UNIT OPERATIONS LABORATORY 1

SYLLABUS

ChEn 475 – Section 1 – Winter 2015

Location and Time	217 CB, MW 2-5 pm
Instructor	Thomas Knotts 350J CB 801-422-9158 thomas.knotts@byu.edu
Lab Manager	Michael Beliveau 223 CB 801-422-3921 beliveau@byu.edu
Assistant Lab Manager	John Sowa 223 CB 801-422-3921 johnsowa@byu.edu
Teaching Assistant	

Course Overview

The senior year of the chemical engineering curriculum at BYU is designed to be a capstone-like experience for students. The two Unit Operations courses (ChEn 475 and 477) as well as Plant Design (ChEn 451) form the core of this instruction whose purpose is to move beyond the basic theoretical principles learned in previous classes. UO Lab contributes to this aim by helping students develop engineering intuition about the physical processes and equipment explained in previous courses. It is done by performing hands-on experiments and analyses of real data that do not always conform to theoretical expectations. This course also helps hone problem-solving skills by presenting students with more open-ended problems than typical textbook homework seen in previous courses.

Another aim of this course is to help simulate daily work activities that engineers commonly encounter. These include working on projects with a team, evaluating the performance of others, writing technical reports and emails, and giving oral presentations. It is often these so-called *soft-skills* that differentiate a good engineering from a great one.

This course can be one of the best classes that you have taken at the university if you "buy-in" to the process. We cannot fully simulate the daily work activities you will experience in future jobs, but we come close. Most of the equipment you will use in the lab is pilot-scale, but it behaves in a manner that is similar to larger equipment found in industry. Also, the teamwork and leadership activities we will have you engage in are specifically suited to your short time in UO lab, but they closely mimic the yearly performance evaluations that you will write about others and that will be written about you. In short, due to the university setting in which we are found, and the department's responsibility to assess learning, there is a temptation to look at some of the things we do in UO Lab as just "jumping through hoops" or "busy work."

However, if you resist this urge, and trust that your instructors have your best interests in mind, including making you competent and confident engineer, this class will be great.

Course Mechanics

The professional engineering environment will be simulated to the extent possible. You will complete three projects during the semester in teams of 3 students. Your teammates will change every project. One project is to learn all you can about a real shell and tube heat exchanger. You will perform theoretical calculations, run experiments, and gain a feel for how the real system works. The second project will deal with either a non-Newtonian fluid or compressible flow of air. There are two main purposes of this project. One is to teach basic statistics in an engineering context. The second is to learn how to analyze a system and use the analysis to answer a design problem. The last project is the most open-ended and will require you to actually build a pilot-scale experiment. You will be given a design objective to obtain and be provided with different sized pumps, pipes, fittings, valves, etc. to accomplish the objective. You will theoretically design the system and then build and test it.

In each project, you will conduct experiments, perform analyses, draw conclusion, and make recommendations. You will report you progress and findings in both written and presentation form. Many of the written communications are small emails and attached slides. Others are longer. Some are done as a team and others are individual assignments. One is a 15 minute presentation on the "statistics" project. A team lab notebook is also kept for each project and is explained in more detail in a separate document.

Use of Team-Generated Material in Individual Assignments

For the individual assignments, there is often a question about what may be shared between teammates. For this class, the main graphs, figures, and tables generated by the team during the course of the experiment may be shared among group members for inclusion in individual reports. Other aspects of the work such as the actual text and layout of the document must be individual work. However, due to individual analysis and writing styles, it may not be optimal to use the same graph as your teammates. The main point is that the data you provide in the document must support what is written, so you may need to change the presentation format of the data to fit your style.

Use of Materials or Information from Other Semesters or Teams

To maximize the learning experience, you are not allowed to talk to other teams about how they are doing (or did) a particular project. Moreover, you are not permitted to use materials, data, or reports from previous semesters. Remember, the purpose of the class is to give each student the maximum opportunity for learning. Using the work of others will weaken your education and ultimately give you less confidence in your abilities.

Schedule

In order to give everyone a chance to perform each type of experiment, each student will be assigned an experiment "group". Do not confuse this experiment "group" with your team. You will change teammates each experiment, but your experiment "group" will remain the same the entire semester.

