

**Class Lectures:** T/R 2 – 3:20 PM (Remote)  
**Discussion Sections:** M 1-2:15 PM (Discussion)  
F 10-11:15 AM (Discussion)

**Instructor:** Assistant Professor Lingyan Shi ([Lingyanshi@ucsd.edu](mailto:Lingyanshi@ucsd.edu))  
Jacob Hall 5408

**Office Hours:** Thu 4-5PM Jacob Hall 5408

**Recommended Text:** White, *Fluid Mechanics* (7<sup>th</sup> Ed.), McGraw-Hill, 2010  
Boal, *Mechanics of the Cell* (2<sup>nd</sup> Ed.), Cambridge Univ. Press, 2012  
Fung, *Biomechanics, Circulation*, Springer Verlag, 1997  
Jay D. Humphrey, Sherry L. O'Rourke (auth.) - *An Introduction to Biomechanics\_ Solids and Fluids, Analysis and Design*-Springer-Verlag New York (2015)

### Course Objectives

To learn in depth, the application of mechanics over a variety of length scales, from mammalian blood vessels to the cells that make up these structures to the bio-viscoelastic, non-Newtonian fluids that flow through them. We will investigate the properties of cells and fluids, analyze the mechanical underpinnings of disease, and study the design of interventions and assist devices.

### Homework

The homework assignments are a very important part of the course and consist of reviews, selected readings that supplement the class material, and problems for grading. Problems assigned for grading consist of two parts, analysis and design. Solution of the design problems is a basic requirement for passing the course. Solutions to the homework set will be presented in the exercise sessions *but will not be posted online*. The homework assignments are due on the **dates and times** indicated on each assignment. No late submissions can be accepted.

### Acknowledgement

You are encouraged to discuss the homework problems with other students (not copy), the Teaching Assistants, and Prof. Shi. But you are expected to write down the solutions to the homework problems entirely by yourself. Therefore, only **hand written** homework sets will be accepted (unless indicated). Any assistance you received for homework solution needs to be listed in the Acknowledgement at the end of each solution set. Failure to do so is considered plagiarism and no points will be awarded. Subsequent violations will be referred to the Dean.

### Course Evaluation

Grading will consist of 1) approximately 6 homework sets counting for 40%, 2) three exams counting for 60% (20% each) of your grade (handed out in week 7). All exams are closed book with one 8.5" x 11" formula page that you make yourself. It must be **hand written** and turned in with your exam.

### Re-grading Policy

All regrade requests must be in writing, explaining the issue in grading, and must be turned in to Prof. Shi and the TAs within 1 week of the assignment's return to the class after grading. Aside from re-grades for clerical errors (i.e error in adding up total points), the entire exam or homework will be re-graded.

BE 112B Fluid and Cell Biomechanics S2021

Date*	Topic	Book (Chpt)	Homework
3/29	Welcome to class. Fluids: Pressure	White (2)	
3/30	Fluids: Pressure Distributions	White (2)	
4/1	Fluids: Control Volumes, Transport	White (2)	
4/5	discussion		
4/6	Fluids: Conservation Laws: Mass	White (3)	HW 1 due
4/8	Fluids: Conservation Laws: Momentum	White (3)	
4/12	discussion		
4/13	Fluids: Bernoulli Eq'ns and Material Derivative	White (3-4)	HW 2 due
4/15	Fluids: Navier-Stokes Derivation	White (4)	
4/19	discussion, pre-exam problem examples		
4/20	Fluids: N-S Examples, dimensionless	White (4)	
4/22	Fluids: Pipe Flow, Plug Flow, and Blood	White (6)	
4/26	discussion,		
4/27	<b>Exam 1: Fluids</b>		HW 3 due
4/29	Fluids: Boundary Layers	White (7)	
5/3	discussion		
5/4	Fluids: Dimensionless Navier-Stokes	White (7)	HW4 due
5/6	Fluids: Stokes Flow	White (7)	
5/10	discussion		
5/11	Fluids: Vessels and Starling's Equation,	Fung (5)	HW 5 due
5/13	polymer, elasticity		
5/17	discussion pre-exam problem examples		
5/18	Cells: Protein Unfolding	Boal (3)	HW 6 due
5/20	<b>Exam 2: Fluids</b>		
5/24	discussion		
5/25	Cells: Cytoskeleton and its Organization	Boal (7-10)	
5/27	Cells: Mechanotransduction	Boal (7-10)	
5/31	<b>No Class: Memorial Day</b>		
6/1	Cells: Membranes	Boal (5)	HW 7 due
6/3	Cells: Law of LaPlace, Membrane Bending (Fung 4)		
6/8	<b>Exam 3: Cells**</b>		

**\*Note that:**

**Tuesday/Thursday classes are 2:00-3:20PM**

**Monday Discussions are 1:00-2:15PM. Friday 10:00-11:15AM**

**\*\*Final Exam: June 8th, 3PM-5:59PM, Location: Zoom**

### **Netiquette**

To minimize background noise and promote clear communications:

1. Use headphones to tune into audio.
2. Keep your microphone on MUTE until you need to ask a question. Then return your microphone to MUTE.

In an online classroom, another major method of communication is written. The written language has many advantages: more opportunity for reasoned thought, more ability to go in-depth, and more time to think through an issue before posting a comment or sending an email. However, written communication also has certain disadvantages, such as lack of the face-to-face signaling that occurs through body language, intonation, pausing, facial expressions, and gestures. As a result, please be aware of the possibility of miscommunication and compose your comments/emails in a professional, respectful, and constructive manner.

