

CHBE 437: Chemical and Biomolecular Engineering Laboratory

Department of Chemical and Biomolecular Engineering

University of Maryland

Fall 2019

Course description

This course focuses on the application of chemical engineering process and unit operation principles in small-scale semi-commercial equipment. Data from experimental observations are used to evaluate performance and efficiency of operations. Correct presentation of results in report form is emphasized.

Instructors

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Mondays 11:00 am-12:00 pm

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Course objectives

1. Apply theoretical concepts learned in previous coursework to experimental equipment.
2. Develop critical thinking through experimental design, data collection, data analysis, and data interpretation.
3. Improve communication of technical content in written and oral form.
4. Gain an understanding and appreciation of safe laboratory practices.
5. Gain experience working in teams.

Prerequisites

CHBE 424, CHBE 426, and CHBE 440

Course website and communication

The course website is on ELMS: <https://myelms.umd.edu/login>. The course website will be used for posting course materials, announcements, and grades, as well as for submitting assignments. The primary means for communicating information with students, including time-sensitive information, will be through ELMS, though email may also be used. Make sure the email you have associated with ELMS is current and that your notification settings ensure you to receive information in a timely manner. Unless announced (in class, by email, or on ELMS), all assignments will be submitted online. All questions regarding course assignments should be posted to the appropriate discussion board on ELMS, so all students can benefit from the response.

Experiments

The available experiments for Fall 2019 are:

1. Absorption
2. Agitation and mixing
3. Distillation
4. Fluid flow
5. Heat exchange - Armfield (Two units are available: Shell and tube, Agitated tank)
6. Heat exchanger - Concentric tube
7. Kinetics
8. Membrane separation
9. Refrigeration

Four experiments will be assigned to each team. Each team will be asked to rank the experiments in terms of preference on the first day of class. The assignments will be based on preference and experiment availability. The experiments cannot be changed once assigned. Note that the Armfield heat exchange experiment has two units: Shell and tube, Agitated tank. Teams will be asked to rotate between the two units.

Textbook

No textbook is required for this course; however, you may find the following books helpful:

1. W.L. McCabe, J.C. Smith, and P. Harriott. *Unit Operations of Chemical Engineering*. 7th ed. McGraw- Hill: New York, 2005.
2. D.W. Green and R.H. Perry. *Perry's Chemical Engineers' Handbook*. 8th ed. McGraw-Hill: New York, 2007
3. Textbooks from the prerequisite courses (kinetics, thermodynamics, transport, and separations courses).

Lab "notebook"

A lab "notebook" is required for recording data and experimental information. The notebook may be electronic. A group can share a single notebook or each group member may maintain his or her own notebook. Instructors and teaching assistants may request to view lab notebooks at any time. If the notebook(s) used by a group do not satisfactorily document the experimental details and data, the group will receive a deduction of 25% of the total points possible on the lab report associated with experiment.

Groups

The majority of the work in this course is performed as a group. Groups will be determined at the beginning of the semester using the CATME Team-Maker tool, which relies on research-based metrics to develop teams. Teams will remain the same for the entire semester. At the beginning of the semester, information on successful teamwork will be presented, and teams will create a contract to outline expectations of each team member and group practices.

CATME group evaluation

For each experiment, students will be required to confidentially evaluate the contribution of each group member. Group members whose contributions are not in line with expectations will see this reflected by a deduction of the group portion of their final grades. Students may meet with one of the instructors to discuss areas of strength and weakness in their group evaluations.

Course materials copyrights

All course materials provided in class or on the course website (e.g., lectures, handouts, slides, laboratory manuals, homework assignments, quizzes) are copyright protected. Students may not copy and/or distribute these materials without the instructors' permission.

Course schedule

<u>Section</u>	<u>Discussion time/location</u>	<u>Lab time/location</u>
Monday (0101)	10:00 am – 10:50 am in CHE 2136	1:00 pm – 5:00 pm in CHE 1145
Tuesday (0201)	10:00 am – 10:50 am in CHE 2118	11:00 am – 3:00 pm in CHE 1145
Thursday (0301)	10:00 am – 10:50 am in CHE 2118	11:00 am – 3:00 pm in CHE 1145
Friday (0401)	10:00 am – 10:50 am in CHE 2108	1:00 pm – 5:00 pm in CHE 1145

The discussion, lab, and assignment schedule below will be followed as closely as possible, but changes may be necessary as the semester progresses. Changes will be announced in class and posted on the course website.

