

# Course Syllabus

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## MEMORANDUM FOR STUDENTS ENROLLED IN CHEN 3302 – Section 01

**Lecture times:** MWF 9:05 am -10:00 am, RBN 1034

**Instructor:** Shuhao Liu

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**Office hours:** MW 1:30 – 3:00 pm

Welcome to CHEN 3302 - Chemical Engineering Thermodynamics II. This course provides coverage of advanced thermodynamic principles, including equations of state for real substances, equilibrium, multicomponent mixtures, and multiphase mixtures. Calculations will be related to practical examples in the chemical industry. The course has 7 learning objectives (see below) that can be broadly grouped into two categories: (a) acquiring the ability to apply equations of state, and (b) acquiring the ability to analyze the thermodynamics of mixtures.

### Course Objectives:

1. Derivate the thermodynamic models of real pure compounds.
2. Perform calculations using equations of state for real substances.
3. Determine the equilibrium composition of single and multi-phase mixtures.
4. Explain the origin of chemical potential and fugacity.
5. Determine the fugacity of a pure component non-ideal gas and of pure liquids under high pressure.
6. Calculate a property of mixing for a system at equilibrium based on ideal gas or ideal solution
7. Calculate phase compositions for real mixtures at equilibrium based on equation of state for gas phases, and activity coefficient models for non-ideal liquid behavior

**Mode of delivery:** This is a face-to-face course.

### Recording of Class Sessions

Class sessions may be recorded by the instructor for use by students enrolled in this course. Recordings that contain personally identifiable information or other information

subject to FERPA shall not be shared with individuals not enrolled in this course unless appropriate consent is obtained from all relevant students. Class recordings are reserved only for the use of students enrolled in the course and only for educational purposes. Course recordings should not be shared outside of the course in any form without express permission.

The course has two prerequisites which must be completed with a minimum grade of "C" prior to taking this course:

- CHEN 3301, Chemical Engineering Thermodynamics I
- MATH 2415, Multivariable Calculus.

## 1. Q&A

Our goal is to be commonly available to you for assistance, so you are encouraged and expected to seek **additional instruction (AI)**. Take advantage of AI, it's FREE and really will help! There are several ways you can seek AI:

- You are welcome to stop by the instructor's office at any time. However, for your own satisfaction, you can ensure the instructor is available at the office by using the following options:
  - Come to Office hours (#). This is the time the instructor has set aside to answer your questions;
  - E-mail instructor to set up a mutually agreeable time to meet with the instructor,
- E-mail your questions to the instructor.

## 2. Class Room Procedures:

1. Bring study notes, **textbooks**, note-taking material, and calculator to every class. You may not borrow or exchange calculators during graded events. If your calculator fails during a graded exercise, I am not responsible to furnish a substitute. Class preparation is your individual responsibility.

### 1. Textbook:

- Required:

*Fundamentals of Chemical Engineering Thermodynamics, Dahm and Visco ISBN-13 : 978-1111580704 (DV)*

Reference textbook:

*Chemical, Biochemical, and Engineering Thermodynamics 5th Edition, Stanley I. Sandler ISBN-13: 978-0470504796*

*Engineering and Chemical Thermodynamics 2nd Edition, Milo D. Koretsky, ISBN-13: 978-0470259610*

*Fundamentals of Chemical Engineering Thermodynamics, Themis Matsoukas, ISBN-13: 978-0132693066*

*Introductory Chemical Engineering Thermodynamics, Carl T. Lira and J. Richard Elliot, ISBN-13: 978-0136068549*

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### 1. Recitations:

Certain lectures will be used for recitation sessions. These will be the students' opportunity to practice problem-solving skills applying the concepts learned in lectures. These skills will be needed for solving homework, quizzes and exam problems. Please bring your textbook for the recitation sessions.

### 3. Evaluations:

1. **ACADEMIC DISHONESTY:** Representation of other's work as your own will not be tolerated. Cheating on examinations, quizzes, and homework and the false representation of work will be interpreted as academic dishonesty. Academic dishonesty will be subject to disciplinary action as outlined by the UT Tyler Student Guide on Conduct and Discipline.
1. **Homeworks:** A set of homework problems will be assigned approximately every two weeks (there will be **seven homework** assignments during the semester). All homework is mandatory and becomes part of your grade. As an engineer, your goal is to make a clear, logical, and professional presentation of your work, which is both accurate and correct. As such, both the presentation and the accuracy of your work are important, and both will be graded. It is

critical that you show all of your work and leave “foot prints” so that it can be easily followed. No guess work should be required to see what you did. For each homework problem, the corresponding topic and numerical answers will be provided. You are encouraged to work in groups, but the work that you turn in should be your own. **Homeworks are due at the 5 pm of the assigned date, and they must be submitted online via Canvas.**

