PH2233

1st Lab course : Intended Learning Outcomes (ILOs)

Basic handling of tools/ apparatus

Error analysis

2nd Lab course : Intended Learning Outcomes (ILOs)

+ Measurement --> Inference

List of experiments

1. Specific heat of solid
2. Lee's method (Thermal conductivity)
3. Stefan's law
4. Thermal expansion
5. Thermister
6. Brewster's angle
7. Michelson's interferometer
8. Photoelectric effect
9. Rydberg's constant
10. Millikan's oil drop

1. Brewster's Angle
2. Michelson Interferometer
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"A Conceptual–Historical Journey Through the Physics Laboratory"

Course Structure

1 day per week, 3 hours lab, 3-6 pm

Blue Lab Journal – to stay in the lab – Data, calculations, graphs

TAs , Faculty – will check journals and take viva

Course Evaluation

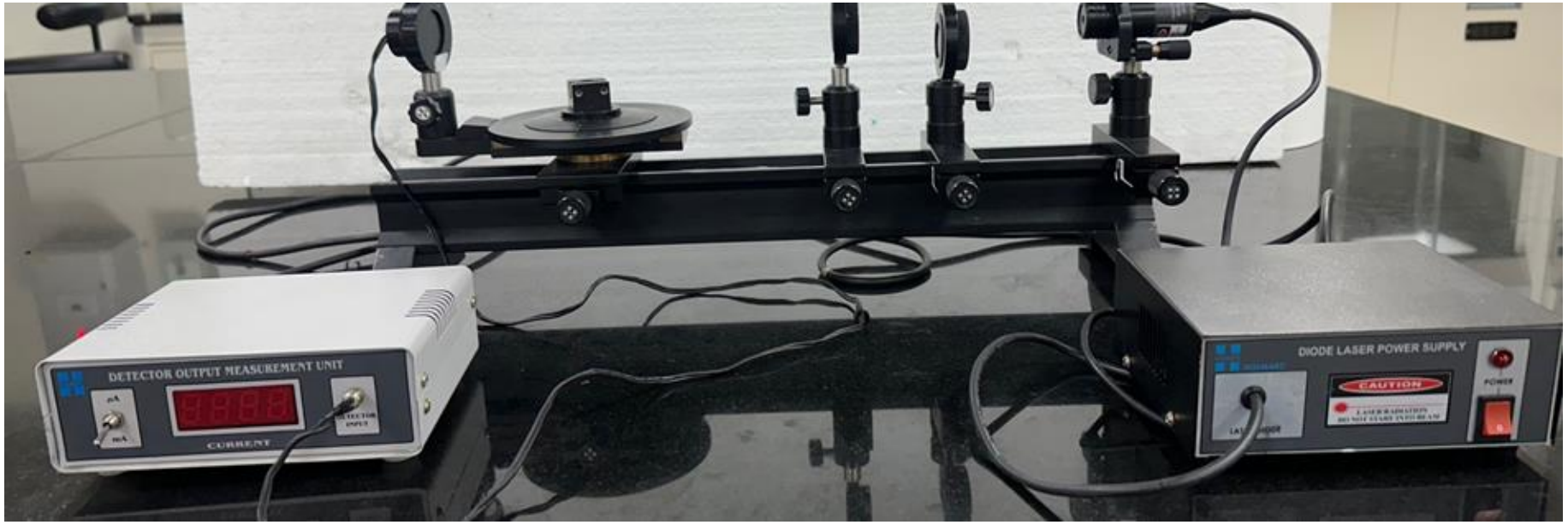
35% mid sem – practicals in the exam week

35% end sem – practicals in the exam week

20% – lab notebook and viva (faculty)

10% – lab notebook and viva (TA)

