ECE 309 M.M. Yovanovich

Entropy

• **Definition of Entropy**: For a system executing a cyclic reversible process the change in the value of the property S called the entropy:

$$dS = \left(\frac{dQ}{T}\right)_{\text{rev}}$$

where

$$\begin{aligned} dQ &= \text{Heat transferred to the system} \\ T &= \text{Absolute temperature of the system} \end{aligned}$$

• The above relation is valid for any reversible process.

• Entropy is an extensive property, and it is a function of the end points only.

• The change in the entropy of a system can be found by integration:

$$S_2 - S_1 = \int_1^2 \frac{dQ}{T}$$

Inequality of Clasius

For any irreversible cycle the following integral is always true:

$$\oint_1^2 \frac{dQ}{T} < 0$$

Principle of the Increase of Entropy

For any isolated system:

$$dS_{\text{isolated system}} \geq 0$$

For any control volume:

$$\frac{d}{dt}S_{\text{CV}} + \frac{d}{dt}S_{\text{surroundings}} \geq 0$$