1. *Open-ended projects:* One group open ended project will be assigned for the semester as a team work (2~3 person per group). The instructor will assign groups at the first two week and the groups will need to submit the topic for the project at the end of Week 3 for the approval from the instructor. Open-Ended projects are characterized for not having a unique, single answer/solution. Instead, they are creative exercises in which you are encouraged to apply the concepts learned in the course and searching your own resources. They must be informative and then may be qualitative or quantitative or. In either case, make sure your report and presentation are clear and detailed, because you will be evaluated by the approach and thought process you use in these exercises. You will need to implement systems thinking to come with an answer that may covers the following aspects:

1. A) Environmental Literacy
2. B) Responsible Business and Economy
3. C) Social Responsibility
4. D) Environmental Impact Assessment
5. E) Materials Selection
6. F) System Design
7. G) Relative information of advanced technology

*Example Topic: Direct Air Capture (CO<sub>2</sub> Capture from the Air Using Materials)*

*This topic could be structured as follows:*

1. *Introduction to Air Carbon Capture: Provide the necessary background for the report.*
2. *Overview of Common Methods: Briefly describe the common techniques used for air carbon capture.*

3. *Thermodynamic Analysis of Adsorption and Absorption Processes: Discuss adsorption isotherms or use Henry's Law to describe the solubility of CO<sub>2</sub> in various solvents.*
4. *Material Phase Diagrams: Locate a database or research paper on material phase diagrams. Analyze how these diagrams impact adsorption or explain the datasets from the research paper and why they are effective.*
5. *Energy Calculation: Choose a system and calculate the total energy input required to capture and sequester a specific amount of CO<sub>2</sub> from the air.*
6. *Case Studies: Present real-world examples of air carbon capture projects and provide a thermodynamic analysis.*
7. *Challenges in Scaling Up: Discuss the challenges of scaling up air carbon capture technologies, including energy consumption, material costs, and environmental impact.*

Each team member should contribute equally to the project, the students will also be asked to perform anonymous peer review rating the effort and conduct of each member.

**The group will present their work to the instructor and classmates at the end of the semester.**

**Written portion of the open-Ended projects must be submitted online via Canvas.**

1. Late Submissions. It is a basic principle of professionalism that "Professionals are not Late." A "COORDINATED LATE" submission occurs when you will miss the due date for a graded assignment and you contact me in advance. Notification immediately before the submission will not suffice. Point cuts up to the amounts below may be assessed for a "COORDINATED LATE" submission:

1. 0-24 hours late a deduction of 25% of the earned grade
2. 24-48 hours late a deduction of 50% of the earned grade
3. More than 48 hours late No credit.

Obviously, there are circumstances that will occur and make a timely submission impossible and I will work with you when and if they occur.

1. Participation, conduct, and professionalism: You should conduct yourself in a professional manner in the class. Attendance in class is the component with more weight on participation. A student who attends classes (except for unavoidable circumstances) and is professional, will receive full credit. One



Quizzes	2×5 (10%)
Mid-term	2×15 (30%)
Final exam	15 (15%)
Participation, conduct and professionalism	10 (10%)

**Total 100 (100%)**

### **Grade Scale based on points**

A	85~100
B	70~84
C	60~69
D	50~59
F	<50

### **5. Collection of Student Work:**

Throughout the semester I will collect student work (best, average, and worst) for the ABET course and outcomes notebooks. This will require me to make a copy of your work, keep your original and return a copy of the graded work to you. I will not draw attention as to what level of work you accomplished.

### **6. Use of Generative AI in This Course**

Generative AI tools (such as ChatGPT or Copilot) are permitted only for specific assignments or situations, and appropriate acknowledgment is required. This course includes open-ended assignments where the use of generative artificial intelligence (AI) tools is permitted. When AI use is allowed, it will be clearly stated in the assignment directions, and all uses of generative AI must be properly acknowledged and cited.

Copying and pasting from AI-generated content or using AI to generate entire reports, presentations, or slides is strictly prohibited. Generative AI tools are to be used only as a supplementary resource to help you quickly understand new concepts that may be involved in your open-ended topics. It is important to cross-check AI-generated information with other reliable sources, as AI can sometimes produce incorrect or misleading information.