Week	Mon	Tues	Thur	Fri	Discussion topic	Lab	Assignment(s) due*
1	8/26	8/27	8/29	8/30	Introduction to course Lab safety	Introduction to experiments Project risk assessment Group contract	<u>Individual</u> : Team-Maker survey
2	9/9	9/3	9/5	9/6	Lab proposals Project risk assessment	Experiment 1 (E1) – plan	<u>Individual</u> : Chemical Hygiene Training
3	9/16	9/10	9/12	9/13	Lab reports	E1 – experiment	<u>Group</u> : E1 proposal (EP1) due two days before start of discussion
4	9/23	9/17	9/19	9/20	Graphs, tables, and equations	E1 – experiment	
5	9/30	9/24	9/26	9/27	TBA	E2 – plan	<u>Group</u> : E1 lab report <u>Individual</u> : E1 group member evaluations
6	10/7	10/1	10/3	10/4	E1 Lab report review	E2 – experiment	<u>Group</u> : E2P due two days before start of discussion
7	10/14	10/8	10/10	10/11	Technical writing	E2 – experiment	
8	10/21	10/15	10/17	10/18	Creating effective oral presentations	E3 – plan	<u>Group</u> : E2 lab report <u>Individual</u> : E2 group member evaluations
9	10/28	10/22	10/24	10/25	Quiz 1-Technical writing	E3 – experiment	<u>Group</u> : E3P due two days before start of discussion
10	11/4	10/29	10/31	11/1	Creating effective memos	E3 – experiment	
11	11/11	11/5	11/7	11/8	No discussion-Preparation for presentations	E3 – group presentations	<u>Group</u> : E3 – group presentations <u>Individual</u> : -Peer evaluations of presentations -E3 group member evaluations
12	11/18	11/12	11/14	11/15	No discussion -AIChE 2019 annual meeting	E4 – plan	
13	11/25	11/19	11/21	11/22	IP and patents	E4 – experiment	<u>Group</u> : E4P due two days before start of discussion
14	12/9	12/3	12/5	12/6	Quiz 2 (Experiment-related problems)		<u>Group</u> : E4 memo report <u>Individual</u> : E4 group member evaluations

*See ELMS for specific deadlines.

Grading

The equation that will be used to determine final grades is the following:

$$\text{Final \% grade} = \text{Individual Assignment} \times 0.1 + (\text{Group Assignment} \times \text{Adjustment Factor}) \times 0.9$$

Where the *individual assignment* is in percentage, the *group assignment* is in percentage, and the *adjustment factor* value derives from the student's group evaluation CATME score as shown below,

CATME score range	Adjustment Factor
≥ 1.04	1.04
≥ 0.95	1.00
≥ 0.9 to < 0.95	0.95
≥ 0.85 to < 0.9	0.90
< 0.85	0.85

The percentage for group assignment will be determined based on the following weighting system:

- 22.2% Experiment proposals (Experiments 1-4)
- 55.6% Written lab reports (Experiments 1, 2, and 4)
- 22.2% Presentations for Experiment 3

Experiment proposals are written experimental plans that must be approved before beginning each experiment. Lab reports convey the work that was completed and then describe and discuss the results that were obtained. (The lab reports in this course take the place of the exams found in typical chemical engineering lecture courses.) Details on the format of the experiment proposals, lab reports, and presentations will be provided in discussion and posted on ELMS. Experiment proposals, lab reports, and presentations will be completed as a group, and each group member should expect to receive the same score. Group members will be required to complete an evaluation of each other following every experiment. If these evaluations show a disproportionate level of contribution from any group member, final grades will be adjusted to reflect the imbalance. Individual assignments and quizzes will be completed as homework or in class. Unannounced quizzes may be given.

Questions regarding grading should be addressed to the instructor or TA who graded the item in question. Requests for regrading must be brought up within one week of the grade being posted. These requests should be made by email to the person responsible for grading, and Dr. Zhang and Dr. Ponce must be copied on these emails. Requests that do not conform to these policies will not be considered.

