CHEG 3304\(^1\) (3053) P02: Chemical Engineering Thermodynamics II
Fall 2022

Instructor: E. Carl McIntyre, Ph.D.  co-instructor: Lealon Martin, Ph.D.
Section # and CRN: P02, 18343
Office Location: Virtual
Office Phone: 936-261-9405
Mobile Phone: TBA
Email Address: ecmcintyre@pvamu.edu
Office Hours: TBA
Mode of Instruction: 100% Face to Face

Course Location: C.L. Wilson 103, Zoom & Canvas
Class Days, Times: TR 1400-1520

Catalog Description: Credit 3 semester hours. Properties of ideal and non-ideal binary and multi-component mixtures. Studies of equilibrium for single-and multi-component systems based on methods of corresponding states, equations of state and activity coefficients. Chemical equilibrium applied to both homogeneous and heterogeneous systems.

Prerequisites: CHEG 2334 (2043) and MATH 2320 (2043)
Co-requisites: Required


*See textbook policy elsewhere in this syllabus.

Student Learning Outcomes:

<table>
<thead>
<tr>
<th>Upon successful completion of this course, students will be able to:</th>
<th>Program Learning Outcome # Alignment</th>
<th>Core Curriculum Outcome Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Demonstrate knowledge of the 1(^{st}), 2(^{nd}) and 3(^{rd}) laws of thermodynamics</td>
<td>1, 2, 3, 4</td>
<td>N/A</td>
</tr>
<tr>
<td>2 Apply knowledge of 1st and 2nd laws of thermodynamics to identify, formulate and solve problems in energy conservation, power cycles, refrigeration cycles and liquefaction systems</td>
<td>1, 2, 3, 4</td>
<td>N/A</td>
</tr>
</tbody>
</table>

\(^1\) Course number reflects the numbering system change beginning fall 2021. Course numbers by the old system are shown in parenthesis for easy reference.
<table>
<thead>
<tr>
<th></th>
<th>Apply knowledge of multi-component mixture physical equilibrium, and chemical equilibrium to identify, formulate and solve problems in reacting and non-reacting systems</th>
<th>1, 2, 3, 4</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Demonstrate use of modern tools of the profession in solving multi-component mixture physical equilibrium problems in reacting and/or non-reacting systems</td>
<td>1, 2, 3, 4</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**COURSE OUTCOMES IN RELATION TO D1: DEPARTMENTAL OUTCOME 1**

Course Outcome 1 (D1): This outcome is a departmental outcome. Students will have an ability to identify, formulate, and solve fundamental engineering problems by applying principles of engineering, science, and mathematics, using tools appropriate to the profession.

1. Identify (classify and describe) chemical engineering problems based on their mathematical nature and the thermodynamics and material & energy balance concepts that need to be applied.
   Students are able to:
   (i) Given a problem statement, identify chemical engineering measurement variables, the units of the variables, and systems of units.
   (ii) Perform unit conversions for common chemical engineering measurements.
   (iii) Classify problem as continuous or steady-state, or transient, static or dynamic, ideal or non-ideal.
   (iv) Sketch a diagram depicting a scenario given in the problem statement.
   (v) List the given information, data and/or constraints, annotating on the sketch as appropriate.
   (vi) List the goals.

2. Formulate calculations in chemical engineering problems using thermodynamics and material & energy balances concepts.
   Students are able to:
   (i) Select the best approach for solving a problem.
   (ii) List the key equations, tables, graphs, methods, etc., needed to reach the goals.
   (iii) List assumptions and whether a basis is needed to reach the goals.
   (iv) Simplify the key equation(s) to show the path forward to a solution.

3. Solve calculations in chemical engineering problems using thermodynamics and material & energy balances concepts.
   Students are able to:
   (i) Solve a system of equations using algebraic techniques.
   (ii) Perform mass or mole balances on single or multiple units.
   (iii) Perform balances on batch or continuous systems.
   (iv) Determine balances for systems at steady state.
   (v) Calculate mole and mass fractions.
   (vi) Separate and integrate kinetic and fluid flow equations.

