BMEN 5315 Biomedical Modeling

Fall 2021

Instructor: Dr. Brian Meckes

Office: Discovery Park K240D

Class: 4:00 pm – 5:20 pm, TR NTDP K150

Laboratory: 11:30 am – 2:20 pm, R NTDP K140 (301)

Office Hours: Office Hours are Thursdays from 12-1PM

Or via appointment

Email: brian.meckes@unt.edu

TA: Jiafeng Liu
jiafengliu@my.unt.edu
K249

Jessica Baas
Jessicabaas@my.unt.edu

Textbook:

Required Text(book)s: None

Class Notes/Lectures and Posted Reading Assignments will be an important resource

Suggested References:

Applied Numerical Methods with Matlab for Scientist and Engineers, Chopra*;*

Physiological Control Systems: Analysis, Simulation and Estimation, Khoo

Specific course information:

a. Course catalog description: Introduction to equations and numerical analysis techniques important to the description of living systems and medical devices; solution alternatives and limitations; compartmental modeling; use of computational fluid dynamics; mathematical models of physiological control systems and devices; the behavior of physiological control systems using both time and frequency domain methods.

b. Prerequisites or co-requisites: Prerequisite(s): BMEN 3321 and senior standing

Specific goals for thecourse:

a. Specific outcomes of instruction: Upon successful completion of this course, students will understand: Gain an understanding of biomedical modeling. Understand the application of modeling to various biomedical engineering applications. Develop a knowledge of statistical modeling using statistics software. Understand the principles of quantitative approaches to modeling. Gain knowledge on simulation techniques

b. ABET Outcome 1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics;

c. ABET Outcome 4: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

Brief list of topics to be covered:

- Equations and numerical analysis techniques
- Solution alternatives and limitations
- Compartmental modeling
- Mathematical models of physiological control systems and devices
- Physiological control systems

COVID-19 Impact on Attendance

While attendance is expected as outlined above, it is important for all of us to be mindful of the health and safety of everyone in our community, especially given concerns about COVID-19. Please contact me if you are unable to attend class because you are ill, or unable to attend class due to a related issue regarding COVID-19. It is important that you communicate with me prior to being absent so I may make a decision about accommodating your request to be excused from class.

If you are experiencing any symptoms of COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider PRIOR to coming to campus. UNT also requires you to contact the UNT COVID Hotline at 844-366-5892 or COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure. While attendance is an important part of succeeding in this class, your own health, and those of others in the community, is more important.

Class Materials for Remote Instruction

Remote instruction may be necessary if community health conditions change or you need to self-isolate or quarantine due to COVID-19. Students will need access to a [webcam and microphone – faculty member to include what other basic equipment is needed] to participate in fully remote portions of the class. Additional required classroom materials for remote learning include: [list specific software, supplies, equipment or system requirements needed for the course]. Information on how to be successful in a remote learning environment can be found at https://online.unt.edu/learn

Statement on Face Covering

UNT encourages everyone to wear a face covering when indoors, regardless of vaccination status, to protect yourself and others from COVID infection, as recommended by current CDC guidelines. Face covering guidelines could change based on community health conditions.

Attendance Policy

Attendance for classes is required.

Homework and Quizzes:

Homework will be given typically every other week. Quizzes will be held periodically (on Canvas during class time). Homework will only be accepted via Canvas. Please use appropriate apps for scanning and submitting as a PDF. Smartphone photos will not be accepted. It is the student's responsibility to ensure that the material is legible. Apps that may be appropriate if you do not have a scanner (typed versions are always welcome too) include: Adobe Scan (free and highly dependable), Microsoft Office Lens, or Tiny Scanner.

Grade Evaluations:

Quizzes	5%
Homework	20%
Midterm Exam	20%
Laboratory assignments and reports	15%
Proposal	15%
Final Exam	25%

A – 90-100%
B – 80-89%
C – 70-79%
D – 60-69%
F – < 60%
This scale may be lowered at the instructor's discretion (but not raised).

