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Heat & Mass Transfer Lab

Mechanical Engineering Lab Equipment

THERMAL CONDUCTIVITY BY GUARDED HOT PLATE

DESCRIPTION:-

The unit consists of a guarded hot plate assembly formed by a central heater and switched between the lower and upper plates and rings. Two identical specimen of the material to be tested are clamped between the two cooling plates and the heater plate assembly. Heater input to central heater measured by voltmeter and ammeter giving the heat flow rate across the specimen. Thermocouple is placed in heater and cooling plated to measure the temperature difference across the specimen.

SPECIFICATION:-

1) Central heater plate dimmer - 90m.m.
2) Cooling chamber with water circulation arrangement.
3) Specimen - Thickness = 6 - 25 m.m. Diameter = 150m.m. approx.
4) Central and guard heaters of suitable ranges.
5) The apparatus packed with outer box housing.
6) Thermocouples in insulating sleevings.

FEATURES:-

- ✓ Thermal conductivity of insulating materials in the form of slab like wood, bakelitethermocole can be determined.
- ✓ Thermal conductivity can be determined over the mean temperature range of 400 to 1000c .

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Heat & Mass Transfer Lab

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THERMAL CONDUCTIVITY OF INSULATING POWDER

DESCRIPTION:-

The unit consists of two thin wall concentric copper spheres. The inner sphere house the heating coil. Heating coil is made up of nichrome wire wound on mica sheet. The insulating powder packed between two shells. Power supply to the heater is given through a dimmerstat& is measured by voltmeter & an ammeter. Temperature can be measured with the help of thermocouples. Four thermocouple are embedded on inner sphere and six thermocouples are embedded on outer sphere. The entire ten temperature indicator, these reading enable of insulating powder.

SPECIFICATION:-

1) Inner sphere - copper sphere, 100 m.m. dia. halved construction with micaheater inside.
2) Outer sphere - copper sphere, 200m.m. dia. halved construction.
3) Thermocouples on outer surface of inner sphere and inner surface of outersphere.
4) Dimmerstat - 2A.
5) Voltmeter, Ammeter. (0 - 300 V) (0 - 3 A)
6) Temperature indicator. (0 - 300^0c)

FEATURES:-

- ✓ Thermal conductivity of insulating powder can be calculated.
- ✓ Wide range of experiments can be performed to find value over a range of temperatures.
- ✓ Ideal for group studies & demonstration.
- ✓ Panelised instruments mounted on a control panel.
- ✓ Easy to operate.
- ✓ Useful for institutions, research laboratories & insulating powder manufactures

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Heat & Mass Transfer Lab

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THERMAL CONDUCTIVITY OF METAL ROD

DESCRIPTION:-

The unit consists of a copper bar, which is heated at one end, a heat sink is provided at other end. The test section of bar is properly insulated and along the length of bar, thermocouples are attached. Heat conducted through the section of bar is measured by heat collection in water cooled heat sink. A panel comprising of controls and measurements is provided, which provides easy operation and study mounting of unit. Bar of different metal other then copper can be provided, on request at extra cost.

SPECIFICATIONS:-

1) Metal Bar - 25 mm diaof adequate length, provided with 6 thermocouples along the length, band heater at one end and heat collection in water cooled heat sink at other end. Test portion of bar is adequately insulated.
2) Instruments panel comprising of
   a) Voltmeter - 1 No. (0 - 300 V)
   b) Ammeter - 1No. (0 - 3 A)
   c) Dimmerstat 0-230v, 2A, capacity.
   d) Digital temperature indicator (0 - 300 C)
3) Measuring flask and stop watch.

SERVICE REQUIRED:-

- ✓ Bench area of 1.5 m. x 1 m. at working height.
- ✓ 230 v, AC electric supply with earthing connection.
- ✓ Water supply at the rate of 1 lit./min. at constant head.

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Heat & Mass Transfer Lab

Mechanical Engineering Lab Equipment

HEAT EXCHANGER APPARATUS

The unit consists of a m.s. shell, in which copper tubes are fitted. The baffle in the end box makes the tube arrangement two-pass type. The cold fluid, i.e. air enters the shell & flows over the tubes. Hot fluid is hot water, which is obtained from a geyser & flows through the tubes. 25% cut baffles are provided in the path of air.

Measuring tank measures water flows rate while an orifice with water manometer measure air flow. Thermometers measure the inlet & outlet temperatures of the fluids. The unit enables students to determine the heat transfer rate, heat transfer coefficient, LMDT & effectiveness of heat exchanger, in laminar and turbulent flow of air.

