ECH 3240L Chemical Engineering Laboratory I
Basic Concepts of Mass and Energy Balances, Fluid Flow and Phase Equilibrium

Course Description:
Laboratory experiments in mass and energy balances, transport phenomena and chemical engineering thermodynamics. In addition to the laboratory exercises (six total), there will be lectures addressing topics in safety, data analysis, scientific method, obtaining information, practice of chemical engineering and professional preparation.

Instructor:
Richard Gilbert
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Office hours: posted on my office door. I am happy to make an appointment with you if you cannot make my posted office hours.

Teaching Assistants:
Laboratory Teaching assistants will be assigned.
You are expected to attend the lab session for which you signed up. If you need to change sections, you must drop and add after obtaining approval from the Department. Also, you are expected to attend all the lecture meetings.
Please turn off all cell phones that you bring to the lab. Leaving the lab during the middle of an experiment is generally not safe. You may bring your laptops to the lab, but please refrain from browsing or emailing while in the lab. It is distracting to the instructor and to your lab partners.

Course Materials:
1. Notes and information about labs (all on course website).
2. Textbooks currently used in your Chemical Engineering courses.
3. Manufacturer’s literature (either provided in the lab or per manufacturer’s websites)
4. Chemistry Laboratory Notebook purchased from the bookstore.
   (At least one per group is required.)

Computer Software used:
1. Logger Pro Version 3.2
2. Excel (MatLab if preferred)

Things you need to get before coming to lab
1. A laboratory notebook. One per group.
   This is essential. Electronic methods for keeping notes are not acceptable.
2. A thumb drive to store your data and presentations.
3. Black or blue ink pens to take data in your notebook. Pencils should not be used.
4. Safety goggles to wear when handling chemicals (safety requirement)
5. Covered shoes to protect your feet (safety requirement)
6. Dress code: No shorts or tank tops (safety requirement)

Expected Course Outcomes
Student completing this course will:
1. demonstrated good experimental techniques
2. apply methods of data acquisition and analysis
3. calibrate transducers
4. relate experimental measurements to theory and design application
5. develop team participation skills
6. develop written and oral communication skills
7. develop good laboratory safety habits
8. apply data analysis and parameter estimation techniques
9. become aware of the importance of safety and the rules and regulations that are applicable to the profession

Grading and Assessment
1. Lab quizzes individual 6 x 20 120 points
   (If quiz is not administered you get 120 points)
2. Lab Reports group 6 x 150 750 points
3. Design project (if assigned) group 150 points
4. Group presentation (if assigned) - group 100 points
5. Statistics/related topics class quiz-individual effort
6. Constructive criticism for improving a laboratory-individual effort
7. Midterm Test- individual effort
   (This test is a great forecaster of what your Final Exam grade is likely to be.)
8. Final Exam-individual effort

Please note:
(a) All lab reports, the design project (if assigned), and the oral presentation (if assigned) will be jointly submitted as a group.
(b) Lecture assignments, in-class assessments, midterm test, and the final exam are individual efforts.

Course Grade Rubric
Your course grade is determined from the combination of the assessment instruments in the laboratory and the classroom. Your work in the laboratory will be assigned a letter grade (the University +/- system) based on the accumulation of points from each activity as shown above. Your midterm test and final exam will be assigned a letter grade (A,B,C,D,F).
Your course grade will be the average of the three letter grades (Laboratory, Midterm Test, and Final Exam). The other in-class assessed activities (including the criticism for laboratory improvement) will, if their cumulative assessment allows, be used to raise your course grade one level in the University +/- system. (For example; a D+ course grade would move to a C- course grade as long as these extra class assessments scored at least a C grade)

Attendance Policy
(a) This is a laboratory course. There is no sit in the back row with you phone or computer tuned into the outside world option. You are expected to be in the lab physically, mentally, and contribute to the progress of the experiment. If you are not in the lab you do not contribute and your value to your group drops drastically. Some experiments may take shorter than the 3 hour time allocated. When that happens you are still expected to use the lab contact hours to start working on the calculation and at least outline what your group written report should be. This course is intended to move you out of the college student go to class get my partial credit operational mode that says you are done because the class that day is over to the go to work mentality where one part of the job (collecting data in the lab) just moves to the next part of the project.
(b) Oral reports (when assigned) cannot be postponed. If you fail to present or unable to attend,
you will lose all points.

