Course Resources:
Course material and announcements will be posted on the course’s main Blackboard page. Grades and assignment drop boxes will be posted on your lab section’s Blackboard page. In addition, engineering resources that will be of use for your projects can be found at the following website provided by the WUSTL Libraries: http://libguides.wustl.edu/eece405

For any questions regarding course concepts or logistics, we will be using Piazza, an online system for getting fast and efficient help from your classmates and course instructors. Please post your questions on the course’s Piazza page and direct your questions either to the whole class or only to the instructors. If you wish, you may post anonymously. Note that posting any form of a design or experimental solution to the unit operations projects is strictly prohibited, and will be treated as academic misconduct. However, questions about the theory behind the unit operations (e.g., “What does this paragraph in this textbook mean?”) are welcome. This course’s Piazza page is located at: http://piazza.com/wustl/fall2017/eece405/home

Course Objectives (students who complete this course should be able to):

1. Explain the general theories and principles important to chemical engineering and use these concepts in the analysis of chemical engineering processes and unit operations.
2. Apply effective engineering experimentation techniques and safety procedures common in the chemical industry.
3. Describe how chemical engineering processes and unit operations are useful in chemical production industry and other related industries.
4. Write and present reports effectively summarizing experimental procedures, observations, results, and conclusions.
5. Demonstrate effective skills necessary for group work.
Course Schedule:
Following two initial weeks, the course will be organized as three four-week lab units. The first three weeks of each unit will be open lab time to work on the lab assignment. The fourth session of each unit will consist only of oral presentations. See the last page of the syllabus for more details on team assignments and lab schedule. For each lab, each group should complete a pre-lab technical memo, a mid-unit worksheet, a full lab report, and an oral presentation. These items are due as noted in the schedule below.

<table>
<thead>
<tr>
<th>Week</th>
<th>Week</th>
<th>Lecture Topic</th>
<th>Unit # - Week #</th>
<th>Deliverable(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 28-Sept 1</td>
<td>• Course Introduction</td>
<td>No lab</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sept 4-8</td>
<td>• Using the libraries to find technical info</td>
<td>Lab Crash Course Wed, Thurs, &amp; Fri - 1 pm (Sections A, B, F attend one session of choice)</td>
<td>Safety form (turn in during Wed. lecture)</td>
</tr>
<tr>
<td>3</td>
<td>Sept 11-15</td>
<td>• Data Analysis and Error Propagation</td>
<td>1 – 1</td>
<td>Prelab 1</td>
</tr>
<tr>
<td>4</td>
<td>Sept 18-22</td>
<td>• Project Management</td>
<td>1 – 2</td>
<td>Mid-Unit Worksheet 1</td>
</tr>
<tr>
<td>5</td>
<td>Sept 25-29</td>
<td>• Instrument Diagrams</td>
<td>1 – 3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Oct 2-6</td>
<td>• Process Safety</td>
<td>1 – 4</td>
<td>Lab Report 1 Oral Presentation 1*</td>
</tr>
<tr>
<td>7</td>
<td>Oct 9-13</td>
<td>N/A</td>
<td>2 – 1</td>
<td>Prelab 2</td>
</tr>
<tr>
<td>8</td>
<td>Oct 16-20</td>
<td>N/A</td>
<td>2 – 2 (Sections C, D)</td>
<td>Mid-Unit Worksheet 2</td>
</tr>
<tr>
<td>9</td>
<td>Oct 23-27</td>
<td>N/A</td>
<td>2 – 2 (Sections A, B, F)</td>
<td>Sections A, B, F; Mid-Unit Worksheet 2</td>
</tr>
<tr>
<td>10</td>
<td>Oct 30-Nov 3</td>
<td>N/A</td>
<td>2 – 3 (Sections A, B, F)</td>
<td>Sections C, D; Lab Report 2 Oral Presentation 2*</td>
</tr>
<tr>
<td>11</td>
<td>Nov 6-10</td>
<td>N/A</td>
<td>2 – 4 (Sections C, D)</td>
<td>Sections A, B, F; Lab Report 2 Oral Presentation 2*</td>
</tr>
<tr>
<td>12</td>
<td>Nov 13-17</td>
<td>N/A</td>
<td>3 – 1 (Sections C, D)</td>
<td>Sections C, D; Prelab 3</td>
</tr>
<tr>
<td>13</td>
<td>Nov 20-24</td>
<td>N/A (Thanksgiving)</td>
<td>3 – 2 (Sections A, B, F)</td>
<td>Sections A, B, F; Mid-Unit Worksheet 3</td>
</tr>
<tr>
<td>14</td>
<td>Nov 27-Dec 1</td>
<td>N/A</td>
<td>3 – 3</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Dec 4-8</td>
<td>N/A</td>
<td>3 – 4</td>
<td>Lab report 3 Oral Presentation 3*</td>
</tr>
<tr>
<td>Reading</td>
<td>Dec 11-15</td>
<td>N/A</td>
<td>N/A</td>
<td>Peer Review Form</td>
</tr>
</tbody>
</table>

*Oral presentations for Section A will be held in Brauer 3020 during regular lab time. Presentations for all other sections will be held in Brauer 3014 during regular lab time.

