

Fluid and Energy Transfer Operations Laboratory

(Unit Operations Lab 1)

ECH 4224L

Sections 2G31 (Mondays), 189B (Tuesdays), 2775 (Wednesdays), 6445 (Thursdays)

Class Periods: 2 - 5 (8:30 am – 12:35 pm)

Location: Unit Operations Lab (CHE 100, 200, 300)

Academic Term: Fall 2019

Instructor:

Dr. Fernando Mérida

You can call me Prof./Dr. Mérida, or “Fernando” if you feel comfortable by doing it so. Remember that calling your instructors by their names must encompass the same level of professionalism and respect than using professional titles.

e-mail: fmerida@ufl.edu

Office: ChE Building, room # 217, Tel. 352-294-7504

Office Hours: Mondays and Wednesdays, 2:00 pm – 3:00 pm

*** Edits to some dates/times may be posted on Canvas

Contacting Dr. Mérida:

- E-mail is the preferred communication platform. Please make sure the subject line of your e-mail has the label “ECH 4224L – Question”. Please expect a response within 36 hours (M-F) and within 48 hours (weekend).
- I have an open-door policy during office hours, so feel free to come in. Planning office hours meeting via e-mail beforehand is also encouraged. When you come in, please first say your name, section, and group number (e.g. *Good afternoon, I am Daenerys Targaryen from Wednesday section, group 3*). Meeting outside office hours can be made by appointment via e-mail when strictly necessary.
- Announcements will be periodically posted on Canvas.

Peer-Tutors:

- Please use “peer-tutor” or simply “tutor” for the people that will guide you during experiments in the lab. Avoid the use of “TA” since this refers to a student in a completely different role.
- Please contact through the Canvas website or via e-mail. Modifications in the list below may be necessary and will be communicated through Canvas.

Name	e-mail	Sections and Modules*			
		Mon	Tue	Wed	Thu
Alexander Shishlov	ashishlov@ufl.edu	FIL		H&B	
Jacob Hay	jjhay15@ufl.edu	FLU			
Wesley Morgan	wesley.morgan@ufl.edu	H&B			
Anthony Araujo	tonyaraujo8@ufl.edu	TFE			H&B
Chris Montevecci	chrismontevecci@ufl.edu		FLU / H&B		
Nicholas Mendez	mendezn@ufl.edu		TFE / FIL		
Whitney Schramm	whitney001@ufl.edu			FIL	
Petrika Tiko	ptiko@ufl.edu			FLU	
Max DiRocco	droc99@ufl.edu			TFE	
Anna Ball	annacball@ufl.edu				TFE
Matthew SooHoo	msooh018@ufl.edu				FLU
Levana Osher	loser@ufl.edu				FIL

* Description of acronyms for experimental modules is given in the Module Description section.

Course Description

(2 credits) Laboratory work in unit operations involving heat and momentum transfer.

Course Pre-Requisites

ECH 3101 (Process Thermodynamics), ECH 3203 (Fluid and Solid Operations), ECH 3223 (Energy Transfer Operations), ENC 3246 (Professional Communication for Engineers)

Course Co-Requisites

ECH 4714L (Safety and Experimental Evaluation)

Materials and Supply Fees: \$100.24

Course Objectives

1. Reinforce classroom theory by the collection and use of data in practical experiments with all their inherent problems and limitations.
2. Gain proficiency in writing technical reports and oral presentations.
3. Gain experience in working in teams.
4. Create a sense of professional responsibility for the quality and integrity of engineering work.
5. Learn the importance of working under Safety guidelines thus promoting a safe environment for others.
6. Learn equipment, instrumentation, and procedures not covered in lectures.
7. Learn and use concepts of statistical analysis and Design of Experiments, whenever is possible.

Professional Component (ABET):

This course is focused on experimental studies of thermodynamics and heat and momentum transfer in the context of unit operations. Theoretical concepts learned in other courses are illustrated by experiments. Technical communications are emphasized.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs	Low
3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	High
4. An ability to communicate effectively with a range of audiences.	High
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Medium
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.	High
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	High

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Unit Operations Lab website: <http://ww2.che.ufl.edu/unit-ops-lab//ech4224L.htm>

- Contains all the documents required for experiments: basic theory, system configuration, standard operation procedures (SOPs), report guidelines, pre-lab homework, etc.
- Additional information available in the website: Safety guidelines, report guidelines and templates, given values for physical measurements/quantities required for calculations, etc.

