

Separations & Mass Transfer Operations

ECH 4403 Section 12933 OR 12934

Class Periods: MWF, P7 (1:55-2:45 PM) OR P9 (4:05-4:55 PM)

Location: CSE E221 OR LIT 0237

Academic Term: Spring 2020

Instructor:

VJ Tocco

I prefer that you call me "VJ", but you may also call me "Dr. Tocco" if you are more comfortable addressing your instructors formally.

E-Mail: vjtocco@ufl.edu

E-mail is my preferred method of communication outside of class time. In order to ensure that I reply, you must use proper e-mail etiquette and put "ECH4403" in the subject line.

Office: 322 Black Hall

Office Hours: MWF, 11:00 AM - Noon

I have an open-door policy; if I am in my office with the door open, you are welcome to come in at any time. However, please do not disturb if the door is closed and you are coming by unannounced.

Supervised Teaching Student:

Suliman Al-Qalaf

E-mail: salqalaf@ufl.edu

Office: 229 Chemical Engineering

Office Hour: Th, 11:30-12:30, in the study cubbies in the Chemical Engineering Student Center

Exam Dates (tentative) (Locations TBD)

Wednesday, February 12; 8:20 PM – 10:20 PM

Wednesday, March 25; 8:20 PM – 10:20 PM

Tuesday, April 28, 12:30-2:30 PM OR Thursday, April 30, 3-5 PM (Note, one exam date will be changed to match the other)

Course Description

Theory, design, and evaluation of diffusional and staged mass transfer principles including distillation, absorption, and extraction, leaching and membrane separations. Computer-aided design methods.

Course Pre-Requisites / Co-Requisites

Pre-requisites: ECH3101 (Process Thermodynamics), ECH3202 (Fluid and Solid Operations) and ECH3223 (Energy Transfer Operations)

Course Objectives

Broadly, at the end of this course, a student should be able to do the following:

- 1) Explain the fundamentals of chemical engineering separation processes.
- 2) Design distillation equipment for binary or multicomponent mixtures in continuous and batch operation.
- 3)
- 4) Design adsorption or stripping operations
- 5) Design liquid-liquid extraction operations
- 6) Design distillation equipment for complex (azeotropic) distillation systems

Materials and Supply Fees

None

Professional Component (ABET):

In addition to the course objectives stated above, the assignments are designed to develop the following skills, which are characteristic of real-world problems, and therefore essential for any practicing chemical engineer:

- 1) Read, interpret, and follow directions, prompts, and problem statements.
- 2) Detect and disregard superfluous given information.
- 3) Use resources to find extra information which is needed, but not given.
- 4) Brainstorm reasons for unexpected behavior (troubleshooting).

Relation to Program Outcomes (ABET):

| Outcome | Coverage* |
|---|-----------|
| 1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics | |
| 2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors | Assessed |
| 3. An ability to communicate effectively with a range of audiences | |
| 4. 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 | Assessed |
| 5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives | |
| 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions | |
| 7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies | |

Required Textbooks

Separation Process Essentials (1st Ed.) by Alan M. Lane (CRC Press)

Wiley, ISBN 978-1138086081

Note: This textbook was recently published, and it is the clearest text on Separations that I've read. I think you will enjoy reading it, but I do not "require" reading or textbook problems (although they are strongly encouraged!)

Required Software

Microsoft Excel and/or python software will be strongly encouraged/required for some homework problems. Therefore, you will need access to this software on your personal laptop.

Recommended Materials

A scientific calculator (any model, except those with communication abilities) is recommended for exams. During exams, you may not use your cell phone as a calculator, nor may you share a calculator with a classmate.

Course Schedule – Subject to change

| Week | Begins | Topic(s) |
|------|--------|--|
| 1 | 1/6 | Course introduction, equilibrium data, single-stage distillation |
| 2 | 1/13 | Multi-stage distillation |
| 3 | 1/20 | Multi-stage distillation (continued) |
| 4 | 1/27 | Energy balances/column design |
| 5 | 2/3 | Multicomponent column distillation and variations |
| 6 | 2/10 | Batch distillation |
| | | Exam 1: Feb 12, 8:20 PM |
| 7 | 2/17 | Batch distillation (continued) |
| 8 | 2/24 | Absorption and stripping columns |
| 9 | 3/9 | Multicomponent/adiabatic absorption |
| 10 | 3/16 | Column Design and Practical Aspects of Separation Processes |
| 11 | 3/23 | Liquid-Liquid Extraction |
| | | Exam 2: March 25, 8:20 PM |
| 12 | 3/30 | Liquid-Liquid Extraction (continued) |
| 13 | 4/6 | Azeotropic/non-ideal separations processes |
| 14 | 4/13 | Class Project Presentations |
| 14 | 4/20 | Review and Catch-Up |

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is required. Although I do not record attendance, some in-class assignments may be unannounced. Make-up work/assignment extensions will be offered if (and only if) you notify the instructor in advance of your absence via email, your reason for absence is consistent with the UF attendance policy (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>), and you provide the appropriate documentation.

