UNIT OPERATIONS LABORATORY 1

SYLLABUS

ChEn 475 – Section 1 – Fall 2017

Location and Time	217 CB, MW 2-5 pm
Instructor	Thomas Knotts 350J CB 801-422-9158 knotts@byu.edu
Lab Manager	Michael Beliveau 223 CB 801-422-3921 beliveau@byu.edu
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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 three 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. However, because writing styles and analysis methods may differ among members of the team, it could be suboptimal to use the same graph as your teammates. 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. Other aspects of the report, such as the actual text and layout of the document, must be individual work.

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

The schedule for the course, including the due dates for assignments, is found on the UO Lab webpage (under my picture) and on the Learning Suite site. Please make sure to be aware of what is due each day.

Attendance

In keeping with the goal of simulating the professional environment, you must 1) be in attendance ("at work") for the *entire* lab period on each day of the lab and 2) comply with the lab safety rules as presented in the next section.

Each class missed will result in a 4-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. Leaving class early will result in a 2-point deduction for each instance. For emergencies or other pressing circumstances, please communicate with Mike Beliveau or your instructor just as you would with an employer. "Pressing circumstances" include job-search activities, professional meeting attendance, or university-excused activities. Sporting events, social engagements, etc. do not constitute legitimate excuses. Students should not take other classes that are taught during UO Lab class hours. They should not attend research group or club meetings during class hours.

Deductions for attendance will be made if you do not follow the UO Lab Safety Rules explained in the next section. Any class period where you are not in compliance with the UO Lab Safety Rules will result in a 2-point deduction from your grade. Students usually have problems with this aspect of attendance by not wearing safety glasses, long pants, and covered shoes.

Deductions for attendance will be made if you do not follow the BYU Honor Code including the Dress and Grooming Standards. Any class period where you are not in compliance with the Honor Code will result in a 3-point deduction from your grade. You can review the official BYU Honor Code, which includes the Dress and Grooming Standards, at https://policy.byu.edu/view/index.php?p=26.

Safety

All students are required to follow the following safety rules. (T*hese are mandatory.*)

1. No food or drink is allowed in the laboratory or in the computer area. (The exception is water *in a sealable water bottle* in the computer area but not the lab.) You may take a short break during non-lecture times to eat lunch or dinner but do *not* do so 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). Long pants and covered shoes are required each class day—even if you aren't planning on being in the lab.
3. All students are required to complete ChEn 311 (where HAZCOM training takes place).
4. No labs/equipment may be run/started before the specific lab safety training has been done and the specific lab safety sheet has been passed off with either the instructor, Michael Beliveau, or John Sowa.
5. 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 Mike Beliveau or John Sowa. At least two students must be present during those additional hours (no one is permitted to work in the lab alone).
6. 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.
7. Students who operate *any* equipment in *any* unsafe manner or in a manner that damages the equipment or results in a user-preventable accident will incur a *significant* grade penalty. This includes not knowing how to run the equipment or shut it down. *All team members should know how to safely run the equipment.*

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).

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. Most of the information you will need has been placed on the UO Lab webpage for each individual experiment.

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, PBL 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 or operating any equipment. 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 not missed and 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	In-class Figures Assignment		10
3	Shell & Tube Calculations	(Team)	10
4	Shell & Tube Theory Email**		25
5	Shell & Tube Assignment		20
6	Shell & Tube Report†		100
7	Shell & Tube Quiz		35
8	Statistics Theory Email**		25
9	Statistics Assignment		20
10	Statistics Oral Report†	(Team)	75
11	Statistics Quiz		45
12	PBL Proposal	(Team)	50
13	Labview Assignment	(Team)	5
14	Pipe Fitting Assignment		5
15	PBL Quality of Design and Execution†	(Team)	50
16	PBL Report†		150
17	Leadership Report for Each Project (5 pts each)		15
18	Notebooks for Each Project (5 pts each)	(Team)	15
19	Attendance		‡
20	Attitude, Safety, Good Engineering Practice		§
	TOTAL POINTS		655

* This is an in-class assignment done on the first day of the semester. 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 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, 4 points will be deducted from the final grade. For each tardy or early exit, 2 pts will be deducted from the final grade. For each day that the Honor Code—including the Dress and Grooming Policy—is not followed, 3 pts will be deducted from the final grade. (See the section entitled *Attendance* above for more information.)

§Up to 50 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 every instructor's 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.

Plagiarism

Intentional plagiarism is a form of intellectual theft that violates widely recognized principles of academic integrity as well as the Honor Code. Such plagiarism may subject the student to appropriate disciplinary action administered through the university Honor Code Office, in addition to academic sanctions that may be applied by an instructor. Inadvertent plagiarism, which may not be a violation of the Honor Code, is nevertheless a form of intellectual carelessness that is unacceptable in the academic community. Plagiarism of any kind is completely contrary to the established practices of higher education where all members of the university are expected to acknowledge the original intellectual work of others that is included in their own work. In some cases, plagiarism may also involve violations of copyright law. Intentional Plagiarism-Intentional plagiarism is the deliberate act of representing the words, ideas, or data of another as one's own without providing proper attribution to the author through quotation, reference, or footnote. Inadvertent Plagiarism-Inadvertent plagiarism involves the inappropriate, but non-deliberate, use of another's words, ideas, or data without proper attribution. Inadvertent plagiarism usually results from an ignorant failure to follow established rules for documenting sources or from simply not being sufficiently careful in research and writing. Although not a violation of the Honor Code, inadvertent plagiarism is a form of academic misconduct for which an instructor can impose appropriate academic sanctions. Students who are in doubt as to whether they are providing proper attribution have the responsibility to consult with their instructor and obtain guidance. Examples of plagiarism include: Direct Plagiarism-The verbatim copying of an original source without acknowledging the source. Paraphrased Plagiarism-The paraphrasing, without acknowledgement, of ideas from another that the reader might mistake for the author's own. Plagiarism Mosaic-The borrowing of words, ideas, or data from an original source and blending this original material with one's own without acknowledging the source. Insufficient Acknowledgement-The partial or incomplete attribution of words, ideas, or data from an original source. Plagiarism may occur with respect to unpublished as well as published material. Copying another student's work and submitting it as one's own individual work without proper attribution is a serious form of plagiarism.

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.

Preventing Sexual Misconduct

As required by Title IX of the Education Amendments of 1972, the university prohibits sex discrimination against any participant in its education programs or activities. Title IX also prohibits sexual harassment-including sexual violence-committed by or against students, university employees, and visitors to campus.

As outlined in university policy, sexual harassment, dating violence, domestic violence, sexual assault, and stalking are considered forms of "Sexual Misconduct" prohibited by the university.

University policy requires any university employee in a teaching, managerial, or supervisory role to report incidents of sexual misconduct that come to their attention through various forms including face-to-face conversation, a written class assignment or paper, class discussion, email, text, or social media post. If you encounter Sexual Misconduct, please contact the Title IX Coordinator at t9coordinator@byu.edu or 801-422-2130 or Ethics Point at https://titleix.byu.edu/report or 1-888-238-1062 (24-hours). Additional information about Title IX and resources available to you can be found at http://titleix.byu.edu.

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.

Course 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.
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 use a process control system.
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.