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ThermoFluids Lab Portfolio

Courses Covered:

Thermodynamics
Heat Transfer
Fluid Mechanics

Lab In-Charge: Engr. Rayan Isran
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Boyle's Law

Figure 1: Boyles Law Apparatus (Versatile Data Acquisition included)

Concerned Lab	**Thermodynamics**
List of Experiments	• Demonstration of Temperature change with change in pressure. • To compare actual test results with theory and confirm Boyles Law. • To show the effect of quickly decompressing a fixed amount of gas in a sealed vessel.

Gay Lussac's Law

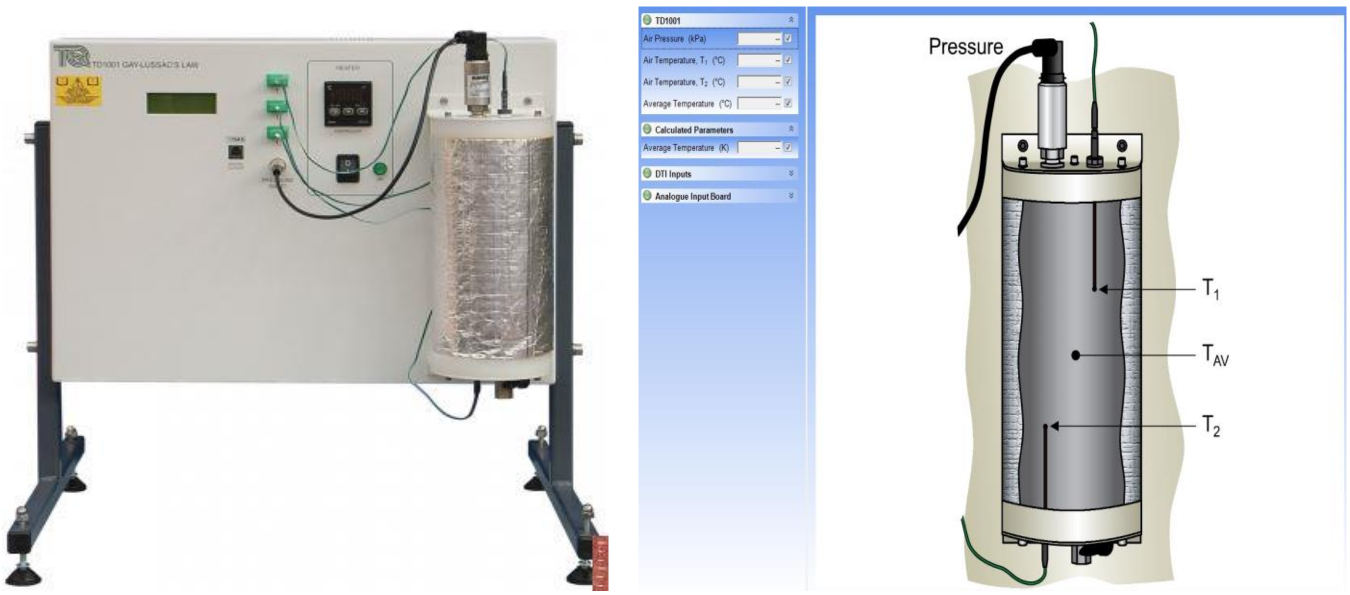

Figure 2: Gay Lussa's Apparatus (Versatile Data Acquisition included)

Concerned Lab	**Thermodynamics**
List of Experiments	• To prove that pressure and temperature of a gas are directly proportional for a fixed volume of a gas. • To prove Gay Lussac's Law.

Francis Turbine

Figure 3: Francis Turbine Apparatus

Concerned Lab	Fluid Mechanics
List of Experiments	• Determination of mechanical power produced by the turbine. • Determination of efficiency of Francis Turbine.