Team evaluation grades will apply to each experiment. Students that do not submit their team evaluation by the deadline, will receive no credit for that individual assignment nor a team evaluation score and forfeit their right to challenge the score received. The points for this assignment will be given based on the evaluation given by your team mates about your contribution to the group. In this course we will use the [CATME](#) web service to evaluate team performance. At the end of the evaluation CATME will release the average factor value between the "Adjustment Factor (w/o Self)" and "Adjustment Factor (w/Self)", this factor will be used for assigning an equivalent number of points for the Team Evaluation Assignment. In the case of conflicts, and situations identified by CATME (see information regarding "[Exceptional Conditions](#)") the scores will be reviewed case by case by the instructors, and if the scores need to be adjusted, they will be at the instructors' discretion.

Final grades will be calculated at the end of the semester, after normalizing scores on experiment proposals and lab reports (group assignments) to account for grading differences among instructors/TAs. The grades of each grader should be within a standard deviation (SD) of 10% considering all the grader's grades given. If the grades given by a

grader are above this SD, the assignment's grades will be lowered until they fall in the previously stated range. The opposite will apply to grader's grades below the SD range.

The final course letter grade will be determined based on looking at the final distribution of all grades in the class, and the plus/minus grading system will be used. Grades will be assigned based on the following campus guidelines:

- A+, A, A- Work was outstanding and at a level well above requirements of the course
- B+, B, B- Work was at a level above the basic requirements of the course
- C+, C, C- Work was at a level that met the requirements of the course
- D+, D, D- Work was at a level that did not fully meet the basic requirements of the course
- F Work failed to satisfy the basic requirements of the course

To our knowledge, there are no departmental or campus policies that map a numerical score to a specific letter grade. Therefore, instructors are responsible for translating numerical scores to a letter grade based on the aforementioned criteria. While it is unusual that numerical scores above 90 map to letter grades less than an A, this is not a departure from acceptable standards.

Late work

Pay close attention to the due dates and times for each assignment, along with the required format (i.e., paper or electronic). Each team member is responsible for checking that uploaded files are the correct ones and in the correct format (typically PDF), and appear as the group intends. Deadlines are based on times reported on ELMS. An automatic 5-minute grace period will be applied for all assignments.

Late work will be accepted up to 4 hours past the deadline, but will receive a deduction of 15% of the total points possible on the assignment. This penalty will be applied under the following assumptions: (1) the student/group (including all members of a group) attends all discussion and lab sessions between the time the assignment is due and the time the work is turned in and (2) the student/group does not work on the assignment during discussion or lab after the time it was due. If either of these assumptions is not valid, the penalty will double to 30% of the total points possible.

Safety

Maintaining a safe work environment for yourself, your classmates, the teaching assistants, and the instructors must be a priority. The following procedures and requirements must be followed:

1. Before entering the laboratory, be aware of the safe operation of your experimental equipment and understand any chemistry relevant to your system.
2. Do not eat or drink in the lab or bring food/beverages into the lab.
3. Find, read, and understand material safety data sheets (MSDS) for all chemicals used in your experiments.
4. Know where all safety equipment is located in the lab (e.g., first aid kit, eye wash).
5. Wear appropriate attire in the lab. Long pants (or the equivalent) and a lab coat are required when equipment is being used (by your group or another group). Closed-toe shoes are required. Students not dressed appropriately will not be allowed in the lab. This will be considered an unexcused absence.
6. Tie long hair back; no neckties are allowed. Jewelry must be secured or removed to prevent interference with equipment or chemicals.
7. Wear safety goggles at all times in the lab when any group is working with their equipment. Contacts are strongly discouraged. Each time a teaching assistant or instructor sees a student not wearing their safety goggles correctly, the student's final course grade will be reduced by 2%.

