# Virginia Western Community College
# EGR 232
# Chemical Engineering Thermodynamics

**Prerequisites**
MTH 265 and EGR 231 (grade of C or higher in both of these courses)

**Corequisites**
none

**Course Description**
Introduces the first and second laws of thermodynamics. Examines energy conservation; concepts of equilibrium, temperature, energy, and entropy; partial molar properties; pure component and mixture equations of state; processes involving energy transfer as work and heat; reversibility and irreversibility; and closed and open systems and cyclic processes.

**Semester Credits: 3 Lecture Hours: 3 Lab/Clinical/Internship Hours: 0**

**Required Materials**

**Textbooks:**
Chemical, Biochemical, and Engineering Thermodynamics, 5th Edition, Stanley I. Sandler, ISBN: 978-1-119-32128-6

**Other Required Materials:**
Engineering paper
Scientific or graphing calculator

**General Course Purpose**

This course prepares students for deeper study in the field of Chemical Engineering, exploring fundamental thermodynamics concepts essential in Chemical Engineering practice.

See: https://courses.vccs.edu/courses/EGR232-ChemicalEngineeringThermodynamics/detail

## Course Outcomes

**At the completion of this course, the student should be able to utilize the following:**

- Critical Thinking
  - Critically analyze different thermodynamic processes to solve the energy inputs necessary for operation
- Quantitative Literacy
  - Solve equations of state and phase equilibrium problems using appropriate math and computational techniques
- Scientific Literacy
  - Apply basic thermodynamic principles via mass, energy and entropy balance equations to analyze open and closed systems and processes

## Topical Description

- First Law of Thermodynamics - Energy Balances
  - Define the types of energy (kinetic, potential, internal) and energy transfer (heat, work), formulate energy balances for closed and open systems, recognize the importance of reference states.
- Properties of Pure Substances - Equations of State
  - Apply cubic equations of state, virial equations of state, and the Principle of Corresponding States to estimate properties of single component real fluids.
- Second Law of Thermodynamics - Entropy
  - Calculate the entropy change for an ideal gas, apply the concept of irreversibility.
  - Utilize Mollier diagrams to calculate the entropy change for real fluids.
  - Apply entropy balances to determine thermodynamic feasibility of processes.
- Fundamental Thermodynamic Property Relationships
  - Apply fundamental property relations, Maxwell relations, and mathematical operations (e.g., chain rule, triple product rule).
  - Calculate desired property change between states using hypothetical paths.
  - Define a departure function.
- Flow Processes, Power Plants, Refrigeration and Liquefaction Cycles
  - Calculate for different working fluids the energy generated by power cycles, the energy required to operate refrigeration cycles, and the energy required to liquify gases with and without recycle.
- Phase Equilibria, Mixtures
  - Predict behavior from liquid/vapor phase diagrams, calculate vapor-liquid equilibria for single component and two component mixtures.

## Notes to Instructors

- All instructors teaching this course in any given semester will use the same textbooks.
- The content of this course will be updated every few years in collaboration with engineering faculty from across the VCCS.

- ADA Statement (PDF)
- Title IX Statement (PDF)