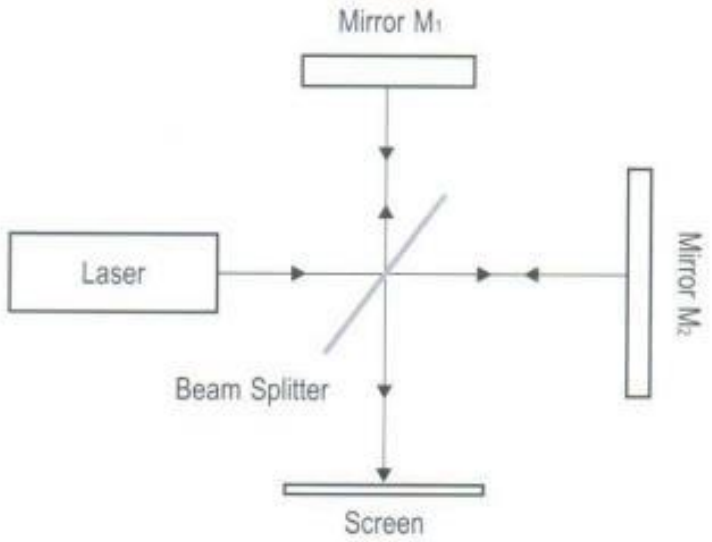
BREWSTER

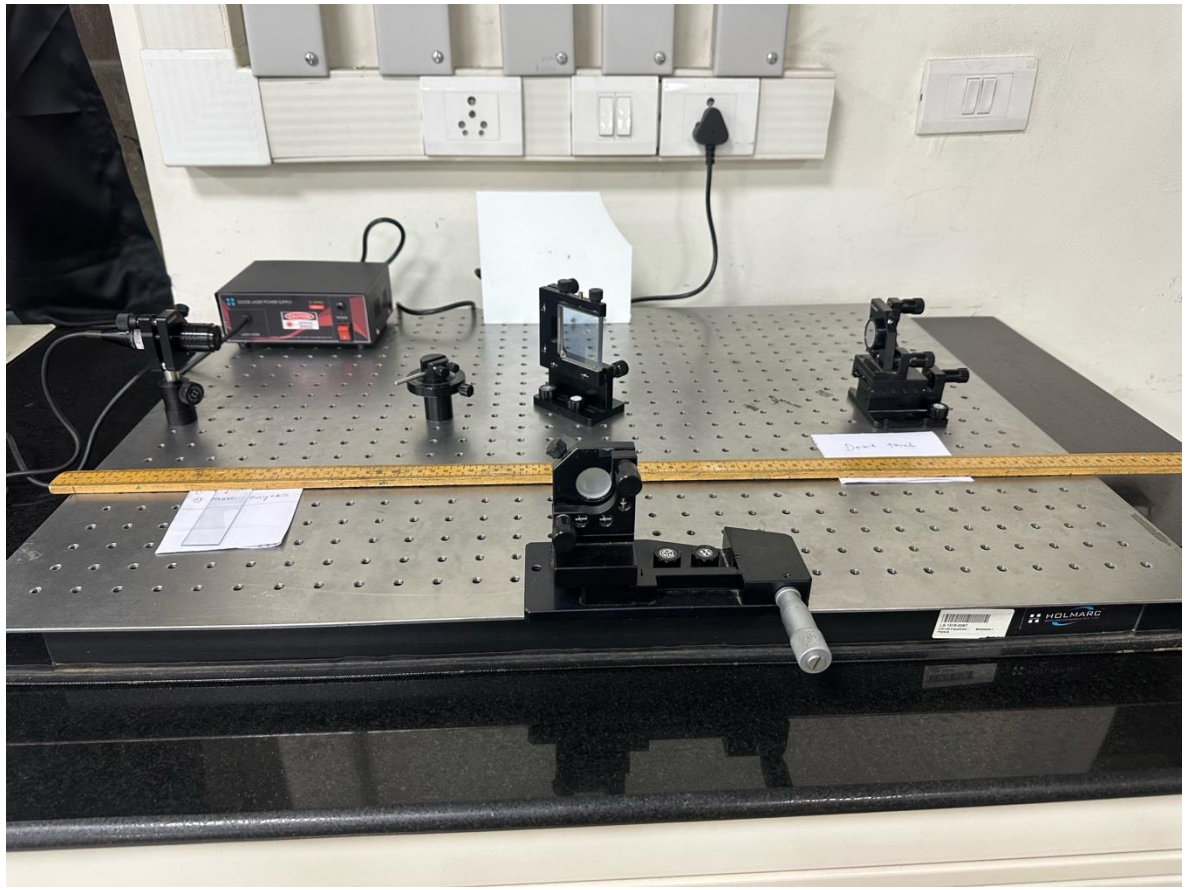


Measure the angle corresponding to the minimum reflected intensity, this is the Brewster angle θ_B.

