Beginning of Course Memorandum (BOCM)

University of Virginia Fall, 2013

CHE 3316 Chemical Thermodynamics and Staged Unit Operations

Revised October 22

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Class Meetings: CHE 005, TR 0930-1045, T 1300-1350

Texts: "Lectures in Thermodynamics, Volume 2 (Beta Version)", by J.M. Haile & J.P. O'Connell, 2008 - 12, Electronic copy on CD available from instructor for $15. Total 641 pages.

"Separation Process Engineering, 3rd Ed.", by P.C. Wankat, Prentice Hall, 2012.

References:

"Physical and Chemical Equilibrium for Chemical Engineers, 2nd Ed." by N. de Nevers, Wiley-Interscience, New York, 2012.

"Introduction to Chemical Engineering Thermodynamics, 7th Ed.," by J.M. Smith, H.C. Van Ness, and M.M. Abbott (SVNA). McGraw-Hill, New York, 2005.

"Chemical, Biochemical, & Engineering Thermodynamics, 4th Ed.," by S.I. Sandler, John Wiley, 2006.

"Schaum's Outline of Thermodynamics with Chemical Applications, 2nd Ed.," by H.C. Van Ness & M.M.Abbott, Schaum's Outlines, McGraw-Hill, 1989.

"Lectures in Thermodynamics, Volume 1," by J.M. Haile, Macatea Productions, 2002.

"Unit Operations of Chemical Engineering, 7th Ed.", W. McCabe, J. Smith, & P. Harriott, New York, McGraw-Hill, 2004.

"Principles of Chemical Separations with Environmental Applications," R.D. Noble & P.A. Terry, Cambridge, UK, Cambridge University Press, 2004.

"Perry's Chemical Engineers' Handbook, 8th Ed.," D. Green & R. Perry, New York, McGraw-Hill, 2007. Accessible to AIChE Members via http://www.aiche.org/membercenter/elibrary.aspx.

CATALOG DESCRIPTION: CHE 3316 - (4) Chemical Thermodynamics and Staged Unit Operations. Principles of chemical thermodynamics developed and applied to chemical and phase equilibria. Principles and methods for staged separation processes including distillation, absorption and stripping, extraction, and adsorption systems. Four lecture hours. Prerequisite: CHE 2202 and 2215, or equivalent. Corequisite: CHE 3321.

COURSE OBJECTIVES

Enhance Technical Capabilities by

Being able to recognize thermodynamic concepts in the properties, behavior, & problems of real, simplified, & idealized physicochemical systems

Developing a proficiency with the use of properties & equations for tendencies for change and equilibria in multiphase & reacting systems, & how to formulate & use data about them for analysis & separation applications in word, equation, & graph forms

Being able to use material balances & equilibrium relations to analyze & design a variety of ideal & real staged separation processes

Expand Industrial Readiness by

Applying thermodynamic principles & property data to mixing, separation & chemical reaction systems

Applying skills to recognize mixing, separation, & chemical reaction systems, & to analyze their behavior; compute properties and responses of multicomponent phase & reaction equilibrium states

Learning to access the AspenPlus Process Simulator to obtain property values, phase/reaction equilibria, & staged separations

Raise Leadership/Cultural Competence from

Analyses & information retrieval about properties of chemical mixtures & their environmental, health, & safety effects, & equilibrium staged industrial separation processes for gases, liquids & solids.

Sharpen Technical Communication Skills with group/class presentations, discussions, collaborative exercises, & quizzes

Increase Individual/Team Effectiveness by collaborative learning in- & outside of class

COURSE GRADING (See "General Considerations" for details)

Final Examination	25%
Examinations (3)	21
In-Class Activities (Clickers, Quizzes, Presentations)	25
Homework & Projects	29
Total	100

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CHE 3316 Lecture Class Syllabus (TR 0930-1045)

Date	Subject	Reading: Lect. L[@]; Chap.Sec[†]
Aug 27	Organization/Introduction/Advanced Applications	LII; 1.1
29[%]	Phase Equilibrium, VLE I.	L67,L68,L71; 1.2,2.3
Sep 3	Calculations of VLE, Excess Properties, Activity Coefficients	L69,L70,L72,L73; 2.1, 2.4
5	VLE from the γ–ϕ Approach	L77-78
10[*]	Azeotropes, Critical Behavior	L80-81
12	Column Distillation	2.4, 3.1-5
17	Internal Balances I.	4.1-4
19	Internal Balances II., Other Situations	4.10-14
24[+*]	Multicomponent Distillation	2.6, 5.1-4
26[+]	Distillation with Process Simulators	6.1-6, 4.App, 6.App
Oct 1	Shortcut Methods	7.1-4
3	Complex Methods I.	8.1, 8.4-5
8[*]	Batch Distillation	9.1-5
10	Column Design	10.1,10.3,10.7-9,10.11-12
17[&]	Henry's Law, Dilute Solutions,	L84
22[+]	Gas Solubilities	L85
24[+]	Absorption and Stripping, Stability, LL Diagrams	12.2-5, L82
29[&]	LLE & VLLE, Complex Distillation Methods III.	L83; 8.2-3, 8.7
31	LL Extraction II	13.6-8
Nov 5	Work on Aspen Project 2	-
7	Solids & Fluids (Video; no class)	L86; 14.1-5
12	Adsorption	Notes, 18.1
14	Chromatography II	18.2-3
19	Extent of Reaction; Reaction Equilibrium & Equilibrium Constant	L58-60
21[&]	Isothermal or Adiabatic?; Multiple Reactions; Manipulating Yield	L64-66
26[+]	Electrolyte Solutions I.	Notes
Dec 3	Biothermodynamics I.	Notes
5[*]	Course Summary	-
Dec 9[#]	Final Examination 1400-1700	

[@]Haile Vol. 2 Lectures; [†]Wankat Chapter.Sections; "Notes" on Collab/Resources.

[+]Exams; Sep 25, Oct 23, Nov 25.

[%]Energy Module Project: Pairs assigned by Aug 29; Due Sep 10. See Collab/Resources/Energy Modules

[*]Aspen Project I: Pairs sign up by Sep 10; Part I due Sep 23; Part II due Oct 21. See AspenAssignment1.pdf

[&]Aspen Project II: Pairs sign up by Oct 17; Part I due Oct 30; Part II due Nov 22. See AspenAssignment2.pdf

[#] Final Exam at UVa scheduled time

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CHE 3316 Workshop Syllabus (T 1300-1350)

Date	Subject	Reading (Lecture[@], Chap.Sec[†])
Aug 27	Advanced Applications, Diagnostics	Collab/Resources/D
Sep 3	Excess Property Models	L74-76; 2.2
10	Aspen Instruction	Collab/Resources/Aspen Project/Aspen Notes
17	Column Balances	4.5-9
24	Summary for Exam 1	
Oct 1	Distillation Calculations: Shortcut/Simulator	
8	Complex Distillation Methods II.	8.6
22	Summary for Exam 2	
29	LL Extraction II.	13.1-5
Nov 5	Work on Aspen Project 2	
12	Chromatography I.	18.2
19	Yield, Temperature Effects, Manipulating Yield	L61-63
26	Electrolyte Solutions II, Ion Exchange	Notes, 18.5
Dec 3	Biothermodynamics II.	Notes