

Transport in Soft Materials

ECH 4905: Special Problems in Chemical Engineering; Section 15JM

Class Periods and Location: Tuesday Period 5-6 (11:45am – 1:40pm) in CSE E222

Thursday Period 6 (12:50pm – 1:40pm) in NEB 202

Academic Term: Fall 2024

Instructor

Prof. Joshua Moon

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Office phone: +1 (352) 392-4752

Office hours: Thursdays 2-4pm or by appointment

Office hours location: NEB 331

Email is my preferred method of communication outside of class. Please include “ECH6937” in your email subject line to ensure that I see your message and reply. I try to reply to emails in a timely manner; however, emails sent late in the evening or during the weekend may not receive replies until the next University workday.

Teaching Assistant/Peer Mentor/Supervised Teaching Student

N/A

Course Description

(3 credits) This course will explore fundamentals of transport phenomena in polymer materials, covering applications such as gas and liquid membrane separations, food packaging, energy storage devices, and biomaterials. Mass transfer models will be considered from both experimental and theoretical viewpoints, with some attention given to measurement techniques. Practical strategies for tailoring polymer properties to particular applications will also be considered.

Course Pre-requisites / Co-requisites

None

Course Objectives

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

1. Understand and distinguish fundamental mechanisms and theories of small molecule mass transport in polymers
2. Explain how polymer properties affect transport phenomena in polymers
3. Identify how transport-centered polymer design enables important technologies such as gas and liquid membrane separations, fuel cells, batteries, barrier materials, drug delivery, and biomaterials
4. Select and describe appropriate measurement techniques to analyze macroscopic and microscale transport rates in polymers
5. Evaluate and apply polymer designs to realize new technologies relevant to clean energy, sustainability, and biological/biomedical applications

Materials and Supply Fees

None

Relation to Program Objectives (ABET)

N/A

Required Textbook and Software

- Course material will be provided by the Instructor on Canvas which includes lecture notes, journal articles, and excerpts from the textbooks below and other sources.

Recommended Materials

- Polymer Chemistry, 2nd or 3rd Ed, Lodge and Hiemenz, CRC Press, 2020, ISBN: 978-1-4665-8164-7 (hardback), 978-0-429-19081-0 (ebook).
- Membrane Handbook, Ho and Sirkar, Chapman & Hall, New York, 1992, ISBN: 978-1461365754.
- Membrane Technology and Applications, 3rd Ed, Richard Baker, Wiley, 2012, ISBN: 978-0-470-74372-0.
- Materials Science of Membranes for Gas and Vapor Separation, Yampolskii, Pinnau, and Freeman, Wiley, 2006, ISBN: 978-0470029039.
- Other recommended materials will be distributed via Canvas

Course Schedule (*Refer to Canvas for current schedule, course materials, and all due dates. Schedule and topics are subject to change, and any changes will be communicated by your Instructor*)

- **Module 1: Properties of Polymers**
 - Basic properties of polymers
 - Polymer physics concepts
 - Polymer thermodynamics concepts
- **Module 2: Transport Mechanisms and Models**
 - Fundamentals of small molecule transport and diffusion
 - Historical transport theories
 - Comparison of governing transport mechanisms for different diffusing species
- **Module 3: Structure-Property Relationships in Polymers**
 - Transport in rubbery and glassy polymers
 - Transport in semi-crystalline polymers
 - Multicomponent transport and polymer aging
 - Transport in hydrogels
 - Transport in dry and solvated charged polymers
- **Module 4: Experimental and Analytical Methods**
 - Measuring equilibrium properties
 - Gradient and non-gradient transport analysis
- **Module 5: Current Applications and Case Studies**
 - Non-porous and porous membranes
 - Electrically driven membranes
 - Biological applications
- **Module 6: Current/Emerging Research Trends**
 - Critical comparison of solution diffusion and pore flow theories
 - Nanostructured materials
 - New transport and separation applications

Course Format, Attendance Policy, and Expectations

Attendance is expected, and participation in in-class literature discussions will contribute to students' overall grade. Class recordings will not be provided by the Instructor. Please be punctual to minimize distractions to your fellow students. All required course materials and resources are contained on, or linked to, the course Canvas page. This page serves as the primary means of communication with your classmates and instructors outside of class. You should also enable Canvas to send you e-mail notifications so 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). Any changes to the format of this course will be clearly communicated to you by your instructor.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies:

<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>

This course uses Perusall to facilitate deeper engagement with reading materials and to enable engagement with your peers about course content outside our regularly scheduled class times. Practicing critical thinking through communication and active discussion with your peers about technical topics is an important learning outcome of this course.

