BME 343-A Transport in Biological Systems (Spring 2023)

Meeting Times:	Wednesday 12:00 – 1:50 pm & Friday 12:00 – 12:50 pm
Classroom Location:	McLean 114
Instructor:	Prof. Jinho Kim
Contact Info:	Office: McLean 302, Email: jkim6@stevens.edu, Phone: 201-216-5518
Office Hours:	Thursday 12:00 pm – 2:00 pm (or by appointment)
Prerequisite(s):	MA 227 Multivariable Calculus
Corequisite(s):	BME 306 Introduction to Biomedical Engineering
Cross-listed with:	None
Teaching Assistant:	Erfan Sarhaadei (esarhaad@stevens.edu)

COURSE MATERIALS

Textbooks: There is no required textbook for this course. Lecture notes will be provided on Canvas after each class.

Suggested readings:

- "Introduction to Fluid Mechanics" by Nakayama and Boucher (Available through Stevens library) http://app.knovel.com/web/toc.v/cid:kpIFM00001/viewerType:toc/?kpromoter=legacy
  *You would need to be on the Stevens network or connected by VPN to access this text.
- "Fundamentals of Fluid Mechanics" by Munson, Young, Okiishi, and Huebsch
- "Transport Phenomena in Biological Systems" by Truskey, Yuan, and Katz

COURSE DESCRIPTION

This course is an **introduction to transport phenomena in biological systems**. The objective of this course is to gain knowledge of the **basic principles of a variety of biological transport phenomena**. Accordingly, the course will cover **conservation relations in fluid transport** with an emphasis on conservation of mass at the tissue and cellular levels. Specifically, topics include hydrostatic pressure, convective flow, surface tension, and mass transport. Emphases will be given with regard to **fundamental fluid mechanics principles**, **quantitative approaches**, as well as **applications of these principles and techniques to biological systems**.

STUDENT LEARNING OUTCOMES

In this course, students will understand biotransport principles and mastering of the basic quantitative approaches in analyzing biotransport problems. Three critical objectives of this course are:

1) To be able to mathematically define and describe general biotransport problems including derivation of the governing equations and defining the appropriate boundary/initial conditions
2) To be able to solve a variety of basic fluid mechanics and biotransport problems
3) To be able to apply mass transport models and approaches to biomedical problems and to interpret the solutions/results

***Disclaimer:** This course syllabus may be subject to change at the instructor's discretion. Any changes will be discussed in class and/or posted on Canvas.

COURSE SCHEDULE

The following is a tentative course schedule and any changes to this schedule will be announced in the class and notified via emails:

Lecture#	Date	Lecture topic(s)	Notes
1	Jan 18	Course introduction	
2	Jan 20	Intro to biotransport	
3	Jan 25	Characteristics of fluids	
4	Jan 27	Fluid statics	
5	Feb 01	Fluid statics	Presentation group formation
6	Feb 03	Fluid statics	Assignment: HW#1
7	Feb 08	Bernoulli equation	
8	Feb 10	Bernoulli equation	
9	Feb 15	Fluid kinetics	Due: HW#1, Assignment: HW#2
10	Feb 17	Fluid kinetics	
11	Feb 22	**No class**	Monday class schedule
12	Feb 24	Reynold Transport Theorem	Due: HW#2, Assignment: HW#3
13	Mar 01	Continuity equation	
14	Mar 03	Continuity equation	Due: HW#3
15	Mar 08	**Midterm exam**	
16	Mar 10	Invited speaker presentation	
17	Mar 15	**Spring recess**	No class
18	Mar 17	**Spring recess**	No class
19	Mar 22	Equations of fluid motion	Assignment: HW#4
20	Mar 24	Equations of fluid motion	
21	Mar 29	Surface tension	Due: Papers to present
22	Mar 31	Surface tension	Due: HW#4, Assignment: HW#5
23	Apr 05	Pipe flow	
24	Apr 07	**Good Friday**	No class
25	Apr 12	Diffusion	
26	Apr 14	Diffusion	
27	Apr 19	Diffusion	Due: HW#5
28	Apr 21	Microfluidics	
29	Apr 26	Microfluidics	
30	Apr 28	Paper presentation	Due: PPT slides before the class
31	May 03	Paper presentation	Due: PPT slides before the class
32	May 05-16	**Final exam week**	Due: Paper summary report