Pelton Wheel Turbine

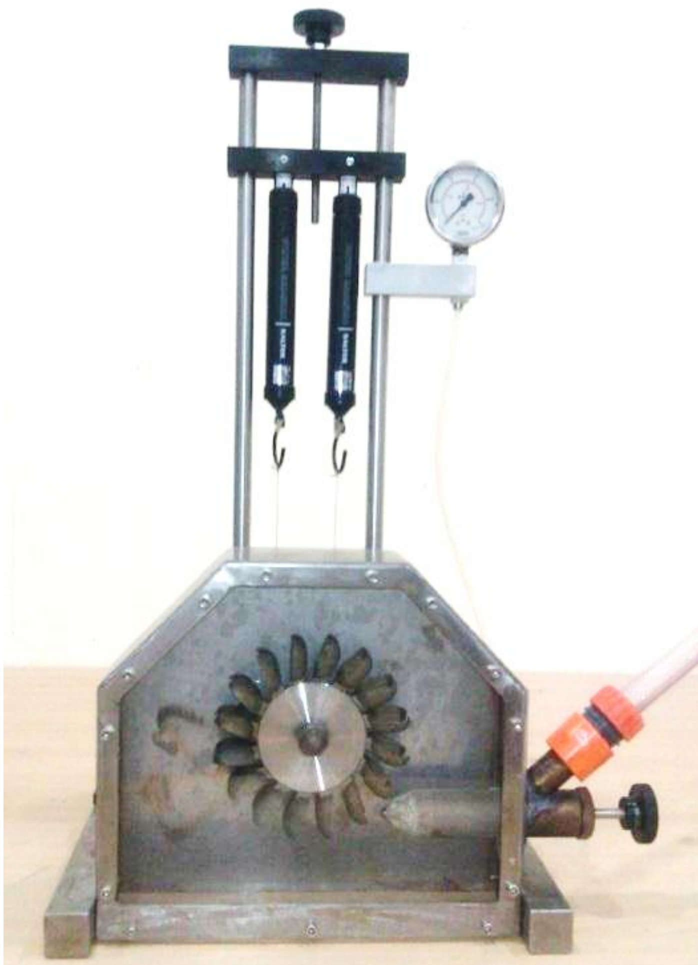

Figure 4: Pelton Wheel turbine Apparatus

Concerned Lab	**Fluid Mechanics**
List of Experiments	• Determination of mechanical power produced by the turbine. • Determination of efficiency of Pelton Wheel Turbine.

Marcet Boiler

Figure 5: Marcet Boiler Apparatus (Versatile Data Acquisition included)

Concerned Lab	**Thermodynamics**
List of Experiments	• To observe the boiling process at different pressures. • To prove that steam pressure in a closed vessel increases with its temperature. • To show that the Marcet boiler experiment gives results that compare well with published steam tables. • To compare actual results with theory and prove the relationship between temperature and pressure for saturated steam and the theoretical equations that link the two variables.

Pressure & Vacuum Measurement

Figure 6: Pressure Measurement Bench

Concerned Lab	**Thermodynamics/Fluid Mechanics**
List of Experiments	• Calibration of Bordon Pressure Gauge • Pressure and Vacuum measurement using Bench

Osborne Reynold’s Demonstration

Figure 7: Osborne Reynold's Apparatus

Concerned Lab	Fluid Mechanics
List of Experiments	• To observe Laminar, Transitional and Turbulent flow • To determine the upper and lower critical velocities at transitional flow • To compute Reynold’s number.

Bernoulli's Theorem

Figure 8: Bernoulli's Demonstration Apparatus

Concerned Lab	**Fluid Mechanics**
List of Experiments	• To determine the discharge coefficient of the Venturi meter. • To demonstrate Bernoulli's Theorem

Energy losses in Bends & Pipe Fittings

Figure 9: Energy Losses in Bends & Pipe fittings

Concerned Lab	**Fluid Mechanics**
List of Experiments	• To measure the losses in the fittings related to flow rate and calculating loss coefficients related to velocity head. • To measure the losses through gate valve related to flow rate and calculating loss coefficients related to velocity head.

