



**BMEN 5319 Vascular Dynamics BMEN  
4319 Vascular Flows Department of  
Biomedical Engineering University of  
North Texas  
Spring 2026**

<b>Instructor:</b>	Dr. Fateme Esmailie, <a href="mailto:fateme.esmailie@unt.edu">fateme.esmailie@unt.edu</a>
<b>Class TA:</b>	Victoria Gnenema, <a href="mailto:ComeninGnenema@my.unt.edu">ComeninGnenema@my.unt.edu</a>
<b>Office:</b>	K240A
<b>Class Time:</b>	Friday 12:00 pm-1:50 pm
<b>Class Location:</b>	NTDP B192
<b>Laboratory:</b>	NTDP E225B
<b>Laboratory Sessions:</b>	We 2:30-5:20 pm, or Fr 9:00 am -11:50 am
<b>Instructor Office Hours:</b>	Fridays 2-2:50 pm/ or by appointment via email
<b>TA Office Hours:</b>	TBA

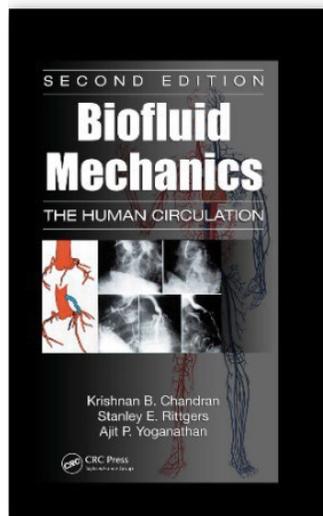
**Recommended Prerequisite:** Computational Methods in Biomedical Engineering or Biomedical Modeling, Linear Algebra, Calculus I & II, Basic knowledge of coding in MATLAB

**Description:** Blood flow is essential for normal body function. Heart operates as a pump and drives the blood flow within our vascular system. Understanding the blood flow in the human body provides valuable insights into human physiology and the interdependence of various organ systems. Cardiovascular diseases disrupt normal blood flow in the human body, affecting many essential processes and organs. In this course, we will learn about the nature of blood and regulation of blood flow in normal and diseased situations using fundamental principles, including physiology, engineering, analytical and computational models, mechanistic approaches, and clinical viewpoints. We will also discuss state-of-the-art therapeutic techniques and medical devices currently used by clinicians for detecting and treating cardiovascular diseases.

**Major Topics:**

- Introduction to cardiovascular physiology
- Introduction to fluid and solid mechanics
- Blood rheology
- Models of blood flow and arterial wall dynamics
- Blood flow mechanics and arterial disease
- Mechanical devices
- Fluid mechanics of cardiovascular implants
- Blood measurements in the cardiovascular system
- Computational Fluid Dynamics (CFD) of blood flow

**Textbook:** *Biofluid Mechanics: The Human Circulation* by Krishnan Chandran, Stanley Rittgers Ajit Yoganathan, 2<sup>nd</sup> edition, CRC Press, 2012 - **The pdf file of the book is available on UNT library. You can download it for free.**



Class notes will also be an important source of material for this class, in addition to reading material uploaded on canvas.

**Reference:**        *Hemodynamics* by Milnor  
                          *Rheology of the Circulation* by Whitmore  
                          *Fluid Mechanics* by FM White

**Course Objectives:**

At the completion of this course, students will be able to:

- Describe the structure and physiology of the human heart
- Apply fundamentals of fluid dynamics to explain the blood flow in arteries and veins
- List the various types of fluids based on their physical properties
- Explain the material behavior of blood vessels
- Assess the hemodynamics of native and prosthetic heart valves
- Memorize the vascular therapeutic techniques
- Apply and compare fluid dynamic measurement techniques
- Explain the steps of computational fluid dynamic analysis of the human circulation

**ABET Criteria:**

- Apply knowledge of mathematics, engineering, and science
- Identify, formulate, and solve engineering problems
- Use techniques, skills, and computer-based tools for conducting experiments and carrying out designs

**Class Policies:**

- Laptop computers may only be used to take notes. The use of cell phones is strictly prohibited in the classroom.
- All work submitted for grading should represent your individual effort. Since engineering is a group activity, students are highly encouraged to help each other to learn the course material and to discuss the homework assignments. However, all homework submitted must be each student's personal work. Students submitting work showing evidence of copying will receive zero credit.
- Submitting work copied from others will be considered academic misconduct. Plagiarism of ideas or work, as well as giving or receiving unauthorized information on examinations, will be considered academic misconduct. All academic misconduct will be dealt with severely and may result in a course grade of F.

