



BMEN 5319 Vascular Dynamics
BMEN 4319 Vascular Flows
Department of Biomedical Engineering
University of North Texas
Spring 2024

Instructor: Dr. Fateme Esmailie, fateme.esmailie@unt.edu

Class TA: Nastaran Jafari, nastaranjafari@my.unt.edu

Office: K240A

Class Time: Friday 12:00-1:50 pm

Class Location: NTDP B190 & NTDP E225B

Laboratory: NTDP E225B

Laboratory Sessions: We 2:30-5:20 pm, or Fr 9:00 am -11:50 pm

Instructor Office Hours: Friday 2:00-3:00 pm

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

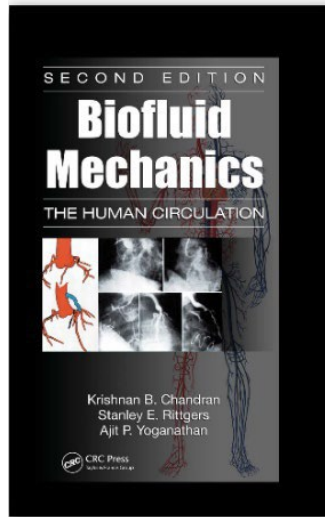
Description: Blood flow is essential for normal body function. Heart operates as a pump and drives the blood flow within our vascular system. Understanding the blood flow in the human body provides valuable insights into human physiology and the interdependence of various organ systems. Cardiovascular 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, 2nd 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:

- **You MUST attend the lectures.**
- 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.
- 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 will be assigned in class, and the submission deadline will typically be in two weeks after uploading the assignment on CANVAS. 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 and one final project 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 1	20%
Exam 2	20%
Final Project Report	15%
Laboratory reports	20%

Grading scale:	
A	90-100%
B	80- < 90%
C	70- < 80%
D	60- < 70%
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 within two weeks of posting it on CANVAS.
- There will be lab reports during the whole semester. You will have a minimum of two weeks to complete your lab reports. 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 05:00 pm. 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.
- 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.**
- TA and grader grade the lab reports and assignments based on the rubric provided by Dr. Esmailie. TA and grader's decision are 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.
- A regrade request after the regrade deadline, and after the final exam, will not be processed under any circumstances.
- You can only submit one regrade request for each assignment, lab report, exam, or final project report. After either of your regrade request was processed and responded, no more comment, or regrade request will be accepted and processed under any circumstances.

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

Exam	Date	Time
Exam 1	Friday Feb 16 th 2023	12-1:50 pm
Exam 2	Friday April 26 th 2023	12-1:50 pm

- 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.
- If you have a valid excuse to change the exam time and date, you MUST communicate your reasons with Dr. Esmailie before January 31st 2024 (by 5 pm CST).
- Requests for reviewing graded Exam 1 and Exam 2 should be made by submitting a detailed request through Canvas within one week of the exam grade being posted.
- Requests for reviewing graded Final project report should be made by submitting a detailed request through Canvas within one day of the grade being posted.
- 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) is the preferred method of contact. Most emails will be answered within 48 hours. **I will not respond to emails 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 check office hours before making an email request for an appointment outside of office hours.** Changes to office hours will be announced on Canvas.

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, unofficial grades, lab manuals, etc.) will be distributed in pdf format at the course website. Students must be registered with the Canvas course site by January 20th, 2024 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.



Policy Chapter: Chapter 6 Faculty Affairs

Policy Number and Title: 06.049 Course Syllabi Requirements

I. Policy Statement

UNT is committed to informing students of specific educational requirements and expectations for the courses in which they are enrolled through the development and delivery of a syllabus. Consistent with UNT Policy 06.035, Academic Freedom and Academic Responsibility, UNT instructional faculty ensure that the content of their course syllabus contains the provisions necessary to be consistent with applicable state law and this course syllabus requirement policy. Faculty also have the academic responsibility of distributing their course's syllabus to their students and to that course's unit administrator prior to the administrative deadline(s), and to giving reasonable notice to students when changes are made to a course syllabus. Instructional faculty are expected to prepare a course syllabus for all credit bearing courses.