Note: There will be no final exam for this course.
Assessment and Grading:

<table>
<thead>
<tr>
<th>Individual Grade Contributions</th>
<th>Guaranteed Grade Cutoffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety Form</td>
<td>1%</td>
</tr>
<tr>
<td>Pre-lab Technical Memos (3)</td>
<td>10%</td>
</tr>
<tr>
<td>Mid-Unit Worksheet (3)</td>
<td>10%</td>
</tr>
<tr>
<td>Full Lab Reports (3)</td>
<td>10%</td>
</tr>
<tr>
<td>Oral Presentations (1 or 2)</td>
<td>10%</td>
</tr>
<tr>
<td>Management/participation (3)</td>
<td>10%</td>
</tr>
<tr>
<td>Questions during presentations</td>
<td>1%</td>
</tr>
</tbody>
</table>

Guaranteed Grade Cutoffs

- 90 ≤ A
- 68 ≤ C < 72
- 85 ≤ A- < 90
- 65 ≤ C- < 68
- 82 ≤ B+ < 85
- 62 ≤ D+ < 65
- 78 ≤ B < 82
- 58 ≤ D < 62
- 75 ≤ B- < 78
- 55 ≤ D- < 58
- 72 ≤ C+ < 75
- F < 55

Dr. Brennan will be offering an extra credit set of surveys for educational research purposes. If you complete the surveys (after signing consent) or the alternate assignment that is provided, you will earn a 1% bonus to your grade. Also, if at least 85% of the class completes the end-of-semester course evaluation, a 2% bonus will be awarded to everyone's grade.

Safety Form
Signed safety forms are due in lecture during the 2nd week of class. Failure to turn these in on time will result in a 50% grade deduction. A signed safety form is required to be able to participate in lab activities.

Pre-lab Technical Memos
No pre-lab assignments will be accepted late. The assignment consists of two parts: A Technical Email Memo and an in-lab oral quiz. The Technical Memo should be writing following the guidelines described in the Laboratory Report Manual and should contain the following information: (1) A description of principle theoretical concepts underlying the unit operation, (2) important correlations, charts, etc. that will aid in your analysis of the unit operation (see the unit operation's assignment handout for more information on the required analysis), and (3) information about chemical and operational safety hazards, including recommendations for appropriate safety precautions. Think of this memo as a formal e-mail to your boss in which you concisely describe the goals of your project, the important theory, correlations (and other information) that will help you achieve the goals, and safety information that you will need to be careful of.

The content above should be divided amongst group members according to team roles (described below) and as described in the relevant rubric available on Blackboard. The Team Leader should turn in the Technical Memo (as a PDF) to your section's Blackboard page before the beginning of the first lab session for each unit.

Mid-Unit Worksheet
No mid-unit worksheet will be accepted late. The purpose of this assignment is to facilitate team progress towards the lab goals and spur discussion between the team and the instructor. The worksheet (available on Blackboard) should be completed by the team and then a paper copy should be brought to lab in week 2 of each lab unit. During lab, the instructor will read and discuss the worksheet with the team. Grades will be assigned based on completion and overall quality.

Full Lab Report and Oral Presentation
No lab report will be accepted late. The Team Leader should turn in the lab report (as a PDF) to your section’s Blackboard page by the beginning of the 4th lab session for each unit. The lab report should following the writing and formatting guidelines described in the Laboratory Report Manual.

During the final lab session for each unit, the Team Leader for each group (Note: NOT the entire group) will also give a 15-minute oral presentation on their group’s work followed by a 5-minute question-and-
answer period. The grade for the oral presentation will be an individual grade for the Team Leader. Note: Because there are three units, someone in each 2-person team will have the role of Team Leader twice, so they will have to give 2 oral presentations. These students’ final presentation grade will be the average of the two individual presentation grades.