Specifications:

- ✓ Shell-150 mm I. D., 750 mm long provided with end boxes, cold & hot fluid inlet & outlet connections & 4 Nos. equi distance 25% cut baffles along the length. (two pass design)
- ✓ Copper tubes-1/4" O. D. copper tubes for hot water 32 Nos
- ✓ Centrifugal blower 1/2 HP, to supply air.
- ✓ Geyser to provide hot water-3 kw capacity.
- ✓ Measuring tank & stop clock for water flow measurement.
- ✓ Orifice with water manometer to measure air flow.
- ✓ Thermometers to measure the inlet & outlet temperature of fluids.

Service Required:

- ✓ Floor space area 1 m x 1.5 m.
- ✓ Water supply @ of about 8-10 lit/min at constant head.
- ✓ 440 v, 32 A, A.C. supply with neutral and earthing connection.

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Heat & Mass Transfer Lab

Mechanical Engineering Lab Equipment

PARALLEL COUNTER FLOW APPARATUS

The unit consists of a tube in tube type concentric tube type exchanger hot fluid flow through inner tube and cooling water flows through the annulus. The apparatus is mounted on a board with system of valves and pipes. The heat exchanger arranging to instruction shown on board. Hot fluid flows always in one direction & cold fluid flow direction can be changed accordingly. Inlet temperature of heat exchanger can be measured by thermometers. A electric geyser is used to heat the water. Outer tube of the heat exchanger is provided with adequate thermocouple insulation to minimize the heat losses.

Features:

- ✓ Performance and working of heat exchangers can be studied easily.
- ✓ Both parallel and counter flow arrangements can be studied on the same set-up with simple operation of valves.
- ✓ Wide range of experiments can be performed with varying flow rates on hot and cold side.
- ✓ Ideal for group studies.

Specification:

- ✓ Heat exchanger :- a) Outer tube - 25 mm. I. D. 1 m. long G. I. b) Inner tube - 12.5 mm. O. D. 1 m. long. Copper.
- ✓ Valve arrangement for parallel flow/counter flow operation and flow control.
- ✓ Geyser to obtained hot water, 3 KW
- ✓ Thermometers to measures inlet and outlet temperature of hot and cold water.

Service Required:

- ✓ Suitable bench area to mount the instrument.
- ✓ 230 V. 15 A. supply with earthing connection.

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Heat & Mass Transfer Lab

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CRITICAL HEAT FLUX APPARATUS

The unit consists of a cylindrical glass container containing distilled water. Heating surface is in the form of a Nichrome heating wire completely surbmerged in the water. Thermometer's are provided to measure the temperature of water in the container, variac is provided to supply electrical input to the test heating wire.

Specification:

- ✓ Cylindrical glass vessel diameter=200 mm. approx.
- ✓ Cylindrical glass vessel height=100 mm.
- ✓ Bulk heater :- Nichrome coil.
- ✓ Test heater :- Nichrome wire.
- ✓ Thermometer:- 0-1000c.
- ✓ Dimmerstat, voltmeter, ammeter (A-10A) (Dimmer-10 A)
- ✓ Heater-1 Kw.

Features:

- ✓ Pool boiling phenomenon can be studied at atmospheric pressure.
- ✓ Ideal for group studies & demonstration for boiling regions upto critical heat flux conditions.
- ✓ A range of experiments can be performed with varying degree of sub cooling.

Service Required:

- ✓ Suitable bench area to mount the instrument.
- ✓ 230 V. A. C. supply with earthing connection.

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Heat & Mass Transfer Lab

Mechanical Engineering Lab Equipment

STEFAN BOLTZMANN APPARATUS

The unit consists of a hemisphere surrounded by hot water. The instrument determines Stefan Boltzmann constant. Water heating tank is provided to supply hot water. Stefan Boltzmann constant is determined from the temperature raise rate when blackned disc is inserted at the center of disc from hemisphere by radiation & its temperature begins to rise.

Specification:

- ✓ Hemisphere diameter-20 cms approx.
- ✓ Diameter of outer jacket-20 cm approx.
- ✓ Base bakelite plate-25 cm approx.
- ✓ Diameter of test disc-2 cm.
- ✓ Thickness of test disc-2 mm.
- ✓ No. of thermocouples on hemisphere-4.
- ✓ Water tank of 8 lit. capacity with immersion heater.
- ✓ No. of thermocouples on test disc-1.
- ✓ Stop clock.
- ✓ In control panel Temperature indicator with normal range 0-000c.

Features:

- ✓ The phenomenon of heat transfer by radiation can be understood well.
- ✓ Stefan Boltzmann constant can be calculated.
- ✓ Easy to operate.
- ✓ Ideal for group studies and demonstration.
- ✓ Service Required.
- ✓ Suitable bench area to mount the instrument.
- ✓ 230 V, 15 A. A. C. supply with earthing connection.