In all other cases, including homework, quizzes, and exams, the use of generative AI is not allowed at any stage of the assignment.

## 7. **Assigned readings:**

The class schedule will include assigned reading for every lecture. Students who read the corresponding sections of the book *before each class* will certainly make the most of the lectures, so this is highly recommended. In addition, the instructor will periodically post the lecture notes on the course website. Doing the assigned reading prior to class will help you to understand the material presented during the instruction and will fill in gaps for things we do not cover (***I will not cover everything***). It will also make you more familiar with terms and concepts to be covered.

8. **UT Tyler Honor Code** - Every member of the UT Tyler community joins together to embrace: Honor and integrity that will not allow me to lie, cheat, or steal, nor to accept the actions of those who do.

9. **Students Rights and Responsibilities:** to know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link: <http://www.uttyler.edu/wellness/rightsresponsibilities.php>.

10. **Campus Carry** - We respect the right and privacy of students 21 and over who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at <http://www.uttyler.edu/about/campus-carry/index.php>.



**11. UT Tyler a Tobacco-Free University** - All forms of tobacco will not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors. Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless tobacco, snuff, chewing tobacco, and all other tobacco products. There are several cessation programs available to students looking to quit smoking, including counseling, quitlines, and group support. For more information on cessation programs please visit [uttyler.edu/tobacco-free](http://uttyler.edu/tobacco-free).

**12. Grade Replacement/Forgiveness and Census Date Policies** - Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.uttyler.edu/registrar>. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar. Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract. The Census Date is the deadline for many forms and enrollment actions of which students need to be aware. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

**13. State-Mandated Course Drop Policy** - Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date). Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

**14. Disability/Accessibility Services** - In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA) the University of Texas at Tyler offers accommodations to students with learning, physical and/or psychological disabilities. If you have a disability, including a non-visible diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or you have a history of modifications or accommodations in a previous educational environment, you are encouraged to visit <https://hood.accessiblelearning.com/UTTyler> and fill out the New Student application. The Student Accessibility and Resources (SAR) office will contact you when your application has been submitted and an appointment with Cynthia Lowery, Assistant Director of Student Services/ADA Coordinator. For more information, including filling out an application for services, please visit the SAR webpage at <http://www.uttyler.edu/disabilityservices>, the SAR office located in the University Center, # 3150 or call 903.566.7079.

**15. Student Absence due to Religious Observance** - Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

**16. Student Absence for University-Sponsored Events and Activities** - Revised 05/19 If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

**17. Social Security and FERPA Statement** - It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

**18. Emergency Exits and Evacuation** - Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.

**19. Student Standards of Academic Conduct** - Disciplinary proceedings may be initiated against any student who engages in scholastic dishonesty, including, but not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

20. "Cheating" includes, but is not limited to:

- copying from another student's test paper;
- using, during a test, materials not authorized by the person giving the test;
- failure to comply with instructions given by the person administering the test;
- possession during a test of materials which are not authorized by the person giving the test, such as class notes or specifically designed "crib notes". The presence of textbooks constitutes a violation if they have been specifically prohibited by the person administering the test;
- using, buying, stealing, transporting, or soliciting in whole or part the contents of an unadministered test, test key, homework solution, or computer program;
- collaborating with or seeking aid from another student during a test or other assignment without authority;
- discussing the contents of an examination with another student who will take the examination;
- divulging the contents of an examination, for the purpose of preserving questions for use by another, when the instructors has designated that the examination is not to be removed from the examination room or not to be returned or to be kept by the student;
- substituting for another person, or permitting another person to substitute for oneself to take a course, a test, or any course-related assignment;

- paying or offering money or other valuable thing to, or coercing another person to obtain an unadministered test, test key, homework solution, or computer program or information about an unadministered test, test key, home solution or computer program;
  - falsifying research data, laboratory reports, and/or other academic work offered for credit;
  - taking, keeping, misplacing, or damaging the property of The University of Texas at Tyler, or of another, if the student knows or reasonably should know that an unfair academic advantage would be gained by such conduct; and
  - misrepresenting facts, including providing false grades or resumes, for the purpose of obtaining an academic or financial benefit or injuring another student academically or financially.
1. "Plagiarism" includes, but is not limited to, the appropriation, buying, receiving as a gift, or obtaining by any means another's work and the submission of it as one's own academic work offered for credit.
  2. "Collusion" includes, but is not limited to, the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any section of the rules on scholastic dishonesty.
  3. All written work that is submitted will be subject to review by plagiarism software.