4. Use software such as ASPENTech’s Aspen or HYSYS, and/or CHEMCAD to perform simple chemical engineering thermodynamics analysis and simulation.
   Students are able to:
   (i) Use Microsoft Excel VBA to perform loops, what-if-then, and other coding calculations including MACROS.
   (ii) Use MATLAB to solve a system of linear equations.
   (iii) Use CHEMCAD to simulate the conversion of multiple units such as mixing or separation.
Major Course Requirements

Method of Determining Final Course Grade

<table>
<thead>
<tr>
<th>Course Grade Requirement</th>
<th>Weight</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Discussion (Post to Forum)</td>
<td>10%</td>
<td>15</td>
</tr>
<tr>
<td>2) Bullet Point Note Uploads (Reading/Viewings)</td>
<td>15%</td>
<td>15</td>
</tr>
<tr>
<td>3) Quizzes and Exercises (Online/Upload)</td>
<td>15%</td>
<td>20</td>
</tr>
<tr>
<td>4) Video Uploads (Articulation of Concepts &amp; Oral Reports)</td>
<td>25%</td>
<td>20</td>
</tr>
<tr>
<td>5) Projects (Upload Letter Reports)</td>
<td>35%</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Non-Participation Discount (Optional)</strong></td>
<td><strong>−10%</strong></td>
<td><strong>−10</strong></td>
</tr>
</tbody>
</table>

Grading Criteria and Conversion:

A = 90 – 100%
B = 80 – 89.9%
C = 70 – 79.9%
D = 60 – 69.9%
F = less than 60%

Detailed Description of Major Assignments:

Assignment Title or Grade Requirement | Description
--- | ---
Discussion Grades | Topics for discussion will be posted by the instructor each week, to which students are expected to post a comment at the forum and also a response to another students post at that same forum.*

Notes/Exercise/Quiz Grades | Reading assignments will be given, for which each student is required to take notes** for upload to complete the assignment. Likewise, screencasts (video lectures) will be assigned, for which students will likewise take notes for later upload. Exercises (similar to the homework concept) will be assigned for completion and submission by upload to eCourses.

Video Upload Grades | The video upload assignments will be individual or team based, as identified by instructor in each assignment. Each video assignment will require each student to be recorded (seen and heard) explaining and/or demonstrating a concept that the student has learned via assigned readings, screencasts (video lectures), class meetings, individual or group study, etc. Typical length will be 5-8 minutes.

Project Grades | The projects will be individual or team based, as identified by instructor in each assignment. Each project will require open ended problem solution, in some cases using computing tools such as Aspen or HYSYS simulation software, accessible via VDI. The results are to be communicated in a letter report, with style and content requirements as communicated by the instructor.

* The first student to post will have to return to the forum later, after another student has also posted, in order to post a comment to another students post.

** The style of note taking is the Bullet Point Notes method, used in the Guaranteed 4.0 Plan, for which guidance will be posted at the eCourses site.

Course Procedures or Additional Instructor Policies

Taskstream

Taskstream is a tool that Prairie View A&M University uses for assessment purposes. One or more of your assignments may be required for submission as an "artifact," an item of coursework that serves as evidence that course objectives are met. More information will be provided during the semester, but for general information, you can visit Taskstream via the link in eCourses.
Semester Calendar

Week One: Review of syllabus; course overview (table of contents); introduction. Pre-requisite skills inventory. Review of highlights from Chapters 1-5.
Readings: Review Chapters 1-5
Assignment (s): Discussion 1 Summarize the laws of thermodynamics

Week Two: Review of highlights from Chapters 1-5 (continued) 1st Law, 2nd Law, Ideal Gas Law
Readings: Read Chapter 6, Sections
Assignment (s): Discussion 2 What is an ideal gas?

Week Three: Thermodynamic Properties of Fluids (Ch. 6) States of Matter, Energy & Entropy Changes
Readings: Read Chapters 6, More Sections
Assignment (s): Discussion 3 What are the states of matter?