8. Use gloves when handling corrosive, reactive, or poisonous chemicals. Do not touch computers, monitors, keyboards, mice, or cell phones when wearing gloves.
9. Report all injuries, however slight, to a teaching assistant or instructor. For emergencies, call 911 from a campus phone or #3333 from your cell phone. (Calling 911 from your cell phone is also acceptable, but #3333 is preferable.)
10. Make sure you understand the operation of a gas cylinder regulator prior to use. Open the main cylinder valve only when in use. Release pressure on the regulator when finished using the gas. Ensure gas cylinders are securely chained at all times.
11. Use caution when working with steam lines. Wear heat-resistant gloves when opening valves, and avoid escaping steam.
12. Dispose of all chemical waste appropriately. Ask an instructor or a teaching assistant, if you are unsure of the proper disposal method.
13. Stay focused on your experiment; lab time (or discussion time) is not for the internet or social media.
14. Pick up all trash and dispose of it properly.
15. Inform your teaching assistant (or instructor) anytime you leave the lab.
16. Do not bring visitors into the lab without permission of an instructor or teaching assistant supervising your lab period.

Housekeeping

At the end of each lab period, each group must make sure their equipment and work area are returned to a condition as good as or better than they were at the beginning of the lab period. All glassware must be cleaned, and all tools and materials must be returned to their proper locations. If any reagents or supplies are running low or the chemical waste is getting full, inform the teaching assistant. Any equipment that is not functioning correctly should also be reported to the teaching assistant or instructor.

Course materials

All course materials provided in class or on the course website (e.g., lectures, handouts, slides, laboratory manuals) are copyright protected. Students may not copy and/or distribute these materials without the instructors' permission.

Academic integrity

The University of Maryland Code of Academic Integrity can be found in full online at www.president.umd.edu/policies/docs/III-100A.pdf. Instances of academic dishonesty will be reported to the Honor Council. The Code states that "any of the following acts, when committed by a student, shall constitute academic dishonesty:

- (a) Cheating: intentionally using or attempting to use unauthorized materials, information, or study aids in any academic exercise.
- (b) Fabrication: intentional and unauthorized falsification or invention of any information or citation in an academic exercise.
- (c) Facilitating academic dishonesty: intentionally or knowingly helping or attempting to help another to violate any provision of this code.
- (d) Plagiarism: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise."

Attendance

Students are expected to be present at and participate in each discussion and lab period for the entire scheduled time. Students are asked to sign in and out for each lab period. Students must spend a minimum of three hours for each lab period. Arriving more than 5 minutes late will be treated as an absence after the first infraction. Any non-medical absences (even for part of the class period) and requests for accommodations must be approved prior to class by email, and the request should be sent to Dr. Zhang and Dr. Ponce. The instructors may request documentation to support your absence, which can typically be supplied by email. Students must arrange with their group to make up for missed laboratory time, possibly through modified responsibilities on other aspects of the experiment. Only university-approved absences will be accepted (with the exception of job interviews that cannot be scheduled outside of class time). Attending discussions is important to receive good grades. Not all discussion slides will be uploaded to Canvas.

Before scheduling an interview that will require missing laboratory time (or exams for other courses), students should inform the company of their academic obligations and request a day/time that requires the least disruption of their coursework. To request approval of an absence due to an interview, students should provide the name of the company and include the name and contact information (email and/or phone number) for a person who could confirm the interview.

In the event that a class must be missed due to illness, the policy in this class follows university and department policies (department policies are reprinted at the end of this syllabus). Documentation required for medically necessary absences should be provided by email, though the instructors may also request to review the original documentation.

Students with unapproved absences from discussion will not be allowed to make up missed work from the discussion section. Students with unapproved absences from a laboratory period will receive a deduction of 25% of the total points possible on the experiment proposal and/or lab report corresponding to the missed work in the lab. Students who miss a presentation without approval will not be allowed to make up the missed work and will receive no credit for the presentation.

Religious observances

The University of Maryland's policy states that students should not be penalized for participation in religious observance. Within the first two weeks of the semester (by Friday, September 6, at 5 pm), students are responsible for notifying one of the instructors by email of any anticipated absences for religious reasons during the semester.

University closures or delays

University closures or delays may require adjustments to the course schedule. Students will be informed of these changes within one week of the university returning to normal operation. Any concerns students have about the schedule changes must be brought up within a day of receiving the changes.

Students with disabilities

Students with disabilities documented by the Disability Support Service Office (DSS; 301-314-7682) will be provided with appropriate accommodations. Students are responsible for presenting their accommodation letter to the instructor by the end of the drop/add period for this course session. Students may email the instructor to set up a meeting or may visit during office hours.

