Engineering Thermodynamics

Classroom Notes

[Handwritten]

For GATE | ESE | PSU's

Mechanical Engineering

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Chapter -1

Basic Concepts

Thermodynamics

It is the science of energy transfer and it effects on properties of system.

Energy transfer may be Heat, or work or both heat and work.

→ The main aim of thermodynamic study is to convert dis-organised form of energy (Heat) into organised form of energy (work) in an efficient Manner.

Applications of Thermodynamics:

Refrigeration, Air-conditioning, steam power plant, I.C. engines etc.

BASIC CONCEPTS

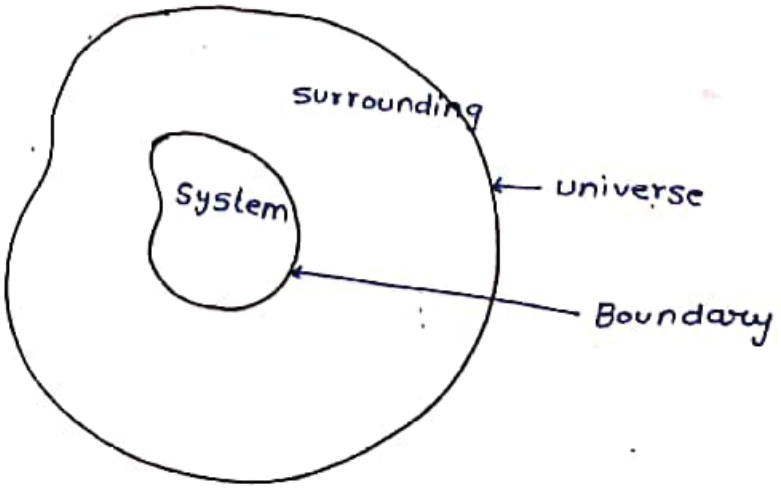
System:-

It is a region in space upon which the study is focused or concentrated.

Surroundings:

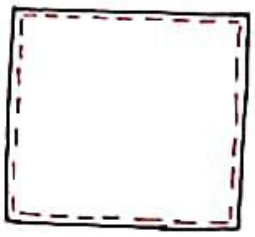
Any thing external to the System, where the effect of system is felt, is known as surrounding.

UNIVERSE = SYSTEM + SURROUNDING

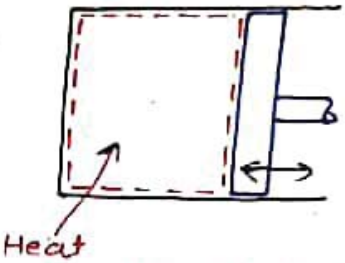


Boundary:- The separation between system and surroundings is known as boundary.

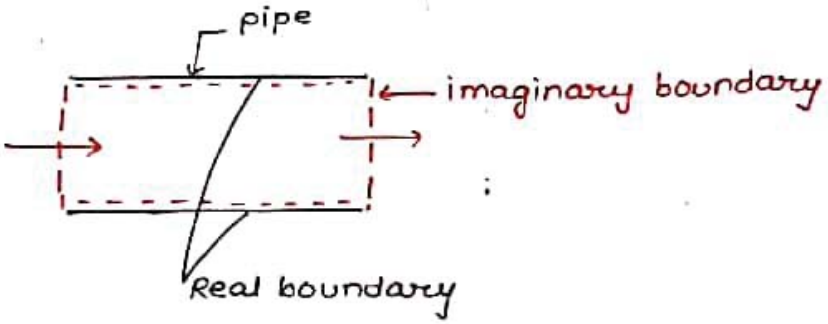
Note: Boundary can be rigid (Fixed), it can be Flexible (Movable), it can be real or imaginary.



Rigid container, Rigid boundary



Movable boundary



Type's of System:→

Type of System	Mass transfer	Energy transfer	Example
closed	X	✓	Water in sealed container, piston cylinder without valve
open	✓	✓	Turbine, compressor, pump, boiler
Isolated	X	X	universe, Hot tea in well insulated Flask.

Note:

In a closed system, as there is no mass transfer, the system mass remains constant and hence it is also known as control mass system.

Control Volume:

It is the volume enclosing or surrounding the device which we wish to analyse. Across the control volume both mass transfer and ~~Heat tra~~ Energy transfer can take place.

Microscopic and Macroscopic Approach of thermodynamics:

In Microscopic approach the behaviour of individual Molecules is taken into consideration, this approach is also stastical thremodynamics. This approach is useful at low densities (at higher altitudes).

In Macroscopic approach individual Molecular behaviour is not taken into consideration that is Average behaviour of molecules is taken into consideration. This approach is also known as classical thermodynamics.

NOTE:

In our Course we follow classical thermodynamics.

Thermodynamic Equilibrium:-

A System is said to be in thermodynamic equalibrium if it is in -

(1) Thermal equilibrium (equality of temperature)

(2) Mechanical equilibrium (equality of pressure/forces)

(3) chemical equilibrium (equality of chemical potential)

Pure Substance:

A substance is said to be pure substance if it is

(1) Homogeneous in chemical composition.

(2) Homogeneous in chemical aggregation. (bonding)