Week Four: Thermodynamic Properties of Fluids (Ch. 6, continued) Maxwell’s Relations, Equations of State, Property Relationships
Readings: Chapters 6 Sections on Maxwell’s Relations, EOS, and Property Relationships.
Assignment (s): Discussion 4 What is an equation of state, with some examples?

Week Five: Thermodynamic Properties of Fluids (Ch. 6, continued) Residual Properties
Readings: Chapters 6 Sections on Residual Properties
Assignment (s): Discussion 5 What is a residual property and for what is it useful?

Week Six: Applications of Thermodynamics to Flow Processes (Ch. 7)
Readings: Chapter 7
Assignment (s): Discussion 7 How are the laws of thermodynamics different for flow processes, as opposed to non-flow situations? Give an example of each.

Week Seven: Power & Refrigeration Cycles (Ch. 8 & 9)
Readings: Read Chapter 8 and 9 sections. Review BPN, exercises, and project work. Ensure all video uploads are completed.
Assignment (s): Discussion 7 Review highlights of semester: What would you put on Exam 1? Exam 1 (During Midterm Examination Period, location to be announced, masks are required)

Week Eight: Introduction to Vapor/Liquid Equilibrium (Ch. 10)
Readings: Chapter 10 Sections
Assignment (s): Discussion 8 Describe vapor liquid equilibrium

Week Nine: Vapor/Liquid Equilibrium (Continued)
Readings: Chapters 6 More Sections
Assignment (s): Discussion 9 Explain the difference between Raoult’s Law, Modified Raoult’s Law, and the Gamma Phi Formulation.

Week Ten: Solution Thermodynamics: Theory (Ch. 11)
Readings: Chapters 11 Sections
Assignment (s): Discussion 10 What is an activity coefficient and how is it different from a fugacity coefficient?

Week Eleven: Solution Thermodynamics: Theory (Continued)
Readings: Chapter 11 More Sections
Assignment (s): Discussion 11 Describe an activity coefficient model and explain when/where it is useful.

Week Twelve: Solution Thermodynamics: Applications (Ch. 12)
Readings: Chapters 12 Sections
Assignment (s): Discussion 12 Explain how to make the choice of activity coefficient model for different binary VLE cases, such as you would need to do to select a fluid package in a chemical process simulator such as Aspen or HYSYS. Feel free to cite any useful reference.

Week Thirteen: Solution Thermodynamics: Applications (Continued) and The Gamma/Phi Formulation of VLE (Ch. 14)
Readings: Chapter 14 Sections
Assignment (s): Discussion 13 Explain how to solve a VLE problem using the Gamma Phi Formulation.

Week Fourteen: The Gamma/Phi Formulation of VLE (Continued) and Course Review
Readings: CHEMCAD Example
Assignment (s): Discussion 14 Review highlights of semester since Exam 1: What would you put on Exam 2? Exam 2 (During last class meeting period before Thanksgiving break, location to be announced, masks are required)

Week Fifteen: Project Assignments: Non-Ideal Binary VLE, Multi-component VLE
Readings: eCourse Uploads
Assignment (s): Discussion 15 Lessons Learned This Semester.

Week Sixteen: Project Wrap-Up

Student Support and Success

John B. Coleman Library
The library and its partners have as their mission to provide resources and instructional material in support of the evolving curriculum, as a partner in Prairie View A&M University's mission of teaching, research, and service and to support the University's core values of access and quality, diversity, leadership, relevance, and social responsibility through emphasis on ten key areas of service. It maintains library collections and access both on campus, online, and through local agreements to further the educational goals of students and faculty. https://www.pvamu.edu/library/ Phone: 936-261-1500

