Chemical Engineering 475
Unit Operations Laboratory I
217 CB
Fall 2012

Prerequisites: ChEn 374, 376 & 391, Engl 316. Stat 201 is recommended.

Description: Experimental verification of unit operations design principles; data collection and reduction; report preparation.

Instructors:

Michael Beliveau; 223 CB; 422-3921; beliveau@byu.edu (Lab Manager)
Tommy Knotts; 350J CB; 422-9158; thomas.knotts@byu.edu (Section 1, MW 2:00-4:50 pm)
Tom Fletcher; 350E CB; 422-6236; tom_fletcher@byu.edu (Section 2, TTh noon-2:50 pm)
Stan Harding; 350F CB; 422-7863; nsharding@attglobal.net (Section 3, TTh 4:00-6:50 pm)

Teaching Assistants:

Section 1: Drake Mailes, drmailes@yahoo.com
Section 2: Jonathan Gallacher, jgallacher726@gmail.com
Section 3: Ganesh Bhattarai, ganes.bhattarai@gmail.com

Goals

The Unit Operations Lab is an opportunity to perform experiments that reinforce concepts learned in the Chemical Engineering curricula. This semester focuses on fluid dynamics, heat transfer, mass transfer, and thermodynamics. This is also an opportunity to improve skills in group work, statistics, writing, and presentations.

Professional Environment

To the extent possible, the professional engineering environment will be simulated. You will be grouped into teams of 3-4 students (a different team for each project) and will be given three projects in the form of memos from your supervisor (instructor). The projects will intentionally be somewhat open-ended, and your team will respond to each project by conducting experiments, performing analyses, drawing conclusions, and making recommendations. The deliverables for the first two assignments are memo reports from each team member. The deliverable for the third project is a team oral presentation. A team lab notebook is also turned in for each project.

For the individual assignments, all graphs, figures, and tables must be your own work. The team cannot use the same figures for each individual report. For all projects, you will be required to maintain professional standards of attendance, teamwork, and safety practices throughout the semester.

Attendance

In keeping with the goal of simulating the professional environment, you must be in attendance ("at work") for the entire lab period on each day of the lab. Each class missed will result in a 5 point deduction from your grade unless you receive permission from your instructor and make up work that is agreeable with your group. Each tardy will result in a 2 point deduction. For emergencies or other pressing circumstances, please communicate with Mr. Beliveau or your instructor just as you would

with an employer. All the experimental work will be done in class, and you should also try to do most data analysis and report writing in class.

Teamwork

You will be assigned to a different team for each project. It is expected that you will work cooperatively, sharing a fair portion of the work-load. At the conclusion of each project, the other members of your team will be required to evaluate how well you performed as a team member (attendance, abilities, contributions, demeanor, etc).

Safety

The following safety precautions are required by all (these are not optional):

1. No food is allowed in the laboratory or in the computer area. You may take a short break after the initial lecture time to eat lunch or dinner, but not in the lab or computer area.
2. All personnel in the laboratory area are required to wear safety glasses, long pants, and covered shoes (no sandals or flip-flops).
3. All students are required to complete ChEn 311; this course includes the HAZCOM training course.
4. Experimental work should be completed during the regular class periods. If additional time is needed in the laboratory, you must clear it with your instructor and make an appointment for the use of the laboratory with Mr. Beliveau. At least two partners must be present during those additional hours (no one is permitted to work in the lab alone).

Resources

Written Materials: No official text is used for this course. Some textbooks and engineering handbooks are kept in the laboratory for your use, but please do not remove them from the room, and please return them at the end of each period. A significant amount of information is also available on the course website at http://www.et.byu.edu/groups/uolab/. Of course, your textbooks from previous courses will also be helpful. YOU MAY NOT USE OR LOOK AT PREVIOUS REPORTS.

Hardware: Instruments, supplies, manuals, etc., may be checked out from the Laboratory Supervisor, Mr. Michael Beliveau, or from the T.A. All materials checked out during the laboratory must be returned to the stockroom at the end of the laboratory period.

Lectures: Periodically, brief lectures will be given in 217 CB at the start of class in order to provide guidance about report writing, data analysis, etc. We hope that these will be helpful, and we welcome your feedback on these lectures, as well as suggestions for additional topics.

Honesty

The honor code at BYU must be followed at all times. As previously stated, you must do your own work for the individual assignments. You may discuss data reduction, experimental results, etc. with your team (not previous teams unless given permission by the instructors) but you must write your own report and prepare your own graphs and figures for presenting your results. YOU MAY NOT USE OR LOOK AT PREVIOUS REPORTS. Plagiarism and cheating is not tolerated in any profession, including chemical engineering. Plagiarism includes copying your partners work or copying reference material without proper references. If you need to include information in your report that is not your own, you should paraphrase the information and provide a reference. Academic dishonesty will result in a grade of E for the course.