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Heat & Mass Transfer Lab

Mechanical Engineering Lab Equipment

EMISSIVITY MEASUREMENT APPARATUS

The unit consists of a two circular aluminium plates of identical dimensions. One of the two plates is the blackened and considered as black surface. While other plates is the test plates. Both the plates have Nichrome wire heater bound in mica sheet attached to them. Both the plates are keep in close enclosure. Supply of heat to both the plates is given by different variacs measured by a voltmeter & ammeter. Heat input to both the plates can be read with the help of SPDT switches. A temperature indicator is provided to measure the temperature of both the plates.

Specifications:

- ✓ Enclosure of suitable size with front side of perfix.
- ✓ Test plate size-16 cm dia.
- ✓ Reference plate size-16 cm dia.
- ✓ Voltmeter-0-300 V, Ammeter-0-3 A, Temp. Indicator 0-3000c.

Features:

- ✓ Emissive of a non black surface can be determined over a range of temperature.
- ✓ Ideal for group studies & demonstration.
- ✓ Panelised instruments mounted on a control panel.
- ✓ Easy to operate.

Service Required:

- ✓ Suitable space to mount the instrument.
- ✓ 230 V. 15 A. A. C. supply with earthing connection.

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Heat & Mass Transfer Lab

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FORCED CONVECTION APPARATUS

The unit consists of mainly a centrifugal blower, electrically heated test section, control valve to regulate the air flow and an orificemeter and U-tube water manometer for flow measurement. Thermocouples are used to measure the pipe wall temperature and also the air temperature at inlet and exit. The apparatus mainly designed to find out the value of heat transfer coefficient under the air different conditions.

Specification:

- ✓ Diameter of test specification (G.I.) pipe 36 mm.
- ✓ Length of the test section-400 mm.
- ✓ Orifice meter 14 mm.
- ✓ No. of thermocouples pipe surface 6 Nos.
- ✓ No. of thermocouples for air temperature 2 Nos.
- ✓ Nichrome heater mounted on pipe surface.
- ✓ Blower 0.5 Hp with motor.

Features:

- ✓ Heat transfer in forced convection can be studied well.
- ✓ The value of heat transfer coefficient is calculated under various fluid flow conditions.
- ✓ Ideal for group studies & demonstration.

Service Required:

- ✓ Suitable bench area to mount the instrument.
- ✓ 230 V. 15 A. A. C. supply with earthing connection.

Range Of Experiments:

To study the temperature distribution along the length of test section by

- ✓ Natural convection.
- ✓ Forced convection.

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NATURAL CONVECTION APPARATUS

The unit consists of vertical cylinder fitted in a large enclose, with top and bottom open to ensure undisturbed natural convection apparatus. Perspex sheet provided at the front side of enclosure for visual display. Heating element provided inside the cylinder to heat it uniformly and the heat is dissipated from other surface by natural convection to ambient air. Thermocouples cylinder surface and one more thermocouple records the ambient temperature in the duct. The heater input can be varied with the help of a dimmerstat and measured by voltmeter and an ammeter.

Specification:

- ✓ Enclosure size-20 cm x 20 cm x 60 cm long approx.
- ✓ Tube size (Test cylinder) 38 mm dia x 500 mm length approx.
- ✓ Heater-Nichrome heater.
- ✓ Thermocouples with sleeving.

Features:

- ✓ Heat transfer coefficient in natural convection conditions can be calculated.
- ✓ Variation of local heat transfer coefficient over the entire length of vertical cylinder can be studied.
- ✓ Average value of heat transfer coefficient can be obtained from suitable correlation & can be compared with the experiments can be performed for various values of heat input.
- ✓ Ideal for group studies demonstration.

Service Required:

- ✓ Suitable bench area.
- ✓ 230 V. 15 A. A. C. electric supply with earthing connection.

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PIN FIN APPARATUS

The unit consists of a brass or aluminum fin of a circular cross section fitted across at one end of a long rectangular dust.

The other end of the duct is connected to suction side of the blower and the air flows past the fin perpendicular to its axis. One end of the fin projects outside the duct & is heated by an electric heater. Temperature at five points along the length of the fin is measured by thermocouples. The blower is not run in natural convection condition while it is run in forced convection conditions. The air flow rate can be varied by control valve on delivery side of the blower.

Specification:

- ✓ Duct size-15 cm x 10 cm x 100 cm long approx.
- ✓ Fin size-12.7 mm. dia. 15 cm long approx.
- ✓ Blower & motor-0.5 Hp centrifugal blower.
- ✓ Heater-Nichrome heater.

