This document is subject to minor revision, but not major revision. Its first version was posted on the first day of the semester (Monday, January 28, 2019). This current version will always display the most recent version and traces of all changes made since the beginning of the semester.

Introduction to Chemical and Biomolecular Engineering CHBE 101

Spring 2019

Lecture: Monday, Wednesday, Friday, 12:00-12:50 pm (JM Patterson 3201)

Recitation Section: Friday, 1:00-1:50 pm (JM Patterson 3201)

Learning community: Thursday, 4:00 – 5:00 (ESJ 0215)

Teaching Team

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Course Pre- and Co-Requisites

CHEM135 is a prerequisite and MATH141 is a corequisite. Students who have taken/are taking courses with comparable content may contact the ChBE department. A restriction is that the student must be in the chemical engineering undergraduate program or have permission from the ChBE department.

Course Description

CHBE101 will introduce analysis and calculation methods in chemical and biomolecular engineering central to chemical process analysis including engineering calculations, chemical process variables, process synthesis, process flowcharting, steady state material balances with and without reaction, single phase and multiphase systems, steady state energy balances with/without reaction and with/without temperature and phase changes as well as combined material energy balances. If time permits, computer and MATLAB aided calculations as well as biomolecular applications will also be introduced.

Course Objectives for Students

On successful completion of CHBE101, students should be able to:

- Describe the types of operations in chemical and biomolecular engineering processing
- Synthesize a chemical process and choose an appropriate reactor type
- Prepare a flowchart of a process from its description
- Perform calculations involving chemical process variables and stoichiometric relations
- Perform steady state material and energy balances on units and processes as well as combined material/energy balances, and the ability to apply these concepts to biomolecular problems

- Utilize knowledge of single phase systems, ideal gases and multiphase systems in material and energy balance calculations
- Use MATLAB, Excel and other software to solve material and energy balances
- Develop and improve teamwork, communication and organizational skills as relevant to the chemical engineering profession

Required Course Readings Textbook

Felder RM, Rousseau RW, Bullard LG (2015) Elementary Principles of Chemical Processes, 4th ed., John Wiley and Sons (hardcover ISBN 9780470616291, loose leaf ISBN 9781118431221). *This book will be referred to as "FRB" throughout the course.*

Students may purchase the hardcopy or the looseleaf (cheaper). Apart from the University bookstore, the textbook is also available from the publisher's website**. There will be in class quizzes that are open note and open book; you will not be allowed to use the electronic version of the book for these. Note that regardless of the version purchased, a printed (not electronic) copies need to be brought to lectures, recitations and exams. Purchasing the looseleaf or electronic versions enables you to bring only the relevant sections.**

Students who use previous editions of this textbook should note that lectures, homework and exams in the course will refer to the 4th edition listed above.

Other Resources

Perry's Handbook

Green D, Perry R (2007) Perry's Chemical Engineers' Handbook, 8th edition. McGrawHill

Professional. Available free of charge (UM campus only) at this link (http://site.ebrary.com/lib/umd/detail.action?docID=10211725) ; ISBN 9780071422949. Some exercises will require you to consult this handbook.

Kirk-Othmer Encyclopedia

Seidel A, Kirk R, Othmer D, Kroschwitz J, Howe-Grant M (2014) Kirk-Othmer Encyclopedia of Chemical Technology. Wiley. Available free of charge (UM campus only) at this link (http://onlinelibrary.wiley.com/book/10.1002/0471238961) ; ISBN 9780471238966. The course project will require you to consult this encyclopedia.

Instructor and Student Expectations

Instructor Expectations

Students can expect the instructor to:

- Be professional.
- Explain new and previously unlearned concepts and information during lectures and answer questions related to the new concepts.
- Hold office hours for additional explanation or clarification of concepts taught in the lectures and/or relevant concepts from prerequisite courses, and assistance with the HW problem interpretation and solution methodology.
- Return graded material within reasonable time (HW within a week, exams within 14 days).
- Respond to students' course related emails/discussion board postings within a reasonable amount of time (two business days).
- Address student concerns provided that the concerns are raised in a timely manner, the concerns relate to the class as a whole, and addressing the concerns has a positive impact on student learning.
- Accommodate students with learning disabilities.
- Assist students with their professional development especially as relevant to this course and as reasonably possible.