Course Assignments

- **Pre-class Readings and Content Checks:** Students will be assigned reading materials (e.g., research articles, book chapters) prior to in-class discussions. To prepare for class participation, they will complete Content Checks on Canvas (e.g., adding comments or discussion posts to reading materials, short quizzes, or similar activities) prior to in-class discussions.
- **In-class Literature Discussions:** Students will be expected to actively participate in in-class discussions, which will contribute a portion of their final grade. Each Tuesday, the class will engage in student-led discussions on one or more seminal works relevant to key topics in this course. Assignment details will be provided on Canvas and discussed in class.
- **Homework Assignments:** A few written assignments will be given throughout the semester to aid practice of key course concepts. All assignments will be submitted through Canvas. Late assignments will not be accepted.
- **Written Concept Paper and Full Proposal:** Throughout the semester, student teams will identify a global engineering challenge and a technical research solution for this challenge that integrates study of mass transfer in polymers. The goals of this project assignment are to learn how to write a compelling team research proposal and to develop scientific communication skills while applying core concepts from this course. Around halfway through the semester, student teams will write a short Concept Paper outlining the challenge and a high-level proposed solution. At the end of the semester, student teams will write a longer Full Proposal that details their proposed plan. These documents will be submitted through Canvas. Peer reviews of other team proposals will contribute to a portion of each student’s grade. Assignment details will be provided on Canvas and discussed in class.
- **End of Semester Proposal Presentation:** At the end of the semester, student teams will deliver a “pitch” on the solution they designed for a global engineering challenge. Participating in in-class peer reviews of other group presentations will contribute a portion to each student’s grade. Assignment details will be provided on Canvas and discussed in class.

Evaluation of Grades

Assignment	Percentage of Final Grade
Pre-class readings and content checks	20%
In-class literature discussions	15%
Written homework assignments	15%
Mid-semester group concept paper	10%
End of semester group written proposal	20%
End of semester group presentation	20%

Grading Policy

Your final letter grade will be based on your average score at the end of the course. Grades may be curved depending on class performance. *The following table is approximate and is subject to modification.*

Average Score	Grade	Grade Points
93.34 – 100	A	4.00
90.00 – 93.33	A-	3.67
86.67 – 89.99	B+	3.33
83.34 – 86.66	B	3.00
80.00 – 83.33	B-	2.67
76.67 – 79.99	C+	2.33
73.34 – 76.66	C	2.00
70.00 – 73.33	C-	1.67
66.67 – 69.99	D+	1.33
63.34 – 66.66	D	1.00
60.00 – 63.33	D-	0.67
0 – 59.99	E	0.00

Regrades: To request a regrade, you must email your Instructor within one week of the day that the assignment is returned to the class as graded. Requests submitted after this deadline will not be honored. In your request, clearly explain the discrepancy and which problem you wish to be regraded. Be aware that there is a possibility your score may decrease after the regrade if additional errors are found.

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

Make-Up Policy

Requests for make-up assignments will be considered only for those students who missed due to an acceptable reason. Excused absences must be consistent with University policies in the undergraduate catalog and require appropriate documentation. Additional information can be found at <https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>. It is required that, whenever possible, the student notifies the instructor about the situation prior to the assignment due date, preferably at least one week in advance.

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, 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.ua.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.ua.ufl.edu/public-results/>.

Public Health Policy

This class will follow University guidelines regarding public health policies. More information about University guidance can be found at <https://wellness.ufl.edu/>. Any changes to this policy will be clearly communicated to you by your instructor.

If you are sick with any potentially contagious illness (such as the flu or COVID), stay home, self-isolate, and do not attend class or in-person office hours until you have recovered. Seek medical attention if needed. Contact your instructor as soon as possible to inform them of which dates you will be absent in order to make up the material or activities covered during your absence in a timely manner.

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.

University Policy on Academic Conduct

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/process/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 varied perspectives and lived experiences within our community and is committed to supporting the University’s core values, including the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information, and veteran status.

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
- HWCOE Human Resources, 352-392-0904, student-support-hr@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: <https://counseling.ufl.edu>, 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 Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.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://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/getting-help/>; <https://distance.ufl.edu/state-authorization-status/#student-complaint>.

Disclaimer

This syllabus represents my current plans and objectives. As we go through the semester, those plans may need to change to enhance the class learning opportunity. Such changes, which will be clearly communicated to you by email or via the course Canvas website, are not unusual and should be expected.