We will cover the following concepts,

- Energy Analysis of Cycles
- Power Cycle and Thermal Efficiency
- Refrigeration Cycle
- Heat Pump Cycle
- Coefficient of Performance

When a system at a given initial state goes through a sequence of processes and returns to that state, then the system has executed a <u>cycle</u>.

#### Energy Analysis of Cycles:

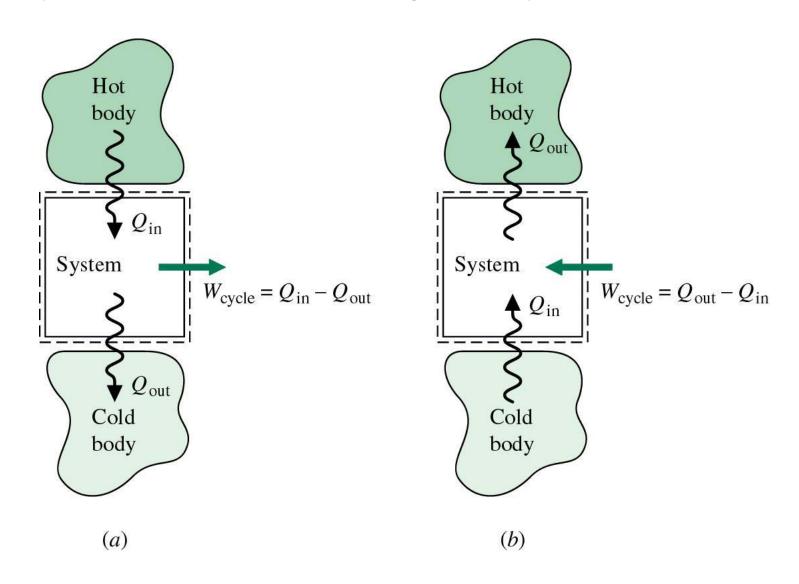
$$\underbrace{\Delta E_{cycle}}_{=0} = Q_{cycle} - W_{cycle}$$

or

$$Q_{cycle} = W_{cycle}$$

# Power Cycle: Generates Work

# Refrigeration Cycle: Generates Work



$$W_{cycle} = Q_{in} - Q_{out}$$

*Q<sub>in</sub>* Source: Fuel Combustion, Nuclear Reaction or Solar Energy

#### Thermal Efficiency

$$\eta = \frac{W_{cycle}}{Q_{in}} = \frac{Q_{in} - Q_{out}}{Q_{in}} = 1 - \frac{Q_{out}}{Q_{in}}$$

$$\eta \leq 1$$

- Refrigeration Cycle: To keep the system at a temperature below the surroundings
- Heat Pump Cycle: To keep the system at a temperature above the surroundings

$$W_{cycle} = Q_{out} - Q_{in}$$

### Coefficient of Performance

Refrigeration Cycle: 
$$\beta = \frac{Q_{in}}{W_{cycle}} = \frac{Q_{in}}{Q_{out} - Q_{in}}$$

Heat Pump Cycle: 
$$\gamma = rac{Q_{out}}{W_{cycle}} = rac{Q_{out}}{Q_{out} - Q_{in}}$$