

# Separation and Mass Transfer Operations

**ECH 4403 Class #23869 and #29448, Sections OL16 and SEP1**

**Class Periods: MWF 6 (12:50 – 1:40 PM) OR 7 (1:55-2:45 PM)**

**Location: CHE 0237 (Except Period 6 on Fridays in LAR 0310)**

**Academic Term: Spring 2022**

## 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](mailto:vjtocco@ufl.edu)**

E-mail is my preferred method of communication outside of class time. To ensure that I reply, you must use proper e-mail etiquette and include “ECH4403” in the subject line.

**Office: 322 Black Hall, (352) 294-1290**

I do not plan to be available for in-person meetings in my office unless necessary.

**Office Hours (via zoom; link to be posted to Canvas): MW 3:00 – 4:00 PM**

## Supervised Teaching Student: Hayden Good

E-mail: [haydengood34@ufl.edu](mailto:haydengood34@ufl.edu)

Office Hours: TBD

## Course Format

All required course materials and resources (except the textbook) for ECH 4403 are contained on, or linked to, the course Canvas page. It also serves as the primary means of communication with your classmates and instructors (outside of class). You should get into the habit of checking this Canvas page regularly for announcements and action items. You should also enable Canvas to send you e-mail notifications, such that you are alerted to any updates or correspondence (the default state is “on”, so no action is required unless you've disabled this feature).

The general format of will be “flipped”, meaning that class sessions will focus on guided problem solving. Core course content will be delivered in a series of short, pre-recorded videos that you will be expected to view and study prior to class. A list of videos, their links, and the expected completion date will be posted on Canvas and/or announced during the preceding class.

### In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation,

assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### “Quizzams”:

“Quizzams” are quiz/exam hybrids, and will be held approximately every two weeks during the term.

#### Quizzam Dates:

Wednesday, Jan. 26  
Wednesday, Feb. 9  
Wednesday, Feb. 23  
Wednesday, Mar. 2  
Wednesday, Mar. 23  
Wednesday, Mar. 30  
Wednesday, Apr. 13  
Wednesday, Apr. 20

There is no “final” exam for this course.

### Course Description

(3 credits) 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

**Prerequisites:** 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) Design adsorption or stripping operations
- 4) Design liquid-liquid extraction operations
- 5) Design distillation equipment for complex (azeotropic) distillation systems

In addition to these learning objectives, 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).

## Materials and Supply Fees

None

## 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	High
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	High
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	Medium
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	Low

## Required Textbook

Separation Process Essentials (1<sup>st</sup> 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 assign reading as an assignment or textbook problems (although they are strongly encouraged!)*

## Required Software

**Microsoft Excel** and/or Python will be needed for some homework assignments. Therefore, you will need access to this software on your personal laptop.

## Recommended Materials

Any model of scientific calculator may be useful for solving homework and exam problems.

## Course Schedule (Tentative)

Week	Topic(s)
1	Course introduction, equilibrium data, single-stage distillation
2	Graphical solutions to problems, energy requirements
3	Multi-stage distillation
4	Distillation column design and variations
5	Distillation column practice
6	Multicomponent distillation, single-stage batch distillation
7	Multistage batch distillation
8	Mass-Transfer separations
9	Absorption and stripping columns
10	Cross-current liquid-liquid extraction
11	Counter-current liquid-liquid Extraction
12	Liquid-liquid extraction designs, Pressure-swing distillation
13	Azeotropic/non-ideal separations processes
14	Membranes/Class Project Presentations
15	Open/review

### Attendance Policy and Expectations

Attendance is expected, but will not be officially monitored or graded. You are required to watch all course content videos before the corresponding class period.

When interacting with fellow students and instructors, you are expected to maintain professionalism and behave respectfully. The community of ECH 4403 will be supportive and inclusive. Offensive imagery and/or language will not be tolerated in any capacity.