Student Expectations

Students are expected to:

- Be professional.
- Follow the guidelines in this document in matters relating to this course.
- Follow the University's Code of Academic Integrity.
- Come to class prepared by reading the relevant textbook sections and any posted handouts in advance and bringing the textbook to class.
- Be aware of deadlines and therefore plan ahead.
- Maintain an atmosphere conducive to learning and not disrupt the class, e.g. by arriving and leaving the class on time, raising one's hand before asking questions, refraining from consuming food in class (a beverage is acceptable), and refraining from using electronic devices meant for communication/entertainment in class. (See policy on electronic devices in class below.)

Lecture

The lecture time will consist of an overview of the topics given in the course calendar for that week. I will upload lecture notes to the Pages for this course in Canvas after each lecture. Students are expected to read the book material to be covered that day before class. Some lecture periods will also consist of in-class problem solving in groups. Therefore, **always bring your textbook and a calculator to class**.

Learning community

Learning community was implemented into the ChBE 426 curriculum by Prof Deborah Goldberg. Learning community is a time for students to work on ChBE 101 homework problems with their fellow classmates in small groups of 3-6 students. The idea is to establish an informal time for students to work together on homework with the instructor and TAs present to answer questions. The instructor and/or Graduate TAs will attend Learning community and float around the room to answer students' questions on a group-by-group basis, but will not lecture or address the entire class. To facilitate group work, learning community will be help in the EJS building in a classroom with round top tables.

Discussion section

Discussion section will be run by a group of TAs, who will present example problems relevant to the prior weeks lectures.

Class Participation

Students will be expected to participate in class and during group problem solving activities. Everyone is expected throughout the semester to contribute to these discussions.

Quizzes

Approximately 4-6 short 10-minute quizzes will be given throughout the semester. These will NOT be announced ahead of time and are open book/notes/calculator (another reason to bring a textbook/calculator to class). The grades will be scored on a 3 pt scale. The lowest quiz grade will not be counted in the final grade.

Homework

Homework problems will be assigned regularly and will be graded. Homework will generally be assigned and due on Wednesdays. Homework will consist of problems that only require pencil and paper to those that require software. While it is acceptable for students to work together on homework problems, each student must complete and turn in his/her own homework. Homework that is copied from another student is in violation the university's Code of Academic Integrity. Similarly, you are not allowed to use solutions from previous students.

Part of each homework assignment will be completed on Wiley Plus, a web based learning tool provided by the book publishers. Wiley plus can be accessed at www.wileyplus.com. Students must follow instructions on the handout provided to establish an account. Homework problems will be assigned through the website and must be completed on time or students will receive a late homework penalty.

Late Homework: These items are due at the designated time stated on each assignment. Email submissions will not be accepted, unless approved by myself. Written homework is generally due at the **beginning** of lecture one week after it was assigned. Wileyplus problems will generally be due at midnight that night. The penalty for lateness without a university-approved reason for absence on the due date is **half credit up to 24 hours late and no credit after 24 hours**.

Follow these guidelines for paper homework assignments:

- Include a cover page with your name, student ID number, date, course number, assignment number and signed honor pledge.
- Write on only one side of the page and include your name and page number on each page.
- Remove “fringe” from notebook paper.
- Staple the pages together.
- Write out a reasonable amount of step-by-step work to make the problem solving process clear, including but not limited to listing knowns, assumptions, diagrams, etc. Graders are not obligated to giving full credit if large gaps are present and the thought process is not clear. In addition, homework should be neatly written or typed. If it is illegible, it will not be graded.

Exams

There will be three midterm exams and a final exam (Dates below) and are considered *Major Grading Events*. The midterm exams will approximately cover the prior material listed on the course calendar. The final is comprehensive but about half of the exam will be on problems related to the final 1/3 of the course. All exams are *CLOSED* book. One “cheat-sheet” (8 x 11 inch paper, front and back) and scientific calculator (graphing calculators are not allows) are allowed for the midterms. Three cheat-sheets front and back are allowed on the final.

Term Project

The term project will be a group project and will be announced mid semester and administered by the graduate teaching fellow. More details will be provided then by Sean. The term project is due on the last day of class, May 13 and is considered a *Major Grading Event*.

Grading Summary

Homework	10%
Exam 1	15%

Exam 2	15%
Exam 3	15%
Final Exam	25%
Quizzes	2.5%
Interview Assignment	2.5%
Term Project	15%

Important Dates

Last date to drop course without a “W”	February 8, 2019 (Friday)
Last date to drop course with a “W”	April 12, 2019 (Friday)

Major Scheduled Grading Events (Attendance Mandatory)

Exam 1 (Major Scheduled Grading Event)	February 25, 2019
Exam 2 (Major Scheduled Grading Event)	March 29, 2019
Exam 3 (Major Scheduled Grading Event)	April 26, 2019
Final Exam (Major Scheduled Grading Event)	May 21, 2019 (Tuesday 8 – 10 am)

Class Policies

University of Maryland hosts a website outlining campus wide undergraduate course related policies at http://www.ugst.umd.edu/courserelatedpolicies.html.

