BE 4337-002: Transport Phenomena In Biomedical Engineering
Fall 2016

Instructor(s): C. Chuong, Ph.D.

Office Number: ERB-233

Office Phone Number: 817-272-2052

Email Address: chuong@uta.edu

Faculty Profile: https://mentis.uta.edu/public/#profile/profile/edit/id/13/category/3

Office Hours: 1-3 pm Tues, Thurs
TA Hours (ERB-280): 10 am - 12 pm Tues, Thurs

Section Information: BE 4337-002

Time and Place of Class Meetings: WH-210, Tues/Thurs 3:30-4:40 pm

Description of Course Content:
A review of fundamental principles in momentum transfer, mass transfer, and heat transfer with their applications in the description of blood flow, capillary transport, interstitial fluid transport, lymphatic transport at normal and disease states, as well as the application in drug delivery. We then examine the applications in the design of artificial organs, including membrane blood oxygenator, kidney dialysis devices, and therapeutic applications including hyperthermia, hypothermia, transport of drug molecules in solid tumors, etc.

Student Learning Outcomes:
Objectives:

- To learn basic engineering principles of momentum, mass, and heat transfer in integrated form through an array of examples and analysis from biological systems (cellular, tissue, organ levels) and from the design of medical devices
- To be able to apply these principles, using quantitative methods based on fundamental physical laws, to solve problems in biology, of clinical significance, and problems in the design and development of medical devices, implants, including tissue-engineered constructs.

Learning Outcomes

1. The capability to apply mathematics (PDEs), science, and engineering principles, methodologies to formulate and to solve problems at the interface of engineering and biology, physiology, including processes leading to disease states.
2. The ability to interpret results from formulated engineering problems derived for living systems as well as the ability to infer and to make refinement for further insights at the interaction between living and non-living materials and systems.
3. Appreciation for the breadth and depth across the range of engineering topics and their applications in biological, physiological problems including medical devices that enhance the quality of health care delivery.

Required Textbooks and Other Course Materials:
Transport Phenomena in Biological Systems; Truskey, Yuan, Katz, 2nd ed.

Descriptions of major assignments and examinations:

Homework sets	17%
Midterm 1	21%
Midterm 2	21%
Final Exam	21%
Project with Presentation:	15%
Attendance and Participation	5%

Late Homework
Homework set is due at 5:30 pm of the announced due date at the classroom (or otherwise specified). There will be penalty for late submission calculated as 10% for every one hour.

Attendance:
I will take attendance sporadically. For the above Attendance and Participation, each student starts with 5 points. One point will be deducted from it when absence at the time of taking attendance.

Grading:
See above under "Description of major assignment and examinations"
Students are expected to keep track of their performance throughout the semester and seek guidance from available sources if their performance drops below satisfactory levels; see "Student Support Services," below.

Make-up Exams:
Only under special circumstances with prior approval. You need to submit request letter from responsible supervisor (e.g. when participating in official athletic activities) or from a doctor (when accommodating a medical emergency).

Expectations for Out-of-Class Study:
Beyond the time required to attend each class meeting, students enrolled in this course should expect to spend at least an additional 6 hours per week of their own time in course-related activities, including reading required materials, completing assignments, preparing for exams, etc.

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance**. Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (http://wweb.uta.edu/aao/fao/).

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA), The Americans with Disabilities Amendments Act (ADAAA),* and *Section 504 of the Rehabilitation Act.* All instructors at UT Arlington are required by law to provide "reasonable accommodations" to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of **a letter certified** by the Office for Students with Disabilities (OSD). Only those students who have officially documented a need for an accommodation will have their request honored. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:
The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364.
Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671 is also available to all students to help increase their understanding of personal issues, address mental and behavioral health problems and make positive changes in their lives.