See the rubrics on Blackboard for more details on how both the report and oral presentation will be assessed. To help you learn the formatting for the Pre-Lab Technical Memo and Final Lab Reports, you will have the opportunity to revise and re-submit your memo and/or report for the first unit only. The final grade for these assignments will be the average of the original grade and the revised grade.

**Project Management/Participation Surveys**
These surveys give each team member the opportunity to assess the performance of the Team Leader and the Team Leader the opportunity to assess the performance of each team member in the context of group dynamics and overall project management skill. Completing the surveys is worth 1% of your final grade, while your score on the surveys is worth 5% of your grade.

**Asking Questions During Presentation Sessions**
*Each student will be required to ask at least one question of their peers during each oral presentation session.* Asking questions is an important professional skill, not to mention it gives you an opportunity to not only understand the other unit operations more fully, but a chance to look ahead to later units. Asking questions appropriately is worth 1% of your total grade.
Team Member Roles:
For each unit operation unit, students will share the project responsibilities as members of a team. The responsibilities will be structured, split up, and graded according to roles **which will be rotated after each unit**. For a three-person team, each team member should experience each role exactly one time. The basic responsibilities of each team member are shown in the tables below. For details on the memo/report components, see pgs. 12-16 of the Laboratory Report Manual. For grading details, see the rubrics available on Blackboard and the Lab Report Manual.

For Three-Person Teams:

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| Team Leader        | Facilitate discussions about and make final decisions on project direction/planning, coordination, and execution.  
Resolve team conflicts or differences.  
Act as primary point of contact and coordinate team communications.  
Schedule regular in-person team meetings for the purposes of planning, analysis, and reporting.  
Assign and set deadlines for team/individual activities and tasks.  
Submit Pre-lab Memo, Mid-Unit Worksheet and Full Lab Report.  
Present Oral Presentation.  
Assist with data analysis, interpretation of data and drawing of conclusions. | Pre-Lab Memo/Quiz:  
Email message to “boss”  
Abstract/introductory statement  
Qualitative theoretical description of unit op  
Conclusion  
Proofreading  
*Submission to Blackboard*  
Final Report:  
Cover page  
Abstract  
Introduction  
Conclusion  
Overall story/coherence  
Final proofreading  
*Submission to Blackboard*  
Final Oral Presentation |
| Experimental Engineer | Complete hazard analysis and develop plan for the safe handling of chemicals and safe operation of equipment.  
Conduct background research on all chemicals and equipment to be used.  
Establish a formal written procedure for data collection  
Collect and manage data, and note experimental observations during lab.  
Assist with data analysis, interpretation of data and drawing of conclusions. | Pre-Lab Memo:  
Cover page  
Memo header  
Safety information  
Proofreading  
Final Report:  
Apparatus  
Procedures  
Discussion  
Data sheets (appendix)  
Proofreading  
Assists with content development for Final Oral Presentation |
### Analyst
- Draw plots/charts and generate data tables.
- Double check calculations for correctness.
- Work with Experimental Engineer to design experimental procedure to include data acquisition replication where statistical analysis is required.
- Apply statistics and error analysis to data.
- Ensure adequate discussion of statistics and error analysis in reports.
- Assist with data analysis, interpretation of data and drawing of conclusions.

### Pre-Lab Memo/Quiz:
- Correlations, charts, equations that might be helpful for analysis
- Final proofreading
- Overall story/coherence

