THERMAL PHYSICS LABORATORY

This laboratory includes the experiments of thermodynamics, statistical mechanics and kinetic theory of gases. It is a good opportunity for students to think about the same phenomena in macroscopic terms (energy supplied to materials) and microscopic terms (how the particles are behaving).

Facilities in the lab: For performing experiments, a separate laboratory, well equipped with the following apparatus is provided to B.Sc. II (non-med) and B.Sc. II (Honors) students. Each equipment has 4-5 sets. In this lab, proper connection of the water supply is given to perform the experiments. Along with this, hot plates and heaters are placed with apparatus where steam is required for the experiment. Measuring Beakers and stands are also placed in the lab. Most importantly, fire extinguisher is positioned in the laboratory.

20 students can perform the experiments at a time in the laboratory in the small groups. Students are provided with the digital manuals, and are guided to make assignments based on practical.

Mission: The mission of this lab is to make students well trained in this field, so that they can practically understand the concepts of thermal and statistical physics and can pursue their research in the same field.

EQUIPMENT

1	Callender and Barne's Kit
2	Black body Kit
3	Stefan's Constant Kit
4	Searle's Kit
5	Lee and Charlton's disc
6	Platinum Resistance thermometer
7	Cu-Fe Thermocouple

Details of some of the instruments are as below:

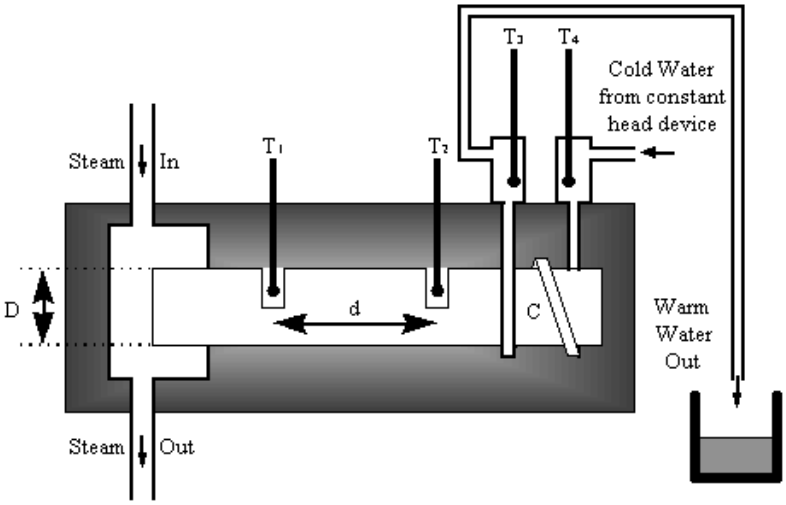
1. The **Callender and Barne's Apparatus** is used to calculate the mechanical equivalent of heat. A steady stream of water is made to flow through a glass tube of the constant flow colorimeter containing a resistance wire in the form of a spiral. The spiral is heated by passing an electric current through

it. The temperature of water rises on its passage through the tube and becomes constant after some time. When a steady state has been reached. i.e., the temperature of out flowing water does not rise further. The apparatus required for this experiment is: Constant flow calorimeter, thermometers, an ammeter, a voltmeter, rheostat, a beaker, a screw type pinch cock, a stop-watch and well insulated connecting wires.

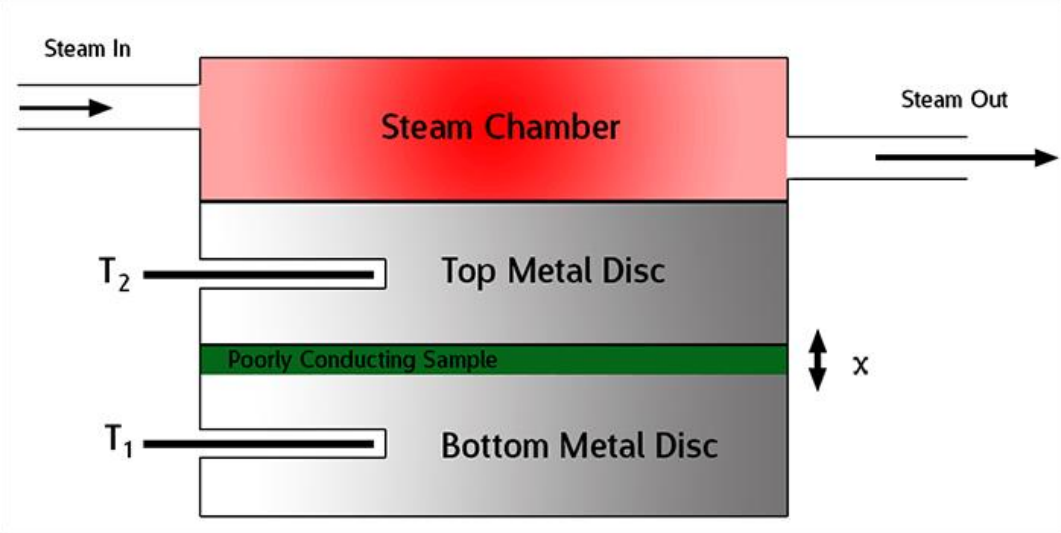
2. The **Black body apparatus** is used to calculate the value of Planck constant, using the Wien displacement law. Different voltages are provided to the black body, which is properly insulated bulb, so the photocurrent is estimated and using a proper table for R/R_0, temperature of the black body at different voltages is calculated.