Non-Discrimination Policy: *The University of Texas at Arlington does not discriminate on the basis of race, color, national origin, religion, age, gender, sexual orientation, disabilities, genetic information, and/or veteran status in its educational programs or activities it operates. For more information, visit uta.edu/eos.*

Title IX Policy: The University of Texas at Arlington ("University") is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit* www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

> *I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.*
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> *I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.*

UT Arlington faculty members may employ the Honor Code in their courses by having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University. Additional information is available at https://www.uta.edu/conduct/.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at http://www.uta.edu/oit/cs/email/mavmail.php.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit http://www.uta.edu/news/info/campus-carry/

Student Feedback Survey: At the end of each term, students enrolled in face-to-face and online classes categorized as "lecture," "seminar," or "laboratory" are directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback via the SFS database is aggregated with that of other students enrolled in the course. Students' anonymity will be protected to the extent that the law allows. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law and aggregate results are posted online. Data from SFS is also used for faculty and program evaluations. For more information, visit http://www.uta.edu/sfs.

Final Review Week: for semester-long courses**,** a period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures:
Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.

Students should be encouraged to subscribe to the MavAlert system that will send information in case of an emergency to their cell phones or email accounts. Anyone can subscribe at https://mavalert.uta.edu/ or https://mavalert.uta.edu/register.php

Student Support Services: UT Arlington provides a variety of resources and programs designed to help students develop academic skills, deal with personal situations, and better understand concepts and information related to their courses. Resources include tutoring, major-based learning centers, developmental education, advising and mentoring, personal counseling, and federally funded programs. For individualized referrals, students may visit the reception desk at University College (Ransom Hall), call the Maverick Resource Hotline at 817-272-6107, send a message to resources@uta.edu, or view the information at http://www.uta.edu/universitycollege/resources/index.php.

The IDEAS Center (2nd Floor of Central Library) offers **free** tutoring to all students with a focus on transfer students, sophomores, veterans and others undergoing a transition to UT Arlington. To schedule an appointment with a peer tutor or mentor email IDEAS@uta.edu or call (817) 272-6593.

Course Schedule

Course outlines:

1. *Introduction of the course*

A. Introduction To Physiological Fluid Mechanics.

2. *Conservation and Momentum Balances.*
3. *Conservation Relations for Fluid Transport, Dimensional Analysis and Scaling.*
4. *Macroscopic Form of Conservation Relations and Applications of Momentum Transport.*
5. *Fluid Flow in the Circulation and Tissues.*

B. Fundamentals And Applications Of Mass Transport.

6. *Introduction to Mass Transport.*
7. *Combined Diffusion with Convection.*
8. *Transport in Porous Media*
9. *Trans-vascular Transport.*

C. The Effect Of Mass Transport Upon Biochemical Interactions.

12. Cell Adhesion and Cell Signaling.
13. Oxygen Transport from the Lungs to the Tissues.
15. *Transport of Drugs and Macromolecules in Tumors.*

16. Transport in Organs and Organisms.
17. Heat Transfer in Biological Systems.

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Emergency Phone Numbers: In case of an on-campus emergency, call the UT Arlington Police Department at **817-272-3003** (non-campus phone), **2-3003** (campus phone). You may also dial 911. Non-emergency number 817-272-3381

This final section is not part of the syllabus template, but a message from the UT Arlington Library.

Faculty members should feel free to incorporate any of the following information into your course syllabus or other course materials. All library services can be found by going to the main page. For direct links, see below.

Library Home Page library.uta.edu

Resources for Students
Academic Help
Academic Plaza Consultation Services library.uta.edu/academic-plaza
Ask Us ask.uta.edu/
Library Tutorials library.uta.edu/how-to
Subject and Course Research Guides libguides.uta.edu
Subject Librarians library.uta.edu/subject-librarians
Resources
A to Z List of Library Databases libguides.uta.edu/az.php
Course Reserves pulse.uta.edu/vwebv/enterCourseReserve.do
FabLab fablab.uta.edu/
Special Collections library.uta.edu/special-collections
Study Room Reservations openroom.uta.edu/
Teaching & Learning Services for Faculty
Copyright Consultation library-sc@listserv.uta.edu
Course Research Guide Development, Andy Herzog amherzog@uta.edu or your subject librarian
Data Visualization Instruction, Peace Ossom-Williamson peace@uta.edu
Digital Humanities Instruction, Rafia Mirza rafia@uta.edu
Graduate Student Research Skills Instruction, Andy Herzog amherzog@uta.edu or your subject librarian
Project or Problem-Based Instruction, Gretchen Trkay gtrkay@uta.edu
Undergraduate Research Skills Instruction, Gretchen Trkay gtrkay@uta.edu or your subject librarian.