MATH 639: Nonlinear Waves

Spring 2020
Schedule Number (unless suppressed)

COURSE INFORMATION

Class Days: MW
Class Times: 14:00-15:15
Class Location: EBA-260
Mode of Delivery: Lecture
Instructor: Chris Curtis

Phone: 619-594-5962
Email: ccurtis@sdsu.edu
Office location: GMCS 591
Office hours: TBD

COURSE MATERIALS

Materials	Required or optional	Where and how it can be obtained
Fluid Mechanics, 5th Edition, Kundu and Cohen	Optional	Library or Online
Python 3.7, Anaconda, Jupyter Notebooks	Required	https://www.anaconda.com/distribution/

STUDENT LEARNING OUTCOMES

- Conservation Laws: We will derive the core conservation laws of fluid mechanics from both an Eularian and Lagrangian perspective. Bernoulli's equation will be derived and basic physical intuition in fluids will be developed through its use to solve fluid flow problems. Scaling will be introduced, and you will rescale the core conservation equations in several different regimes and explore the impact of non-dimensional parameters.

- Vorticity: The impact of vorticity on flows will be determined through the use of point-vortex approximations. Connections with differential equations will be derived as well as core theoretical results such as Kelvin and Helmholtz's Theorems. The definitions of baroclinic and barotropic fluids will also be introduced.

- Potential Theory: The use of analytic function theory to determine invisicid, incompressible, irrotational flows will be presented in several different geometries. The formulas for finding drag and lift on a body will be derived and used to compute profiles for a given body.

- Fourier Analysis for PDE's: We will solve linear PDE's using Fourier Series/Transforms. The concepts of group and phase velocity and dispersion will be explored and used to show how energy is distributed a dispersive PDE.

- Free Boundary Value Problems: Techniques for succinctly deriving evolution equations in the context of oceanic-free surface flows will be developed. This will make use of core results in vector calculus, such as the Divergence Theorem.

- Multiple Scales Analysis: The use of multiple scale ansatzes to reduce complex nonlinear models to simpler ones over smaller scales will be developed and used to solve several problems in fluids.

- Deriving nonlinear wave equations: The Korteweg de-Vries and Nonlinear Schroedinger equations will be derived. Solutions will be derived and their properties and implications for oceanic flows will be examined.

COURSE DESIGN

- The course consists of four-five homework assignments and a final project.

GRADING POLICIES

Your final score will consist of homework (50%), and a final project (50%). Homework is due every two weeks. The project consists of three pieces: a proposal (15%), presentation (15%), and a final paper (20%). Guidelines for the project are formalized in a separate document which can be found on the Blackboard Course page.

SCHEDULE

- Due dates for major assignments and exams, including time and date of final exam from University finals schedule.

UNIVERSITY POLICIES

Accommodations: If you are a student with a disability and are in need of accommodations for this class, please contact Student Ability Success Center at (619) 594-6473 as soon as possible. Please know accommodations are not retroactive, and I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Ability Success Center.

Student Privacy and Intellectual Property: The Family Educational Rights and Privacy Act (FERPA) mandates the protection of student information, including contact information, grades, and graded assignments. I will not post grades or leave graded assignments in public places. Students will be notified at the time of an assignment if copies of student work will be retained beyond the end of the semester or used as examples for future students or the wider public. Students maintain intellectual property rights to work products they create as part of this course unless they are formally notified otherwise.

Religious observances: According to the University Policy File, students should notify the instructors of affected courses of planned absences for religious observances by the end of the second week of classes.

Medical-related absences: Students are instructed to contact their professor/instructor/coach in the event they need to miss class, etc. due to an illness, injury or emergency. All decisions about the impact of an absence, as well as any arrangements for making up work, rest with the instructors. Student Health Services (SHS) does not provide medical excuses for short-term absences due to illness or injury. When a medical-related absence persists beyond five days, SHS will work with students to provide appropriate documentation. When a student is hospitalized or has a serious, ongoing illness or injury, SHS will, at the student's request and with the student's consent, communicate with the student's instructors via the Vice President for Student Affairs and may communicate with the student's Assistant Dean and/or the Student Ability Success Center.

SDSU Economic Crisis Response Team: If you or a friend are experiencing food or housing insecurity, or any unforeseen financial crisis, visit sdsu.edu/ecrt, email ecrt@sdsu.edu, or walk-in to Well-being & Health Promotion on the 3rd floor of Calpulli Center.

Resources for students: A complete list of all academic support services--including the Writing Center and Math Learning Center--is available on the Student Affairs' Academic Success website. Counseling and Psychological Services (619-594-5220) offers confidential counseling services by licensed therapists; you can Live Chat with a counselor at http://go.sdsu.edu/student_affairs/cps/therapist-consultation.aspx between 4:00pm and 10:00pm, or call San Diego Access and Crisis 24-hour Hotline at (888) 724-7240.

Academic Honesty: The University adheres to a strict policy prohibiting cheating and plagiarism. Examples of academic dishonesty include but are not limited to:

- copying, in part or in whole, from another's test or other examination;

- obtaining copies of a test, an examination, or other course material without the permission of the instructor;
- collaborating with another or others in work to be presented without the permission of the instructor;
- falsifying records, laboratory work, or other course data;
- submitting work previously presented in another course, if contrary to the rules of the course;
- altering or interfering with grading procedures;
- assisting another student in any of the above;
- using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work);
- copying and pasting work from an online or offline source directly and calling it your own;
- using information you find from an online or offline source without giving the author credit;
- replacing words or phrases from another source and inserting your own words or phrases.

The California State University system requires instructors to report all instances of academic misconduct to the Center for Student Rights and Responsibilities. Academic dishonesty will result in disciplinary review by the University and may lead to probation, suspension, or expulsion. Instructors may also, at their discretion, penalize student grades on any assignment or assessment discovered to have been produced in an academically dishonest manner.

Classroom Conduct Standards: SDSU students are expected to abide by the terms of the Student Conduct Code in classrooms and other instructional settings. Prohibited conduct includes:

- Willful, material and substantial disruption or obstruction of a University-related activity, or any on-campus activity.
- Participating in an activity that substantially and materially disrupts the normal operations of the University, or infringes on the rights of members of the University community.
- Unauthorized recording, dissemination, or publication (including on websites or social media) of lectures or other course materials.
- Conduct that threatens or endangers the health or safety of any person within or related to the University community, including
    1. physical abuse, threats, intimidation, or harassment.
    2. sexual misconduct.

Violation of these standards will result in referral to appropriate campus authorities.