Attendance

Students are expected to attend all lectures, submit assignments on time and take all exams in this course. The instructor will follow the University's Policy on Attendance and Assessments/Examinations (http://www.umd.edu/catalog/index.cfm/show/content.section/c/27/ss/1584/s/1540) as well as the ChBE Department's Policy on Medically Necessitated Excuses, (to be provided separately), in all matters relevant to attendance. Students should note the following:

- Four exams have been designated as Major Scheduled Grading Events above and in the course calendar. **Medically necessitated absences at these events must be substantiated by verifiable documentation from a medical professional that is in accordance with the University's guidelines.** Any other University approved absences at these events also require verifiable documentation. If a student fails to provide documentation in a timely manner, the student will be unable to make up for the missed event. Additionally, students should inform the instructor of absences as soon as possible in case of medically necessitated absences and in advance of the absence for nonmedically necessitated absences. Makeup policies for exams are outlined below.
- Students who are absent at non-Major Scheduled Grading Events due to medically necessitated reasons at two or more nonconsecutive lectures or for a prolonged period (three or more consecutive lectures) must provide verifiable documentation from a medical professional that is in accordance with the University's guidelines. Failure to provide the documentation in a timely manner will result in not being able to make up for any missed grading events such as quizzes or HW.
- Students who miss an exam, HW, or class activity without a legitimate (medically necessitated or University approved), documented and verifiable reason will not be able to make up.
- Students who miss class are still responsible for the material covered during the absence and it is recommended that they obtain notes from classmates.

Accommodations for students with disabilities: In order to receive accommodations, students with learning disabilities must provide a written request and documents from the University of Maryland Disability Support Services (http://counseling.umd.edu/DSS). Please submit any requests by **Monday, February 11**. Find the policy for disability support services here: https://www.counseling.umd.edu/global/docs/ads/policy/disabilityandaccessibilitypolicy.pdf

No Electronic Devices in Class To maintain an atmosphere conducive to learning, students should not use electronic devices for communication and/or entertainment purposes during class. Such devices include, but are not restricted to cell phones, smart watches, tablets, computers, music players and games. These devices should be put away out of sight in backpacks or pockets, and not kept on a desk or chair. Repeated reminders to put devices away may result in negative class participation points. Students may use watches or calculators that do not have communication or

entertainment capability. **Students may not use their own calculators during exams; the instructor will supply calculators for use in exams.** A student with a compelling need to use an electronic device other than watch or calculator in class should discuss this need with the instructor and obtain the instructor's advance permission to use the device.

Inclement weather: In the event of inclement weather, I will comply with the University's decision regarding whether classes are going to be held or not. Any assignments due on the day of a cancellation will be due instead at the next class meeting.

Make-ups: Exams and quizzes may only be made up if you are absent for a documented, university- approved reason. If you miss class without a university-approved reason on a day that an exam or quiz takes place, you will not be able to make it up.

Religious observation: If you will miss class on the day of an exam or on the date that an assignment is due because of a religious observation that is not officially recognized by the university, you must contact me **at least 2 weeks before your anticipated absence** in order to discuss alternative dates for the exam or assignment.

ELMS/CANVAS (www.elms.umd.edu): On ELMS, I will post this syllabus, assignments, and any major changes to the course calendar. In addition, I may sometimes post handouts utilized in class and links to useful web sites. Lecture notes will be posted in the Pages section. You will also be able to access your grades via ELMS.

CourseEvalUM (www.courseevalum.umd.edu): Your participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of our academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as to the tenure and promotion process. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Academic Integrity

The University of Maryland, the Department of Chemical and Biomolecular Engineering (ChBE) as well as the professional societies American Institute of Chemical Engineers (AIChE) uphold and follow the highest ethical standards. The University has a Code of Academic Integrity (http://www.president.umd.edu/policies/docs/III100A.pdf) (hereafter, code) that prohibits students from cheating or consulting their colleagues during exams, cheating or plagiarizing on HW, buying papers, submitting fraudulent documents and forging signatures. Additionally, the ChBE Department has a policy on academic integrity (to be provided separately). The instructor will follow the University code and the ChBE policy in all matters relating to academic integrity.