At a special angle, light vibrating in the plane of incidence disappears from the reflected beam, leaving only the perpendicular vibration

MICHELSON INTERFEROMETER





Fringes on the screen

3 parts to the experiment. Determine –

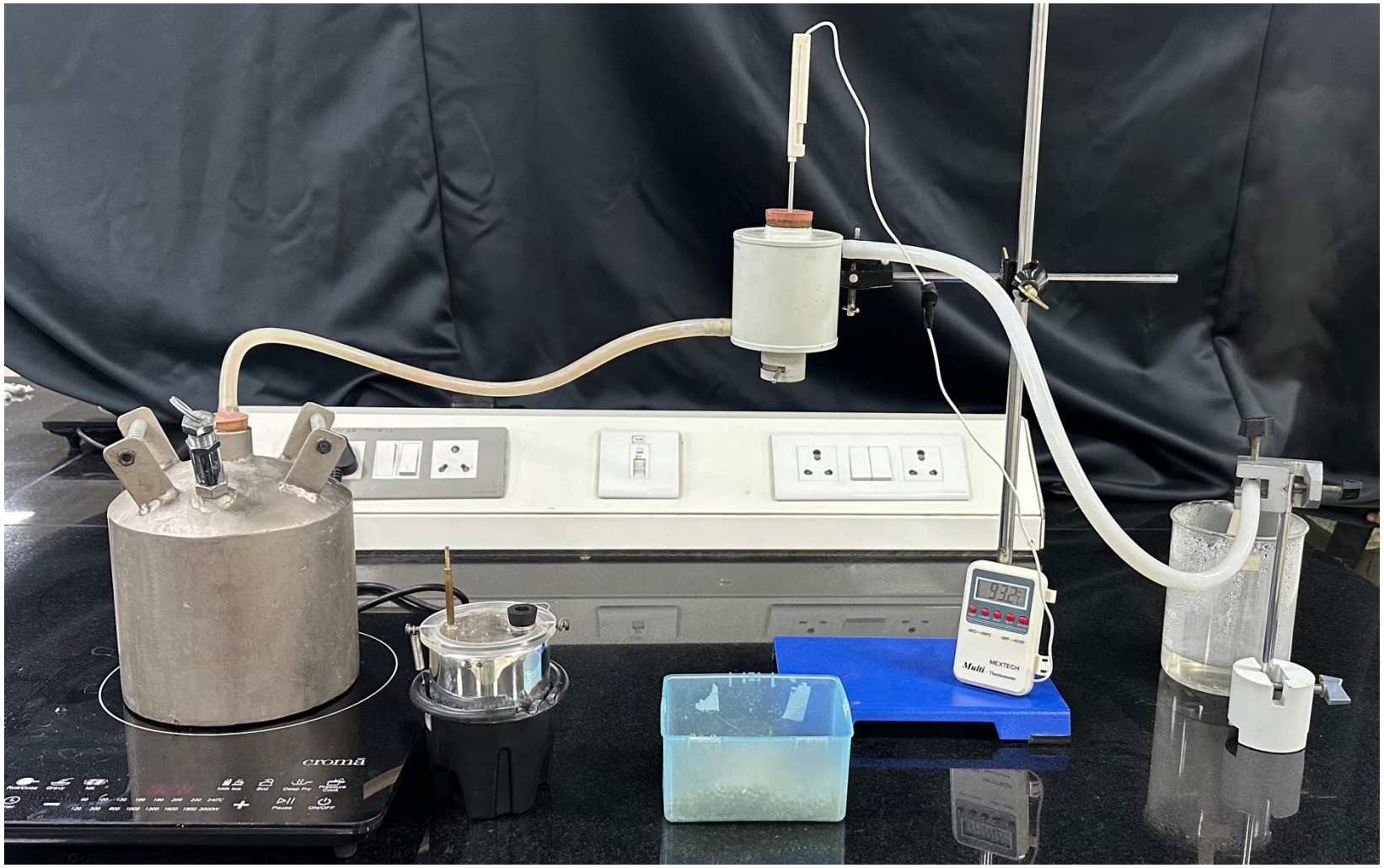
1) Wavelength
2) Refractive index (glass slide)
3) Refractive index of air (pressure cell)

