

## The Continuum Basis of Chemical Engineering

ECH 6270 All Sections

**Class Periods:** Tuesday 7<sup>h</sup> period (1:55pm-2:45pm) and Thursday 7-8<sup>h</sup> period (1:55pm-3:50pm) EST

**Location:** Online

**Academic Term:** Spring 2021

### **Instructor:**

Name: R. Narayanan

Email: [ranga@ufl.edu](mailto:ranga@ufl.edu) (please include ECH 6270 in your email to receive an answer)

Office Hours: Thursday Friday 10:30-11:30 via the ZOOM room unless indicated otherwise in Announcements.

Office hours will commence from the second week of class.

### **Supervised Teaching Student:**

None

### **Course Description**

(3 credit hours) Integrated introduction to transport processes in continuous media with emphasis on fluid mechanics and heat and mass transfer.

### **Course Pre-Requisites / Co-Requisites**

Undergraduate Courses in Fluid Dynamics, Transport Phenomena, Heat Transfer, Differential Equations, Separation of Variables

### **Course Objectives**

Students will learn a series of transport phenomena modeling methods used widely throughout science and engineering. Emphasis will be on Fluid Dynamics.

### **Materials and Supply Fees**

N/A

### **Required Textbooks and Software**

**Text: Optional:** Analysis of Transport Phenomena by William Deen

I will NOT follow this book for its style for its chapter sequence. Therefore it is NOT assigned. However, the book's problems are good and I will refer to some of the problems, in which case I will make those problems available on CANVAS and only if I refer to them. In any case it's a good reference book to have in general but not needed for the course.

**Videos:** In addition to the class ZOOM lectures, you should view the pre-recorded lectures on mediasite below:

[https://ufedge.video.ufl.edu/Mediasite/Catalog/catalogs/fall2017\\_ech6270](https://ufedge.video.ufl.edu/Mediasite/Catalog/catalogs/fall2017_ech6270)

Logon and use your UFID to view these lectures.

**Notes** (some NOTES will be posted online. However you must be prepared to make your notes of the class lectures. The online notes are from J.S. Vrentas' course on Transport Phenomena. I will follow the sequence given in these notes and will supplement this with class lectures

***This is a graduate course and so you must be prepared to spend a lot of time on it. Some of the material will come from research in the literature. At the end of the course, you should be in a position to read a book on your own and when you need to for your own research or for your reference.***

### **Course Schedule (Approximately corresponds to weekly schedule)**

- 1) Vector and Tensor notation. Summation convention. Manipulations with vectors
- 2) Reynolds Transport Theorem, Derivation of the continuity. Stress vector and tensor. Derivation of the momentum equations. The Jump mass balance.
- 3) Jump momentum balance, Condition for Angular momentum. Problems on Steady Rectilinear flow in Cartesian and cylindrical coordinates.
- 4) Mechanical Energy balance. The Decay constants in a perturbed viscous fluid. Energy method and what we can learn from them.- Eigenvalues
- 5) Creeping flow, Stokes flow, Regular perturbation, Driven cavity
- 6) Ideas on stability of flows.; Static stability, Hydrodynamic stability
- 7) More on stability; Faraday's problem
- 8) Lubrication approximations.- Review and summary
- 9) HEAT: Thermal energy equation, Jump energy balance. Applications-Fluid flow and energy- problems
- 10) Solidification problems; Convection, Benard Problem
- 11) The entropy inequality and making a connection of entropy generation to gradients
- 12) Mass Transfer- Species equations; Jump Species Balance, Problems

#### **Online Course Recording**

Our class sessions may be audio visually 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. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

#### **Attendance Policy, Class Expectations, and Make-Up Policy**

Attendance is voluntary and the ZOOM lectures will be recorded. However all quizzes will be during class times and must be taken during such times. Exam times will be announced on CANVAS if different than those posted below.

You will be assigned Homework problems. These will be posted on CANVAS and will NOT be evaluated. **These problems will typically NOT involve number crunching.** They will usually involve derivations of expressions. The instructor will provide hints and at times solutions to these problems will be provided during the lectures or in special ZOOM recordings. **However, in general we will not always provide solutions. If you have difficulty working out these problems meet the instructor via ZOOM. These problems will be reflected in the exams and quizzes with moderate changes.**

There will be TWO exams and TWO quizzes. There will be NO Final exam. The exams and quizzes will be open notes/books unless otherwise announced. You must have a WEBCAM turned on all the time while the

exams/quizzes take place. No other communication devices such as smart phones will be permitted. TOTAL EXAM POINTS WILL AMOUNT TO 600 POINTS. TOTAL QUIZ POINTS AMOUNT TO 50 POINTS AND ARE BONUS. SO IF YOU MISS A QUIZ YOU JUST MISS THE BONUS FROM THAT QUIZ. MAXIMUM POINTS ARE 600 BUT THEORETICALLY A PERSON COULD SCORE 650 POINTS (IF HE/SHE GETS ALL EXAMS AND ALL QUIZZES CORRECT).

Grades percentage % (NOT drawn on a curve).

Percent of total points	Grade
0-10	E
11-15	D (no D minus grade will be given)
16-20	D+
20-30	C (no C minus grade will be given)
31-40	C+
41-50	B-
51-65	B
66-80	B+
81-90	A-
91-100	A

### **Exam Dates:**

March 4 Thursday Periods 7-8

April 15 Periods Thursday 7-8

Quiz Dates: (will be announced ONLY one week prior to the quizzes- you must be prepared by working out the HW and class work). ALL QUIZZES/EXAMS WILL BE HELD DURING CLASS periods unless announced otherwise.

EXAM MAKEUP POLICY: **NO MAKEUP EXAMS OR QUIZZES WILL BE PERMITTED.**

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

### ***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/>.

### ***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 assistants 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](mailto:rbielling@eng.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/>.

## 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://care.dso.ufl.edu>.

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