Fluid Friction Measurement

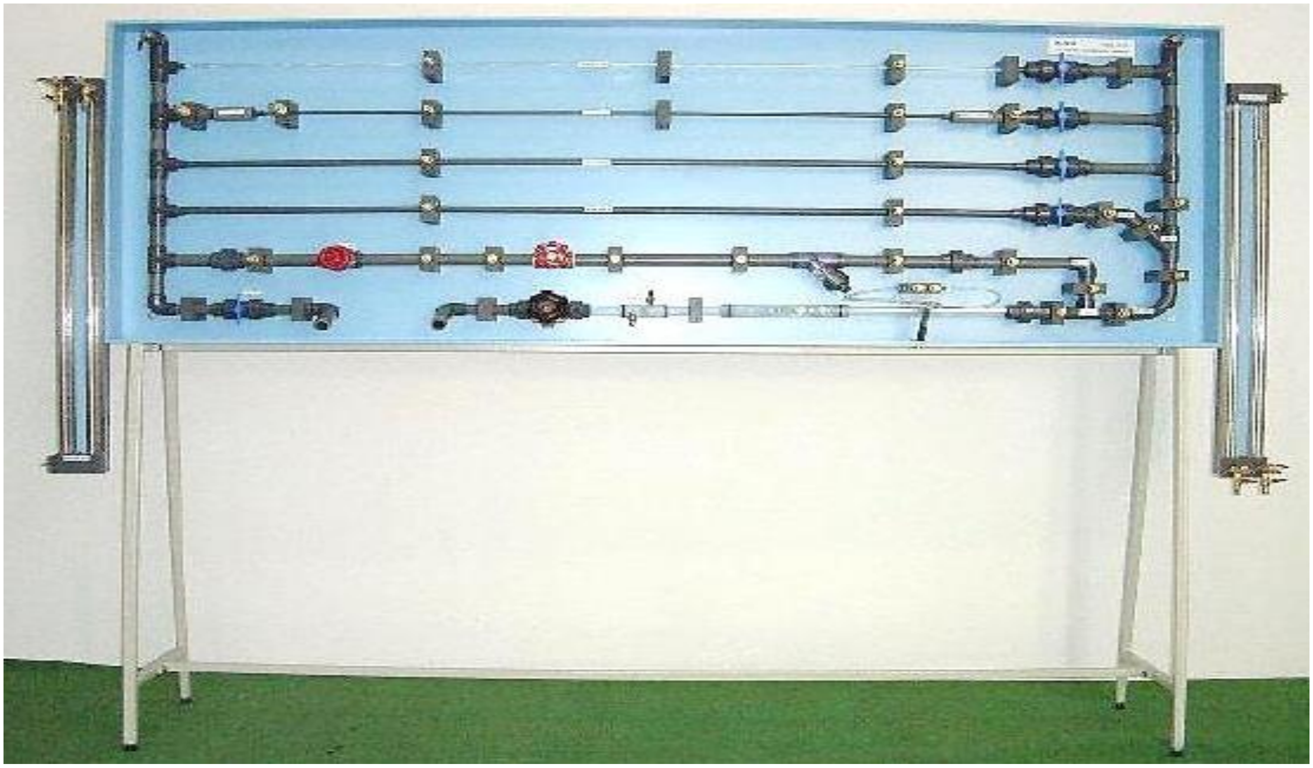

Figure 10: Fluid Friction Measurement

Concerned Lab	**Fluid Mechanics**
List of Experiments	• To determine the relationship between head loss due to fluid friction and velocity for flow of water through smooth bore pipes. • To confirm the head loss predicted by pipe friction equation associated with flow of water through a smooth bore pipe. • To determine the relationship between fluid friction coefficient and Reynolds' number for flow of water through a pipe having a roughened bore. • To determine the head loss associated with flow of water through standard fittings used in plumbing installations. • To demonstrate the application of differential head devices in the measurement of flow rate and velocity of water in a pipe.

