SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

ACADEMIC AFFAIRS

Course Number: ENGR 440 Department: Engineering & Sci. Transfer

Course Title: Chemical Engineering Thermodynamics I Semester: Spring Year: 2001

Objectives/Competencies

Course Objective	Competencies
1. To understand the SI and American Engineering Systems of Units.	1. List the primary unites of each system. 2. Be able to relate a derived unit to the primary units 3. Convert any unit on one system to its corresponding unit in the other system.
2. To be able to relate the pVT properties of a pure substance.	1. Define pressure, temperature and specific volume. 2. Draw pressure-temperature, pressure-specific volume, and temperature-specific volume phase diagrams. 3. Use the Ideal Gas Law, the Virial Coefficient Equation of State, the Redlick/Kwong Equation, and the Compressibility Factor Equation of State to relate the pVT properties of a gas. 4. Use the generalized density correlation to relate the pVT properties of a liquid. 5. Use tables and/or software to look up the pVT properties.

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3. To understand what a Thermodynamic System is.	1. Define a system. 2. Classify systems as open or closed.
4. To understand the concepts of Equilibrium and Reversibility.	1. Define equilibrium. 2. Explain the difference between reversible, an internally reversible, and an irreversible process.
5. To be able to determine how, if adequate thermodynamic information is available, to establish equilibrium.	1. Define intensive and extensive properties. 2. Know Gibb's Phase Rule. 3. Apply Gibb's Phase Rule to determine the degrees of freedom of a system.
6. To learn the Thermodynamic concept of Work.	1. Define work. 2. Calculate boundary work. 3. Calculate shaft work.
7. To understand that heat and work are path dependent.	1. Graphically illustrate on a p-V diagram that work depends on the path followed between two equilibrium states. 2. Graphically illustrate on a T-s diagram that heat depends on the path followed between two equilibrium states.
8. To be familiar with the Thermodynamic property Internal Energy.	1. Define internal energy. 2. Calculate internal energy changes using the constant volume heat capacity.
9. To be familiar with the Thermodynamic property Enthalpy.	1. Define enthalpy. 2. Calculate enthalpy changes using the constant pressure

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	heat capacity. 3. Use tables and/or software to look up enthalpy.
10. To be able to relate energy, heat and work together and thus form the First Law of Thermodynamics.	1. Verbally explain the concepts of conservation of mass and energy. 2. Derive the conservation of mass equation for an open system. 3. Derive the conservation of energy equation (First Law of Thermodynamics) for a closed system. 4. Derive the conservation of energy equation (First Law of Thermodynamics) for an open system.
11. To be able to calculate various types of heat effects.	1. Calculate sensible heats. 2. Calculate latent heat. 3. Calculate the Standard Heat of Reaction. 4. Calculate the Standard Heat of Formation. 5. Calculate the Standard Heat of Combustion. 6. Investigate the temperature dependence on the Heat of Reaction.
12. To be able to apply the First Law of Thermodynamics to both open and closed system problems.	1. Solve the following types of closed system problems: a. Constant volume process. b. Constant pressure process c. Constant temperature process d. Adiabatic process. e. Polytropic process. f. Isentropic process.

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	2. Solve the following types of open system problems: a. Turbine problem. b. Compressor problem. c. Duct flow problem. d. Filling and emptying tanks.
13. To know the Second Law of Thermodynamics and how it restricts the conversion of one type of energy to another.	1. Give the Kelvin Planck Statement of the Second Law of Thermodynamics. 2. Give the Clausius Statement of the Second Law of Thermodynamics.
14. To learn the theory and operation of heat engines and heat pumps.	1. Make calculations with a Carnot Cycle (Ideal) heat engine or heat pump. 2. Make calculations with actual heat engines or heat pumps.
15. To be familiar with the Thermodynamics property Entropy.	1. Define entropy. 2. Calculate entropy change of a system. 3. Calculate entropy change of the surroundings. 4. Calculate entropy change of the "universe." 5. Explain how the entropy change of the "universe" can determine whether a process is reversible, irreversible, or impossible.
16. To study and relate together all of the thermodynamic properties of a pure substance.	1. Define Gibb's Free Energy. 2. Define Helmholtz Free Energy. 3. Derive the four Gibb's equations. 4. Derive the four Maxwell's equations.

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	5. Derive Gibb's generating function equation. 6. Define residual properties. 7. Derive residual Gibb's generating function equation. 8. Be able to calculate h and s for a real gas from the residual Gibb's generating function equation. 9. Derive the Clapeyron Equation. 10. Calculate the latent heat of a phase change from the Clayeyron Equation.