FTS LAB POTFOLIO

Course ID: ME - 3307
Department: Mechatronics Department – College of Engineering

Lab Objectives:

- The objective of this lab is to introduce the student the fundamental theories and the industrial applications of thermodynamics and heat transfer developed in class.
- Recall the associated concepts form theory regarding thermodynamics and heat transfer.
- Compute the thermodynamic properties of fluids.
- Observe the basic principles of thermodynamics on systems of refrigeration.
- Observe thermodynamic parameters in modes of heat transfer on different materials.
- Design/Develop solutions for complex engineering problems covered under the scope of this course and lab.

Text Books:

1. Introduction to Thermodynamics and Heat Transfer, 2nd Edition McGraw Hill, by Yunus A. Cengel.

2. Fundamentals of Heat and Mass Transfer, 6th Edition John Wiley & Sons Inc., by Frank P. Incopera et. al.

Radiation heat transfer unit

The unit consists of a horizontal track fitted with interchangeable heat radiation source end and light source. Either the heat radiation detector or the light meter may be placed on the horizontal track. In addition, a number of accessories can be fitted for experimental purposes. These include metal plates, two vertically orientated metal plates to form an aperture, and a number of light filters. The radiation detectors accessories are all clamped to stand, which enable them to be positioned at different distances from the source. Distances are measured with measuring tape.
Temperatures of the three metal plates used in conjunction with the heat radiation source are displayed on the Heat Transfer Apparatus. Output from heat radiation detector and light meter are displayed on digital read out.

Temperature Measurement Bench

The **EES® Temperature Measurement and Calibration** apparatus has been designed for students to study different types of temperature measurement methods. This is a complete, freestanding apparatus to demonstrate fundamental temperature measuring techniques using thermocouples, mercury in glass thermometer, resistance temperature detector (RTD), thermistor, bimetallic temperature indicator and etc.
Temperature measurement is used to measure air temperature, boiling water temperature, ice-point temperature and wet or dry bulb temperature.
Temperature can be measured via a various ranges of sensors. All of these sensors infer temperature by sensing changes in physical characteristics. Thermocouples consist essentially of two wires made of different metals that joined at one end. Resistance temperature detector devices capitalize on the fact that the electrical resistance of a metal changes as a result of temperature change. Thermistors are based on resistance change in ceramic semiconductor where the resistance drops nonlinearly with temperature rise. Bimetallic devices take advantage of the difference in rate of thermal expansion between different metals.

Free and Force convection unit

Free Convection:
A heated surface dissipates heat primarily through a process called convection. Heat is also dissipated by conduction and radiation, however these effects are not considered in this experiment. Air in contact with the hot surface is heated by the surface and rises due to a reduction in density. The heated air is replaced by cooler air which is in turn heated by the surface and rises. This process is called free convection.
Forced Convection:
In free convection the heat transfer rate from the surface is limited by the small movements of air generated by this heat. More heat is transferred if the air velocity is increased over the heated surface. This process of assisting the movement of air over the heated surface is called Forced Convection. Therefore a heated surface experiencing forced convection will have a lower surface temperature than that of the same surface in free convection, for the same power input.

Laminar / Viscous Flow Heat

When more viscous fluid e.g. most oils have to be processed , the velocities used are very low due to excessive pressure drop and pumping power which would otherwise be involved. Flow of these fluids is likely to be laminar rather than turbulent and this is also applies to any heat exchangers in the process plant.

The EES® Laminar and Turbulent flow Apparatus unit has been designed to demonstrate and investigate heat transfer in laminar and viscous flow provide students, experimental work related to transfer of heat in a concentric tube heat exchanger, when flow is laminar. The unit will be of interest of everyone involved in heat transfer.

Radial and Linear Heat transfer unit

The equipment comprises two heat-conducting specimens, a multi-section bar for the examination of linear conduction and a metal disc for radial conduction Linear Module:

Fourier's Law of Heat Conduction is most simply demonstrated with the linear conduction module. This comprises a heat input section fabricated from brass fitted with an electrical heater. Three thermistor temperature sensors are installed at 10mm intervals along the working section

Radial Module:

The radial conduction module comprises a brass disc 110mm diameter and 3mm thick heated in the center by an electrical heater and cooled by cold water in a circumferential copper tube. Thermistor temperature sensors are fitted to the center of the disc.

Shell and Tube Heat Exchanger

Most chemical Process involves heat transfer to and from the process fluids. The most commonly used heat transfer equipment is the shell and tube heat equipment.

Refrigeration Laboratory unit

The basis for the functioning of a heat pump is a thermodynamic cyclic process. In a thermodynamic cyclic process a service medium (e.g. R134a) passes through various changes of state in a pre-set sequence. The changes of state are repeated cyclically, so the service medium repeatedly returns to its initial state. That is why the process is termed a cyclic process. Change of state refers to compression, expansion, heating or cooling:

1. Compression means absorption of mechanical energy
2. Expansion means discharge of mechanical energy
3. Heating means absorption of thermal energy (heat)
4. Cooling means discharge of thermal energy

EXPANSION PROCESS OF A PERFECT GAS

The concept of an ideal gas (perfect gas) is introduced early in the study of thermodynamics because it plays a crucial role in understanding the simplest relationships between pressure, volume, temperature and other thermodynamic properties. By using these relationships, and informed by the First Law of Thermodynamics, process path calculations can give heat and work requirements.

Many gases that exist near room temperature and atmospheric pressure exhibit near ideal gas behavior. Air is one of these gases. This experiment, although simple in concept, will allow you to consolidate your knowledge of ideal gas behavior.

The Expansion of Perfect Gas apparatus is a self-sufficient bench top unit designed to enable students to familiarize with some fundamental thermodynamic processes.

Comprehensive understanding of the P-V-T relationship is fundamentally important in the applications of thermodynamics in the industry.