Vapour Compression Refrigeration Cycle

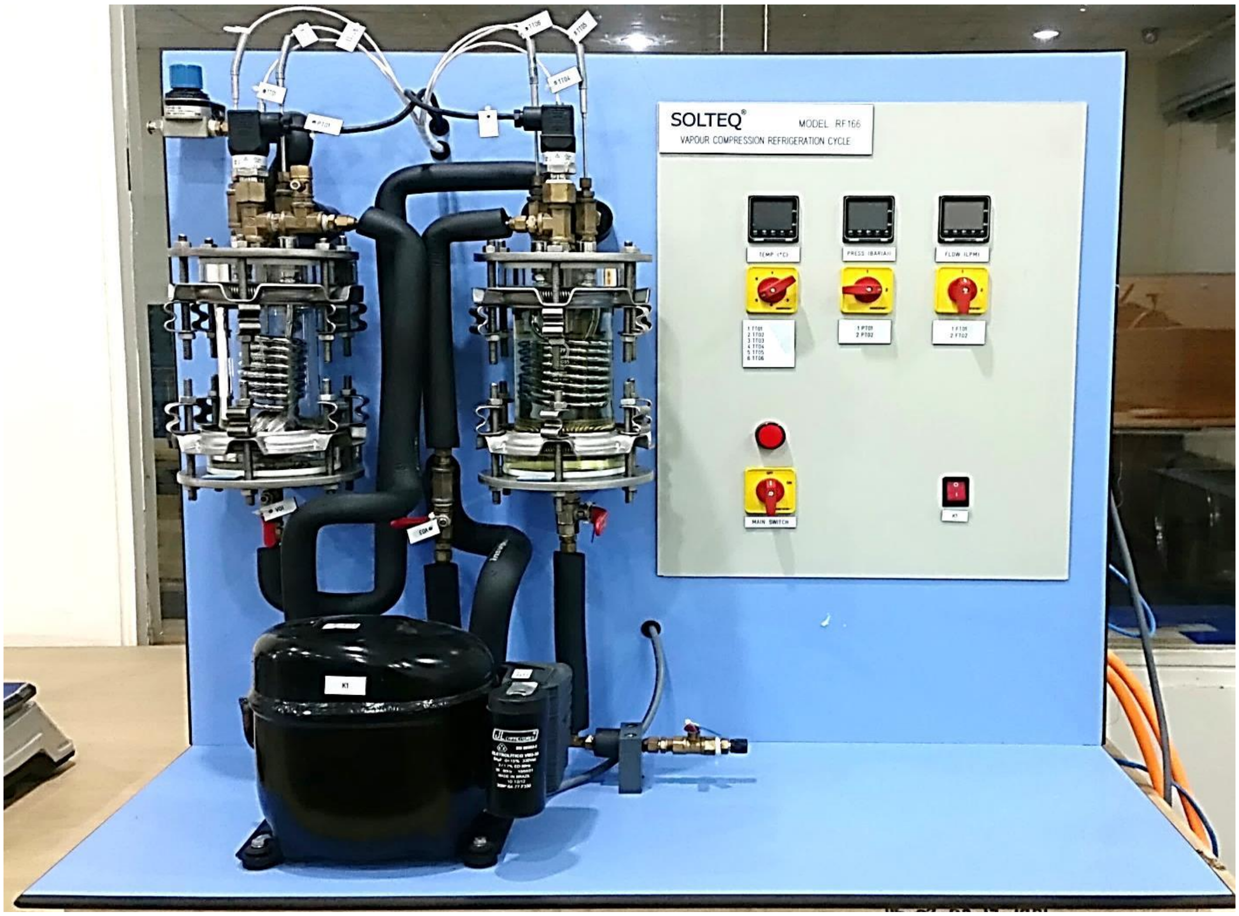

Figure 11: Vapour Compression Refrigeration Cycle

Concerned Lab	**Thermodynamics/Heat Transfer**
List of Experiments	• Demonstration of Vapour Compression Cycle • To investigate the relationship between saturation pressure and temperature in the condenser. • To investigate the effect of condensing and evaporating temperatures on the refrigeration rate and condenser heat output. • To determine the compression ratio and its effect on system performance.

Steam Power Plant with Steam Engine

Figure 12: Steam Engine Apparatus

Concerned Lab	**Thermodynamics/Heat Transfer**
List of Experiments	• Demonstration the function of a steam engine. • Investigate the effect of additional evaporation on load fluctuations. • Demonstrating the effect that occurs when additional cold water is supplied.