GRADING PROCEDURES

Grades will be based on:

- Attendance and participation (**5%**)
- Homework (**20%**): collected at the beginning of the class, not be accepted after solutions are posted.
- Paper presentation (**15%**): See the handout.
- Midterm exam (**30%**)
- Final exam (**30%**): comprehensive but will be weighted toward new materials learned after midterm.

*To obtain the final grade of the course, ***all of the above components are required***, including attendance and paper presentation.

Grading Scale

Letter grade	Final score
A	94-100%
A-	90-94%
B+	87-90%
B	84-87%
B-	80-84%
C+	77-80%
C	74-77%
C-	70-74%
D+	67-70%
D	64-67%
D-	61-64%
F	0-61%

ACADEMIC INTEGRITY

Undergraduate Honor System

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"*I pledge my honor that I have abided by the Stevens Honor System*."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

Graduate Student Code of Academic Integrity

All Stevens graduate students promise to be fully truthful and avoid dishonesty, fraud, misrepresentation, and deceit of any type in relation to their academic work. A student's submission of work for academic credit indicates that the work is the student's own. All outside assistance must be

acknowledged. Any student who violates this code or who knowingly assists another student in violating this code shall be subject to discipline.

All graduate students are bound to the Graduate Student Code of Academic Integrity by enrollment in graduate coursework at Stevens. It is the responsibility of each graduate student to understand and adhere to the Graduate Student Code of Academic Integrity. More information including types of violations, the process for handling perceived violations, and types of sanctions can be found at www.stevens.edu/provost/graduate-academics.

Special Provisions for Undergraduate Students in 500-level Courses
The general provisions of the Stevens Honor System do not apply fully to graduate courses, 500 level or otherwise. Any student who wishes to report an undergraduate for a violation in a 500-level course shall submit the report to the Honor Board following the protocol for undergraduate courses, and an investigation will be conducted following the same process for an appeal on false accusation described in Section 8.04 of the Bylaws of the Honor System. Any student who wishes to report a graduate student may submit the report to the Dean of Graduate Academics or to the Honor Board, who will refer the report to the Dean. The Honor Board Chairman will give the Dean of Graduate Academics weekly updates on the progress of any casework relating to 500-level courses. For more information about the scope, penalties, and procedures pertaining to undergraduate students in 500-level courses, see Section 9 of the Bylaws of the Honor System document, located on the Honor Board website.

EXAM ROOM CONDITIONS

The following procedures apply to quizzes and exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Room Conditions on the quiz or exam.

1. Students may use the following devices during quizzes and/or exams. Any electronic devices that are not mentioned in the list below are not permitted.

Device	**Permitted?**	
	Yes	No
Laptops		X
Cell Phones		X
Tablets		X
Smart Watches		X
Google Glass		X

2. Students may use the following materials during quizzes and/or exams. Any materials that are not mentioned in the list below are not permitted.

Material	**Permitted?**	
	Yes	No
Handwritten Notes (maximum: 1 sheet)	X	
Typed Notes		X
Textbooks		X
Readings		X

3. Students are not allowed to work with or talk to other students during quizzes and/or exams.

LEARNING ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students. These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.

Disability Services Confidentiality Policy

Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone (201) 216-3748.

INCLUSIVITY

Name and Pronoun Usage

As this course includes group work and in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement

Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.

You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression). Appointments are strongly encouraged and can be made by phone (201-216-5177) or in-person (on the 7th floor of the Howe Center). CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. Other 24/7 resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is *not* urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.