Fluid Dynamics I - Math 6750/6880
Fall 2019

Lectures: TTH 12:25pm-1:45pm
Instructor: Christel Hohenegger
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Course Webpage: http://www.math.utah.edu/~choheneg/fluids
Office Hours: TBD or by appointment

Description: This course is a one semester introduction to the mathematical description and solution techniques of the equations governing the motion for “simple” fluids like water. The dynamics of simple fluids are described by the Navier-Stokes equations which were derived in the 19th century and are based on a linear relationship between stress and the fluid’s rate of strain. The Navier-Stokes equations have proved extremely useful for understanding and predicting the behavior of fluids such as water or air, which consist of large ensembles of small molecules, over a wide range of conditions and in many technologically important applications.

Topics covered:

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<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Fluids, Units, Kinematics, Coords, Tensors</td>
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<tr>
<td>2</td>
<td>Reynolds Transport Thm, Conservation of mass, Stresses, Fluid statics</td>
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<td>3</td>
<td>Conservation of linear and angular momentum, Conservation of energy</td>
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<td>4</td>
<td>Constitutive equations, Newtonian stress tensor, Fluid decomposition,</td>
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<td>5</td>
<td>Boundary conditions, Navier-Stokes, Surface tension, Vorticity equations</td>
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<td>6</td>
<td>Unidirectional flow, Bernoulli’s equations</td>
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<td>7</td>
<td>Irrotational and incompressible flows</td>
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<td>8</td>
<td>Irrotational and incompressible flows</td>
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<td>9</td>
<td>Open channel flows, waves</td>
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<td>10</td>
<td>Open channel flows, waves</td>
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<td>11</td>
<td>Boundary layers, Perturbation</td>
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<td>12</td>
<td>Boundary layers, Instabilities</td>
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<td>13</td>
<td>Lubrication theory</td>
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<td>14</td>
<td>Stokes flow, Singularity solutions</td>
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<td>14</td>
<td>Stokes flow, Taylor swimming sheet</td>
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<td>15</td>
<td>Stokes flow, Scallop theorem</td>
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Prerequisites: “C” or better in partial differential equations (MATH 5440 or MATH 6420). The course is intended both for students who have no prior experience with fluid dynamics and for students who have had an introductory course in fluid dynamics but little experience with theoretical aspects. No advanced knowledge of numerical methods for fluid dynamics is required.

Texts:
Lecture notes will be provided and posted online. The following free ebook is recommended:

Additional suggested books are


**Homework:** There will be 4 homework sets. Late homework will only be accepted under exceptional circumstances. Collaboration is allowed, however students are required to turn in their own solutions. Only handwritten or typed and stapled homework will be accepted (no digital copies). Not all problems might be graded for correctness.

**Final Exam:** There will be no final exam.

**Grading:** Grades are determined according to class participation and homework score.

**Technologies:** Students should refrain from using cell phones, tablets and laptops to check emails or social media accounts, to chat with friends, to play games, or to surf the web. Students are welcome to use technologies to take notes.

**The Americans with Disabilities Act:** The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If students will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 801-581-5020. CDS will work with the student and us to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

**Honor Code:** All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. You have specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, collusion, fraud, theft, etc. Students should read the Code carefully and know you are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

[http://regulations.utah.edu/academics/6-400.php](http://regulations.utah.edu/academics/6-400.php)
**Campus Safety:** The University of Utah values the safety of all campus community members. To report suspicious activity, call campus police at 801-585-COPS (801-585-2677). Students will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

**Addressing Sexual Misconduct:** Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If anyone has been harassed or assaulted, students are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

**Wellness Statement:** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness at www.wellness.utah.edu or 801-581-7776.

**Classroom Social Equity:** We will be using the name and pronoun that feels best for each student. Please advise us of any name or pronoun changes (and update CIS) so we can help create a positive and respectful learning environment. We strive to be ethical, kind, fair, inclusive and respectful in the classroom and expect students to behave likewise. In this regard, we request that:

- If a student has any sort of anxiety disorder, TBI, PTSD, C-PTSD, or any other challenge that might cause being called out in class or working in groups psychological harm, then please do tell us, discreetly. We will confidentially accommodate any such request.
- If a student’s preferred name is different than the student’s legal first name, please log into Canvas and go to Account (on far left)- Settings and change your Display Name to be the name you prefer to be addressed by.
- If there is ever a time that a student feels this course or the curriculum is not equitable, please email me or meet with me to discuss such concerns.

If you need any assistance or support, please reach out to the LGBT Resource Center at https://lgbt.utah.edu/campus/faculty_resources.php

**Diversity Statement:** It is our intent that students from all diverse backgrounds and perspectives be well served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is our intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Suggestions are encouraged and appreciated. Please let us know ways to improve the effectiveness of the course.
I reserve the right to change the policies stated in this syllabus at some point in the semester. If I do make a change to a policy, I will announce it in class and send the change in email or post an Announcement on Canvas.

Important Dates:

- Class begins ......................................................... August 19
- Labor Day Holiday ................................................... September 2
- Fall Break .............................................................. October 6-13
- Thanksgiving Break .............................................. November 21-24
- Class ends ............................................................. December 5