University Tutoring Center
The Center offers tutoring via peer tutoring. The services include workshops (i.e., Save My Semester, Recalculate Your Route), seminars (i.e., Tools You Can Use: TI-84), group review sessions (i.e., College Algebra Topic Reviews, GRE Preparation), group study opportunities (i.e., TSIA, HESI, Study Break, Exam Cram), and test-taking strategies (How to take Notes, Study Buddy, 5 Day Study Guide). The Learning Curve is a nationally certified tutoring program through the National Tutoring Association. The peer tutors are trained and certified by the coordinator each semester. Location: J.B. Coleman Library Rm. 307. Phone: 936-261-1561
The Student Academic Success Center
The Student Academic Success Center is designed to help Prairie View students in their second year and beyond navigate toward graduation by providing the following services: Academic Advisement, Targeted Tutorials for Personalized Learning, Campus-Wide Referrals, and Academic & Social Workshops. Location: J.B. Coleman Library Rm. 306. Phone: 936-261-1040

Writing Center
The Writing Center provides student consultants on all aspects of the writing process and a variety of writing assignments. Writing Center consultations assist students in such areas as prewriting, brainstorming, audience awareness, organization, research, and citation. Students taking online courses or courses at the Northwest Houston Center or College of Nursing may consult remotely or by email. Location: Hilliard Hall Rm. 121. Phone: 936-261-3724

Student Counseling Services
The Student Counseling Services unit offers a range of services and programs to assist students in maximizing their potential for success: short-term individual, couples, and group counseling, as well as crisis intervention, outreach, consultation, and referral services. The staff is licensed by the State of Texas and provides assistance to students who are dealing with academic skills concerns, situational crises, adjustment problems, and emotional difficulties. Information shared with the staff is treated confidentially and in accordance with Texas State Law. Location: Owens-Franklin Health Center Rm. 226. Phone: 936-261-3564

Testing
The Department of Testing administers College Board CLEP examinations, the HESI A2 for pre-nursing majors, LSAT for law school applicants and MPRE for second-year law students, the Experiential Learning Portfolio option, the Texas Success Initiative (TSI) Assessment, which determines college readiness in the state, and exam proctoring, among other services such as SAT and ACT for high school students. Phone: 936-261-3627

Office of Disability Services
As a federally-mandated educational support unit, the Office of Disability Services serves as the repository for confidential disability files for faculty, staff, and students. For persons with a disability, the Office develops individualized ADA letters of request for accommodations. Other services include: learning style inventories, awareness workshops, accessibility pathways, webinars, computer laboratory with adapted hard and software, adapted furniture, proctoring of non-standardized test administrations, ASL interpreters, ALDs, digital recorders, Livescribe, Kurzweil, and a comprehensive referral network across campus and the broader community. Location: Evans Hall Rm. 317. Phone: 936-261-3585

Veteran Services
Veterans Services works with student veterans, current military and military dependents to support their transition to the college environment and continued persistence to graduation. The Office coordinates and certifies benefits for both the G.I. Bill and the Texas Hazlewood Act. Location: May Hall Rm. 118. Phone: 936-261-3563

Office for Student Engagement
The Office for Student Engagement delivers comprehensive programs and services designed to meet the curricular needs of students. The Office implements inclusive and accessible programs and services that enhance student development through exposure to and participation in diverse and relevant social, cultural, intellectual, recreational, community service, leadership development and campus governance. Location: Memorial Student Center Rm. 221. Phone: 936-261-1340

Career Services
Career Services supports students through professional development, career readiness, and placement and employment assistance. The Office provides one-on-one career coaching, interview preparation, resume and letter writing, and career exploration workshops and seminars. Services are provided for students at the Northwest Houston Center and College of Nursing in the Medical Center twice a month or on a requested basis. Distance Learning students are encouraged to visit the Career Services website for information regarding services provided. Location: Evans Hall Rm. 217. Phone: 936-261-3570
University Rules and Procedures

Disability Statement (Also See Student Handbook):
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Evans Hall, Room 317, or call 936-261-3585/3.

Academic Misconduct (See Student Handbook):
You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with your Student Handbook, especially the section on academic misconduct. Students who engage in academic misconduct are subject to university disciplinary procedures.

Forms of Academic Dishonesty:
1. Cheating: deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not mastered; giving or receiving aid unauthorized by the instructor on assignments or examinations.
2. Academic misconduct: tampering with grades or taking part in obtaining or distributing any part of a scheduled test.
3. Fabrication: use of invented information or falsified research.
4. Plagiarism: unacknowledged quotation and/or paraphrase of someone else’s words, ideas, or data as one’s own in work submitted for credit. Failure to identify information or essays from the Internet and submitting them as one’s own work also constitutes plagiarism.