Pipe Friction

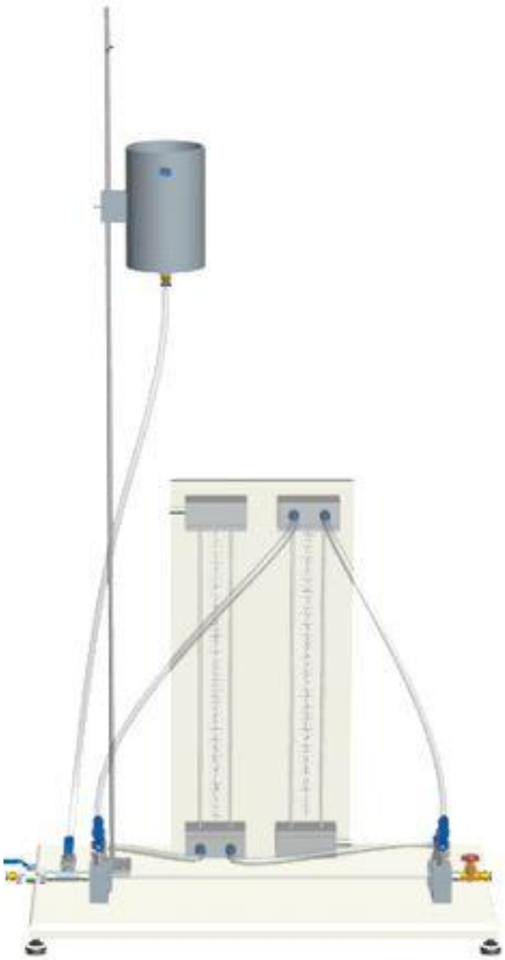

Figure 13: Pipe Friction Apparatus

Concerned Lab	**Fluid Mechanics**
List of Experiments	• To determine the relationship between head loss due to fluid friction and velocity for flow of water through smooth bore pipes. • To confirm the head loss predicted by pipe friction equation associated with flow of water through a smooth bore pipe demonstrating the effect that occurs when additional cold water is supplied.

Properties of Fluid and Hydrostatics

Figure 14: Properties of Fluids and Hydrostatics Bench

Concerned Lab	Fluid Mechanics
List of Experiments	• To determine the density of a liquid. • To determine the specific gravity of liquid using universal hydrometer • To demonstrate the capillary effect in the capillary tubes and thin films • To determine the kinematics viscosity for different kind of fluid • To demonstrate the Pascal's Law • To demonstrate the Archimedes' Law • To determine the key parameters of a pontoon and to investigate its stability • To determine the center of pressure on both submerged and partially submerged plane surface. • To demonstrate the application of dead weight tester in bourdon pressure gauge calibration • To demonstrate and compare the application of water and mercury manometer