Canvas website: <http://elearning.ufl.edu/>

- This website will be used for submission of reports and post-lab homework, special assignments, posting of grades, and announcements.
- Pre-lab homework will NOT be uploaded to Canvas (see the “Homework” section for additional details)

Recommended Literature:

The following titles are recommended to support fundamentals and theoretical background, physical constants, empirical correlations, and other concepts:

1. Geankoplis, C. J., *Transport Processes and Unit Operations* [On reserve in the Science Library].
2. Incropera, F. P. and D. P. DeWit, *Fundamentals of Heat and Mass Transfer* [On reserve in the Science Library]
3. McCabe, W. L., J. C. Smith, and P. Harriet, *Unit Operations of Chemical Engineering* [On reserve in the Science Library]
4. Perry, R. H., D. W. Green, and J. O. Maloney, *Perry's Chemical Engineers' Handbook* [E-book is available through UF Library website]

There is no required textbook for this class.

Course overview

- The course consists of four experimental modules and each module may have one or more experiments.
- Each module is three weeks long and this three-week period will be called “Quarter”.
- Each course section is divided into groups of four or less students and the groups rotate through all four modules.
- Quizzes and pre-lab homework will be required at the beginning of each module.
- During and after completion of experiments the groups are required to submit preliminary calculations, lab reports and/or post-lab homework (see the “Homework” section).
- A complete schedule of modules throughout the semester will be uploaded and periodically updated via Canvas website.
- **Regardless of individual contributions, each team member is responsible for understanding all elements of each experiment in the different modules.**

Module description

- Module 1: Thin Film Evaporator (TFE)
- Module 2: Fluids (FLU)
 - Experiment 1: Fluid flow in pipes (FF)
 - Experiment 2: Various small fluid experiments (SFE)
- Module 3: Filtration (FIL)
 - Experiment 1: Batch filtration (BF)
 - Experiment 2: Continuous filtration (CF)
- Module 4: Heat Exchanger and Fluidized Bed (H&B)
 - Experiment 1: Heat Exchanger (HX)
 - Experiment 2: Fluidized Bed (FB)

Course schedule

The table below depicts an example of a typical group rotation throughout the semester for any given section. Modifications to this course schedule may be necessary due to holidays as indicated in the academic calendar, class cancellation due to other reasons (e.g. hurricane/storm warning), or other reasons not listed in this document. Announcements will be posted on Canvas regarding the modification of the course schedule.

		Group 1	Group 2	Group 3	Group 4
Quarter 1	Aug 26 - 30	TFE	FLU	FIL	H&B
	Sep 3 - 6				
	Sep 9 - 13				
Quarter 2	Sep 16 - 20	FLU	FIL	H&B	TFE
	Sep 23 - 27	Career Showcase (no lab sessions)			
	Sep 30 - Oct 4	FLU	FIL	H&B	TFE
	Oct 7 - 11				
Quarter 3	Oct 14 - 18	FIL	H&B	TFE	FLU
	Oct 21 - 25				
	Oct 28 - Nov 1				
Quarter 4	Nov 4 - 8	H&B	TFE	FLU	FIL
	Nov 11 - 15				
	Nov 18 - 22				

Attendance Policy, Class Expectations, and Make-Up Policy

- Class attendance is mandatory for all lab sessions.
- To make up for a missed lab due to acceptable excuses, the students will be required to perform the missed experiment with another group in another day-section. Unexcused absences and tardiness will result in a grade reduction.
- The Unit Ops Lab has an explosion proof requirement for all electronics thus the use of cell phones, tablets and/or laptops is strictly prohibited (rooms 100, 200, and 300). They can be used in rooms 200A and 300A whenever is necessary and it doesn't involve an interruption in the work of others.
- The Unit Ops Lab has a Personal Protective Equipment (PPE) policy that includes the use closed-toe shoes, long sleeve pants, hard hats, and safety glasses at all times. Additional PPE and Safety instructions will be given during the orientation meeting which will take place the first day of classes.
- Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