Excused absence work make-up

Make-up work will be considered on a case-by-case basis, commensurate with your circumstances in a manner that is fair to you and your classmates. **There will be no make-up assignments for unexcused absences.**

Evaluation of Grades/Course Assignments

| Assignment | Total Points | Percentage of Final Grade |
|------------------------------|--------------|---------------------------|
| Homework Sets (10) | 20 each | 20% |
| Exams (2 Midterms, 1 Final) | 200 each | 60% |
| Team-Based In-class problems | 100 | 10% |
| Team-Based Project | 100 | 10% |

Exams: 2 Midterms, 1 Final; 200 Points Each

Each exam will last two hours. The final exam is cumulative.

The format of the questions will vary, but expect a range of “easy” (roughly 30%), “medium” (roughly 40%) and “challenging” (roughly 30%) parts, with the point values for each question/part

clearly labeled. During the exam, you are permitted to use a calculator (any model, provided that it has no communication ability; you also may not share calculators), but are not permitted to refer to books or notes.

Note: Make-up exams will be considered on a case-by-case basis for documented, excused absences or emergencies. However, once you begin an exam, you may not be granted an excused absence for any reason.

Homework: 200 points Total; 10 assignments, 20 points each

Homework will be assigned approximately once per week, and will consist of **5 problems, or 4 problems** and an **essay response**.

Homework Problems: The homework problems will be challenging. You should plan to spend at least 5 hours per week developing your solution (if not more). You are permitted to discuss the problems and problem-solving strategies with your colleagues, but you may not breach the Academic Honesty Course Policy (see below).

Your homework submission must include the pages of the assignment, with all requested answers reported in the answer box below the problem statement. Your solutions must include a full description of your problem-solving logic, and should be easy to follow in order to receive full credit (see below)

All homework submissions are to be scanned and submitted via canvas.

Grading of homework problems occurs on the following basis:

- Blank or minimal effort – 0 points
- Not completed/insufficient work shown – 1 point
- Complete and incorrect, but difficult to follow – 2 points
- Correct, but difficult to follow **or** incorrect, but presented professionally – 3 points
- Correct and presented professionally – 4 points

Essay Response: Writing and communication are essential and undervalued skills of successful, professional engineers. Each week, you will be prompted to craft a written response of 300-400 words that will be graded for content, concision, clarity, and grammar (1 point each).

Due Date: Homework is due by 10 PM on Wednesdays. To incentivize you to start (and finish) homework assignments early, homework submitted by noon on the Monday before the due date will receive two automatic bonus points. **Late homework policy:** Homework submitted up to two hours late (midnight) will earn a maximum of 2 points per problem. Homework submitted up to the posting of the solutions (typically 1-2 days after) will earn a maximum of 1 point per problem. No homework will be accepted after solutions are posted. **No exceptions! Plan for the unexpected, double-check your submission and don't procrastinate.**

Team-based In-class Problems: 100 Points

Some class time will be allotted for problem-solving in small groups (approximately 1 problem/week). Completed assignments must be submitted via Canvas, and may be graded for completion OR correctness.

Team-based Class Project: 100 Points

In the class project, you will work in groups of four to research and present a separations technique that we do not cover in the course. Groups will be assigned, but you will have the option to choose one of your teammates. Topics will be claimed on a first-come, first-serve basis, and no duplicate topics are allowed.

More details will be given when the project is assigned in March.

Extra Credit: 20 Points Possible

You will have the opportunity to earn a maximum of 20 extra-credit points.

Option 1: Write an original exam/homework questions (maximum of 10 points/question). You must submit the **question statement, an answer key, and an explanation of the concept** that the question is testing. In addition, by submitting these questions, you authorize me to use them in subsequent semesters (or, if the question is good enough, this semester!). You may submit as many questions as you like.

Option 2: Submit a creative expression of your experiences in ECH4403. Submissions may include a song, video, poem, craft, artwork, or any other creation. The only constraints are that your submission must be completely original, and your submission must be **shared** with the rest of the class on the last day of class.

The deadline to turn in extra-credit is **Monday, April 20, 2020**.

Grading Policy

You may earn **1000** possible points in this course by completing assignments (see below). Your final letter grades will be based on your final point total only (no curve). The thresholds to earn a given letter grade are listed below:

| Point Value | Letter Grade |
|-------------|--------------|
| 960-1000 | A |
| 920-950 | A- |
| 880-910 | B+ |
| 840-870 | B |
| 800-830 | B- |
| 760-790 | C+ |
| 720-750 | C |
| 680-710 | C- |
| 640-670 | D+ |
| 610-630 | D |
| 0-600 | F |

At the end of the term, the instructor may add points to all students' scores uniformly to improve grades, but may **not subtract** points to diminish grades.

Students in the "gray" areas between grading bins may earn either the next letter grade up, or the next letter grade down based on their professionalism, participation, effort, distance to the next bin, and performance trajectory. Final decisions are based solely on the instructor's discretion.

More information on UF grading policy may be found at:
<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

Regrades:

To submit a regrade, fill out the regrade request form (a blank copy may be found on Canvas). This form will require you to directly state the number of points you think you deserve and a full explanation of the discrepancy (unless it is a simple addition error). **Do not write anything directly on any page of your assignment.** You must scan and upload your entire assignment, with the regrade request as the cover page to Canvas within **one week** of the date the assignment was returned to the class.

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](#), 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>.