II. Application of Policy

All Instructional Faculty

III. Policy Definitions

A. Credit Bearing Course

"Credit bearing course," in this policy, means any undergraduate or graduate educational course taken at the institution that leads to a qualification or institutional credit at the end of the semester.

B. Exempted Courses

"Exempted courses," in this policy, means courses that do not meet regularly or have low enrollment such as independent study, private lessons, thesis, and dissertation courses.

C. Unit

"Unit," in this policy, means an academic department/division under the administration of a UNT official with responsibilities for personnel actions.

D. Unit Administrator

"Unit administrator," in this policy, means the person responsible for the unit.

IV. Policy Responsibilities

The syllabus is an agreement between the instructional faculty member teaching a course and the students enrolled in that course. The syllabus document establishes the instructional faculty member's expectations, providing students with an overview of course content and explanations of course guidelines, procedures, and requirements. Consistent with UNT Policy 06.035, Academic Freedom and Academic Responsibility, instructional faculty have the academic freedom to design the course and present the syllabus as they wish, and instructional faculty have the academic responsibility to include specific items to fulfill state, institutional, and accreditation requirements.

Other topics may be included at the discretion of the faculty member.

A. Syllabus Contents

1. UNT Requirements for Undergraduate and Graduate Courses.
 - a. Brief description of each major course requirement, including each major assignment and examination
 - b. The learning objectives for the course
 - c. A general description of the subject matter of each lecture or discussion
 - d. Lists of any required or recommended readings
2. Institutional Academic Requirements
 - a. Instructor contact information (name, office location, office hours, phone, email address)
 - b. Basic course information (course title, number, and section)
 - c. Required and optional materials needed for course
 - d. Course competencies/assignments/requirements
 - e. Evaluation and grading policies
 - f. Attendance expectations and consequences (UNT Policy 06.039)
 - g. Date, time, and place of final examination
 - h. ADA accommodation statement (UNT Policy 16.001)
 - i. Course safety procedures for laboratory courses
 - j. Emergency notification and procedures
 - k. Academic integrity expectations and consequences (UNT Policy 06.003)
 - l. College/school requirements for learning objectives as approved through the curriculum process
3. Optional Syllabus Statements

These include, but are not limited to the following.

 - a. Student responsibility in their learning
 - b. Late or missed assignments
 - c. Incomplete grades
 - d. Digital copyright and intellectual property protection

- e. Environmental, health, and safety issues
- f. Student evaluation administration dates
- g. Advice for academic success in the course
- h. Records retention policy (UNT Policy 04.008)

B. Creation, Distribution, and Usage of Course Syllabi

1. Faculty must prepare a comprehensive syllabus for each credit bearing course (excluding exempted courses).
2. Faculty must make available a paper or electronic copy of the course syllabus on the first class day (and thereafter), for all students enrolled in their course, and provide a paper or electronic copy to the unit designee during the first week of the semester.
3. Faculty are required to upload all credit bearing undergraduate course syllabi to the university faculty information system (FIS) by the 7th class day. To comply with state law, undergraduate syllabi will be posted on the public FIS website. Faculty will be given the option of posting their graduate syllabi on the public FIS website when they upload their syllabi.
4. The FIS team will make credit bearing undergraduate course syllabi:
 - a. accessible on the university website's home page by use of three (3) links or fewer,
 - b. searchable by keywords or phrases,
 - c. accessible to the public without requiring registration or use of a username, password, or other user identification, and
 - d. available on the website for two (2) years from the date initially posted.
5. Faculty must give reasonable notice to students when changes are made to a course syllabus and any changes must be reflected in the corresponding online syllabus.

V. References and Cross-References

[Texas Education Code § 51.974](#)

[19 Texas Administrative Code § 4.227](#)

[19 Texas Administrative Code § 4.228](#)

[UNT Policy 04.008, Records Management and Retention](#)

[UNT Policy 06.003, Student Academic Integrity](#)

[UNT Policy 06.035, Academic Freedom and Academic Responsibility](#)

[UNT Policy 06.039, Student Attendance and Authorized Absences](#)

[UNT Policy 16.001, Disability Accommodation for Students and Academic Units](#)

VI. Revision History

Policy Contact:	Policy Director, Office of the Provost and VP for Academic Affairs
Approved Date:	09/26/2017
Effective Date:	09/26/2017
Revisions:	07/16/2020