Evaluation of Grades

Assignment	% Final Grade
Lab Reports	60%
Prelim Calculations/Predictions	15%
Post-Lab Homework	10%
Quizzes	10%
Lab participation	5%
Final Grade	100%

* The class participation grade will be based on the peer-tutor feedback, peer evaluations, and the course instructor's observations. **A failing grade for participation will result in a failing course grade.**

Grading Policy

Percent	Grade	Grade points
93.4 - 100	A	4.00
90.0 - 93.3	A-	3.67
86.7 - 89.9	B+	3.33
83.4 - 86.6	B	3.00
80.0 - 83.3	B-	2.67
76.7 - 79.9	C+	2.33
73.4 - 76.6	C	2.00
70.0 - 73.3	C-	1.67
66.7 - 69.9	D+	1.33
63.4 - 66.6	D	1.00
60.0 - 63.3	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Safety

Students are expected to know and follow safe operating procedures of the equipment as well as proper handling of hazardous materials. The students are required to attend a safety orientation session at the beginning of the semester. **Failure to follow safe operating procedures will result in a significant grade reduction.** Examples of safety violations are listed below (this list is not exhaustive):

Safety violation	Penalty
Leaving the lab without shutting down an experimental system	Failing grade
Not wearing PPE required by an experiment	Letter grade reduction
Not disposing of hazardous waste properly	Letter grade reduction
Not handling a chemical spill properly	Letter grade reduction
Causing a spill due to negligence (e.g., by opening wrong valves).	Letter grade reduction
Bringing food or drink into the lab	Letter grade reduction

Homework, due dates, format, and policies:

Instructions to prepare all assignments are available in the Unit Ops Lab website. Some modifications are in progress thus announcements will be posted on Canvas and/or sent via e-mail.

- **Pre-Lab Homework:** These are individual assignments. Format: printed. You must give your assignment to the peer-tutor at the beginning of each new experiment (remember that modules can have one or more experiments). A failing grade will be assigned to students whose cumulative pre-lab homework grade is less than 50%. Late Pre-lab submissions will be accepted only if a student was not able to complete the homework on time due to an acceptable reason (see the attendance policy)
- **Preliminary Calculations:** These are group assignments. Format: printed. All experiments involve a 2 – 3 pages document showing preliminary calculations and/or predictions. The document will be given to your peer-tutor at the beginning of the second experimental week for each module and discussed with her/him. Revision of your calculations (e.g. Excel spreadsheets) may be also be required so you should have the file handy (e.g. flashdrive, saved in your computer for review outside the Unit Ops Lab). Specific details on the contents of Preliminary Reports for each experiment will be provided in Canvas and/or via e-mail. No late submission will be accepted.
- **Final Reports:** These are group assignments. Format: Word, submitted via Canvas. All experiments (except SFE) require submitting a final report via Canvas website one week after each experiment is completed (until 11:59 pm). Late Report submissions will be penalized by a 20% grade reduction for each day the report is overdue. Details on report preparation are provided in sections “Guidelines for Lab Reports and Data Analysis” and discussed with more detail here: http://ww2.che.ufl.edu/unit-ops-lab//pdf-files/report_guidelines_rev3.1.pdf
- **Post-Lab Homework:** These are group assignments. Format: Word, submitted via Canvas. Small Fluid Experiments (SFE) require submitting a post-lab homework via Canvas website one week after these small experiments are completed. Late Post-Lab homework submission will be penalized by a 20% grade reduction for each day the homework is overdue. The contents and instructions for post-lab homework are provided in the Unit Ops Lab website.

Additional homework, due dates, and format:

- **Safety and Statistical Analysis homework:** Individual assignment. Format: Word or PDF, submitted via Canvas. You must submit your homework before your very first week of experiments (August 26 – 30, depending on your day-section, until 8:00 am). Details for the preparation of this assignment will be available in Canvas.
- **Professional writing:** Individual assignment. Format: Word or PDF, submitted via Canvas. You must submit your homework before your third week of experiments (Sept. 9 – 13, depending on your day-section, until 8:00 am). Details for the preparation of this assignment will be available in Canvas.