Disability Policy: The University of North Texas does not discriminate on the basis of an individual's disability and complies with Section 504 and Public Law 101-336 (Americans with Disabilities Act) in its admissions, accessibility, treatment, and employment of individuals in its

programs and activities. A copy of the College of Engineering ADA Compliance Document is available in the Dean's Office. It is the responsibility of the student to inform the instructor of any disabling condition that will require modifications by the 12th class day. All reasonable accommodation will be made to facilitate special needs. Office of Disability Accommodation (ODA), Union Suite 322, (940) 565-4323. http://www.unt.edu/oda.

Late Work: Late work is accepted up 3 days after the deadline. You lose 10% of the available points for each day late. After 3 days, you will receive a zero. All late work may not receive complete feedback and only a score may be available.

Examination Policy: All exams are in person. You may utilize a single sheet of paper (front and back) with notes. Cell phones must be put away. Only pens, paper, and calculators may be on your desk. Any student found to have a cell phone on their desk during exam time will receive a zero.

Assignment Policy: All assignments are due via Canvas in PDF format. I strongly advise students to utilize Adobe's free PDF creator app available on Apple and Android devices. All students are responsible for ensuring that the work is legible. Failure to submit legible work may result in a zero for that assignment.

Additional Comments

- Students are encouraged to discuss class material and homework in order to better understand concepts. However, all the homework you submit must be of your own. Direct copying of a solution (from a friend or a book) will be considered as plagiarism and a violation of the University Honor Code.
- Homework assignments are to be turned at the beginning of the class on the due date. Late submission (homework and project) will not be accepted.
- Make up exams may be given only under exceptional circumstances and with prior approval of the instructor.
- All students are responsible for announcements made in lecture on the student access website or via the class email list.
- Students not able to attend class should coordinate getting access to class notes from their colleagues. Classes will not be retaught for absences.
- It is the responsibility of students with certified disabilities to provide the instructor with appropriate documentation from the Dean of Students Office (see http://www.unt.edu.oda).
- Provision will be provided for students who observe religious holidays. Please notify the professor within the first 2 weeks of class.

Schedule of classes (subject to change):

#	Date	Day	Topic Covered
1	Aug 24	T	Introduction
2	Aug 26	R	Modeling of Drug Distribution
3	Aug 31	T	Numerical Approximation of Drug Distribution

4	Sep 2	R	Introduction to Compartmental Modeling
5	Sep 7	T	Compartmental Modeling – Drug Clearance Models
6	Sep 9	R	Compartmental Modeling – Drug Distribution
7	Sep 14	T	Diffusion Fick's First Law – Membrane Transport
8	Sep 16	R	Diffusion Fick's Second Law
9	Sep 21	T	Membrane Transport: Mediated Pathways
10	Sep 23	R	Membrane Transport: Mediated Pathways
11	Sep 27	T	Membrane Potentials, Goldman-Hodgkin-Katz Relationship
12	Sep 30	R	Nervous System: Overview
13	Oct 5	T	Neuronal Signaling Pathways
14	Oct 7	R	
15	Oct 12	T	**Review**
16	Oct 14	R	**MIDTERM EXAM**
17	Oct 19	T	Neuronal Signaling Pathways
18	Oct 21	R	MATLAB exercises for simulating neural signal transmission
19	Oct 26	T	Diffusion Revisited: Oxygen Transport
20	Oct 28	R	Diffusion Revisited: Oxygen Transport II
21	Nov 2	T	Respiratory Physiology
22	Nov 4	R	Respiratory Modeling I
23	Nov 9	T	Respiratory Modeling II
24	Nov 11	R	Respiratory Modeling in Disease
25	Nov 16	T	Feedback Loops
26	Nov 18	R	Transfer Functions
27	Nov 23	T	Time vs Frequency Domain
28	Nov 25	R	Thanksgiving – Be thankful for the day off
29	Nov 30	T	
30	Dec 2	R	REVIEW
31		T	Finals week
32		R	Finals week