Four different calendars are provided on Learning Suite corresponding to Groups 1-4. These calendars contain the schedule of experiments and the due dates for the assignments. Each group has different due dates, but by the end of the semester everyone will turn in all the assignments. Make sure to follow the calendar for your group. Also, don't follow the dates on Learning Suite. Learning Suite does not allow me to assign different due dates for different people, so all the due dates are artificially set to the end of 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 in a manner that is agreeable with your group. Each tardy will result in a 2 point deduction. For emergencies or other pressing circumstances, please communicate with Mike 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

All students are required to follow the following safety rules. (T*hese are not optional.*)

1. No food is allowed in the laboratory or in the computer area. You may take a short break during non-lecture times 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 (where HAZCOM training takes place).
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 students must be present during those additional hours (no one is permitted to work in the lab alone).
5. At least one student from each team must be in the lab when running experiments. This student should be monitoring the experiment so that emergency procedures can be enacted if problems occur.

Resources

Written Materials

This course has no official text. 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. Remember, you may not use or look at previous reports.

Hardware

Instruments, supplies, manuals, etc., may be checked out from the Laboratory Supervisor (Michael Beliveau) or the Assistant Lab Manager (John Sowa. All materials checked out during the laboratory must be returned to the stockroom at the end of the laboratory period.

Lectures

Lectures will be given periodically in 217 CB in order to provide guidance about report writing, data analysis, etc. A large number of these occur during the "statistics" lab and the shell and tube lab. The fewest number

of lectures are given during the pilot-scale lab. We hope that these will be helpful, and we welcome your feedback on these lectures as well as suggestions for additional topics.

Safety Sheets

You are required to complete a safety sheet before starting any experiment. The purpose of the safety sheet is to demonstrate safety precautions that should be taken when performing experiments, familiarity with the equipment, start-up/shutdown procedures, and emergency procedures. Each member of the group is expected to know this information, so each student will turn in a separate safety sheet.

Grading and Due Dates

Unless otherwise noted, all assignments must be turned in at the beginning of class 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

The assignments are found below. Note that this list is subject to change.

Assignment		Points
1. In-class safety/lab assignment		P/F
2. Labview Assignment*	Team	10
3. Leadership Report #1-3 (10 pts each)		30
4. Shell & Tube Calculations	Team	15
5. Shell & Tube Theory Email**		25
6. Shell & Tube Assignment		25
7. Shell & Tube Report†		80
8. Shell & Tube Quiz		35
9. Statistics Theory Email**		25
10. Statistics Assignment		25
11. Statistics Oral Report†	Team	80
12. Statistics Quiz		50
13. PBL Proposal	Team	100
14. PBL Progress Report**		25
15. PBL Quality of Design and Execution	Team	50
16. PBL Report†		185
17. Notebooks for Each Project (15 pts each)	Team	45
18. Attendance		‡
19. Attitude		§
TOTAL POINTS		

* 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.

** One of the skills we are trying to teach is effective technical email writing. You have three assignments for this. The first of these assignments will be scored out of 12.5 points rather than 25. This is so that you can learn how to write without being severely penalized for possible poor performance the first time through.

† Successful completion of these assignments is required to pass the class. An E grade will be given if one or more of these assignments are 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.

§Up to 25 points may be deducted from your final grade based on your attitude in the course. These points are left to the discretion of the instructor, TA, lab manager, and assistant lab manager.

Honor Code

In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to

adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university's expectation, and my own expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

Lab-Specific Honesty

Remember, you must do your own work for the individual assignments. You may discuss data reduction, experimental results, etc. with your current team (not previous teams unless given permission by the instructors) and use the same main graphs generated during the data analysis, but you must write all the text of your own report, alter the team graphs to fit the flow of your individual report, and generate any new graphs that may be needed to support your arguments. 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.

Sexual Harassment

Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds. The act is intended to eliminate sex discrimination in education and pertains to admissions, academic and athletic programs, and university-sponsored activities. Title IX also prohibits sexual harassment of students by university employees, other students, and visitors to campus. If you encounter sexual harassment or gender-based discrimination, please talk to your professor or contact one of the following: the Title IX Coordinator at 801-422-2130; the Honor Code Office at 801-422-2847; the Equal Employment Office at 801-422-5895; or Ethics Point at http://www.ethicspoint.com, or 1-888-238-1062 (24-hours).

Student Disability

Brigham Young University is committed to providing a working and learning atmosphere that reasonably accommodates qualified persons with disabilities. If you have any disability which may impair your ability to complete this course successfully, please contact the University Accessibility Center (UAC), 2170 WSC or 422-2767. Reasonable academic accommodations are reviewed for all students who have qualified, documented disabilities. The UAC can also assess students for learning, attention, and emotional concerns. Services are coordinated with the student and instructor by the UAC. If you need assistance or if you feel you have been unlawfully discriminated against on the basis of disability, you may seek resolution through established grievance policy and procedures by contacting the Equal Employment Office at 422-5895, D-285 ASB.

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 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.