# Chemical Engineering Thermodynamics I ChE 301

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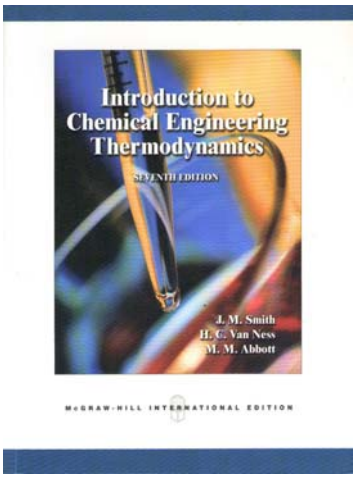
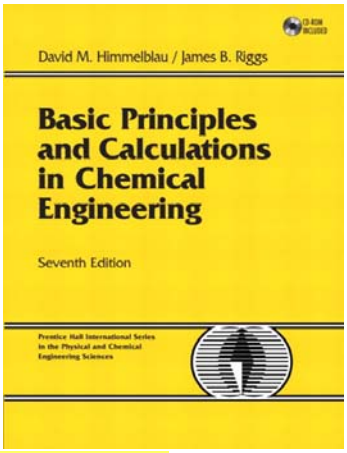
| **Credit Hours and Term** | 3: 0 & 2- Every Fall/Spring |
| **Prerequisite** | CHEM 102 |
| **Instructor** | Dr. Hamad A. Al-Turaif |
| **Office** | Building 45, room 216 |
| **Lecture Time & Room** | 13:00 - 14:20 S. M.<br>11:00 - 12:20 T.<br>Building 45, room 104 |
| **Textbook** | Smith J.M., Van Nees H.C., Abbot M.M., Introduction to Chemical Engineering Thermodynamics, 7/e, Mc.Graw-Hill, (2005).<br><br>Himmelblau D., Basic Principles and Calculations in Chemical Engineering, 6/e Prentice Hall, (2001) |
| **Office Hours** | 13:30 – 14:30 Su. T. |
| **Grade Distribution** | Home Work 10%<br>Mid-terms 30%<br>Quizzes 15%<br>Performance 5%<br>Final exam 40% |




## Outline

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| **2000 Catalog Description** | ChE 301: Chemical Eng. Thermodynamics (1) (3 : 3 & 1) Introduction to thermodynamics concepts, first law of thermodynamics, Mass and energy balances in closed and open systems, volumetric properties of pure fluids, heat effects, humidity charts, second law of thermodynamics, entropy, Computer applications to thermodynamics problems. |
| **Prerequisite** | CHEM- 201; General chemistry (2) |
| **Textbook** | Smith J.M., Van Nees H.C., Abbot M.M., Introduction to Chemical Engineering Thermodynamics, 7/e, Mc.Graw-Hill, (2005).<br>Himmelblau D., Basic Principles and Calculations in Chemical Engineering, 6/e Prentice Hall, (2001) |

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| **References** | Wong, K.V., Thermodynamics for Engineers, CRC Press, (2000). |
| **Goals** | To develop a student's ability to apply the first and second laws of thermodynamics to reversible and irreversible processes.<br>To develop a student's ability to predict real behavior of gases based on equations of state and generalized Correlations.<br>To understand the humidity charts and use it for determining the proprieties of the moist air and solve heating and cooling problems involving moist air.<br>To give a student's the ability to apply the second law understanding to the heat engines. |
| **Prerequisites by Topics** | General Chemistry. |
| **Topics** | First law of thermodynamics.<br>PVT behavior of pure substances.<br>Equations of state.<br>Heat effect.<br>Humidity Charts.<br>Second law of thermodynamics, reversibility. |
| **Laboratory** | None |
| **Projects** | None |
| ABET category content as estimated by faculty member who prepared this course description. | |
| **Engineering science** | 3 credits |
| **Engineering design** | 0 credit |

## Chemical Engineering Thermodynamics I ChE 301
## Weekly Notes

| Week | Topics to be covered |
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| 1 | **Introduction**<br>Dimensions and units.<br>Force.<br>Temperature.<br>Volume.<br>Pressure. |

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| 2 | Work.<br>Energy.<br>Heat.<br>**The First Law and Other Basic Concepts**<br>Joule's Experiments.<br>Internal Energy. |
| 3 | The First Law of Thermodynamics.<br>Thermodynamic State and State Functions.<br>Enthalpy.<br>The Steady-State Flow Process. |
| 4 | Equilibrium.<br>The Phase Rule.<br>The reversible Process.<br>Constant-V and Constant-P Processes.<br>Heat Capacity. |
| 5 | **Volumetric Properties of Pure Fluids**<br>PVT Behavior of Pure Substances.<br>The Ideal Gas. |
| 6 | Virial Equations.<br>Applications of the Virial Equations.<br>Cubic Equation of State. |
| 7 | Generalized Correlations for Gases.<br>Generalized Correlations for Liquids.<br><br>{First Exam} |
| 8 | **Heat Effects**<br>Sensible Heat Effects.<br>Internal Energy of Ideal Gases: Microscopic View.<br>Latent Heats of Pure Substances.<br>Standard Heats of Reaction. |
| 9 | Standard Heat of Formation.<br>Standard Heat of Combustion.<br>Temperature Dependence of $DH^o$.<br>Heat Effects of Industrial Reaction. |
| 10 | **Humidity Charts and Their Use**<br>Define humidity and other variables.<br>Adiabatic cooling lines. |
| 11 | Cooling and Humidification.<br>Combined Material and Heat Balances<br><br>{Second Exam} |

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| 12 | **The Second Law of Thermodynamics**<br>Statements of the second Law.<br>Heat Engines.<br>Thermodynamic Temperature Scale. |
| 13 | Entropy.<br>Entropy Changes of an Ideal Gas.<br>Mathematical Statement of the Second Law. |