Projects: Three projects will be given during the semester. The following outline gives some guidelines for the required reports. Additional details are provided in the supplemental handout entitled "Experiments and Communication"

Item	Who?	Details
Safety Sheets (3)	Team	Submit by the third lab period for each project. You must review the form with an Instructor or TA prior to starting any experiments. Although no points are given for this assignment, you may not begin any experiments until the form is completed and approved.
Proposals (3)	Team	Before any experimental work can begin, each team must submit a proposal outlining steps that will be followed to solve the problem. The proposal should be written in *Memo Report* format and should include the following: a) the objective or decision to be made, b) a brief description of the experimental methods and the experimental design c) theory, equations, and assumptions d) preliminary calculations and statistics
Quizzes (3)	Individual	A three-question, project-specific multiple choice quiz will be given at the conclusion of every project. These quizzes test basic understanding and should be easy to pass if the lab has been completed. Each quiz usually has a simple question about theory or definitions, a question that asks you to complete a calculation that was needed to analyze the data, and a question about the "design problem" found in the problem statement for each project.
Progress Reports (3)	Individual	A 1-paragraph progress report with an accompanying 1-page powerpoint file is required in the middle of the time for experiments on each project. This is a very common method of communication in industry, but will be graded for clarity in communication.
Complete Report (1)	Team	A complete report is required for the 1st project, but limited to 4 pages. This report will include sections like introduction, experimental procedure, test matrix, results, analysis of results, and conclusion. Both an initial and a revised report are required. The report will be critiqued by classmates. Team members will assess distribution of points for their own team.
Memo Report (1)	Individual	A 2-page memo report is required for the 2nd project. Both an initial and a revised report are due for these reports. Please note that the initial report is what the submitting individual considers to be the **final version** of the report, complete in all required sections and polished. It is **NOT** a draft. Each of these reports will be critiqued by your classmates. Your grade for these reports will be based on a revised document.
Grading critiques (2)	Individual	At the end of the 1st and 2nd projects, you will be required to critique reports of a peer doing a different experiment. You will perform two critiques on each lab for a total of four during the entire semester. For these critiques, you will mark-up a hard-copy of the report you are reading to provide feedback to the peer. You will also grade the report using the grading rubric. Once done, you will write a memo to the peer which summarizes your review. These critiques are an important part of learning how to write well. The critiques will be graded (to ensure adequate effort is placed into the activity) on your assessment of the technical aspects of the report and the writing. Thus, if you let poor experimental work, incorrect analyses, or ineffective writing slide without comment, then you will lose points on the critique. However, if the project is truly well done with few opportunities for constructive criticism, then few comments and corrections would be expected to obtain the maximum number of points. Class attendance and participation in the report grading is mandatory during the entire lab period. (See grading guidelines in grading section.)
Oral Presentation (1)	Team	Your team will be assigned to present an oral presentation for the 3rd project. The grading scheme is given in the rubric. The oral presentation should be approximately 20 minutes with 2 minutes for questions. The oral presentation content should be similar to the content of the written reports.
Leadership Report (3)	Individual	At the end of each lab, you will provide feedback to the members of your team about their performance as a teammate and leader. This will include both positive items and items that can be improved on. You will then make goals based upon the feedback from your teammate that you will work on in later teams. You will also be assessed on your efforts at achieving the goals you have made. For the first lab experience, you use goals that were set during ChEn 376 (Heat and Mass). For the second and third lab experiences, you will work on the goals made during the first and

		second labs respectively. The goals you make for the third project will be used in the first lab of ChEn 477 (UO Lab 2).
Lab book (3)	Team	Submit a team notebook at the end of each project. As is standard professional practice, all pertinent details of each project must be recorded <u>in ink</u> in your project notebook. You must write in page numbers if not already present. If questions arise about the accuracy and validity of the data in your reports, it should be possible to answer those questions by referring to the project notebook. Recorded details should include but not be limited to the following: 1. Dates, times, names, and signatures when experimental work was performed 2. A brief summary of the objective and project at the beginning of the project 3. A brief summary of each daily experiment 4. All raw data (taken by hand or computer data stapled in notebook) with appropriate labels. 5. Pertinent experimental observations and conditions 6. Calculations performed during the experiment 7. Key conclusions at the end of the project

Grading and Due Dates. All assignments must be turned in <u>at the beginning of class</u> to receive possible full credit. See the class schedule for the due dates for each item. For each late assignment, you may obtain up to the following maximum credit:

- 75% if turned in within 24 hrs (but class is not missed and report is not worked on in class)
- 60% if turned in within 24 hrs (but class is missed or report is worked on in class)
- 50% if turned in between 24 and 48 hrs
- 0% if turned in after 48 hrs.