THERMAL EXPANSION

Pass steam, heat the rod, once T is stable measure the change in spherometer reading

SPECIFIC HEAT OF SOLIDS

Shots in steam chamber,
Drop them into the dewar with water at RT,
Mix and record change in T of water



STEFAN'S LAW

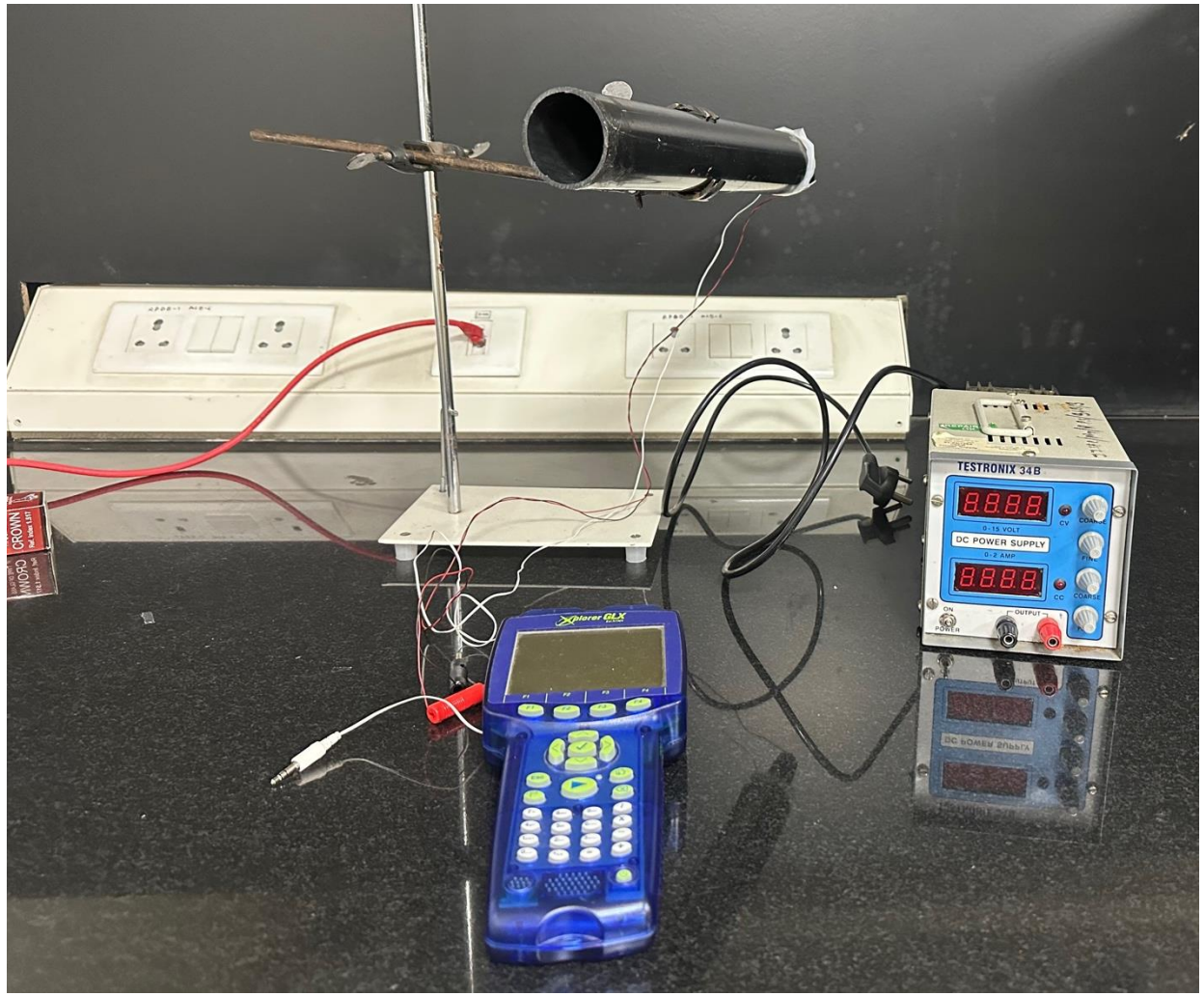
$P_{rad} \propto T^4$

Heat the tungsten filament, vary V, note I
R = V/I

The temperature dependence of resistance is given by the equation

$$R(T) = R_0(1 + \alpha T + \beta T^2)$$

For tungsten $\alpha = 5.21 \times 10^{-3}\ [\mathrm{K}]^{-1}$ and $\beta = 7.2 \times 10^{-7}\ [\mathrm{K}]^{-2}$.