- During the lectures, students are expected and encouraged to ask questions and participate in discussions. However, it may happen that some individuals have different points of view. While such an interactive and animated environment is usually beneficial from a learning standpoint, any disrespectful behavior toward the instructor or a classmate will not be tolerated. Any student showing such disrespectful behavior will be asked to leave the classroom.

**Class Lectures Attendance:**

- Class lecture attendance is mandatory.
- If you have a university athletic or academic activity or a business engagement, please contact the instructor before you leave to determine appropriate accommodations for the absence.
- If you are absent for any other reason, please contact your classmates for any pertinent material. Do not see the instructor for notes and handouts.

**Lab Attendance:**

- **You MUST attend the lab sessions.**
- If you have a University athletic or academic activity or a business engagement, please contact the instructor before you leave to determine appropriate accommodations for the absence. The lab sessions cannot be repeated; however, you may ask questions or participate in an earlier lab session.
- If you are absent for any other reason that doesn't fall under one of the valid excuses listed in UNT Policies, you will miss the attendance point for the session.

**Evaluation:** Homework and laboratory reports will be assigned during the semester. You will not have more than one assignment, or one lab report due in the same week. There will be two exams during the semester. The grading policy will be as follows:

	Weight
Assignments (including paper presentation for 5319)	10 %
Lab and lecture participation (Attendance)	15%
Exam Midterm Exam	30%
Exam Final Exam	30%
Laboratory reports	15%

Grading scale:	
A	90-100%
B	80-89.999%
C	70-79.999%
D	60-69.999%
F	< 60%

**Assignments and Lab Reports Policies:**

- All assignment sets should be scanned (use a smartphone app or a dedicated printer/copier/scanner) and uploaded to Canvas before the due date of assignment.
- The submission deadline will be indicated on CANVAS. It is feasible to complete them during the lab time. Lab reports and assignments deadlines will not be in the same week. Each week you will have maximum one deadline.
- Assignments and lab reports must be turned in by the time indicated on CANVAS on the assignment's due date to avoid a zero for the assignment. **NO LATE SUBMISSION IS ACCEPTED**, even if it is a millennium of a second or if it is because of any technical issues. Please submit the assignments in advance to avoid losing any points.
- Unofficial test and homework scores will be listed on the course Canvas site. It is the student's responsibility

to check that scores have been properly recorded.

- e) Requests for reviewing any graded work must be made by submitting a detailed request through Canvas within one week of the grade being posted. **Each student may only submit one regrade request per assignment, lab report, and exam.**
- f) TA grades the lab reports and assignments based on the rubric provided by Dr. Esmailie. TA's decision is fully supported and accepted by Dr. Esmailie. CANVAS is the only method of requesting a regrade. Dr. Esmailie will not respond to any email, canvas message, or in-person request related to an assignment or lab report regrade request.
- g) A regrade request after the regrade deadline, after the final exam, or more than one regrade request for the same assignment or lab report will not be processed under any circumstances.

**Exams:** Two exams are scheduled for this course. Exams are scheduled for the following dates and times:

<b>Exam</b>	<b>Date</b>	<b>Time</b>
Midterm Exam	Friday March 6 <sup>th</sup> 2026	12:00 pm – 1:50 pm
Final Exam	Saturday May 2 <sup>nd</sup> 2026	10:00 am- 12:00 pm

- a) NO late or early exam request will be accepted unless it falls under one of the excuse categories included in UNT [06.039 Student Attendance and Authorized Absences](#) Policy.
- b) If you have a valid excuse to change the exam time and date, you **MUST** communicate your reasons with Dr. Esmailie before January 31<sup>st</sup> 2026 (by 5 pm CST).
- c) Requests for reviewing graded Midterm Exam should be made by submitting a detailed request within one week of the exam grade being posted.
- d) Requests for reviewing graded Final exam should be made by showing up in-person to see your graded exam in the allotted time that will be announced on CANVAS after the release of the grades.
- e) A regrade request after the regrade deadline, after the final exam, or more than one regrade request for the same assignment or lab report will not be processed under any circumstances.

