**ECE 309 M.M. Yovanovich**

# First Law of Thermodynamics: Fixed Mass System

The **First Law of Thermodynamics** deals with conservation of energy of fixed mass system as it interacts with its surroundings through **Work** and **Heat** transfer across its boundaries. The initial total energy of the system at state 1 is denoted $E_1 = PE_1 + KE_1 + U_1$ and its final total energy at state 2 is denoted $E_2 = PE_2 + KE_2 + U_2$.

$PE, KE, U$ represent the total potential, kinetic and internal energies of the system.

The First Law of Thermodynamics can be expressed as:

$$\boxed{E_1 \pm W_{12} \pm Q_{12} = E_2}$$

where $W_{12}$ and $Q_{12}$ represent the work and heat which have crossed the system boundaries between the initial (state 1) and the final (state 2) states.

**Sign Convention**

The sign convention used here is:

$$+W_{12} \qquad \text{and} \qquad +\, Q_{12}$$

denote energy gain by the system, ie, the internal energy will increase; however,

$$-W_{12} \qquad \text{and} \qquad -\, Q_{12}$$

denote energy loss by the system, ie, the internal energy will decrease.

**Alternate Form**

$$\boxed{\Delta\, E = E_2 - E_1 = \pm W_{12} \pm Q_{12}}$$