Serious violations of academic integrity are exemplified by, though not restricted to, the following:

- Altering a graded exam and then requesting regrading. (To prevent this, the instructor will routinely photocopy and file graded exams.)
- "Copying" a quiz or homework response verbatim, either from a classmate or from previous years' student solutions or the instructor solution manual (unauthorized for students), without intellectually contributing to the assignment. (See paragraph below for what constitutes academic dishonesty on quizzes and HW.)
- Using or consulting material that is not available to the entire class or to which students do not have authorized access, e.g. the instructor solution manual to the textbook.

What constitutes independence and academic dishonesty on HW. Students and teams may discuss HW with colleagues outside the team with regard to interpretation and methodology; however, individual students and their teams should exhibit independence in proceeding with the solution. If a student is doubtful about the acceptable extent of collaboration on HW, the student should check with the instructor. In general, submission of a HW problem solution that clearly demonstrates lack of intellectual input on the entire problem or part thereof, or facilitating someone else's submission of such a solution is academic dishonesty. For an example of how HW copying correlates with low grades on analytical final exams, see: Palazzo DJ, Lee Y, Warnakulasooriya R, Pritchard DE, 2010, *Phys. Rev. Spec. Topics – Phys. Ed. Res.* 6: 010104.

Violations of academic integrity or the Honor Code may entail negative consequences on the course outcome and/or disciplinary action. University of Maryland's standard penalty for an act of academic dishonesty is an "XF" grade with the annotation "failure due to academic dishonesty" on the student's transcript. More severe penalties and disciplinary action could also be imposed, depending on the intensity of the violation.

Honor Pledge: The University has a student administered Honor Pledge:

"I pledge on my honor that I have not given or received any unauthorized assistance on this examination."

which students and teams are asked to write and sign on every exam and assignment. Failure to do so will require the student to confer with the instructor.

Course Calendar

*Note: The overall topic of each week of lecture is shown in **bold** followed by more specific topics that will be covered. Students should read the chapter sections associated with the lecture PRIOR to class. Homework (HW) assignment dates are listed in **blue**; due dates will be listed on the assignment. HW will generally be assigned and due on Mondays. Exam dates are listed in **purple**. Holidays are listed in **green**. Project dates listed in **orange**.*

Week Dates	Topics covered	Chapter/Section	HW

1	1/28-2/1	**Units:** Syllabus overview, Intro, Units and Conversion, Dimensional analysis	Ch 2.1-2.3	**1**
2	2/4-2/8	**Physical data:** Data analysis, Force weight and density, flow rates, pressure and temperature	Ch 2.4-2.6, Ch. 3.1-3.5	**2**
3	2/11-2/15	**Material balance intro**: degree of freedom and single unit balances	Ch 4.1-4.2	**3**
4	2/18-2/22	**Material balances:** multi-unit processes	Ch. 4.3-4.5	
5	2/25-3/1	**Exam 1 (2/25): Units/dimensions, physical data, DOF, material balances; Reactive material balances**: Reaction conventions, reactive material balances	Ch. 4.6-4.7	**4**
6	3/4-3/8	**Reactive material balances:** Reaction matrices, reactions in multiunit processes	Ch. 4.6-4.7	**5**
7	3/11-3/15	**Reactive material balances:** reactions with recycle/purge	Ch. 4.7-4.8	**6**
8	3/18-3/22	**Spring break**		
9	3/25-3/29	**Exam 2 (3/29): multi-unit balances, reactions, reactive material balances; Combustion reactions**	Ch. 4.8 – 4.9 5.1-5.2, Ch. 6.1-6.2	
10	4/1-4/5	**Phase equilibria:** Fluid properties, single/multi component phase equilibria, single unit processes with phase equilibria	Ch. 6.3-6.4	**7**
11	4/8-4/12	**Intro to energy balances:** Types of energy changes, open and closed systems, steam tables	Ch. 7.1-7.3	**8**

12	4/15-4/19	**Combined mass-energy balances (MEB):** solution methods for MEB; mechanical energy balances	Ch. 7.4-7.7, Ch. 8.1	**9**
13	4/22-4/26	**Exam 3 (4/26): phase equilibria, VLE, energy balances, MEB; Mixing thermodynamics:** non-reactive energy balances, reactive balances	Ch. 8.2-8.4	**10**
14	4/29-5/3	**Thermodynamics of reactions:** Heat of reaction, formation reactions	Ch. 9.1-9.3	**11**
15	5/6-5/10	**Combustion reactions**: in MEB	Ch. 9.4-9.5	**12**
16	5/13	Last day of class; **Project due**, final exam review	notes	
	5/21	**Final exam (8-10 am in Armory, room TBD): 50% cumulative, 50%: mixing thermo, reactive balances, thermodynamics of reactions**		