**Paper Presentation:** Each Graduate and Grad Track student should choose one paper from the list of the papers assigned at the beginning of the semester, read and review it critically, and present it to the class. The detailed instruction about the paper presentation will be given on CANVAS. Undergraduate students do not need to present any paper.

**Communications and Class Website:**

**My Email:** Email ([Fateme.esmailie@unt.edu](mailto:Fateme.esmailie@unt.edu)) is the preferred method of contact. Most emails will be answered within 48 hours. **I will not respond to emails after 5 pm, during the weekend and holidays.**

**Your email:** Direct communications with students will be made via your university email address as compiled by the registrar. If your university email address is not checked frequently, you should update it and forward it to your active email address through the university system. You may also want to set Canvas to notify you when items are posted to the course site.

**Office hours:** Office hours are blocks of time that are reserved for you. If you cannot attend office hours, please send me an email and make an appointment. Please use this link to see the office hours (<https://calendly.com/fateme-esmailie/30min>). Each student is allowed to schedule only one 30-minute appointment per week. **Please check office hours before making an email request for an appointment outside of office hours.** Please do not stop by my office without making an appointment because I have other commitments, and I will not be able to help you.

**CANVAS Message:** You may contact me using the CANVAS message option, but it might be slower to get an answer through CANVAS.

**CANVAS:** All handouts (syllabus, homework assignments, homework and test solutions, etc.) will be distributed in pdf format at the course website. Students must be registered with the Canvas course site by January 20<sup>th</sup>, 2026 to access the site throughout the semester. Electronic communication with all students will be made by a class email list compiled by the registrar, which is connected to Canvas. The Canvas gradebook is unofficial. Its purpose is to communicate all scores recorded for student work. It is your responsibility to verify that the correct scores have been recorded.

### **Inclusivity Statement**

My intent for this class is to create a space where students feel included, heard, and respected and that students' diverse identities and backgrounds are valued and viewed as an asset to our shared learning community. We all come to this course with unique life experiences, and there will be a diversity of perspectives in our discussions. This diversity is our strength as we strive to communicate and connect across differences and build an inclusive and equitable learning environment. If you have a conflict with a class or assignment and a religious/cultural/spiritual event, please notify me beforehand, and we will make arrangements.

### **Biomedical Engineering Department DEI Statement**

It is our intention to ensure that students from diverse backgrounds and perspectives will be well served by this course. The diversity of students in this class will be an asset to learning and understanding the material. This course welcomes students of all ages, backgrounds, beliefs, ethnicities, gender identities, national origins, religious affiliations, and sexual orientations. All students in this class are expected to contribute to a respectful, welcoming, and inclusive environment for all other members of this class. If you feel that your contribution is not being valued, please feel free to speak with me during office hours.

### **Homework Guidelines:**

The following format for homework is suggested as it provides the opportunity to think systematically about a problem before attempting the solution. The format consists of the following steps:

- **Known:** After carefully reading the problem, state briefly and concisely what is known about the problem. Do not repeat the problem statement.
- **Find:** State briefly and concisely what must be found.
- **Schematic:** Draw a schematic of the physical system. If the application of the conservation laws is anticipated, represent the required control surface by dashed lines on the schematic.
- **Assumptions:** List all pertinent simplifying assumptions (if any).
- **Properties:** Compile property values needed for subsequent calculations and identify the source from which they were obtained.
- **Analysis:** Begin your analysis by applying appropriate conservation laws and introduce rate equations as needed. Develop the analysis as completely as possible before substituting numerical values. Perform calculations needed to obtain the desired results.
- **Comments:** Discuss your results briefly. Such a discussion may include a summary of key conclusions, an inference of trends, and a critique of the original assumptions.
- **Computer Solutions:** If a computer solution is developed, be sure a copy of the program is included in addition to the items above