Hydraulic Bench

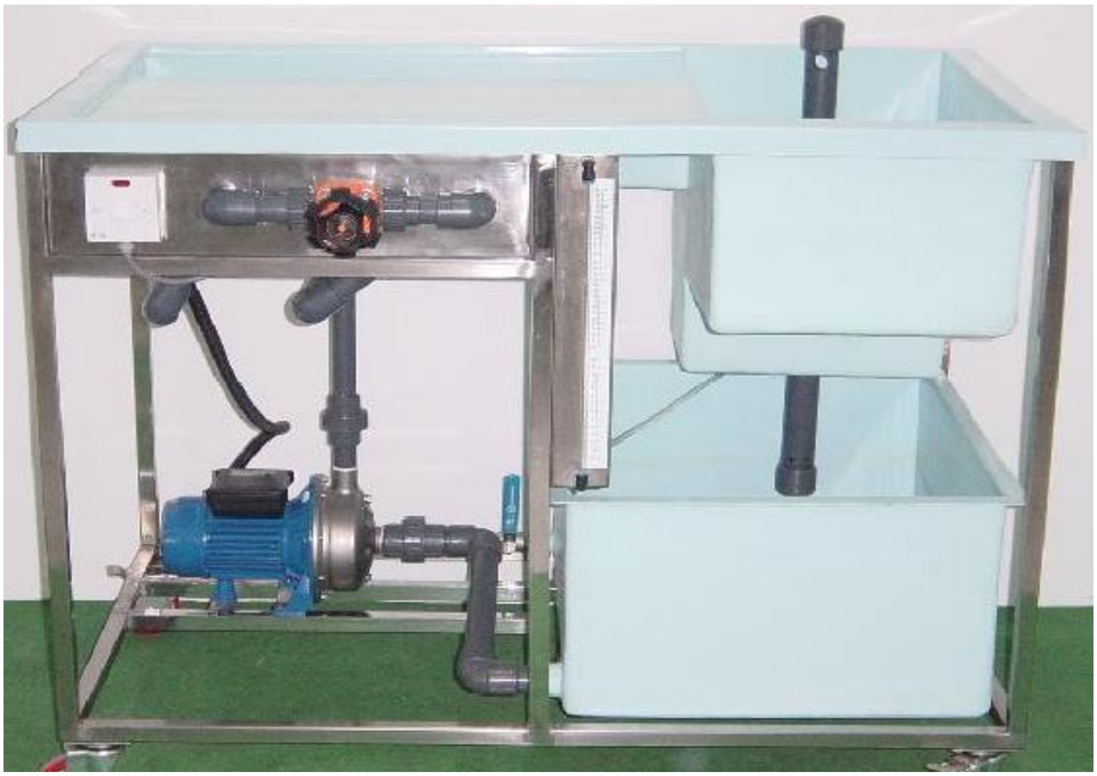

Figure 15: Hydraulic Bench

Concerned Lab	Fluid Mechanics
Purpose	• To determine volumetric flow rate using volumetric method

Temperature measurement and Calibration

Figure 16: Temperature Measurement and Calibration unit

Concerned Lab	**Thermodynamics**
List of Experiments	• PRT Simulation, Constant voltage and Current • PRT Simulation, Two, Three and Four wire Connection. • PRT Calibration • NTC Thermistor Linearity • J and K Thermocouple Linearity • Thermocouples in series and parallel • Thermocouples and Seebeck effect

