INTRODUCTION TO THERMODYNAMICS

INTRODUCTION

Thermodynamics is the study of force due to heat or the study of heat due to force

The study of the flow of the heat or any other form of energy into or out of a system as it undergoes a physical or chemical transformation is called thermodynamics

BASIC DEFINITIONS IN THERMODYNAMICS

1. System: This is the part of the world under study

2. Surroundings: This is everything outside the system

3. Boudary: This is the separation between the system and the surroundings. A boundary could be real or imaginary, rigid or non rigid.

4. Universe: This is everywhere including the system, surroundings and boundaries.

SYSTEM

TYPES OF SYSTEMS

1. Open System: This is also known as Control Volume. This is a system in which mass and energy are exchanged with the surrounding

2. Closed System: This is also called the Control mass.

THERMODYNAMIC PROPERTIES

Thermodynamic properties are defined as characteristic features of a system, capable of specifying the system’s state.

TYPES OF PROPERTIES

1. Intensive Properties: These depend on the type of matter and not on the amount of the substace. Examples include Temperature, Pressure, Specific Volume, Concentration, Density, Chemical potential, Refractive index, Specific heat, Melt point, Boiling point, Colour, Viscosity

2. Extensive Properties: These depend on the amount of matter. Examples include Amount of substance (n), Internal Energy (U), mass (m), Volume (V), Energy (E), Enthalpy (H), Entropy (S), Gibb’s free energy (G), Heat Capacity (C\_p), Helmholts Energy (A) or (F).

THERMODYNAMIC STATE

A thermodynamic state of a system is its condition at a specific time i.e. fully identified by values of a set of parameters, known as state variables, state parameters or thermodynamic variables.

STATE VARIABLES

When the properties of a system define the state of that system, it is called state variables.

Therefore, the state may be represented, identified or described by certain observable microscopic properties (state variables) such as:

Pressure (P), Volume (V), Temperature (T), Concentration (C), Internal Energy (U), Enthalpy (H).

STATE FUNCTION

A state function is also known as a point function. It is a thermodynamic property of a system whose value depends only on the present state of the system and is independent of the path by which that state was removed.

Examples of state functions include volume, pressure, Internal Energy, Enthalpy, Entropy

State functions are exact integrals because they do not depend on the path taken

PATH FUNCTION

This depends on the path taken. Examples include arc length and heat (q), work (W).

Path functions are not exact integrals because details of the path taken has to be processed.

Work and heat transfer are process functions. This means that they occur when there is a change in state.

STEADY STATE AND TRANSIENT STATE

A system is at steady state if none of its properties change with time.

In real applications, when property variations with time are small enough to ignore, the devices are assumed to be at steady state.

E.g. Energy transfer rates of a gearbox at steady state.

TRANSIENT STATE

Many devices undergo periods of transient operation where the state changes with time. This is observed during startup and shutdown periods.

E.g. transient operation of a motor