# University of Calcutta
# Semester 2
# PHYSICS
# Paper: PHS-G-CC-3-3-TH (NEW SYLLABUS)
# THERMODYNAMICS : BASIC CONCEPT, ZEROTH LAW, FIRST LAW
# ASSIGNMENT

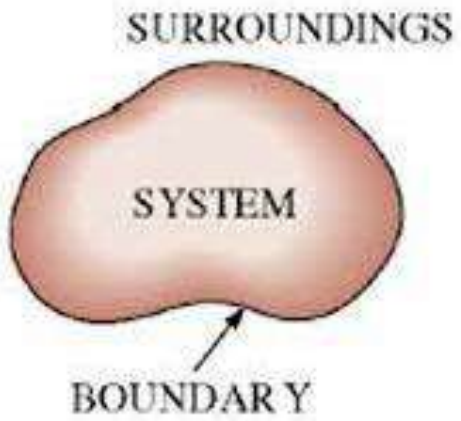
Dr. Koel Adhikary,
Department of Physics
Government Girls' General Degree College

# SOME BASIC IDEAS

**System**—A quantity of matter or a region in space bounded by an arbitrary surfaces for study.

**Surrounding**—The mass or region outside the system.

**Boundary**—The surfaces separate the system from its surroundings.




The boundary can be real or imaginary, fixed or variable.

–It is critically important to *define* your system before attempting to solve a thermodynamic problem.

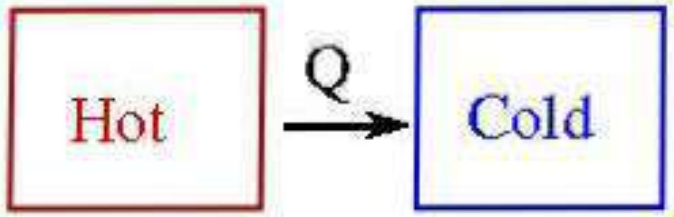
# WHAT IS HEAT AND TEMPERATURE

Temperature: measure of the internal (thermal) energy of a system

How can the temperature (internal energy) of a system be changed?

(1) Work - done by or done on the ystem
(2) Heat - flow into or out of the system

Heat is thermal energy transferred between systems at different temperatures.

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# WHAT DO YOU MEAN BY THERMODYNAMICS

- Thermodynamics= therme + dynamis
- Latin word therme means = heat
- Dynamis means = power or forces causing motion

so, overall meaning of thermodynamics is heat–power or force interaction between system and surrounding.

for example

It is based upon general observation and those may be formulated in form of thermodynamic law as –

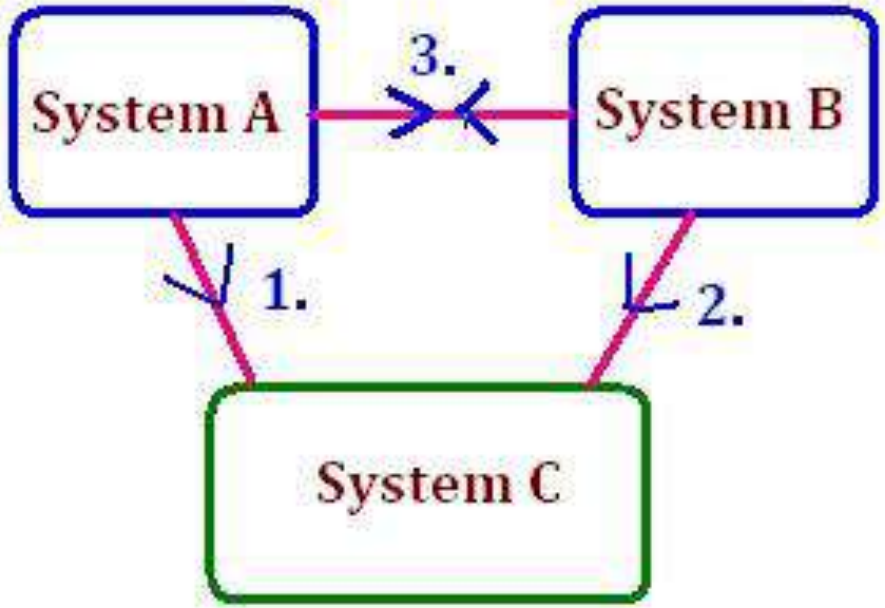
- Zeroth law of thermodynamics
- First law of thermodynamics
- Second law of thermodynamics

