

59-240
Lecture 5
Intro to Thermodynamics

Thermodynamics

- Stationary states of matter
- Energy differences
- Patterns of energy change
- Types of energy change

Definitions

- System
- Surroundings
- Boundaries
 - Matter
 - Open
 - Closed
 - Mechanical
 - Isolated System
 - Thermal
 - Diathermic
 - Adiabatic

Processes

- Isochoric, $\Delta V = 0, w = 0, \Delta U = q_V$
- Isobaric, $\Delta p = 0, \Delta U = q + w, \Delta H = q_p$
- Adiabatic, $q = 0, \Delta U = w_{ad}$
- Isothermal, $\Delta U = 0, \Delta T = 0, q = -w$
- Cyclic, $\Delta U = 0, U_f = U_i$

Energy

- work
 - organized
 - $w > 0$; work done on system
 - $w < 0$; work done by system
- heat
 - random
 - $q > 0$; system heated
 - $q < 0$; system cooled (surroundings heated)
 - $q = 0$; adiabatic system
 - endothermic process, $q > 0$
 - exothermic process, $q < 0$
- internal energy
 - total energy, U
 - $\Delta U = U_f - U_i$
 - state function
 - extensive property

First Law

- $\Delta U = q + w$**
- bank analogy
- isolated system, $\Delta U = 0$
- heat/work transferred **to** system:
 $q > 0, w > 0$ - **acquires** energy
- heat/work transferred **from** system:
 $q < 0, w < 0$ - **releases** energy
- Conservation of energy
- $\Delta U_{universe} = \Delta U_{system} + \Delta U_{surroundings} = 0$
- Universe is isolated system
- Mountain climbing analogy