FDE 208 HEAT TRANSFER AND THERMAL PROCESSES

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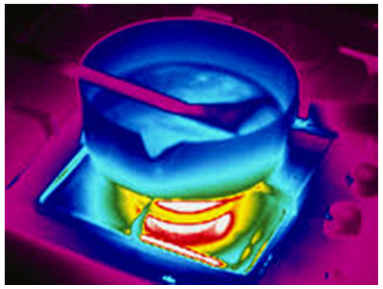
INTRODUCTION TO HEAT TRANSFER

- Energy exists in various forms
  - Neither created nor destroyed
- Heat is one of the forms of energy
  - Can be transferred from one system to another as a result of temperature difference
  - Net heat transfer always occurs from the higher temperature medium to the lower one
  - It stops when the two mediums reach the same temperature.



Definition of heat transfer

Physical process by which thermal energy is exchanged between material bodies or inside the same body as a result of a temperature difference.

- Heat transfer is the study of the mechanism and rate of this process.

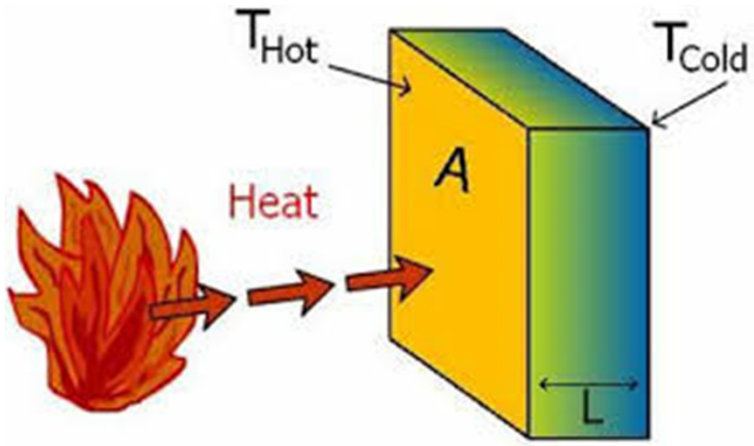
- The transfer of heat occurs in our daily life
  - Refrigerators, freezers, air conditioning, car radiators, irons, computers etc.
- The transfer of heat also occurs in many engineering systems.
- In the food industry, we sterilize or pasteurize foods by heating them to increase the shelf life.
  - Cold or frozen storage
  - Drying
  - Evaporation
  - Distillation

Simultaneous heat and mass transfer

MECHANISM OF HEAT TRANSFER

- In order to transfer a property we need a driving force.
  - In momentum transfer : pressure difference
  - In heat transfer: temperature difference
  - In mass transfer: chemical potential difference

- When a temperature gradient exists in a system, the heat will be transferred from high temperature region to the low temperature region.



MECHANISM OF HEAT TRANSFER

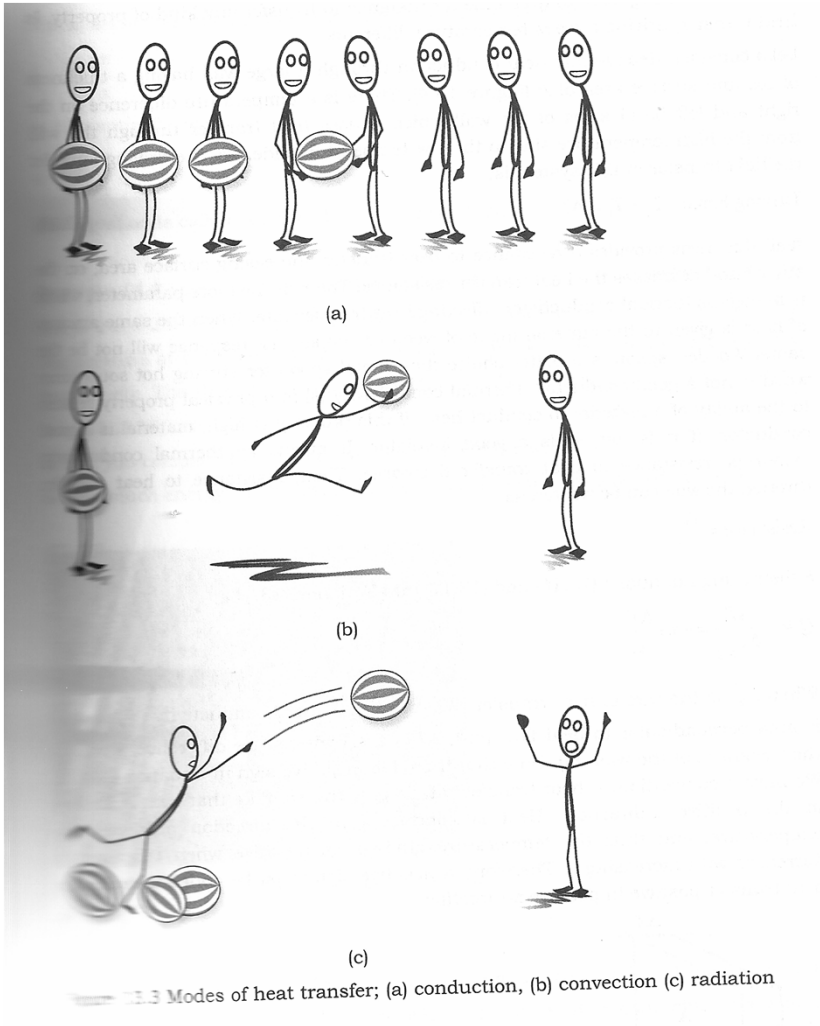
- Heat can be transferred in three different modes:
  - **conduction,**
  - **convection, and**
  - **radiation.**

  - All modes of heat transfer require the existence of a temperature difference, and all modes are from the high-temperature medium to a lower-temperature one.

MECHANISM OF HEAT TRANSFER

- **Conduction**– thermal energy is transferred by the direct contact of molecules, not by the movement of the material
- **Convection**– thermal energy is transferred by the mass motion of groups of molecules resulting in transport and mixing of properties
- **Radiation**– thermal energy is transferred by electromagnetic radiation (waves)

- Transfer of water melon from one person to another in different ways is a good representation of heat transfer mechanism.
  - Passing water melon from one person to another standing side by side brings conduction to mind.
  - When a person carries water melon by walking or running and gives it to his friend , it represents convection.
  - On the other hand if water melon is thrown from one person to another, it represents radiation.



Modes of heat transfer; (a) conduction, (b) convection (c) radiation