Late Pre-lab submissions for these assignments will be accepted only if a student was not able to complete the homework on time due to an acceptable reason (see the attendance policy)

Quizzes: Due dates, format, and policy:

- Quizzes are scheduled at the beginning of each day of experiments and they will involve questions on the experiment (theory, equipment operation, expected results) and safety.
- Quizzes will be given to students by peer-tutors in a printed format and must be answered in an organized, legible, and clear fashion.
- Quizzes will be rescheduled only for those students who missed them due to an acceptable reason (see the attendance policy). It is required that whenever possible the student notifies the course instructor about the situation before the quiz.

- Students arriving late for a quiz will be given only the balance of time remaining to complete their work unless an acceptable reason (see above) is provided.
- The use of notes, manuals, or any other material during quizzes is not allowed.
- **Failure to correctly answer safety-related questions will result in a 5% reduction of the course grade per each wrong answer.**
- **A failing grade will be assigned to students whose cumulative quiz grade is less than 50%**

Additional details on schedule for each experiment

a) Before the experiment:

- Review theory, safety manual, and operating instructions posted on the Lab website.
- If necessary, meet with the instructor or the peer-tutor to discuss the upcoming experiment.
- Answer pre-lab questions posted on the Lab website. Written/typed answers to the pre-lab questions should be submitted to your peer-tutors at the beginning of the lab session.

b) During the experiment:

- Get acquainted with equipment.
- Learn proper start-up and shutdown procedures.
- Learn how to perform measurements.
- Learn about limits of the system.
- Experiment with the system under various conditions.
- Perform basic checks of your data (e.g., mass and energy balances) during the experiment. Avoid a situation in which you collect data just to discover that it does not satisfy the mass or energy balance **after** you are out of the lab and writing your report. It is necessary to perform the basic checks **during** the lab and repeat an experiment, if necessary.
- Your preliminary analysis will be reviewed by the Peer Tutors and will contribute to your lab participation grade.

c) After the experiment:

- All reports / post-lab homework are group assignments thus you must coordinate with your team to analyze data and write or prepare these documents.
- See the Homework section for specific details.

Guidelines for the Lab Reports

1. Detailed guidelines and grading rubrics are posted on the Lab website. Reports will be graded on both technical content and communication effectiveness.
2. Reports should be written using complete sentences, with correct spelling and grammar. All symbols should be defined on their first use. Clarity and brevity will be rewarded; sloppy thinking and writing will be penalized.
3. Do not copy theoretical derivations from a textbook or a website. Instead, clearly state assumptions behind a derivation, provide relevant derivation results, and cite your sources.
4. All reports should be submitted via e-learning either in MS Word format. There is no need to submit hard copies.
5. In addition to a report file, your submission should contain all supporting information, such as spreadsheet files with your data and files with your computer codes. However, your reports should be self-contained, i.e. one should be able to understand your work by reading your report without referring to supporting materials.

Guidelines for Experiments and Data Analysis

1. Check energy and material balances.
2. Investigate effects of all control parameters on the experimental results.
3. Almost all experiments should be performed at a steady state. Exceptions are the batch filtration and the 3-tank experiments.
4. Clearly identify and justify all assumptions in your theoretical calculations.
5. Compare the measured data with your theoretical calculation.
6. Check reproducibility of your data. Whenever possible, **perform at least three runs for each experimental condition** and obtain error estimates by computing standard deviations based on these runs. Report the average values and error estimates in the main text of the report and provide an appendix containing data for all experimental runs.
7. Report any anomalous results and discuss their possible sources.
8. Use spreadsheets (e.g., Excel) to store your data. Use Python (or another equivalent programming language) for data analysis and theoretical calculations. Use of spreadsheets for complex calculations is discouraged due to difficulty of their debugging.
9. Make sure that your objectives can be met with your operating conditions. It is easy to choose conditions that are outside of the performance limits of the apparatus or produce results with no measurable difference. Carefully study the limitations of the existing experimental apparatus as a part of the planning process rather than finding out in the laboratory that the experimental values obtained are useless.

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator

- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the [Office of Title IX Compliance](mailto:title-ix@ufl.edu), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.