### **Other points to keep in mind as you prepare your homework to include:**

- a. On each page, use a heading that includes: your name, problem number, due date, and the page number.
- b. Use brief comments - in good English - to make your thinking clear, to connect parts of the problem, and to indicate where data and equations were obtained.
- c. Clearly show all steps of the solution. Partial credit can only be considered if a sufficient amount of detail is provided.
- d. Be sure your work is neat and readable. This will maximize your chances of receiving all the credit the work deserves.
- e. Be sure units are correct, consistent, and clearly stated.
- f. Show the appropriate number of significant figures.

- g. Clearly identify the answer (box, arrow, etc.)
- h. Show only one problem solution per page.
- i. Keep work inside the one-inch margin.

## University Policies

**Relevant Policies:** <https://clear.unt.edu/student-support-services-policies>

**Disability Policy:** All reasonable accommodation will be made to facilitate special needs. If special accommodations are required, the student must first meet with the staff of the Office of Disability Accommodation (ODA), Union Suite 322, (940) 565-4323. After meeting with that office, please contact me to discuss what accommodations will be necessary. For more information, see <http://www.unt.edu/oda>.

### University Policy on Academic Misconduct

Academic Misconduct (Sec. 3.4 from the Student Handbook):

Any act that violates the academic integrity of the institution is considered academic misconduct. The procedures used to resolve suspected acts of academic misconduct are available in the offices of Academic Deans and the Office of Campus Life. Specific examples include, but are not limited to:

**Cheating:** Copying from another student's test paper, written assignment, other report, or computer files and listings; Using, during any academic exercise, material and/or devices not authorized by the person in charge of the test; Collaborating with or seeking aid from another student during a test or laboratory without permission; Knowingly using, buying, selling, stealing, transporting, or soliciting in its entirety or in part, the contents of a test or other assignment unauthorized for release; Substituting for another student or permitting another student to substitute for oneself.

**Plagiarism:** The appropriation, theft, purchase or obtaining by any means another's work, and the unacknowledged submission or incorporation of that work as one's own offered for credit. Appropriation includes the quoting or paraphrasing of another's work without giving credit (especially online resources). Turnitin will be utilized to ensure online resources are not misappropriated.

Any work not meeting this standard will be evaluated and subject to either a re-write, if the instructor concludes that the assignment was unintentionally plagiarized or a zero for the assignment. Egregious forms of academic conduct are subject to a formal hearing. For more information on paper writing, including how to avoid plagiarism, and how to use citations, see <http://anthropology.unt.edu/resources-writingpaper.php>. For information on the University's policies regarding academic integrity and dishonesty, see the UNT Center for Student Rights and Responsibilities, <http://www.unt.edu/csrt/>.

**Collusion:** The unauthorized collaboration with another in preparing work offered for credit.

**Sexual Discrimination, Harassment and Assault:** UNT is committed to providing an environment free of all forms of discrimination and sexual harassment, including sexual assault, domestic violence, dating violence, and stalking. If you (or someone you know) has experienced or experiences any of these acts of aggression, please know that you are not alone. The federal Title IX law makes it clear that violence and harassment based on sex and gender are Civil Rights offenses. UNT has staff members trained to support you in navigating campus life, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more.

**Personal Distress:** Excerpts from <http://studentaffairs.unt.edu/care> "The University of North Texas cares

about our students' success, not only academically, but emotionally and physically.... Because of our commitment, we provide literally hundreds of departments and services across campus that respond to our students' unique needs.... UNT believes it is important to foster an environment that encourages students to maintain a standard of responsibility for self-care which includes the ability to respond adequately to one's emotional, physical, and educational needs. If you are experiencing physical or emotional distress which adversely affects your ability to succeed in class, please see me as soon as possible. Together, we will point you towards the appropriate resources.