**Quizzes**
At the discretion of your Laboratory Instructor, quizzes will be given at the beginning of each lab experiment to test your understanding of the experiment that you are about to do. Basically you will be asked to provide a short (not more than one page) summary of the experiment you are about to do, with the summary addressing two parts:

1) what are the general objectives of the lab;
2) the general steps you will follow.

You can prepare for the quiz by reading the experiment description and doing the problems suggested at the end. Note that the quizzes are taken as individuals.

**Tests (2 total)**

**Midterm exam**
This exam will assess your knowledge of the statistics learned from lecture notes at that point in the course.

**Comprehensive final exam**
This will be a comprehensive examination of the concepts and ideas explored in this course. This will also include any special lectures. Topics for the final exam include population probability based statistics and dimensional analysis. Final exam schedule will be indicated by the University final exam week exam matrix.

**General requirements for lab reports**
All reports should be typed using 12 point Times Roman font. Use 1 ½ spacing. Also, all reports should have a title page, clearly indicating the experiment, lab group members, section (please include the day (for example, “Tuesday”) that your lab meets), date, etc. Lab notebook pages that are attached obviously do not need to be retyped.

**Requirements for Lab reports**

General format:
- Title page (include group member names, the experiment done, day the lab meets, and date)
- A short statement of the laboratory objectives (approx. ½ page)
- A discussion of the underlying theory (2 pages max). Include diagrams if you want.
- A summary of the procedure (include a basic diagram of the experimental unit).
  - Be sure to address accuracy/precision issues.
  
  *(Note: feel free to take pictures and include them in your report.)*
- Data analysis/tasks specifically asked for in the experimental write-up. Be sure to include sample calculations as appropriate; also include error propagation analysis (except for the first two labs)
- A discussion of any safety issues specific to the experiment.
- A discussion on what the experiment taught you/what you learned (include also a description of any challenges, concerns, measurement issues, etc.).
- Answers to “check your understanding” questions
- References as appropriate

**More details:**
1. Data Analysis as asked for in the Experimental Write up. Please number these in the order listed in the Write up. Handwritten calculations are okay, but please be neat and legible. Partial credit can be given only if the calculations are well described and easy to follow. Attach any graphs or tables generated, but label and identify these clearly. Also,
please number any graphs or tables and be sure to reference them in your text.

2. Copies of the lab notebook pages should be included with the short report.
3. Copies of spreadsheets, and other software that were written for this lab.
4. As already noted above, a short section on safety as related to the chemicals and apparatus used.

Frequent mistakes in reports:
1. Figures with no captions. Also figures with curves not labeled clearly.
2. Figures and/or tables not referenced in the text.
3. Not doing a spell check. You must do it manually also as the computer does not catch all mistakes.
4. Axes with no labels
5. Too many significant digits. Your results should reflect the accuracy of your measurements.
6. Numbers with no units specified.
7. Tables that have too many rows and columns
8. Tables and figures with too small font on items
10. Table, figures, text with scalars but no appropriate units
11. Too many pages of unlabeled, computer printouts.
12. Too many computer printouts.
13. Too many zeros with numbers. Use units like millions of dollars or thousands of ft³/hr.
14. Alignment of numbers in tables
15. Equations are not numbered. (units on left side don't match the right side.)
17. Forgot to address safety issues
18. Sections/subsections not numbered properly (and/or inconsistent format used).

