# CHAPTER ONE

# INTRODUCTION AND OVERVIEW

**Thermal Sciences (Section 1.1)**

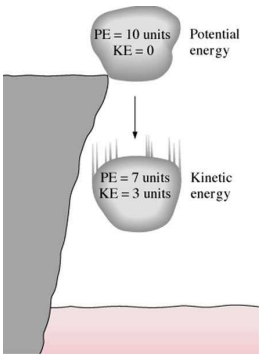
- The physical sciences that deal with energy and the transfer, transport, and conversion of energy
- Divided into two main subcategories: thermodynamics, heat transfer.

**Thermodynamics (Section 1.2)**

The study of thermodynamics is concerned with the ways energy is stored within a body and how energy transformations, which involve heat and work, may take place.

Conservation of Energy Principle

- During an energy interaction, energy can change from one form to another but the total amount of energy remains constant
- Energy cannot be created or destroyed




First Law of Thermodynamics

An expression of the conservation of energy principle

Second Law of Thermodynamics

- Actual processes occur in certain directions and not in the opposite directions.

**Heat (Section 1.3)**

The form of energy that can be transferred from one system to another as a result of temperature difference

Heat Transfer

- The science that deals with the determination of the rates of transfer of heat
- The basic requirement for heat transfer is the presence of a temperature difference

What's the Difference Between Thermodynamics and Heat Transfer?

- Thermodynamics tells us the amount of heat that must be transferred to change the state of a system
- Heat transfer tells us about the rate at which heat is transferred (time necessary for heat to be transferred)

**Dimensions and Units (Section 1.5)**

- Any physical quantity can be characterized by dimensions
- The arbitrary magnitudes assigned to dimensions are called units

Primary (Fundamental) Dimensions

Basic dimensions such as mass, length, time, and temperature

Secondary (Derived) Dimensions
Dimensions that are expressed in terms of primary dimensions (e.g. velocity, energy, volume)

Unit Systems

***SI Units***

- A simple, logical system based on a decimal relationship between the various units
- It is used for scientific and engineering work in most countries

***English Units***

- Has no numerical base
- Various units are related to each other arbitrarily
- Used in the United States

**SI and English Units of Primary Dimensions**

| **Dimension** | **SI Unit** | **English Unit** |
|---|---|---|
| Mass | kilogram (kg) | pound-mass (lbm) |
| Length | Meter (m) | foot (ft) |
| Time | second (s) | second (s) |
| Temperature | Kelvin (K) | rankine (R) |

*Example*: Derive the SI units of velocity, acceleration, force, and work using the units of primary dimensions

Dimensional Homogeneity

- All equations must be dimensionally homogeneous
- Every term in an equation must have the same unit

*Example*: Calculate the total power output of a power plant containing a gas turbine whose output is 200 MW and 10 microturbines whose outputs are 800 kW each.