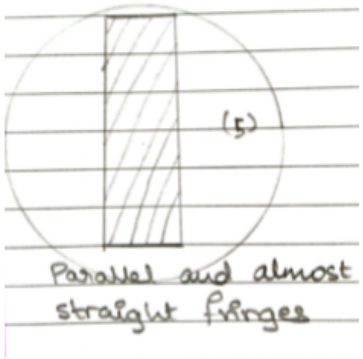










## Conclusions

The final order of flatness is
1 > 5 > 2 > 4 > 3
with 1 being flattest and 3 being least flat

The flatness is checked by seeing which fringe pattern has highest curvature (being the least flat sample). Finer comparisons can be made by checking which pattern has more parallel fringes and which has higher flatness error.

## Sources of Error

- Any kind of dust or fingerprint particles on the flat surfaces would lead to inaccurate interference.
- The positioning of the eye / pointing of the camera may not be exactly what is required due to human error.
- The light may not be perfectly monochromatic because of external light sources acting as disturbances.
- Improper placement of flats can lead to errors.