Introduction to Chemical and Biological Process Analysis
ChemBE 540.202 — Spring 2014

Instructor: Professor Jeffrey J. Gray, jgray@jhu.edu, 410-516-5313

TA: Tiana Warren, twarre12@jhu.edu
Facilitator/Grader: Jena Daya, jdaya2@jhu.edu

Office Hours: Gray: WF 2:30-3:30 p.m., or by appointment, Maryland 208
Warren: F 12-1 p.m., or by appointment, NEB 170
Daya: Th 12-1 p.m., NEB 170

Lectures: MWF 1:30-2:20 p.m., Hackerman B17

Sections: Peer-Led Team Learning (PILOT)
Section 1: Tu 2:30-4:30 p.m., Krieger 309
Section 2: Th 4:00-6:00 p.m., Gilman 132

Course Website: http://graylab.jhu.edu/courses/540.202
Course Google Group: http://groups.google.com/group/chembe202,
Email to chembe202@groups.google.com
HashTag: #ChemBE202

An errata is available at http://highered.mcgraw-hill.com/sites/0072849606/information_center_view0/errata.html

Recommended Software and Text:

MATLAB, Student Version (~$100; available at the Krieger lab)
Octave (free, http://www.gnu.org/software/octave) is a suitable alternative.

Essential MATLAB for Engineers and Scientists, Fifth Edition
Brian D. Hahn & Daniel T. Valentine, Newnes 2013 (~$40)

Supplementary Text: (on reserve at the MSEL)

Elementary Principles of Chemical Processes, Third Edition
Richard M. Felder and Ronald W. Rousseau, Wiley 2005

Overview: Chemical and Biomolecular Engineers analyze and design processes, both to understand biological processes and to design synthetic processes to manufacture goods for society. In this class, you will learn to model, analyze, evaluate and design chemical and biochemical engineering processes. This course will introduce concepts in material and energy
balances, thermodynamics, and reactor and separations design, and will include both steady-state and non-steady state systems. These concepts constitute the fundamentals for all courses in the Department of Chemical and Biomolecular Engineering. Furthermore, this course will emphasize the skills and behavioral traits needed to be successful in the ChemBE curriculum.

Course Topics:

1. Chemical Processes – Converting Raw Materials to Useful Products
2. Material Balances and Process Flow Calculations
3. Tools of the Trade – Reactors and Separators

Prerequisites:

030.101 Introductory Chemistry I
171.101 General Physics I

Co-requisite:

030.205 Organic Chemistry I – This requirement may be waivered with permission of the instructor, if the student has completed the math or physics series.

Assessment: Course grades will be determined from an assessment of submitted homework assignments, exams, a project, and from participation in the Peer-Led Team Learning exercises. Grades will be determined from an *absolute* scale: 97% = A+, 93% = A, 90% = A-; 80% = B-; 70% = C- etc. I reserve the right to shift these percentages down (but not up). For example, if a particular exam is more difficult than I originally planned, an A- may be achieved with an 88. It is not advisable to rely on a grade shift, however.

Your course grade will be computed as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>PILOT</td>
<td>5%</td>
</tr>
<tr>
<td>Homework</td>
<td>20%</td>
</tr>
<tr>
<td>Project</td>
<td>15%</td>
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<tr>
<td>Exams</td>
<td>60%</td>
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<tr>
<td>Total</td>
<td>100%</td>
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**PILOT:** PILOT is a loose acronym for Peer-Led Team Learning. It consists of supervised, structure, small-group learning in weekly meetings with a group of other students and a peer leader (specifically trained for PILOT) who facilitates different and exciting ways to learn and practice material. You will work together to solve problems specifically designed by the facilitators for maximum understanding of relevant course material. PILOT will meet during the two-hour sections on Tuesday (section 1) or Thursday (section 2). Some PILOT sections will also include short computer tool tutorials.
The PILOT program has been tested in the past as an option for the calculus and chemistry courses as well as in this course. This year it is a required portion of the class for the following reasons:

1. The best way to learn to solve engineering problems is to practice solving engineering problems!
2. You will learn different methods of learning complex material.
3. You will learn to more clearly articulate your ideas, which helps cement your understanding.
4. You’ll learn how to know your answer to a problem is right—without looking in the back of the book!
5. The more you help your peers, the stronger your mastery of the material becomes.
6. Scientific and engineering professions are increasingly team oriented. Future employers, medical admissions committees and graduate schools expect their applicants to have a proven record in team work and collaboration.
7. You will make new friends! You may even form a strong and cohesive team to adventure together through the ChemBE program, and even beyond into your careers.

It is essential to have strong participation in the PILOT teams. Therefore, you are required to attend, and 5% of your course grade will be given based on your attendance and level of participation. You are allowed two absences during the semester; after that your PILOT grade will decrease a full grade for every session missed.

**Homework:** Weekly homework assignments will be given (and posted to the course web site) on Mondays. Homework will usually be due each Monday, to be submitted during the afternoon class. They will be returned in sections. Solutions will be posted on the course webpage.

Problems will be worth varying amounts of points (typically 4 points for a Warm-Up, 8 points for a Scrimmage, and 12 points for a Game Day problem). Each week, scores of all problems assigned will be added and the result scaled to 100 pts. The average of the weekly scores will become the "HW Grade" to be factored into the course grade as described above.

You are encouraged to work together on the homework. The first four homework assignments will be completed individually. Thereafter, we will assign groups of three to four students to complete homework assignments as a team. Further details will be provided at that time. In both cases, homework is provided as practice of your problem solving skills. Since exam problems will primarily test skills developed through the homework, you are expected to attempt to solve the problems individually first. Teams will be periodically asked to assess the individual contribution of each team member.

