

# CH365 Chemical Engineering Thermodynamics

## Lesson 1 Introduction and Fundamentals 1

Professor Andrew Biaglow

# Classroom and Computer Etiquette

The following items are disruptive and can result in a COR or other disciplinary action:

- Working on assignments for other classes.
- Printing documents while I am speaking.
- Consuming food of any kind in the classroom.
- Chewing gum.
- Sleeping during class.
- Failure to sign out of computers.
- Not having a textbook.

If you see a computer floor plate open, please replace it.

If you print a document, please either collect it or cancel the print job.

Please bring any printer issues to the attention of your instructor.

Please sign out of lab computers (use Ctrl-Alt-Del to sign out).

# USMA Chemical Engineering Mission

To prepare commissioned leaders of character who are proficient in applying chemical and engineering principles to solve problems in a complex operational environment.

Published in the USMA Redbook (Part 2 – Disciplinary Offerings)

# Chemical Engineering Program Educational Objectives

During a career as commissioned officers in the United States Army and beyond, program graduates:

- Demonstrate effective leadership and chemical engineering expertise.
- Contribute to the solution of infrastructure or operational problems (in a complex operational environment).
- Succeed in graduate school or other advanced study programs.
- Advance their careers through clear and precise technical communication.

Published in the USMA Redbook (Part 2 – Disciplinary Offerings)

Firsties provide input to development of PEOs during the program briefing in January.

# Chemical Engineering Student Outcomes

## Program Student Outcome 8

The chemical engineering curriculum closely tracks the topics in the Fundamentals of Engineering Exam

On completion of the chemical engineering program, our graduates demonstrate an ability to understand ...

- Chemistry
- Material and energy balances
- Safety and environmental factors.
- Thermodynamics of physical and chemical equilibria**
- Heat, mass, and momentum transfer
- Chemical reaction engineering
- Continuous and staged separation processes
- Process dynamics and control
- Modern experimental and computing techniques
- Process design.

Published in the USMA Redbook (Part 2 – Disciplinary Offerings)

# Student Outcomes, cont.

The Chemical Engineering Major contains the student outcomes recommended by ABET.

On completion of the chemical engineering program, our graduates demonstrate an ability to ...

- Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- Communicate effectively with a range of audiences.**
- Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
- Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- Design and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- Acquire and apply new knowledge as needed, using appropriate learning strategies.**

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(Part 2 – Disciplinary Offerings)

# Redbook

3.0 Credit Hours (BS=0.0, ET=3.0, MA=0.0)

Prerequisites: MA366, MC312, CH364, CH363

Lessons: 40 @ 55 min

Labs: 0 @ 0 min

Course web site: <https://abiaglow.github.io/CH365/indexCH365.html>

# Assessment AY2022-1

count	event	points ea.	points	percent
1	TEE	500	500	20.75
1	Capstone	300	300	12.45
3	IPRs	30	90	3.73
3	WPRs	200	600	24.90
66	Problems	10	680	27.39
1	Resume	200	200	8.30
1	SIS Quiz	60	60	2.49
	<i>Total</i>		<i>2410</i>	<i>100.00</i>

## Notes:

Problems are 10 points each and collected as *Problem Sets*

Problem Sets are entered in AMS and the point value varies from 30 to 100 points.



# Documentation Policy

Documentation of Academic Work (DAW), July 2017

- Assignments

- Cover sheets are required for all graded events.
- Must be completed in accordance with instructions in App B
- Assignments will not be accepted without a cover sheet.
- Example cover sheet for individual paper submission, App B1
- Problem sets are documented, App E
- Document all assistance and collaboration, App A
- Document internet and e-sources as per *Little Brown*, App D
- E-submissions – **single** e-signed pdf

- Formal groups are by assignment.

- Definition: see Section 6.I, p. 15

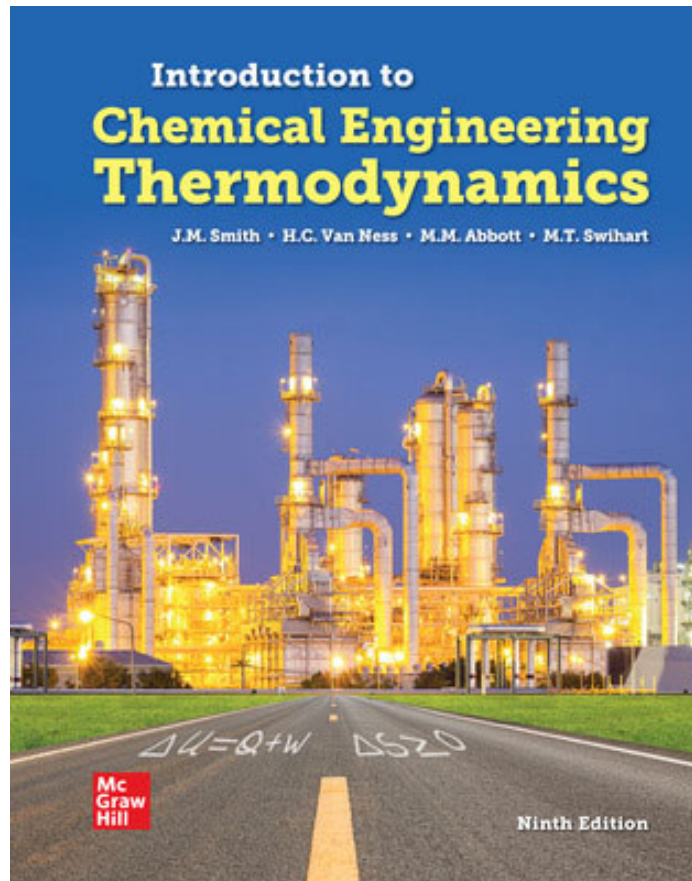
- Intent of DAW is honesty and integrity

- Do not imply that someone else's idea or work is your own.
- Self-referencing is required.
- Give credit where it is due.

Instructions for adding additional initial or CAC-signatures to your cover sheet are linked on the web site at "eSignatures in Adobe."

A fillable cover sheet pdf form is linked to the web site

# Textbook – Paper Copy – ~~Required~~ Preferred



First edition in 1949; very influential book.

ISBN: 978-1-260-72147-8

Instructor is using 1<sup>st</sup> printing

**Introduction to Chemical Engineering Thermodynamics**

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Smith, Van Ness, Abbott, Swihart

# Parts of the Course

Where we are going - roadmap

- Chapter Coverage
  - Chapter 1 – Fundamentals
  - Chapter 2 – First Law
  - Chapter 3 – Properties of Pure Fluids
  - Chapter 4 – Heat Effects
  - Chapter 5 – Entropy
  - Chapter 6 – Real Fluids
  - Chapter 10 – Solution Thermodynamics
  - Chapters 12 and 13 – Phase Equilibria
- Chemical Engineering Perspective

# What you will learn in this course

Where you are going – end state

- How are physical properties calculated?
- How does the CHEMCAD thermodynamics wizard work?
- What is an activity coefficient? Fugacity?
- What is an equation of state? How many are there?  
Which one is best?
- How does an equation of state allow calculation of properties like enthalpy and entropy?
- How are the properties of a solution calculated?

Critical chemical engineering questions addressed in this course.

# Admin Questions?

# Scope of Thermodynamics

- Originally – how much work (or power) from heat
  - “Primitive laws” (no contrary experience)
  - Derivation of a network of equations that are general.
- Chemical systems - how much product can I make?
  - Heat and work requirements for physical and chemical processes
- Determination of properties when data are unavailable