### Evaluation of Grades/Course Assignments

**Quizzams: 8 quizzams, 100 points each (80% total)**

**Homework: 6 assignments, 20 points each (lowest score dropped, 10% total)**

Each homework assignment will consist of 5 problems, and occasionally an essay response might replace one of the problems.

Expect the homework problems to challenge you. VJ will answer direct, well-articulated questions relating to the homework, but will not guide you through the solution, troubleshoot your mistakes, or check your

answers before submission. You are permitted to discuss the problems and problem-solving strategies with your classmates, but you may not breach the Academic Honesty Course Policy (see below).

**Solution Submission:** Homework is to be submitted electronically on Canvas. Your homework solution must include the problem statements, with all requested answers reported in the answer box(es) provided.

A good problem solution primarily consists of a description of problem-solving logic in complete sentences, with equations to supplement the logic. Your work should be organized neatly and be easy to read and follow. You may type your solutions, but equations must be typeset with the "Equation Editor" in Word (or equivalent in another program). Because this can become quite time-consuming, I recommend hand-writing your solutions.

There are several free smartphone apps that can scan your work and convert it to a PDF (such as "CamScanner"). Photographs (learn the difference between a PDF and a photograph) are not acceptable. Please let VJ know if access to this technology is unavailable, and accommodations will be made.

**Grading:** 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 responses will be graded for content, concision, clarity, and grammar.

**Due Date:** Homework is due at 11:59 PM on Fridays and graded *as submitted*.

To incentivize you to start (and finish) homework assignments early, homework submitted by **noon** on the Wednesday before the due date will earn two automatic bonus points.

Late homework will be penalized 4 points per day, up to **three days** after the due date. In other words, assignments submitted from 12:00 AM – 11:59 PM on Saturday can earn a maximum of 16 points, from 12:00 AM – 11:59 PM on Sunday: 12 points, and 12:00 AM – 11:59 PM on Monday: 8 points. Homework solutions will be posted on Tuesday morning, after which no homework will be accepted.

**Low Score Drop:** Each student's lowest homework score will be dropped at the end of the semester. This policy covers emergencies and technological issues alike, and no documentation or action is required of the student.

No further accommodations or deadline extensions for homework or quizzes will be granted due to technological issues or emergencies. You should anticipate that these issues will arise at the worst possible time (for example, Wi-Fi always seems to crash 10 minutes before the homework is due), and plan contingencies.

**Significant progress must be demonstrated on a minimum of 70% of the homework problems in order to pass the course.**

### **Team-Based Project: 100 Points**

In the class project, you will work in groups of 3-4 to give a virtual presentation about a separation technique of your choice. More details will be given when the project is assigned in early March.

**Extra Credit: 10 Points Possible (due Monday, 4/18)**

Option 1: Write an original exam/homework problem. You must submit the **problem 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.

## Grading Policy

You may earn 1000 possible points in this course by completing assignments (see above). Your final letter grade will be based on your final point total. General point totals needed to earn a given letter grade are listed below:

Point Value	Letter Grade
900-1000	A/A-
800-899	B+/B/B-
720-799	C+/C
700-719	C-
600-699	D+/D/D-
<600	E

Determination of +/—/- letter grades will be based primarily on the distribution of student scores within the tier (with roughly 1/3 in each bin). However, these may also be subject to instructor's discretion, considering professionalism, participation, effort, and performance trajectory. These decisions will be 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 request a regrade, email VJ and Hayden. In your email, directly state the number of points you think you deserve and a full explanation of the discrepancy (unless it is a simple addition error). **The deadline for regrades is one week from the date the assignment was returned as graded.**

## Make-Up Policy

In the case of an emergency, technological issue, or excused absence during a quizzam, one **comprehensive** make-up quizzam will be offered at the end of the semester, provided that **adequate proof/documentation is presented in writing.**

Make-up work for extended excused absences will be considered on a case-by-case basis in a manner that is fair for you and your classmates. 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.

## 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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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](mailto: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/>.

### COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

## Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto: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](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

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