Additional information on university policies for undergraduate courses

Students and instructors have a shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Further information regarding policies relevant to undergraduate courses can be found at <http://ugst.umd.edu/courserelatedpolicies.html>. Topics that are addressed in these various policies include

academic integrity, student and instructor conduct, accessibility and accommodations, attendance and excused absences, grades and appeals, copyright and intellectual property.

Policy on Academic Integrity

Department of Chemical & Biomolecular Engineering (ChBE)

University of Maryland, College Park, MD (UM)

Revised October 13, 2011

1. The Code of Academic Integrity is printed in Course Catalogs and the UM Policies and Procedures Manual.

Please visit

www.umd.edu/catalog (Section 4) and
www.president.umd.edu/policies/iii100a.html

A discussion of Academic Dishonesty is given in the Schedule of Classes. Please visit

www.testudo.umd.edu/ScheduleOfClasses.html and
www.testudo.umd.edu/soc/dishonesty.html

Students are responsible for knowing and understanding the content of the Code. The first examination in each course may include one question about the Code of Academic Integrity.

2. Violations of the Code of Academic Integrity will not be tolerated. Except as noted in No 4 below, suspected cases will be immediately reported to the Student Honor Council for resolution. Cases will not be negotiated between faculty members and students. The standard penalty for violations of the Code of Academic Integrity is a grade of "XF."
3. Instructors may prohibit the use of personal calculators during examinations. If needed, departmental calculators will then be provided by the instructor.
4. Graded examinations and other significant assessment materials will be routinely copied and filed. Cases of students who alter graded material and present such for re-grading are reviewed by the Office of Judicial Programs, not the Student Honor Council. The standard penalty in such cases is suspension from the University.
5. Submission of work for grading implies that it is the original work of the named student(s). This includes all exams, homework, research papers, project & lab reports, and computer programs. If a question on originality arises, the work may be withdrawn or retracted, at the discretion of the Instructor, if the student feels that it is appropriate to do so. Withdrawn or retracted work will not be graded and cannot be resubmitted. This option does not apply to either in-class or take-home exams, and can only be exercised once per semester.
6. "Plagiarism" will be interpreted in its broadest sense: ideas from others must be referenced; words from others must be in quotation marks and referenced. Paraphrasing without referencing will be considered plagiarism.
7. The same work cannot be submitted for credit in two different courses without the written permission of both instructors.
8. All excuses for missed work must be timely and verifiable. Falsification of excuses will not be tolerated, and will be treated as cases of academic dishonesty. **Excuses for illness must be signed by a doctor or other medical professional**, except as provided for in UM and ChBE policies on Medically Necessitated Absences.

Policy on Medically Necessitated Absences

Department of Chemical & Biomolecular Engineering (ChBE)
University of Maryland, College Park, MD (UM)
Adopted October 13, 2011

1. The ChBE departmental policy applies to all CHBE and ENCH courses. Additional provisions and some exceptions may apply, as communicated in writing in the individual course syllabus or supplement.
2. The ChBE departmental policy both supplements and compliments the UM policy on Medically Necessitated Absences. Students are expected to know and understand the university policy. Please visit

www.president.umd.edu/policies/v100g.html

www.umd.edu/catalog/index.cfm/show/content.section/c/27/ss/1584/s/1540

3. For every medically necessary absence from class (lecture, discussion, recitation lab, etc.), a reasonable effort is required to notify the instructor in advance of the class. The following assessments are considered to be Major Grading Events:
 - a. Examinations given during lecture, discussion, recitation or laboratory periods
 - b. Take home examinations
 - c. Final examinations of any kind
 - d. Course or laboratory papers, projects and reports
 - e. Computer programs
 - f. Scheduled presentations
 - g. Other as stated in written course syllabus or supplement
4. The University's once per semester self-signed note option does not apply to Major Grading Events, be they identified herein or in the course syllabus. Timely and verifiable written documentation from a doctor or other medical professional must be provided. The submittal procedure and written record must follow the university guidelines.
5. Non-consecutive and/or prolonged medically necessitated absences from more than a single lecture, discussion, recitation or lab require timely and verifiable written documentation from a doctor or other medical professional. The submittal procedure and written record must follow the university guidelines.
6. Guidelines for Resolution of Problems are given in the university policy.