# Thermodynamic Properties, Processes and Cycles

- Properties
  - Characteristics by which physical condition of any system can easily be defined , is known as property.
  - ***Two types-***
  - **Intensive** ( Independent of mass example pressure, temperature, density, composition, viscosity, thermal conductivity)
  - **Extensive** ( depends on mass examples- energy, enthalpy , entropy, volume etc.)
  - Check for a property-

    dP= Mdx + Ndy would be a thermodynamic property if its differential is exact i.e. $\left(\frac{\partial M}{\partial y}\right)_x = \left(\frac{\partial N}{\partial x}\right)_y$
  - Specific quantity = Absolute / Mass and denoted by small letters.Applicable for quantities depending upon the mass like, internal energy, enthalpy, heat, work, volume etc.

# ZEROTH LAW OF THERMODYNAMICS




1. A & C are in thermal equilibrium
2. B & C are in thermal equilibrium

then

3. A & B are also in thermal equilibrium with each other

# FIRST LAW OF THERMODYNAMICS

- Work and heat are path-dependent quantities

- Quantity $Q + W = \Delta E_{\text{int}}$ (change of internal energy) is path-independent

- 1st law of thermodynamics: the internal energy of a system increases if heat is added to the system or work is done on the system

$$\Delta E_{\text{int}} = E_{\text{int},f} - E_{\text{int},i} = Q + W$$

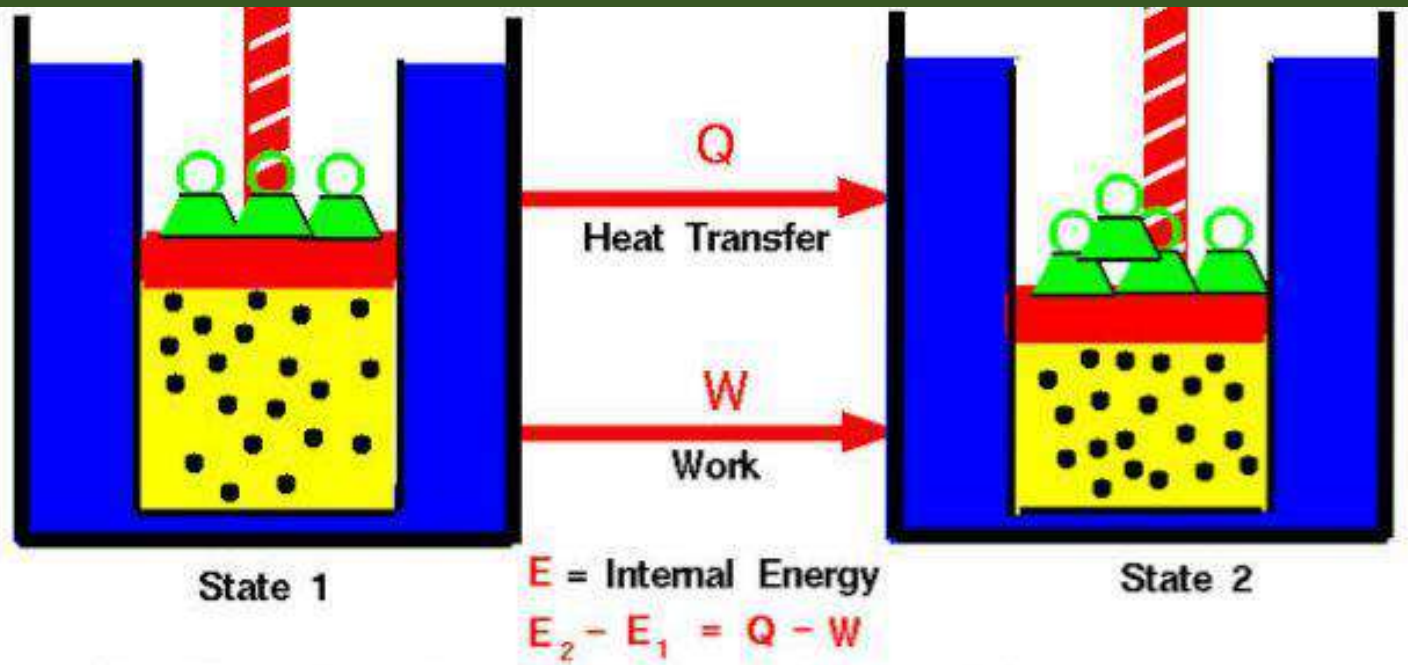
If the pressure is constant, the work done is the pressure multiplied by the change in volume:

$$W = P\,\Delta V \qquad (15\text{-}3)$$

In an isovolumetric process, the volume does not change, so the work done is zero.

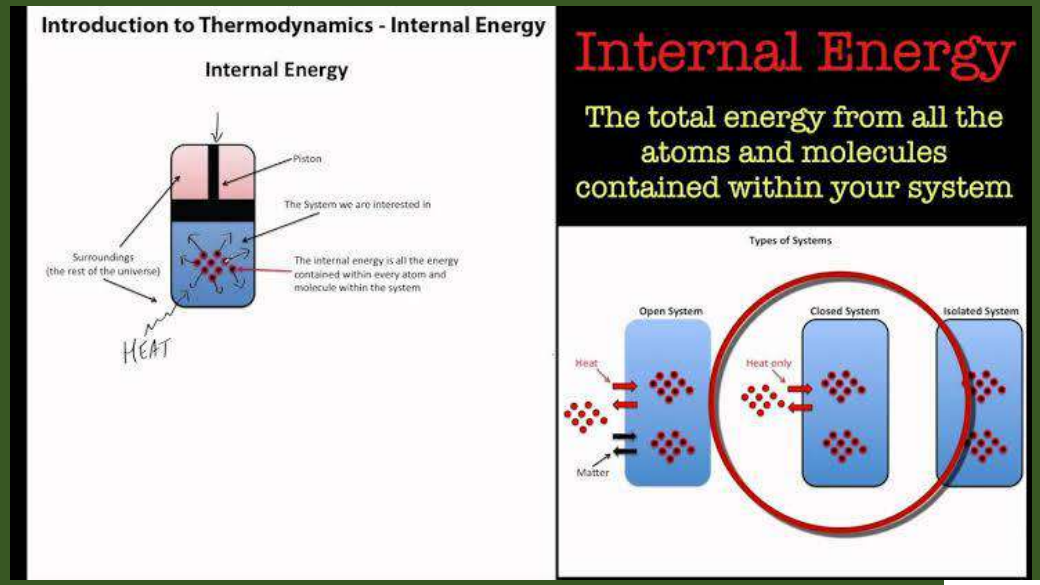
# ASSIGNMENT

## Explain the figure



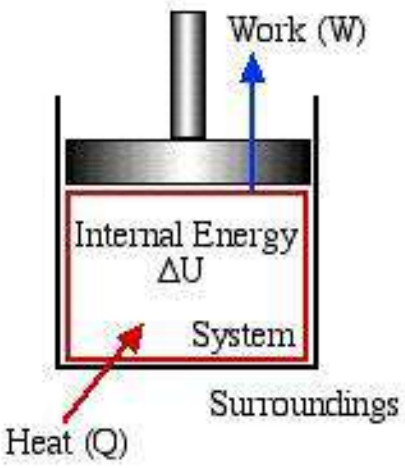

Any thermodynamic system in an equilibrium state possesses a state variable called the internal energy (E). Between any two equilibrium states, the change in internal energy is equal to the difference of the heat transfer into the system and work done by the system.

# INTERNAL ENERGY










Energy Equation for Stationary Closed Systems:

$$Q - W = \Delta U \quad [kJ]$$

where: Q is the Heat Transferred to the System

W is the Work Done by the System

ΔU is the Change of Internal Energy

Dividing each term by the system mass m [kg] we obtain the specific form of the Energy Equation:

$$q - w = \Delta u \quad \left[\frac{kJ}{kg}\right]$$