

Course Syllabus for ECH 4905, Spring 2021

- Course Title:** Rheology Fundamentals & Practice
- Content:** Theoretical and practical introduction to the measurement and characterization of fluid deformation and flow properties (i.e. *rheology*).
- Instructor:** Jason E. Butler
Professor of Chemical Engineering
431 Chemical Engineering Bldg. (CHE)
e-mail: butler@che.ufl.edu
Office hours (virtual): Tuesdays 1:00 to 3:00 pm, or by appointment
- Class Meetings:** Monday, Wednesday, and Friday, 10:40 am to 11:30 am
Class lectures will occur synchronously on zoom (links posted online) and a recording of each lecture will be posted after class.
- Textbook:**
- Introduction to Polymer Rheology, by Montgomery T. Shaw available through UF for free at <https://ebookcentral.proquest.com/lib/ufl/detail.action?docID=818512>
 - Additional texts that may be helpful include:
 - Larson, R.G., *The Structure and Rheology of Complex Fluids*, Oxford University Press.
 - Morrison, Faith A., *Understanding Rheology*, Oxford University Press.
- Grading Criteria:** 15% Homework
25% Project
30% Midterm Assessment
30% Final Assessment
- Assessments:**
- Midterm Assessment, *tentatively* Monday March 8th
 - Final Assessment, Thursday April 29th, 12:30 pm - 2:30 pm
- Homework:** Homework should be completed, scanned, and uploaded to elearning prior to the due date. On the due date, solutions will be posted. Please note that you are responsible for checking your own work against the solutions, as not every homework problem will be graded.
- Project:** Report and presentation that reviews the rheology of a class of fluids (i.e. gels, suspensions, etc.). Details on topic selection and the report and presentation requirements will be given later in the class.
- Grading:**
- Partial credit on individual questions will be made on a basis specified by the instructor and will be consistently applied. You should present solutions that are neat and well thought-out to maximize your grade.
 - More information on UF grading policies may be found at: <http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

Teaching Objectives for ECH 4905, Spring 2021

At the completion of this course, students will have a working knowledge of quantitative and qualitative fundamentals of rheology sufficient for reading rheological literature as well as designing and implementing their own rheological studies. Detailed topics will include:

- Introduction and motivation for course of study
 - Rheology applications in industry and academia
 - Fluid deformation and associated material properties
 - Measurement methods
 - Summary of required expertise

- Vector/tensor review
 - Vector and tensor definition
 - Vector/tensor algebra (addition/subtraction, and inner, cross, and dyadic products)
 - Vector/tensor calculus (gradient, divergence, and curl)
 - Gibbs and Einstein notation

- Equations of fluid mechanics (review)
 - Conservation of mass
 - Euler equations (conservation of momentum)
 - Strain and strain rates
 - Constitutive laws: constraints
 - Newtonian fluid and Navier-Stokes equations

- Practical Measurement Strategies
 - Viscometry: capillary flows
 - Shear rheology: shearing flows and torsional flows (cone and plate, Couette, etc.)
 - Extensional rheology: planar and axial

- Material Properties and Example Measurements
 - Steady and unsteady shear measurements and definitions
 - Elongational flow measurements
 - Experimental data for polymers

- Constitutive models
 - Generalized Newtonian fluids
 - Generalized linear viscoelastic fluids

- Presentations on rheology of classes of fluids, including
 - Gels and gelation
 - Brownian and non-Brownian suspensions
 - Active suspensions
 - and more...

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Owing to current circumstances, we will rely heavily on the classroom website and two other resources: zoom and honorlock. Additionally, you will need to scan copies of your written work so that it can be uploaded here to e-learning. Some instructions are given here:

Class Website: The class website can be found by searching for “UF elearning” on google and following the links, or alternatively going directly to <http://elearning.ufl.edu/>. After logging in using your UF credentials, you should be able to identify our class website and navigate to it. The home page of the website includes contact information, zoom meeting IDs for class and office hours, and due dates. Recordings of each class lecture will be posted on the class website, following each class (see link on the website titled “Course Lecture Videos”). Homework assignments and their solutions will be posted in the files link.

Zoom: Classes will be taught over Zoom synchronously (i.e., live), and office hours will be hosted virtually on Zoom. Information on downloading and using Zoom can be found here: <https://elearning.ufl.edu/zoom/>. Links for the classes and office hours are on the first page of the website. During class and at other times, please mute your microphone unless you are speaking. Please feel free to ask questions during class by unmuting your microphone. Also, give me feedback if the videos and/or audio are not clear from my side, and suggestions are always welcome on how to handle the remote lectures better as I am still adjusting to teaching in this manner. The lectures will be recorded and posted as described above.

Honorlock: Proctoring of assessments will be done using Honorlock. A guide is available at <https://warrington.ufl.edu/covid-19/information-for/for-students/honorlock-student-guide/>. In our case, you will take the exam using honorlock, typing your final answer to each question into the computer. Then, you will need to scan and upload your detailed work to elearning, within a few minutes of the exam ending. A practice exam will be posted so that you can confirm that your equipment works correctly and that you understand the procedure.

Online Course Recording: Our class sessions may be recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the “chat” feature, which allows students to type questions and comments live. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

Attendance:

- Students are strongly encouraged to attend all lectures, though attendance is not required.
- Exams/quizzes will be rescheduled only for those students who missed due to an acceptable reason (illness, serious family emergencies, military obligation, religious holidays, and participation in official university activities) as listed in the student catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>).
- Students arriving late for a quiz/exam will be given only the balance of time remaining to complete their work unless an acceptable reason (see above) is provided.

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.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/>.

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.
- No consultation among students is allowed during assessments; only those materials approved by the instructor may be used as a reference during exams and quizzes.

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 student 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/>.

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