### **Integrity of Scholarship**

The Department of Bioengineering adheres to the UCSD Policy on Integrity of Scholarship. This Policy states that "Students are expected to complete the course in compliance with the instructor's standards. No student shall engage in any activity that involves attempting to receive a grade by means other than honest effort ...". The full descriptions of these policies, as well as others regarding acceptable behavior are given in the Student Code of Conduct at <http://students.ucsd.edu/student-life/organizations/student-conduct/regulations/22.00.html>. The regulations on exams, grading and integrity of scholarship are also in the General Catalog at <http://www.ucsd.edu/catalog/front/AcadRegu.html>. Helpful resources on understanding and complying with these regulations can be found at: <http://students.ucsd.edu/academics/academic-integrity/index.html>

Students are not discouraged from discussing homework assignments among themselves or engaging in group study. However, **individual homework assignments must be the sole work of the submitting student**. Specific guidance will be given in the case of group projects. When submitted coursework incorporates material authored by a third party, the source should always be attributed according to the accepted standards of scholarly endeavor. Material taken from the internet or other forms of electronic media are subject to the same requirements of attribution applicable to printed reference sources or materials. Work suspected of being tainted by plagiarism will receive no credit. **All cases of suspected academic dishonesty** including *collaboration*, *plagiarism* and *cheating* as defined by UCSD regulations **will be referred to the UCSD Academic Integrity Coordinator**.

In cases of suspected academic dishonesty including cheating in an examination or altering graded work and resubmitting it, the student will be handed a copy of the student conduct code, and the case will be referred to the appropriate dean. The academic penalty for serious academic dishonesty will generally be a grade of F.

## Computing

Computer and network access will be needed for some assignments in this course. All UCSD engineering students are eligible for computer accounts through Academic Computing Services. You can see what kind of account you have on-line using the Account Lookup Tool at <https://sdacs.ucsd.edu/~icc/index.php>.

For assistance with UCSD instructional computing facilities, do not come to the instructor or TAs as they are not managed by departmental personnel. You can email questions to [acs-consult@ucsd.edu](mailto:acs-consult@ucsd.edu).

## ACADEMIC SUPPORT

<a href="#">Geisel Library</a>	Research tools and eReserves
<a href="#">Content Tutoring with the Teaching + Learning Commons</a>	Drop-in and online tutoring through the Academic Achievement Hub
<a href="#">Supplemental Instruction with the Teaching + Learning Commons</a>	Peer-assisted study sessions through the Academic Achievement Hub to improve success in historically challenging courses
<a href="#">Writing Hub Services in the Teaching + Learning Commons</a>	Improve writing skills and connect with a peer writing mentor
<a href="#">Learning Strategies Tutoring</a>	Address learning challenges with a metacognitive approach
<a href="#">OASIS</a>	Intellectual and personal development support
<a href="#">Student Success Coaching Program</a>	Peer mentor program that provides students with information, resources, and support in meeting their goals
<a href="#">Academic Integrity</a>	Policy on Academic Integrity of Scholarship and strategies to excel with integrity
<a href="#">Technical Support</a>	Assistance with accounts, network, and technical issues

## STUDENT RESOURCES

UC San Diego (as an institution) and I (as a human being and instructor of this course) are committed to full inclusion in education for all persons. Services and reasonable accommodations are available to students with temporary and permanent disabilities, to students with DACA or undocumented status, to students with health or other personal concerns, and to students with other kinds of support needs. Please feel free to let me know if there are circumstances affecting your ability to participate in class. Some resources that might be of use include:

<a href="#">Basic Needs</a>	Provides access to food, housing, and financial resources
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<u>Counseling and Psychological Services (CAPS)</u>	Provides services like confidential counseling and consultations for psychiatric services and mental health programming
<u>Community Centers</u>	As part of the <u>Office of Equity, Diversity, and Inclusion</u> the campus community centers provide programs and resources for students and contribute toward the evolution of a socially just campus
<u>Counseling and Psychological Services</u>	Individual, group, couples, and family psychotherapy services for registered undergraduate and graduate students
<u>Office for Students with Disabilities</u>	Documents student disabilities, provides accessibility resources, and reasonable accommodations
<u>Triton Concern Line</u>	Report students of concern at (858) 246-1111
<u>Undocumented Student Services</u>	Programs and services are designed to help students overcome obstacles that arise from their immigration status and support them through personal and academic excellence

## **CAMPUS POLICIES**

### **UC San Diego Principles of Community**

The University of California, San Diego is dedicated to learning, teaching, and serving society through education, research, and public service. Our international reputation for excellence is due in large part to the cooperative and entrepreneurial nature of the UC San Diego community. UC San Diego faculty, staff, and students are encouraged to be creative and are rewarded for individual as well as collaborative achievements.

To foster the best possible working and learning environment, UC San Diego strives to maintain a climate of fairness, cooperation, and professionalism. These principles of community are vital to the success of the University and the well being of its constituents. UC San Diego faculty, staff, and students are expected to practice these basic principles as individuals and in groups.

[Click here for the complete UC San Diego Principles of Community in English and Spanish.](#)

### **Nondiscrimination and Harassment Policy Statement**

The University of California, in accordance with applicable federal and state laws and university policies, does not discriminate on the basis of race, color, national origin, religion, sex, gender, gender identity, gender expression, pregnancy, physical or mental disability, medical condition, genetic information, ancestry, marital status, age, sexual orientation, citizenship, or service in the uniformed services. The university also prohibits harassment based on these protected categories, including sexual harassment, as well as sexual assault,

domestic violence, dating violence, and stalking. The nondiscrimination policy covers admission, access, and treatment in university programs and activities.

If you have questions about student-related nondiscrimination policies or concerns about possible discrimination or harassment, they should contact the Office for the Prevention of Harassment & Discrimination (OPHD) at (858) 5348298, [ophd@ucsd.edu](mailto:ophd@ucsd.edu), or [reportbias.ucsd.edu](http://reportbias.ucsd.edu).