Homework should be prepared in a professional manner. (You should think of homework as a technical report that you are presenting to your boss. This often means that a final copy should be prepared from your working scratch documents.)

- Homework must be stapled at the upper left hand corner (no clips or other substitutes).
Homework must be prepared on paper with clean edges, i.e., no paper torn from spiral notebooks.

Homework must be legible.

Engineer’s paper is recommended for hand-calculation.

Plots must be completed with software such as Excel or MATLAB.

Computer spreadsheets should be formatted neatly and printed; when MATLAB programs are used for solutions, the script files should be clean and commented and submitted with the solutions.

Your submitted homework should be a neatly copied final solution, rather than a loose collection of scrap paper with all your explorations of unfruitful solution pathways.

Graders retain the right to refuse and/or penalize any homework not conforming to these professional standards.

Collaboration on Individual Homeworks: Homework is provided as practice of your problem solving skills, and exam problems will primarily test skills developed through the homework. Therefore, you are expected to develop your individual problem solving skills. However, problem solving requires deep and creative thought, and human brains often work better when juiced with discussion. In fact, a true test of whether one understands something is the ability to explain it to others.

Therefore, you may consult with your colleagues if you have difficulty with a problem, and you may also act as a consultant. For example, legitimate consulting questions might be, “How do I convert lb-mol to g-mol?” or “Does this process diagram look correct to you?” However, copying of another person’s homework (“I don’t understand problem 3.1, can I see yours?”) or giving a colleague a copy of your results are strictly forbidden. Violations will be dealt with in accordance to the university’s policies on academic ethics. If you consult another member of the class on a particular homework assignment, please put the name of that person (or persons) under your name at the top of your homework. The number of consultants will not alter your homework grade. Even when you work in a group, your own solution should be in your own words and each Excel spreadsheet and Matlab script should be written by you individually.

When we switch to team homework, you will submit one completed homework assignment but these same principles will still apply. You will outline all the problem solutions before meeting with your team, and you will work through the problems on your own paper, even as you work together with a group. Computer code and spreadsheets will be co-developed with all team members participating actively in their creation.

You are allowed to use the Internet in your problem solving process, but in no case are you ever allowed to access problem solutions or copy problem solutions from any source.

Project: The project will give you an opportunity to design a chemical process, including flowsheeting, specification of process equipment, estimating raw material and energy costs, and capital investment. You will work in groups of four people, assigned mid-semester. Each group will submit their final project as a team at the end of the semester.
**Exams:** Two midterm exams will be given in an extended class period (3-5 p.m.) to allow ample time for completion. Your course grade for Exams will be computed by a weighted average of the two midterm exams and the final exam, with the lowest grade of the three exams counting half as much as the other two exams.

**Regrades:** Any regrade requests (exam or homework) must be submitted in writing within one week of the return of the exam or assignment. Homework regrades will be performed by the grader, with review by the professor. Exam regrades will be performed by Prof. Gray. In the event of a regrade, the entire submission (not just the item of contention) is subject to regarding, at the discretion of the reviewer.

**Class Participation:** I will use a variety of individual and small-group active learning exercises in class, therefore you are expected to participate. I will frequently call on students for answers and examples. Thinking time will be provided, but answers of “I don’t know” are not allowed. Additionally, you are encouraged to ask questions during lecture.

**The Learning Den:** The Learning Den (tutoring@jhu.edu) offers free small group tutoring in Gilman Hall. Schedule information is found at [http://www.jhu.edu/academic-assistance/tutoring_schedule.html](http://www.jhu.edu/academic-assistance/tutoring_schedule.html). To reserve your seat:

1) Sign up online at http://tutoring.jhu.edu (Your User ID and password is your 6-character Hopkins ID; the two fields are identical)
2) Call 410-516-8216 and ask to speak with Ms. Anne Benner
3) Stop by the Office of Academic Advising, Garland Hall, Suite 3A

**Ethics:** Cheating is wrong. Cheating hurts our community by undermining academic integrity, creating mistrust, and fostering unfair competition. The university will punish cheaters with failure on an assignment, failure in a course, permanent transcript notation, suspension, and/or expulsion. Offenses may be reported to medical, law or other professional or graduate schools when a cheater applies.

Violations can include cheating on exams, plagiarism including from other students or the Internet, reuse of assignments without permission, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Ignorance of these rules is not an excuse.

You may collaborate with other students in this course, but only on homework and the project as detailed above. If you have questions about this policy, please ask the instructor.

On every exam, you will sign the following pledge: "I agree to complete this exam without unauthorized assistance from any person, materials or device. [Signed and dated]"

For more information, see the guide on "Academic Ethics for Undergraduates" and the Ethics Board web site ([http://ethics.jhu.edu](http://ethics.jhu.edu)).
### Special Dates and Times:

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<tr>
<th>Day</th>
<th>Date</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>M</td>
<td>Jan 27</td>
<td>First day of class</td>
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<tr>
<td>M</td>
<td>Feb 24</td>
<td>Exam I, 1:30-3:30 p.m.</td>
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<tr>
<td>M-F</td>
<td>Mar 17-21</td>
<td>Spring Break</td>
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<tr>
<td>M</td>
<td>Apr 7</td>
<td>Exam II, 1:30-3:30 p.m.</td>
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<tr>
<td>F</td>
<td>May 2</td>
<td>Last day of class</td>
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<tr>
<td>W</td>
<td>May 14</td>
<td>Exam III (Final), 9-12 a.m.</td>
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