Thermal Conductivity of Liquids & Gases

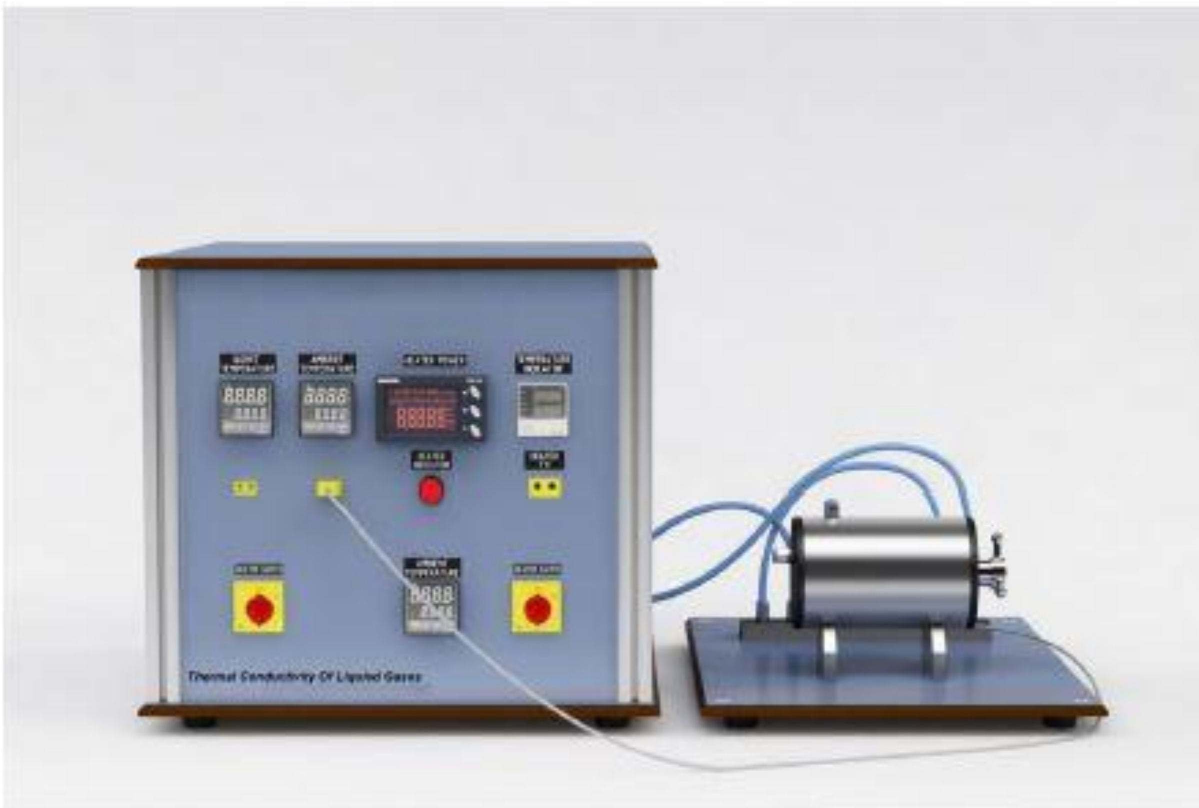

Figure 17: Conductivity Apparatus for Liquids and Gases

Concerned Lab	**Heat Transfer**
List of Experiments	• To calibrate the unit by establishing the incidental heat transfer. • To determine the thermal conductivity of air and acetone

Linear and Radial Heat Transfer

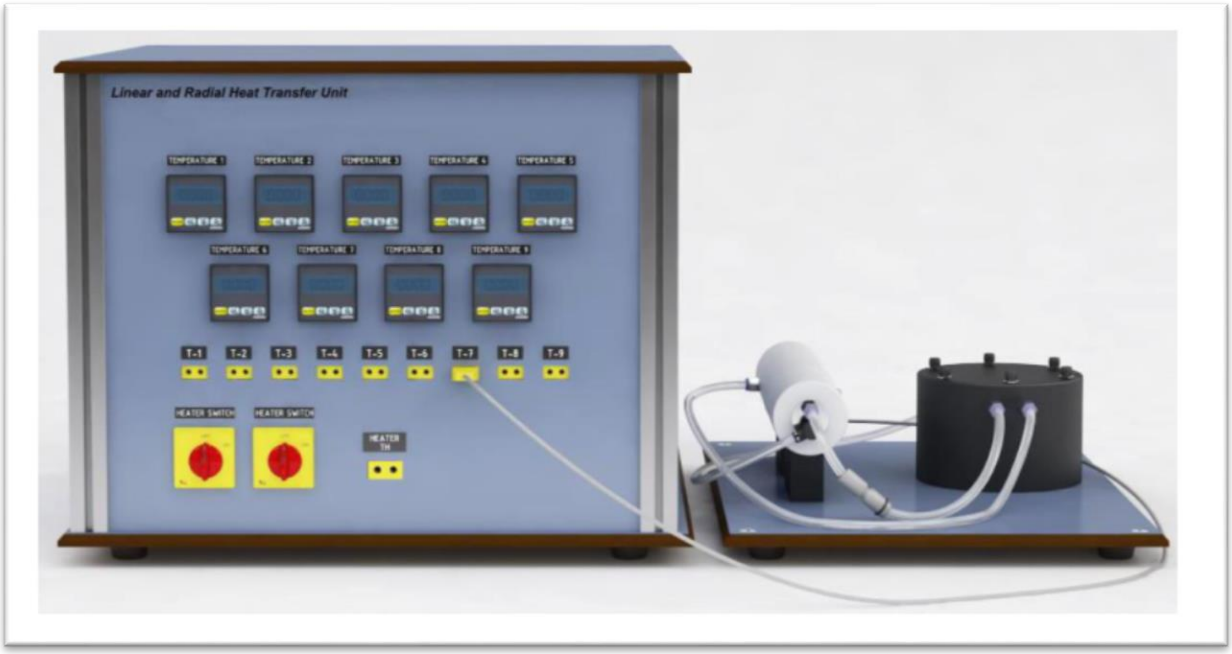

Figure 18: Conductivity Apparatus for Linear and Radial Metals

Concerned Lab	**Heat Transfer**
List of Experiments	• To investigate Fourier's Law for the linear conduction of heat along a homogeneous bar. • To study the conduction of heat along a composite bar and evaluate the overall heat transfer coefficient. • To investigate the effect of a change in the cross-sectional area on the temperature profile along a thermal conductor. • To examine the temperature profile and determine the rate of heat transfer resulting from radial conduction through the wall of a cylinder. • To demonstrate the effect of surface contact on thermal conduction between adjacent slabs of material. • To investigate the influence of thermal insulation upon the conduction of heat between adjacent metals.

