# BEGINNING OF COURSE MEMO

*CHE 2202, THERMODYNAMICS, SPRING, 2013*

**FULL CLASS MEETINGS:** MWF 1100-1150; CHE 005.

**INSTRUCTOR:** Mr. J. P. O'Connell; jpo2x@virginia.edu
(Office: CHE 310; Phone: 924-3428; Hours: MWF 0900-1000; M 1530-1800; TR 1400-1600)
**GTA:** Simpson Gregoire, seg3ms@virginia.edu, WDF 209A. Hours: TBA

**E-MAIL**: CHE2202S13@collab.itc.virginia.edu

**TEXT:** J.M. Haile, "Lectures in Thermodynamics, Volume 1", Central, SC: Macatea Productions, 2002 plus "Volume 2, Lectures II - 57. Purchase pdf file on CD from Instructor for $22.00. Volume 1, but not 2, is also available from http://www.booksonboard.com/index.php?BODY=viewbook&BOOK=190956.

**REFERENCE BOOKS (*ON RESERVE AT SCIENCE & ENGINEERING LIBRARY):**

S.I. Sandler, "Chemical, Biochemical, and Engineering Thermodynamics 4th Ed.", New York: Wiley, 2006.
*M.D. Koretsky, "Engineering and Chemical Thermodynamics", Hoboken: Wiley, 2004.
*R. Sonntag, C. Borgnakke, & G. van Wylen, "Fundamentals of Thermodynamics, 6th Ed., New York: Wiley, 1998 (Used previously as text for ENGR 202, MAE 210).
*J.M Smith, H.C. Van Ness, & M.M. Abbott, "Introduction to Thermodynamics, 5th Ed.", New York: McGraw-Hill, 1996 (Used previously as text for CHE 202).
*M.M. Abbott & H.C. Van Ness, "Schaum's Outlines: Thermodynamics with Chemical Applications, 2nd. Ed.", New York: McGraw-Hill, 1989.
*H.C. Van Ness, "Understanding Thermodynamics", New York: McGraw-Hill, 1969.
*J.B. Fenn, "Engines, Energy and Entropy", Pittsburgh: Global Publishing, 2003.
*P. Perrot, "A to Z of Thermodynamics", Oxford University Press, 1998.

**CATALOG DESCRIPTION**: CHE 2202 -(3)(S) Thermodynamics. Corequisite: APMA 2120
Includes the formulation and analysis of the first and second laws of thermodynamics; 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. Three lecture hours.

**COURSE OBJECTIVES**

Enhance Technical Capabilities by
- Learning the fundamental concepts, principles & terminology of macroscopic thermodynamics of pure components and mixtures
- Being able to recognize thermodynamic concepts in the phenomena, behavior and problems of real, simplified & idealized physicochemical systems and problems
- Knowing the expected quantitative behavior of the thermodynamic properties of matter & how to formulate and use data about them in word, equation, and graph forms
- Developing a proficiency with the use of 1st & 2nd law equations (including entropy generation) on real, simplified & idealized, single & multiphase, static and dynamic systems

Expand Industrial Readiness by
- Applying 1st & 2nd law principles & property data to energy conversion systems
- Appreciating measures of efficiency & the factors most influencing energy device design
- Applying skills to recognize energy conversion devices & analyze their behavior; compute properties of pure component and mixture equilibrium states

Raise Leadership/Cultural Competence
- from analyses and information retrieval about energy efficiency and environmental effects

Sharpen Technical Communication Skills with group/class presentations, discussions and quizzes
Increase Individual/Team Effectiveness by collaborative learning in class

**COURSE GRADING** (See "General Considerations" for details)

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|---|---|
| Final Examination | 25% |
| Examinations (3) | 30 |
| In-Class Activities (Clickers, Presentations, Demos, Quizzes) | 30 |
| Homework | 15 |
| Total | 100 |

## CHE 2202, Spring 2013 Class Syllabus

| Date | Topic | Reading Assignment* |
|---|---|---|
| Jan 14 | Organization | - |
| 16 | The Thermodynamics of Things | Preface, Notes |
| 18 | What Is Thermo & The Nitty-gritty | L1, L2 |
| 23 | Quantities, Review of *PvT* Properties | L3, L4 |
| 25 | Review of *PT* & *Pv* Diagrams, Changing the State | L5, L6 |
| 28 | Idealized Models for Pure Components & Virial EOS | L7, L8 |
| 30 | Cubic EoS | L9 |
| Feb 1 | Corresponding States I. | L10 |
| 4 | Corresponding States II. | L11 |
| 6 | Work of Volume Change, Reversible Changes | L12, L13 |
| 8 | Problem Solving | L14 |
| 11 | Joule's Experiments | L15 |
| 13+ | Internal Energy (Exam 1 through Problem Solving) | L16 |
| 15 | One-step Processes | L17 |
| 18 | Enthalpy & Isenthalpic Expansions | L18, L19 |
| 20 | Sensible & Latent Heats | L20 |
| 22 | Multistep Processes I. | L21 |
| 25 | Multistep Processes II. | L22 |
| 27 | Steady Flow Systems Including Kinetic Energy Changes | L23, L24 |
| Mar 1 | Steady Isenthalpic Processes | L25 |
| 4 | Shaft Work | L27 |
| 6 | Cyclic Processes | L28 |
| 8 | Efficiency | L29 |
| 18 | Second Law, Entropy | L30, L31 |
| 20 | Feasibility of Adiabatic Processes | L32 |
| 22 | Thermodynamic Analysis of Steady Nonadiabatic Processes | - |
| 25 | Vapor-Liquid Power Cycles | L34 |
| 27+ | Gas Power Cycles (Exam 2 through Entropy and Feasibility) | L35 |
| 29 | Vapor-Compression Heat Pumps I | L36 |
| Apr 1 | Vapor-Compression Heat Pumps II. Fundamental Equations for Conceptuals | L36, L37 |
| 3@ | No Class - Facilities Visit | - |
| 5@ | No Class - Facilities Visit | - |
| 8 | Residual Properties | L38 - L40 |
| 10 | Phase Equilibria for Pures, Pure Component VLE | L41- L43 |
| 12 | Introduction to Mixtures, Partial Molar Properties (PMP) | LII, L45 |
| 15 | Fundamental Equations for Open Systems; Changes in Properties on Mixing | L46, L47 |
| 17 | Changes of Properties on Mixing & PMP of Ideal Gases; Entropy & Disorder | L48, L49, L50 |
| 19 | Properties of Ideal Solutions; Fugacity | L51, L52 |
| 22 | Pure-Component Fugacities from PvT Models and Condensed Phases | L53, L54 |
| 24+ | PvTx Models for Mixtures; Residual Properties from PvTx Models; Mixture Fugacities from PvTx Models (Exam 3 through Fugacity) | L55, L56, L57 |
| 26 | Thermodynamics and Biology | Notes |
| 29 | Summing Up | L44, Notes |
| May 6# | Final Examination | - |

* **Lectures** (L*n*) of Haile's Lectures to be looked at **BEFORE CLASS**; "Notes" in Collab/Resources

+ **Exams** taken during evenings

@ Days of **equipment demo/facility inspection**

# **Final Examination** at UVa scheduled day & time (0900-1200) for MWF 1100.