

ENCH 445: Separation Processes; Fall term, 2025

Instructor: Professor Doug Frey, TRC 252B, 455-3418; dfrey1@umbc.edu

Office hours: Tuesday and Thursday at 4 pm (tentative)

Standard Textbook: *Separation Process Engineering (SPE)*, 4th Ed. by P. C. Wankat

On-line Textbook: *Professor Frey's Separation Processes WebBook (SPW)*. This reference is contained in the ENCH 445 course website given below.

ENCH 445 Course Website: <http://userpages.umbc.edu/~dfrey1/ench445/>

Grading: Two midterms: 40%; Final: 40%; Homework: 20%.

Course Goals: Processes for separating mixtures are critically important in the chemical, pharmaceutical, and food industries, and in the environmental engineering field. The purpose of this course is to develop skills in qualitative reasoning and the conceptual design of separation processes, as well as skills in the detailed quantitative design of separation equipment. An example of qualitative reasoning is the selection of what is likely the most efficient separation method based on an inspection of the physical properties of the components to be separated. An example of quantitative design is the determination of the optimal solvent to use, the optimal solvent flow rate, and the corresponding optimal number of equilibrium stages for a liquid extraction process which removes a pollutant from wastewater.

Specific Learning Objectives:

By the end of this course students will be able to:

1. Apply basic principles of thermodynamics and numerical methods for the simulation and design of single-stage separation processes.
2. Apply the description rule, degree of freedom analysis, identification of separation agent, and related basic principles to provide a fundamental understanding of the behavior and mathematical structure of separation processes.
3. Determine the basic behavior of idealized liquid-liquid extractors, distillation columns, absorbers, strippers, and related types of equilibration separation processes using graphical methods.
4. Apply software packages such as Aspen and COCO for the detailed simulation and design of equilibration separation processes such as liquid-liquid extractors, distillation columns, absorbers, and strippers.
5. Apply results for staged separation processes to the simulation and design of separation processes employing packed columns.
6. Perform simple calculations that describe the behavior of membrane processes.
7. Use simple principles based on the inspection of component physical properties and experience-based heuristic rules for selecting an efficient separation processes.

Course Outline:

Week	Readings		Topics
	SPE [†]	SPW [‡]	
1	Ch. 1	Ch. 1	Organize course, general features of separation processes.
2		Ch. 2 Ch. 3	Basic elements of numerical methods Numerical methods using Excel and Matlab
3	Ch. 2	Ch. 4	Phase equilibrium.
4	Ch. 2	Ch. 5	Binary and multicomponent single-stage processes, lever rule, description rule, rate-governed processes
5	Ch. 3	Ch. 6 Ch. 6	Staging of separation processes Introduction to ChemSep, COCO and Aspen
6, 7	Ch. 4	Ch. 7	Binary distillation
8	Ch. 5	Ch. 8	Binary distillation (cont.), multicomponent distillation. Midterm 1: October 16 (tentative)
9,10	Ch. 12	Ch. 9	Absorption, stripping, Kremers-Sauders-Brown equation
11	Ch. 13		Extraction
12	Ch. 10	Ch. 10	Stage efficiency, equipment capacity
13	Ch. 10, 16	Ch. 11	Packed column contactors Midterm 2: Nov. 20 (tentative)
14	Ch. 17	Ch. 12	Membrane processes
15			Review and catch-up

Final examination: Thursday, Dec. 11, 1 - 3 pm

[†]SPE: Separation Process Engineering (P. C. Wankat)

[‡]SPW: Professor Frey's Separation Processes WebBook

Additional Information Related to Course Outline:

1. Dates given for examinations are approximate and might change to account for scheduling considerations.
2. Topics and reading assignments are subject to revision based on scheduling considerations.
3. Weighting factors for determining the final grade are subject to minor revision depending on various factors. The **approximate** grade ranges (which are subject to revisions) are A: 85 – 100%; B: 75 – 85%; C: 60 – 75%; D: 50 – 60%.
4. Course materials such as lecture materials, homework assignments, tutorials, and detailed descriptions of the reading assignments are located on the ENCH 445 course website (<http://userpages/umbc.edu/~dfrey1/ench445/>) and **not on Blackboard**.

Statement on Academic Conduct:

By enrolling in this course, each student assumes the responsibility of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal. To read the full Student Academic Conduct Policy, consult the UMBC Student Handbook, the UMBC Faculty Handbook, the UMBC Policies Section of the UMBC Directory, or the UMBC website.

In order for the grading in this course to be as fair as possible, you are prohibited from accessing homework and examinations given in any of the previous years that this course has been taught. Adequate samples of previous work will be provided to you as needed. Anyone who does not abide by this prohibition will be in violation of the Academic Conduct Policy for this course.

Regrading Policy:

Deadline: Requests to regrade material must be submitted no later than one week after the material in question was returned to the class or was made available to be picked up.

Additional Information: You should submit material to be regraded only if you think a serious grading error is present, and not because you want to argue about partial credit judgement calls made by the grader. All requests for regrading must include a concise written description of the alleged grading error. You should also be aware that graded material will be stored electronically. Instances where regrading is requested for student work that has been altered after it has been graded will be treated as a case of serious academic misconduct.

Homework Policy:

You will learn the course material best if you work on the homework entirely by yourself. However, if you feel that you learn better by working in a small group, you are permitted to do so. If you do decide to work in a small group, note that each student must turn in his/her unique solution for grading. Any evidence of direct copying of homework solutions will be considered as a violation of the Academic Conduct Policy for this course. All homework must be submitted as single document in pdf format to Blackboard.

Accessibility and Disability Accommodations, Guidance and Resources:

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: [410-455-2459](tel:410-455-2459)

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination:

[UMBC Policy](#) in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at titleixcoordinator@umbc.edu or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the [Online Reporting/Referral Form](#). Please note that, if you report anonymously, the University's ability to respond will be limited.

Notice that Faculty and Teaching Assistants are Responsible Employees with Mandatory Reporting Obligations

All faculty members and teaching assistants are considered Responsible Employees, per UMBC's [Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination](#). Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received. While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their [rights, resources, and support](#). While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of [Confidential Resources](#) available to support you:

[Retriever Integrated Health](#) (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.

[Center for Counseling and Well-Being](#) (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) [Online Appointment Request Form](#)

Pastoral Counseling via [The Gathering Space for Spiritual Well-Being](#): 410-455-6795; i3b@umbc.edu; Monday – Friday 8:00 a.m. – 10:00 p.m.

Other Resources:

[Women's Center](#) (open to students of all genders): [410-455-2714](tel:410-455-2714); womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.

[Shady Grove Student Resources](#), [Maryland Resources](#), [National Resources](#).

[Child Abuse and Neglect](#):

Please note that Maryland law and [UMBC policy](#) require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.

[Pregnant and Parenting Students](#):

UMBC's [Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination](#) expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University's [Office of Equity and Civil Rights](#). Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the [Office of Student Disability Services](#).

Religious Observances and Accommodations:

UMBC [Policy](#) provides that students should not be penalized because of observances of their religious beliefs, and that students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences or requested modifications for religious observances in advance, and as early as possible. For questions or guidance regarding religious observances and accommodations, please contact the Office of Equity and Civil Rights at ecr@umbc.edu.

Hate, Bias, Discrimination and Harassment:

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement. Consistent with these principles, [UMBC Policy](#) prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate, or bias based upon a protected status or who have such matters reported to them should use the [online reporting/referral form](#) to report discrimination, hate, or bias incidents. You may report incidents that happen to you anonymously. Please note that, if you report anonymously, the University's ability to respond may be limited.