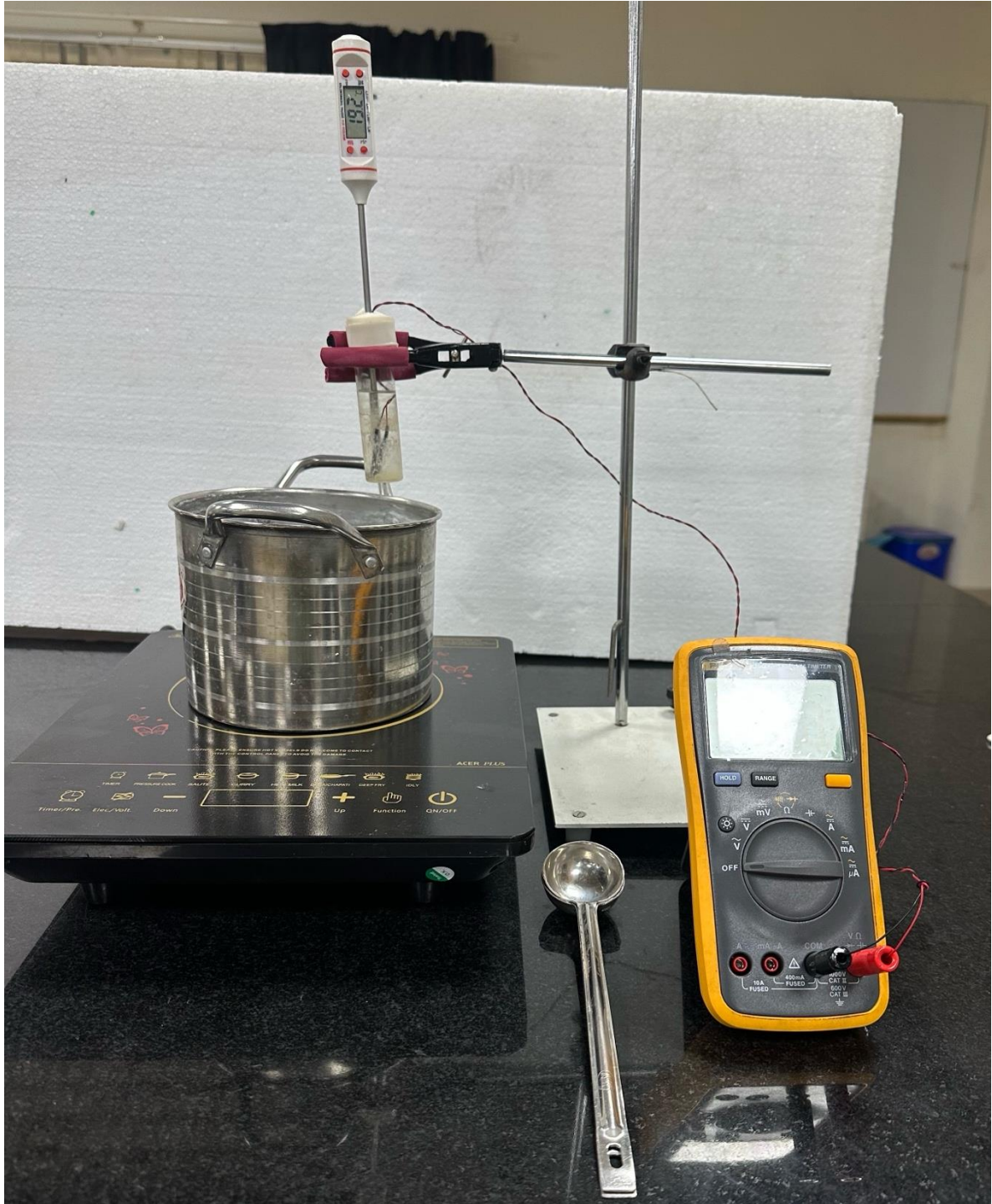
THERMAL CONDUCTIVITY BY LEE'S METHOD

Rate of heat transfer between the metal disc and poor conductor

THERMISTER

Connect the thermistor to a voltage source and place it in water bath.

