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>.

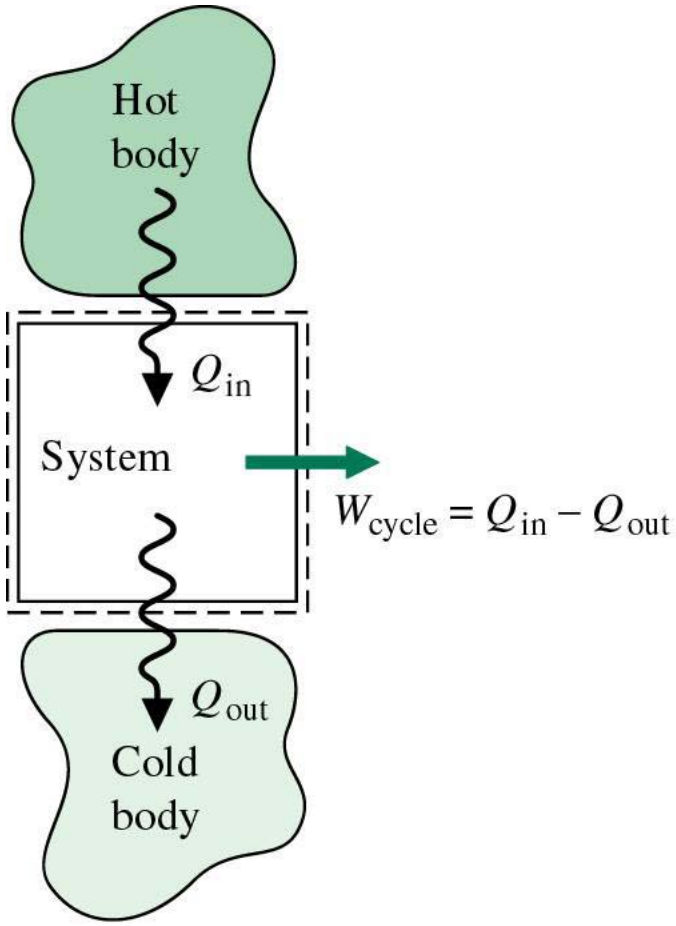
Energy Analysis of Cycles:

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

or

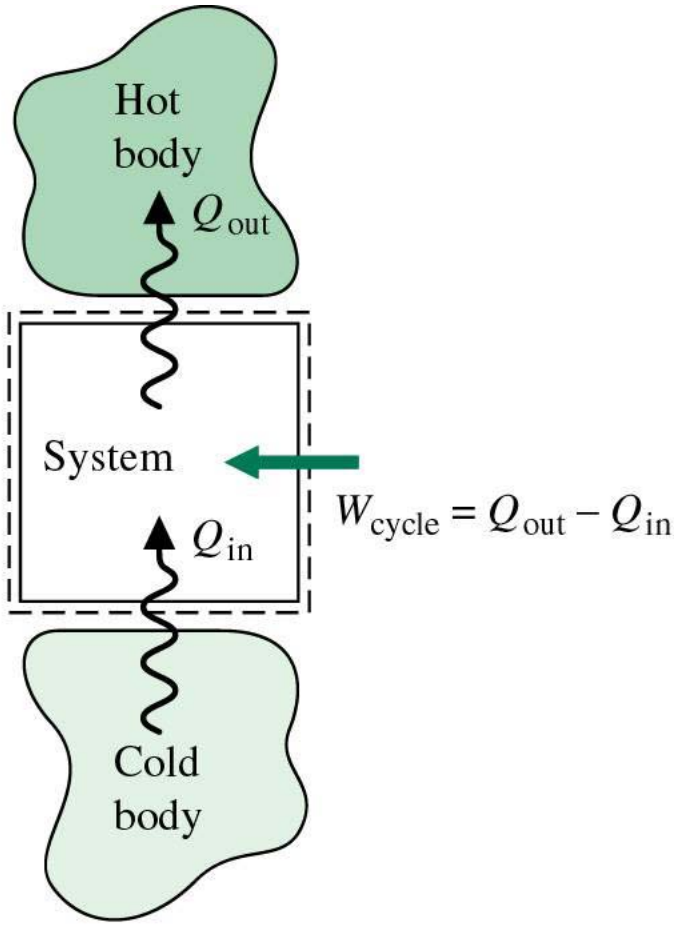
$$Q_{cycle} = W_{cycle}$$

Power Cycle: Generates Work



(*a*)

Refrigeration Cycle: Generates Work



(*b*)

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

Q_{in} Source: Fuel Combustion, Nuclear Reaction or Solar Energy

<u>Thermal Efficiency</u>

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

$$\eta \leq 1$$

- Refrigeration Cycle*: To keep the system at a temperature <u>below</u> the surroundings*

- Heat Pump Cycle*: To keep the system at a temperature <u>above</u> the surroundings*

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

<u>Coefficient of Performance</u>

Refrigeration Cycle:

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

Heat Pump Cycle:

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