3. This experiment is again dedicated to study the one of the important concepts of Statistical Mechanics known as Stefan law. In this experiment, the power and the temperature of the black body (bulb) is calculated and the slope of logP and logT is calculated which comes out to be 4.

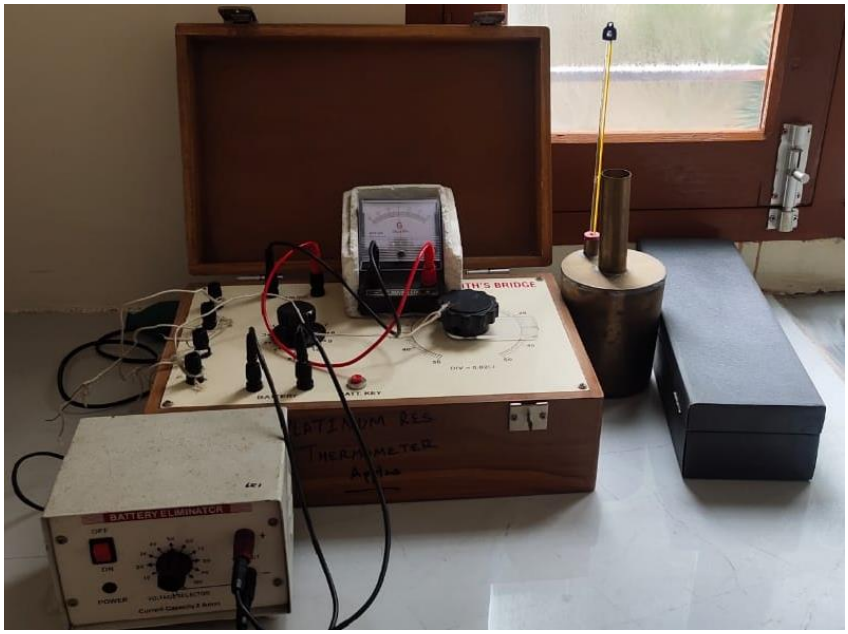
4. **Searle's apparatus** is used to calculate the thermal conductivity of copper. The apparatus required for this experiment is: Constant-head apparatus, measuring cylinder, stop watch, Searle's apparatus, steam generator, four thermometers T_1, T_2, T_3, T_4. The steam is allowed to pass through the apparatus, which is generated by the container placed on the hot plate. The four thermometers are allowed to attain the steady state temperature, and the further calculations are made on these temperatures to find out the values of K. Moreover, the mass collected per unit volume is also estimated for the steady flow.



5. **Lee and Charlton's disc** method is used to calculate the thermal conductivity of the bad conductor. In this experiment, the experimental setup for Lee's Disc method is quite simple and involves the use of two metal discs (usually brass), a steam chamber, the sample to be measured and two thermometers to measure the temperature gradient. The sample is placed in between the two metal discs (the thermometers are inserted into the metal discs) and the steam chamber is placed on top of the top metal disc. The whole setup is suspended in air so any other conduction effects are removed, although convection is a key factor in calculations.



6. **Platinum Resistance thermometer** is used to calculate the temperature coefficient of resistances for platinum using **Callender and Griffith's bridge.** Firstly, the battery eliminator, galvanometer and PRT are connected to get the value of electrical zero. Following this, determination of the resistance per unit length of the bridge wire is calculated, then the resistances are calculated at steam and room temperatures to estimate temperature coefficient of resistance.



7. **Cu-Fe Thermocouple** is used to measure the variation of emf with temperature difference of the hotter and the colder junctions. Copper and iron, are joined together to form a closed loop and if two junctions are kept at different temperatures, an electric current begins to flow in the loop. This phenomenon is called thermoelectric effect, and generation of current in the loop due to difference in temperatures is called Seebeck effect. The loop comprising the two metals is referred to as a thermocouple. The existence of current implies that there is an electromotive force (emf) acting in the circuit. This is known as thermo-electromotive force and the electric current produced in this way is called thermo-electric current.