Features:

- ✓ Temperature distribution along the length of the fin can be studied in forced convection conditions.
- ✓ Theoretical temperature distribution can be obtained & compared with the experimental results.
- ✓ Fin of brass materials can be tested.
- ✓ A range of experiments can be performed forced convection conditions.
- ✓ Ideal for group studies & demonstration.

Service Required:

- ✓ Suitable floor space.
- ✓ 230 V, 15 A. A. C. supply with earthing connection.

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HEAT PIPE APPARATUS

The unit consists of 3 identical cylindrical conductors in respect of geometry. One end of these is heated electrically while there are small capacity tanks acting as heat sinks at the other end. The unit consists of a heat pipe, a copper pipe & stainless steel pipe.

Thermocouples are embedded along the lengths to measure the temperature distribution & the heat transfer rate is noted in terms of the temperature rise in the heat sink tanks. Performance of heat pipes as a super conducting device could be studied well in terms of the temperature distribution along the length at a given instant and could be compared with other two members. The apparatus could be operated under different heat input rates to the heaters.

Specification:

- ✓ O.D. of heat pipe-30 mm. Dia. nominal stainless steel pipe.
- ✓ Stainless steel pipe-30 mm. dia. nominal.
- ✓ Copper pipe-30 mm. dia. nominal.
- ✓ Length of the pipes-350 mm. each approx.
- ✓ Condenser tank-Approx. 2 Lit. Capacity.
- ✓ Working fluid in heat pipe-distilled water.
- ✓ Dimmerstat 0-2 A, 0-250 V.
- ✓ Voltmeter-240 volts.
- ✓ Ammeter-0-3 A.
- ✓ Temperature indicator 0-2000 c multi channels

Service Required:

- ✓ Suitable bench area.
- ✓ 230 V. 15 A. A. C. electric supply with earthing connection.

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LAGGED PIPE APPARATUS

The unit consists of a three concentric pipes of a very small thickness as compared to diameter. They are arranged concentrically over two supports and closed with the help of two disces. The annual in between the cylinders are filled completely by two different insulating materials. Thermocouples at proper position are used to measure the temperature. Inside the inner pipe a nicrome wire heater is placed. Heat input to the heater is given through a variac and measured by a voltmeter and ammeter. By varying the heat input rates wide range of experiments can be performed.

Specification:

- ✓ G.i pipe inside-5 cm dia. Approx.
- ✓ G.I. pipe middle-10 cm dia Approx.
- ✓ G.I pipe outer-15 cm dia Approx.
- ✓ Length of pipes-1 meter Approx.

Features:

- ✓ The concept of double and single lagging can be studied easily.
- ✓ Effects of different insulating material combinations can be seen.
- ✓ Easy to operate.
- ✓ Ideal for group studies and demonstration.

Range Of Experiments:

- ✓ To determine heat flow rate through the lagged pipe and compare it with the heater input for known values of thermal conductivity of lagging material.
- ✓ To determine the thermal conductivity of lagging material by assuming heater input to be the heat flow rate through the lagged pipe.
- ✓ To plot the temperature distribution across the lagging material.

Service required:

- ✓ Suitable bench area to mount the instrument.
- ✓ 230 V A.C. supply with earthing connection.

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COMPOSITE WALL APPARATUS

The unit consists of a three slabs of different materials namely mild steel, wood & backlite. Nicrome heater is provided to supply heat input across these composite walls. Total heater assembly comprises of a heater bound between two aluminum plates, on both sides of this heater identical structures of composite wall are placed. Thermocouples are provided at proper position in the composite wall to record desired inside temperature of composite wall. Multichannel temperature indicator is used to measure this temperature. Small hand press provided to press the wall on each other & to ensure that no air gap remaining between two plates. Heat input to heater is given through a variac & measured by voltammeter & ammeter. By varying heat input & combinations of the composite structure wide range of experiment can be performed.

Specification:

- ✓ Diameter of slabs.
- ✓ Wood-30 cm.
- ✓ Mild steel-30 cm.
- ✓ Backlite-30 cm.
- ✓ Thickness of slabs.
- ✓ Approximately-10-12 mm each.
- ✓ Heater-Nicrome wire type.

Features:

- ✓ The temperature distribution across the composite wall can be studied for given arrangement of slabs.
- ✓ The change in temperature distribution across the composite walls by altering combination of slabs can be observed.
- ✓ Easy to operate.
- ✓ Ideal for group studies & demonstration.

Service Required:

- ✓ Suitable floor space for the instrument.
- ✓ Electric supply 230 V, 5 A. A. C. with earthing connection.