

# ENGRD 221: ENGINEERING THERMODYNAMICS

## Lecture 9: September 20, 2007

**Reading Assignments** (from Moran & Shapiro, Sixth Edition): Read all of chapter 5 with particular emphasis (for now) on the topics below.

### Topics covered:

- The second law of thermodynamics
- The natural direction of physical processes, reverse processes and spontaneous processes
- Constrained expansion of gases without work, expansion of a gas with work transfer
- Process inefficiencies, tendency in all processes and cyclic devices to produce unrecoverable energy in either doing or consuming work
- Examples of thermal inefficiency in all processes and thermodynamic cycles
- The work done by the system is maximum for reversible or quasi-static processes
- Clausius statement of the 2nd law of Thermodynamics
- Kelvin-Planck statement of the 2nd Law of Thermodynamics
- The equivalence of the Clausius and Kelvin-Planck statements of the 2nd law of thermodynamics
- Demonstrating that violation of one statement of the 2nd law leads to a violation of the other
- Equilibrium processes, external irreversibilities, internal irreversibilities, local surroundings, tests for reversibility
- Carnot (reversible) cycle
- The Carnot cycle corollaries
- The Carnot cycle efficiency, coefficient of performance