Heat – change T – record R
Add ice to the bath – change T – Record R



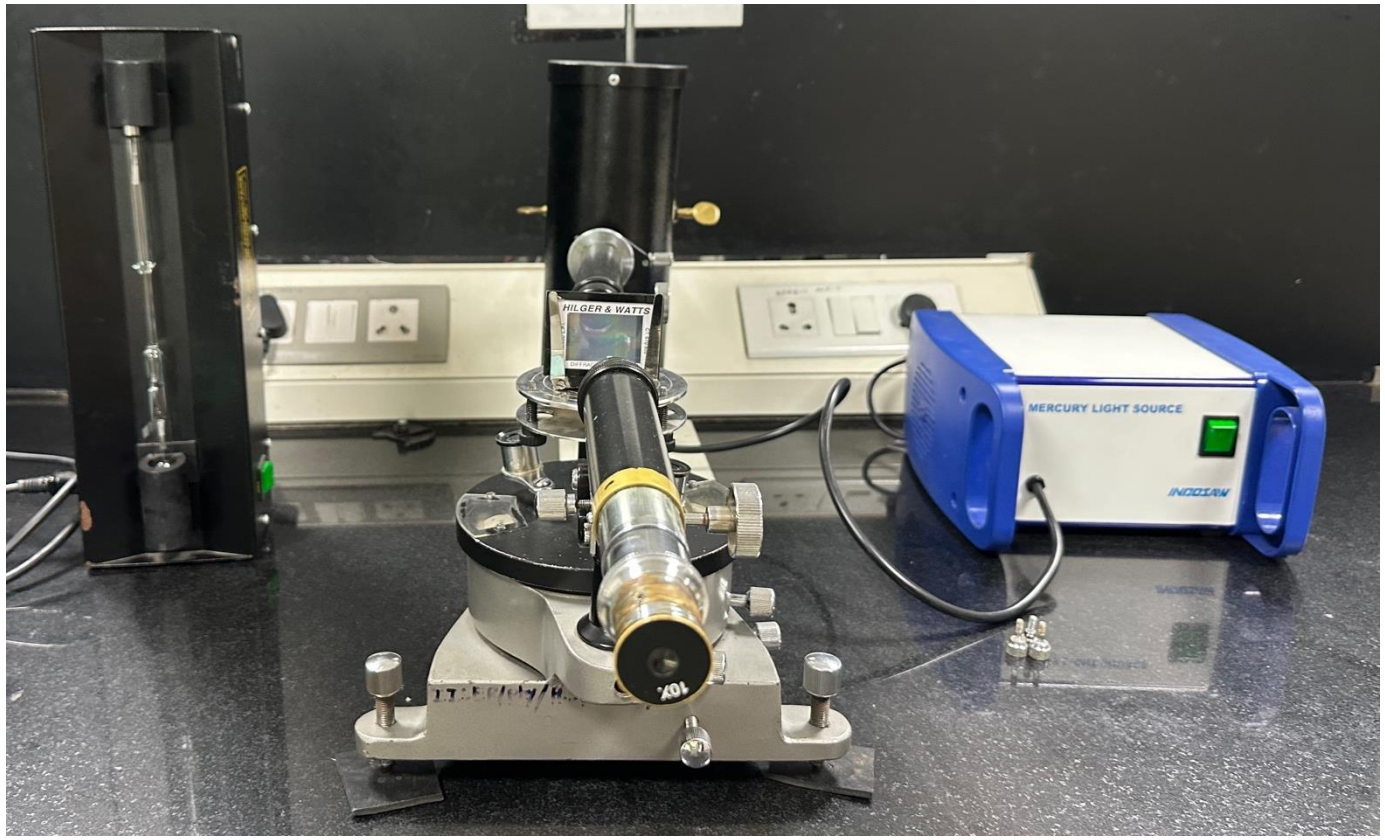
RYDBERG CONSTANT

Dark room

Diffraction grating

Hydrogen discharge lamp

Observe the first order spectral lines and record the angles

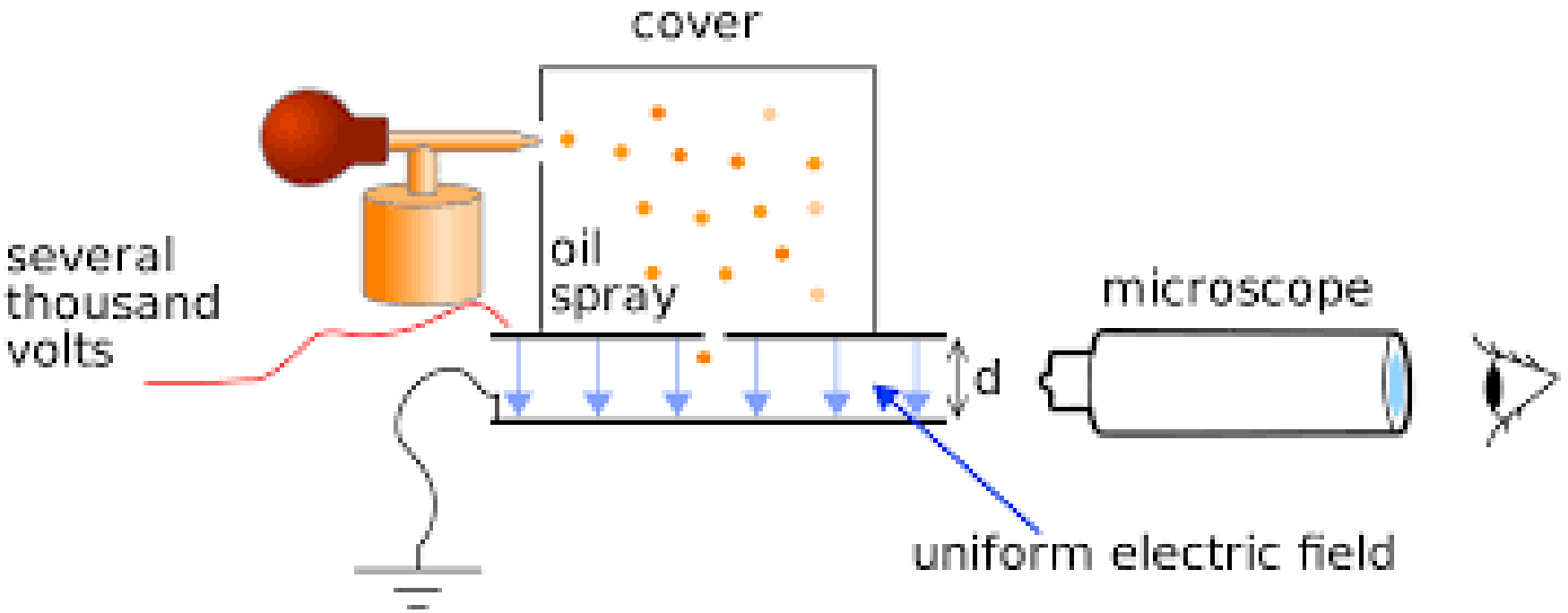


PHOTOELECTRIC EFFECT

maximum kinetic energy of emitted electrons depends only on the frequency of incident light and not on its intensity.

Light from the source is focused on the cathode of the phototube through a selected colour filter. The emitted electrons are collected at the anode. A variable retarding potential is applied. The stopping potential is the value of V at which the photocurrent becomes zero, corresponding to the maximum kinetic energy of emitted electrons.

MILLIKAN'S OIL DROP



“A Conceptual–Historical Journey Through the Physics Laboratory”

Brewster’s Angle – 1811-1815 – wave nature of light was under debate

Michelson Interferometer – 1880s – wave nature confirmed, Michelson-Morley experiment

Thermal expansion – 1820-40, atoms not known, heat as a macroscopic entity

Specific heat – 1819, material property (bulk) to something microscopic (atoms!)

Stefan’s law – 1879, how matter radiates energy $P_{rad} \propto T^4$

Lee’s method (Thermal conductivity) – heat flow through poor conductors

Thermister – temperature dependence of resistance --> towards solid state physics

Rydberg’s constant – 1885, empirical formula, nature prefers integers!

Photoelectric effect – 1905, Quantization

Millikan’s oil drop – 1909, charge quantization