### Final Report:
- Error analysis
- Data analysis
- Results
- Sample calculations (appendix)
- Proofreading

Assists with content development for Final Oral Presentation

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**For Two-Person Teams:**

<table>
<thead>
<tr>
<th>Role</th>
<th>Description</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| Team Leader/Experimental Engineer  | • Facilitate discussions about and make final decisions on project direction/planning, coordination, and execution.  
• Resolve team conflicts or differences.  
• Act as primary point of contact and coordinate team communications.  
• Schedule regular in-person team meetings for the purposes of planning, analysis, and reporting.  
• Assign and set deadlines for team/individual activities and tasks.  
• Complete hazard analysis and develop plan for the safe handling of chemicals and safe operation of equipment.  
• Conduct background research on all chemicals and equipment to be used.  
• Establish a formal written procedure for data collection  
• Collect and manage data, and note experimental observations during lab.  
• Submit Pre-lab Memo, Check-In Worksheet and Full Lab Report.  
• Present Oral Presentation.  
• Assist with data analysis, interpretation of data and drawing of conclusions. |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Pre-Lab Memo/Quiz:                | • Cover page  
• Email message to “boss”  
• Memo header (title and subject)  
• Abstract/introductory statement  
• Safety information  
• Qualitative theoretical description of unit op  
• Proofreading  
• Submission to Blackboard |
| Final Report:                      | • Cover page  
• Abstract  
• Introduction and theory  
• Apparatus  
• Procedures  
• Conclusion  
• Data sheets (appendix)  
• Final proofreading  
• Overall story/coherence |
| Final Oral Presentation            |                                                                                                                                                                                                            |-------------------------------------------------------------------------------------------------------|
| Analyst | Pre-Lab Memo/Quiz:  
|---------|-------------------|
| • Draw plots/charts and generate data tables.  
| • Double check calculations for correctness.  
| • Work with Experimental Engineer to design experimental procedure to include data acquisition replication where statistical analysis is required.  
| • Apply statistics and error analysis to data.  
| • Ensure adequate discussion of statistics and error analysis in reports  
| • Assist with data analysis, interpretation of data and drawing of conclusions.  | • Correlations, charts, equations that might be helpful for analysis  
| | • Conclusion  
| | • Final proofreading  
| | • Overall story/coherence  
| | • Submission to Blackboard  

| Final Report:  
|------------------|
| • Error Analysis  
| • Data Analysis  
| • Results  
| • Discussion  
| • Sample calculations (appendix)  
| • Proofreading  

Assists with content development for Final Oral Presentation
Additional Course Policies:

Absences
If you or your team member(s) have a scheduling conflict in a given week, it is up to you to make arrangements prior to the lab date to get your lab work done. If you must reschedule, it is your responsibility to talk to your lab group and/or the appropriate TA. We will try to accommodate your requests, but ultimately attending lab and completing the project is your responsibility. Unexcused absences for labs can result in no credit for the lab report.

Safety Violations
All students will adhere to the laboratory safety rules. Any unsafe practice will result in a deduction of approximately 10% from the lab report. It is up to the discretion of the TA to not allow the group to work on a unit operation if that group violates safety rules, resulting in a zero for that lab report and oral presentation. Any “serious” violation of any of these safety rules may lead to immediate dismissal from the entire course.

Academic Integrity Policy
As adults training to become accredited (and potentially practicing) engineers, you are expected to adhere to professional behavior with regards to planning your data collection, writing your lab reports, and giving your final presentations. This means that any work you present should be the product of your team only. Any evidence of plagiarism or unauthorized collaboration will be dealt with harshly, and could result in being reported to the Dean’s office. These policies are in place not only to ensure that grades are assigned fairly, but to encourage personal growth and learning – copying from others is not a skill that will help you long-term!

For more information, please see the Washington University undergraduate academic integrity policy: http://wustl.edu/policies/undergraduate-academic-integrity.html

Diversity
We consider our classroom and lab environments to be places where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

Accommodations Based Upon Sexual Assault
The University is committed to offering reasonable academic accommodations to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support services and accommodations. If you need to request such accommodations, please direct your request to Kim Webb (kim_webb@wustl.edu), Director of the Relationship and Sexual Violence Prevention Center. Ms. Webb is a confidential resource; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain as confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

If a student comes to the instructor to discuss or disclose an instance of sexual assault, sex
discrimination, sexual harassment, dating violence, domestic violence or stalking, or if he/she otherwise
observe or become aware of such an allegation, he/she will keep the information as private as they
can, but as a faculty member of Washington University, they are required to immediately report it to the
Department Chair or Dean or directly to Ms. Jessica Kennedy, the University’s Title IX Coordinator. If
you would like to speak with the Title IX Coordinator directly, Ms. Kennedy can be reached at (314)
935-3118, jw kennedy@wustl.edu, or by visiting her office in the Women’s Building. Additionally, you
can report incidents or complaints to Tamara King, Associate Dean for Students and Director of
Student Conduct, or by contacting WUPD at (314) 935-5555 or your local law enforcement agency.
You can also speak confidentially and learn more about available resources at the Relationship and
Sexual Violence Prevention Center by calling (314) 935-8761 or visiting the 4th floor of Seigle Hall.

Bias Reporting
The University has a process through which students, faculty, staff and community members who have
experienced or witnessed incidents of bias, prejudice or discrimination against a student can report
their experiences to the University’s Bias Report and Support System (BRSS)
team. See: brss.wustl.edu

Mental Health
Mental Health Services’ professional staff members work with students to resolve personal and
interpersonal difficulties, many of which can affect the academic experience. These include conflicts
with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety
and depression. See: shs.wustl.edu/MentalHealth