Thermal Conductivity of Building Materials

Figure 19: Conductivity unit for different building materials

Concerned Lab	**Heat Transfer**
List of Experiments	• To determine the thermal conductivity of different building materials • To determine the efficiency of insulating material

Free and Forced Convection

Figure 20: Free and Forced Convection Unit

Concerned Lab	Heat Transfer
List of Experiments	• To demonstrate the relationship between power input and surface temperature in free convection. • To demonstrate the relationship between power input and surface temperature in forced convection. • To demonstrate the use of extended surface to improve heat transfer from the surface. • To determine the temperature distribution along an extend surface.

Radiation Heat Transfer

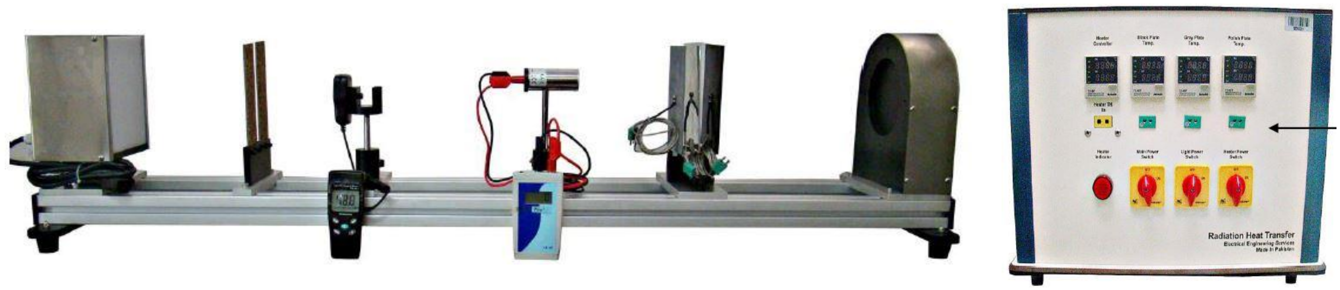

Figure 21: Radiation Heat Transfer unit

Concerned Lab	Heat Transfer
List of Experiments	• To show that the intensity of radiation on a surface is inversely proportional to the square of the distance of the surface from the radiation source • To show that the intensity of radiation varies as the fourth power the source temperature. • To show that the intensity of radiation measured by the radiometer is directly related to the radiation emitted from a source by the view factor between the radiometer and the source • To determine the emissivity of radiating surfaces with different finishing, namely polished, grey and matt black • To demonstrate how the emissivity of radiating surface in close proximity to each other will affect the surface temperature and heat exchanged. • To determined validity of Kirchhoff's Law, which states that, the emissivity of a grey surface is equal to its absorptivity of radiation received from another surface when in a condition of thermal equilibrium • To demonstrate that the exchange of radiant energy from one surface to another is dependent upon their interconnecting geometry, i.e. a function of the amount that each surface can 'see' of the other • To show that the luminance of a surface is inversely proportional to the square of the distance of the surface from the light source • To show that the energy radiated in any direction at an angle with a surface is equal to the normal radiation multiplied by the cosine of the angle between the direction of radiation and the normal to the surface • To show that light passing through non-opaque matter is reduced in intensity in proportion to the thickness and absorptivity of the material.

Conduction & Convection

Figure 22: Heat Conduction & Convection Unit

Concerned Lab	Heat Transfer
List of Experiments	• To study the conduction of heat and overall heat transfer along a composite bar. • To experimentally prove Fourier's Law. • To demonstrate the effect of surface contact on thermal conduction between adjacent slabs of material. • To examine the temperature profile and determine the rate of heat transfer resulting from radial conduction through the wall of a cylinder. • To study the temperature curves over the length for different materials. To observe the effect of flow velocity on the convective heat transfer coefficient.