	Points
Individual Points	
1. In-class safety/lab assignment (0, 2.5, or 5 points)	5
2. Labview Assignment	20
3. Writing Assignment	20
4. Leadership Report #1-3 (15 pts each)	45
5. Progress Reports (15 pts each)	45
6. Project #1 Team Complete Report†	100
7. Project #2 Individual Memo Report†	100
8. Critiquing Assignment *	20
9. Critiquing of Reports (4)	40
10. Project #1-3 Quizzes (30 pts each)	90
11. Statistics Quiz	20
12. Attendance	‡
TOTAL INDIVIDUAL POINTS	460
Team Points	
1. Projects #1-3 Team Proposals (50 pts each) †	150
2. Projects #1-3 Team Notebooks (20 pts each)	60
3. Project #3 Team Oral Presentation†	100
TOTAL TEAM POINTS	310
TOTAL POINTS	**815**

* This is an in-class assignment. Attendance and participation during the entire lab period is required since this exercise is

part of the lab period. If you have to miss this class, please contact the instructor prior to the class to make arrangements for making up the assignment.

† Successful completion of these assignments is required to pass the class. An E grade will be given if one or more assignments is not submitted, or if a grade of 60% or less is given on any of these deliverables.

‡ Attendance is required. For each unexcused absence, 5 points will be deducted from the grade. For each tardy, 2 pts will be deducted from the grade.

There are 815 points. A sample grade distribution is given below. This distribution may change slightly depending on individual circumstances and natural breaks in the grade distribution. There is no pre-assigned grade point average for this class.

A 93.5%	B+ 87%	C+ 77%	D 60%
A- 90%	B 84%	C 74%	E < 60%
	B- 80%	C- 70%	

Competencies

1. Students will gain hands on experience with chemical processes, units, and corresponding equipment through lab experiments.
2. Students will demonstrate an understanding of basic engineering statistics in their laboratory reports.
3. Students will understand and be able to describe the physical significance of key dimensionless quantities.
4. Students will understand qualitatively conduction, forced and free convection, and radiation and have experience with one or more modes during experiments.
5. Students will be able to analyze systems containing multiple resistances to heat transfer during laboratory experiments.
6. Students will understand convective heat transfer and be able to use heat transfer coefficients as they relate to the UO Laboratory experiments.
7. Students will demonstrate familiarity and experience with the measurement of process variables (e.g., P, T, flow rate, conc.) using manual and/or electronic devices and computers.
8. Students will demonstrate knowledge of basic laboratory techniques.
9. Students will be able to use the scientific method and problem solving strategies, as well as statistical methods, to design and carry out experiments in order to solve engineering problems.
10. Students will demonstrate familiarity and experience with an industrial control system as a data acquisition and/or controller interface to experimental apparatus.
11. Students will demonstrate familiarity and experience with chemical process equipment.
12. Students will demonstrate an ability to solve engineering problems.
13. Students will be able to integrate topics from various chemical engineering courses to solve realistic problems in the areas of heat transfer, fluid flow, and thermodynamics.
14. Students will exhibit critical and creative thinking skills for analysis and evaluation of problems and cause-effect relationships.
15. Students will be able to obtain and evaluate appropriate input information/data from databases, handbooks, correlations, experiments, literature, etc.
16. Students will be able to rationalize units, make order of magnitude estimates, assess reasonableness of solutions, and select appropriate levels of solution sophistication.
17. Students will understand and practice safe laboratory and chemicals-handling principles.
18. Students will be able to give effective, well-organized oral presentations including the handling of questions and the use of appropriate visual aids.
19. Students will be able to write effective, well-organized technical reports, including formal engineering reports and short letter reports.
20. Students will demonstrate effective reading of technical material.
21. Students will demonstrate effective interpretation of graphical data.
22. Students will practice good teamwork principles.
23. Students will be able to do performance calculations on heat exchangers from experimental data and demonstrate abilities or understanding in one or more of the following aspects: heat exchanger sizing, heat exchanger design, fouling, utilization of overall heat transfer coefficients, types of heat exchangers, and materials of construction.
24. Students will be able to design or analyze flow systems involving one or more of the following aspects: pipes, valves, fittings, pumps, flow meters, Newtonian fluids, non-Newtonian fluids, laminar flow, and turbulent flow.