Grading Rubric for Lab Reports
See information provided by your laboratory Instructor

Class presentation
Each group will present the last lab performed in a class (lab section) presentation. These will typically be 10-15 minute presentations using Powerpoint. The presentation should also include the group’s design application (if appropriate). Additional requirements are as follows:
1. Generally each technical talk has the following parts:
   a. Title slide. Include title of experiment, your names, organization, course name, date of presentation
   b. Introduction. Why are you doing this experiment? Learning objectives? Why is it important for chemical engineers? State some applications.
   c. Background information. Something about past history of the subject. Alternative approaches to the same problem.
   d. Main body of the talk. Experimental apparatus used. Photo and/or schematic. Equipment used (list make manufacturer, accuracy). Procedure used. Main data collected. Theory used. Data analysis done. Main results obtained. Where possible use graphs and charts instead of tables. Discuss your main results.
   e. Conclusions. This is different from results and usually covers the following question: What are your interpretations of the data and impact of your results? Your conclusions section has your opinions as supported by the results you obtained. (For example:
you might conclude that the friction factor correlation of Fanning is invalid. However, you might also conclude that your data was flawed and hence the experiment needs to be redone with changes.

f. A presentation of your design project/topic
g. Acknowledgements. Thank people or organizations that helped you.
h. References. List sources for data, information.

2. Plan on taking about 1-2 minutes per slide. Less than 1 minute is too short. More than 2 minutes will not hold the attention of the audience.

3. The number of slides should be based on total time available.

4. Use large fonts on lettering. Prefer Arial or similar font.

5. A slide should contain only about 5-10 lines

6. You should use bullets as opposed to sentences

7. Each title should have a title telling what it is addressing

8. Try to use graphs instead of tables, pictures instead of words

9. Do not show large complicated diagrams which are hard to explain in 1-2 minutes

10. Use thick lines for drawings

11. Prefer a white background. Lettering should be dark colored

12. Use color, but make sure the colors are visible on the projected slide (yellow can be problematic).

13. Do not show large tables or long equations with many terms

14. Do not show unnecessary detailed calculations. Get to the point

Presentation Tips

1. Face audience. Look at persons in the eye. Maintain eye contact for 5-6 seconds to let each person know that you are talking to them. Move your eyes from person to person, so that all are involved.

2. Use cue notes if needed but do not read from them

3. Practice ahead of time so you can time yourself

4. Speak clearly and loudly so everyone can hear

5. Stand erect, do not slouch or hide behind the podium all the time. Appear confident.

6. See http://www.youtube.com/watch?v=HLpjrhzgSRM for some pointers on Powerpoint mistakes

Frequent mistakes while making oral presentations:

1. Using a complicated drawing to show your setup instead of leading the audience through the basics.

2. Using too many equations or numbers on a page

3. Showing detailed calculations on a slide

4. Do not carry on a private conversation with your partner during the presentation

5. Use appropriate scales on graphs. Label axes

6. Do not use variables unless you explain it well. Use words instead.

7. Too much writing on a slide. Long sentences.

8. Not spending enough time on a slide to explain what it is about.

9. Hard to read due to dark background

10. Using colors (for example, yellow) that are hard to see on a white background

11. Do not repeat simple concepts that audience already is familiar with.

12. Units omitted

13. Significant figures issues
Design projects (When Assigned)
For the last lab, each group should be prepared to develop a practical application of the subject matter. The practical application should include a “design” of some sort. The topic should be chosen by the group itself, although they are free to consult with the TAs and the instructor. Your group will provide a separate report on your design project. Here’s what the report should contain:
1. Title page
2. A 100 word or so abstract (separate page)
3. Sections as follows:
   Statement/summary of the problem
   - Your analysis/calculations/etc regarding the problem
     (including all assumptions that were made)
   - A summary of your design (include illustrations if you want)
   - References as relevant
   The design project is worth 150 points and is submitted as a group project.