

SPRINGFIELD TECHNICAL COMMUNITY COLLEGE

**ACADEMIC AFFAIRS**

Course Number: ENGR 350 Department: Engineering & Sci. Transfer

Course Title: Engineering Thermodynamics Semester: Spring Year: 1999

**Objectives/Competencies**

<b>Course Objective</b>	<b>Competencies</b>
1. To be able to make conversions between all systems of units.  2. To understand what a Thermodynamic System is, and why it is the key to understanding Thermodynamics.  3. To be aware that Thermodynamics is a study of conservation of Energy and Matter.	1. Make conversions between the SI system and the USCS system for: a. mass units b. length units c. area units d. volume units e. force units f. pressure units g. energy units h. temperature units  1. Classify systems as being closed systems or open systems.  1. Verbally explain the concepts of conservation of mass and conservation of energy.

Course Objective	Competencies
<p>4. To be able to use several equation of state for the vapor phase calculation of pure compressible substances.</p>	<p>1. Calculate pressure, volume or temperature from any of the following equations:</p> <ul style="list-style-type: none"> <li>a. Ideal Gas Law</li> <li>b. Van der Waals' Equation</li> <li>c. Beattie Bridgeman Equation</li> <li>d. Compressibility Factor Equation</li> </ul>
<p>5. To be able to relate the standard pVT Thermodynamic properties to phase diagrams of pure substances.</p>	<p>1. Draw the following phase diagrams for a pure substance:</p> <ul style="list-style-type: none"> <li>a. Pressure - temperature phase diagram</li> <li>b. Pressure - volume phase diagram</li> <li>c. Temperature volume phase diagram</li> </ul>
<p>6. To be able to use Thermodynamic property tables such as the Steam Tables</p>	<p>1. Extract pressure, volume, temperature, internal energy, enthalpy, and entropy data from the Thermodynamic Property Tables for a pure substance for the following situations:</p> <ul style="list-style-type: none"> <li>a. Single phase system</li> <li>b. Two phase system</li> <li>c. Three phase system</li> </ul>
<p>7. To learn the Thermodynamic definition of work.</p>	<p>1. Compute the following types of Thermodynamic work:</p> <ul style="list-style-type: none"> <li>a. Boundary work</li> <li>b. Electrical work</li> <li>c. Shaft work</li> </ul>
<p>8. To understand that work and heat are path functions and inexact differentials.</p>	<p>1. Graphically illustrate on a p-V diagram that work depends on the path followed between two equilibrium states.</p>

Course Objective	Competencies
<p>9. To be able to relate energy, heat, and work together and thus form the First Law of Thermodynamics.</p> <p>10.To be able to apply the First Law of Thermodynamics to both open and closed system problems.</p>	<p>2. Graphically illustrate on a T-s diagram that heat depends on the path followed between two equilibrium states and not just the two equilibrium states.</p> <p>1. Mathematically express the First Law of Thermodynamics for a closed system and an open system.</p> <p>1. To solve closed system problems:</p> <ul style="list-style-type: none"> <li>a. Constant volume process</li> <li>b. Constant pressure process</li> <li>c. Constant temperature process</li> <li>d. Adiabatic process</li> <li>e. Polytropic process</li> <li>f. Isotropic process</li> </ul> <p>2. To solve open system problems:</p> <ul style="list-style-type: none"> <li>a. Turbine problem</li> <li>b. Compressor problem</li> <li>c. Nozzle problem</li> <li>d. Diffuser problem</li> <li>e. Throttling process</li> <li>f. Mixing process</li> <li>g. Heat exchanger problem</li> <li>h. Filling and emptying tanks</li> </ul>
<p>11.To know the Second Law of Thermodynamics and how it restricts the conversion of one type of energy to another.</p>	<p>1. Summarize the two versions of the Second Law of Thermodynamics: The Kelvin Planck statement and the Clausius statement.</p>

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<p>12.To learn the theory and operation of heat engines, heat pumps, and Carnot Cycle engines.</p>	<p>1. Make computations for the following types of heat engines and heat pumps:</p> <ul style="list-style-type: none"> <li>a. Actual heat engine</li> <li>b. Carnot cycle heat engine</li> <li>c. Actual heat pump</li> <li>d. Carnot cycle heat pump</li> </ul>
<p>13.To study the Thermodynamics property, Entropy, and see how it provides information about the degree of irreversibility of a process.</p>	<p>1. Entropy</p> <ul style="list-style-type: none"> <li>a. Define the property entropy.</li> <li>b. Indicate what causes the entropy to change during a process.</li> <li>c. Explain how an entropy calculation can determine whether a process is reversible, irreversible or impossible.</li> </ul>
<p>14.To be able to apply the Second Law of Thermodynamics of both open and closed system problems.</p>	<p>1. Applications of the Second Law of Thermodynamics:</p> <ul style="list-style-type: none"> <li>a. Solve reversible closed system problems.</li> <li>b. Solve irreversible closed system problems.</li> <li>c. Solve reversible open system problems.</li> <li>d. Solve irreversible open system problems.</li> </ul>
<p>15.To study and relate together the Thermodynamic properties of internal energy, enthalpy, and entropy with pVT properties.</p>	<p>1. Using Gibbs' Equations, derive the Gibbs' Equations for T dS.</p> <p>2. Using Gibbs' equations, apply it to derive equations for the entropy change of an ideal gas.</p>

<b>Course Objective</b>	<b>Competencies</b>
16.To derive the Continuity equation and to discuss its use in Fluid Mechanics.	<ol style="list-style-type: none"><li>1. Explain the importance of the Continuity Equation.</li><li>2. Apply the Continuity Equation to steady state, one dimensional flow problems.</li></ol>
17.To derive and discuss the Mechanical Energy Equation.	<ol style="list-style-type: none"><li>1. Explain the importance of the Mechanical Energy Equation.</li><li>2. Convert the Mechanical Energy Equation into Bernoullis' Equation.</li><li>3. Apply the Mechanical Energy Equation to solve reversible steady state, steady flow problems.</li></ol>
18.To be able to work adiabatic efficiency problems involving turbines, compressors, nozzles, and diffusers.	<ol style="list-style-type: none"><li>1. Calculate the adiabatic efficiency of a turbine, compressor, nozzle, or diffuser.</li><li>2. Calculate the actual exit temperature of an adiabatic turbine, compressor, nozzle, or diffuser.</li></ol>