## 20. UT Tyler Resources for Students

- UT Tyler Writing Center (903.565.5995), writingcenter@uttyler.edu
- UT Tyler Tutoring Center (903.565.5964), tutoring@uttyler.edu
- The Mathematics Learning Center, RBN 4021, this is the open access computer lab for math students, with tutors on duty to assist students who are enrolled in early-career courses.
- UT Tyler Counseling Center (903.566.7254)

### Schedule:

week	Aug	Material	Reading	Assignment	Evaluation due (5:00 pm)
Aug 1	M 26	Syllabus, Review	Chpt 1-5		

	W	28	Review	Chpt 1-5	HW 1
	F	30	Industrial tour- no class	Chpt 1-5	
	M	2	Labor Day- no class		
2	W	4	Joule-Thomson Expansion	Chpt 6.1 6.2	
	F	6	Mathematical Models, Heat Capacity	Chpt 6.2 6.3	HW 2 HW 1
	M	9	Heat Capacity and Residual Properties	Chpt 6.3	
3	W	11	EOS	Chpt 7.1 7.2	
	F	13	Cubic EOS	Chpt 7.2	
Sept	M	16	Cubic EOS	Chpt 7.2 7.3	HW 3 HW 2
4	W	18	The Principle of Corresponding States	Chpt 7.3 7.4	
	F	20	Beyond the Cubic EOS	Chpt 7.4	
	M	23	Beyond the Cubic EOS	Chpt 7.4	
5	W	25	<b><u>Midterm 1</u></b>	Chpt 6-7.3	
	F	27	- Modeling Phase Equilibrium for Pure Components	Chpt 8.1 8.2	HW 3
6	M	30	Mathematical Models of Phase Equilibrium	Chpt 8.2	

6	W	2	Mathematical Models of Phase Equilibrium	Chpt 8.2	HW 4
	F	4	Fugacity and Its Use in Modeling	Chpt 8.3	
	M	7	Fugacity and Its Use in Modeling	Chpt 8.3	
7	W	9	Fugacity and Its Use in Modeling	Chpt 8.3	
Oct	F	11	An introduction to Mixtures & ideal solutions	Chpt 9.1 9.2	
	M	14	Property of mixture	Chpt 9.2 9.3	HW4
	W	16	Mathematical Framework for Solutions	Chpt 9.3 9.4	
	F	18	Mathematical Framework for Solutions	Chpt 9.3 9.4	HW5
	M	21	Ideal Gas Mixtures	Chpt 9.4	
9	W	23	Summary Pure component modeling and introduction to mixture		
10	F	25	<b><u>Midterm 2</u></b>	Chpt 7.4~9.3	
	M	28	VLE & Raoult's Law	Chpt 10.1 10.2	
	W	30	Raoult's Law and Data	Chpt 10.2	HW5

	F	31	Mixture	Chpt 10.2 10.3	
	M	4	Mixture Critical Point	Chpt 10.3	HW6
11	W	6	Critical Point and Lever Rule	Chpt 10.3 10.4	
	F	8	Lever Rule and the Flash Problem	Chpt 10.4	
	M	11	Theories and Models for VLE Mixtures	Chpt 11.1 11.2	
12	W	13	Fugacity in Mixtures	Chpt 11.3 11.4	HW6
<b>Nov</b>	F	15	Gamma-Phi Modeling	Chpt 11.4	
	M	18	Modified Raoult's Law	Chpt 11.5	HW7
13	W	20	Excess Molar Gibbs Free Energy Models	Chpt 11.6 11.7	
	F	22	Excess Molar Gibbs Free Energy Models & Consistency	Chpt 11.8 11.9	
	M	25	<i>Thanksgiving</i>		
14	W	27	<i>Thanksgiving</i>		
	F	29	<i>Thanksgiving</i>		
<b>Dec</b>	15	M	2	<i>Open-end Project presentation</i>	HW7

W	4	<i>Open-end Project presentation</i>	<i>Open-end Project Writing report</i>
F	6		

**Tentative Dates for Assessments and Deliverables:** There will always be more than one week to complete homework after it is assigned.

**Open-end project presentation and Writing report due dates** will not be changed.

**Final Exam:** TBA University Schedule (Chpt 9 ~ 11.4)

**This is a tentative syllabus. It is within my discretion to change aspects of this syllabus as needed.**