Nonacademic Misconduct (See Student Handbook)
The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor's ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. Such incidents will be adjudicated by the Dean of Students under nonacademic procedures.

Sexual Misconduct (See Student Handbook):
Sexual harassment of students and employers at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating this policy will be subject to disciplinary action.

Title IX Statement
Prairie View A&M University (PVAMU) is committed to supporting students and complying with the Texas A&M University System non-discrimination policy. It seeks to establish an environment that is free of bias, discrimination, and harassment. If you experience an incident of sex- or gender-based discrimination, including sexual harassment, sexual assault or attempted sexual assault, we encourage you to report it. While you may talk to a faculty member about an incident of misconduct, the faculty member must report the basic facts of your experience to Ms. Alexia Taylor, PVAMU’s Title IX Coordinator. If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are individuals who can meet with you. The Title IX Coordinator is designated to handle inquiries regarding non-discrimination policies and can assist you with understanding your options and connect you with on- and off-campus resources. The Title IX Coordinator can be reached by phone at 936-261-2123 or in Suite 013 in the A.I. Thomas Administration Building.

Class Attendance Policy (See Catalog for Full Attendance Policy)
Prairie View A&M University requires regular class attendance. Attending all classes supports full academic development of each learner whether classes are taught with the instructor physically present or via distance learning technologies such as interactive video and/or internet.
Excessive absenteeism may result in a student’s course grade being reduced or in assignment of a grade of “F”. Absences are accumulated beginning with the first day of class during regular semesters and summer terms.

**Student Academic Appeals Process**
Authority and responsibility for assigning grades to students rests with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.

**TECHNICAL CONSIDERATIONS**

**Minimum Recommended Hardware and Software:**
- Intel PC or Laptop with Windows 7; Mac with OS X; Smartphone or iPad/Tablet with Wi-Fi
- High speed Internet access
- 8 GB Memory
- Hard drive with 320 GB storage space
- 15” monitor, 800x600, color or 16 bit
- Sound card w/speakers
- Microphone and recording software
- Keyboard & mouse
- Most current version of Google Chrome or Firefox

**Note:** Be sure to enable Java & pop-ups in the Web browser preferences

**Participants should have a basic proficiency of the following computer skills:**
- Sending and receiving email
- A working knowledge of the Internet
- Proficiency in Microsoft Word (or a program convertible to Word)
- Proficiency in the Acrobat PDF Reader
- Basic knowledge of Windows or Mac O.S.

**Netiquette (online etiquette):**
Students are expected to participate in all discussions and virtual classroom chats as directed. Students are to be respectful and courteous to others on discussions boards. Foul or abusive language will not be tolerated.

**Technical Support:**
Students should go to [https://mypassword.pvamu.edu/](https://mypassword.pvamu.edu/) if they have password issues. The page will provide instructions for resetting passwords along with whom to contact if login issues persist. For other technical questions regarding eCourses, call the Center for Instructional Innovation and Technology Services at 936-261-3283

**Communication Expectations and Standards:**
Emails or discussion postings will receive a response from the instructor, usually in less than 48 hours. Urgent emails should be marked as such. Check regularly for responses.

**Discussion Requirement:**
Online courses often require minimal to no face-to-face meetings. However, conversations about the readings, lectures, materials, and other aspects of the course can take place in a seminar fashion. This will be accomplished by the use of the discussion board. The exact use of discussion will be determined by the instructor.

It is strongly suggested that students type their discussion postings in a word processing application and save it to their PC or a removable drive before posting to the discussion board. This is important for two reasons: 1) If for some reason your discussion responses are lost in your online course, you will have another copy; 2) Grammatical errors can be greatly minimized by the use of the spell-and-grammar check functions in word processing applications. Once the post(s) have been typed and corrected in the word processing application, it/they should be copied and pasted to the discussion board.