BMED 4803 Syllabus

Biomedical Microdevices (CRN 57460) 3 credits

Summer 2026

Instructor Information

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General Course Information

Description

The goal of this course is to build the foundation necessary for research in micro- and nano-biotechnology towards more accurate *in vitro* platforms. The course will teach the fundamentals of fluid dynamics at the microscale, microfluidic device design considerations, active Lab-on-a-chip technologies deployed on chip, and delve into applications such as droplet microfluidics, organs-on-chip and BioMEMS. We will discuss microfluidic techniques to detect and transfect cells for diagnostic and treatment applications, as well as cell manufacturing. The students will learn methods for manipulating bioparticles such as electrokinetic transport, acoustophoresis, dielectrophoresis and inertial microfluidics. Along with the design considerations necessary for biomedical microdevices, the course will also teach current nano- and micro-fabrication techniques to build these devices for biomedical applications. The culmination of the course will provide students the knowledge required to design, fabricate, and operate biomedical micro- and nano- devices with a focus on the unique physics, biology and engineering at these scales.

Course Learning Outcomes

The goal of this course is to build the foundation necessary for research in micro- and nano-biotechnology. Application examples will be drawn from biomedical devices, microfluidics, drug delivery, implantable devices, surgical robotics, and microsurgical tools. At the conclusion of this course, students will be competent with the following topics.

1. BioMEMS fabrication

2. Fundamentals of microfluidics
3. Organ-on-chip Design considerations
4. Electrokinetics
5. Micro- and nano- particle manipulation
6. Engineering aspects of cells and their membranes

Required Course Materials

The following textbooks are recommended by not required.

1. (Optional) Theory of Microfluidics, H. Bruus
2. (Optional) An Introduction to MEMS, N. Maluf

Grading Policy:

The grades for the course will be based on 2 quizzes during the term, 3 literature reviews, a final project and a final exam.

Assignments

- Quiz 1, 15%
- Quiz 2, 15%
- Literature Review 1, 10%
- Literature Review 2, 10%
- Literature Review 3, 10%
- Final Project, 20%
- Final Exam, 20%

Description of Graded Components

The literature reviews will be a report or presentation based on a topic/lab in the field of microfluidics / microdevices. The oral presentations will be 15 minutes long and should be presented without reading notes. There should be no duplicate topics for presentations. Grades will be based on the content presented as well as the delivery.

The written report should be 3-4 pages long in IEEE journal format. These reviews should provide a brief review of the literature, discuss the theory, describe how the devices are made and the future of the technology.

For the final project, students may work in groups or alone. For the final project, students will be expected to develop a new design of a microdevice. Students will be taught how to

do ‘customer discovery’ when refining their idea for a project. The grade will solely be based on their presentation. The presentation should include a review of the existing technology (i.e., What missing?), the theory, methods (device design, design considerations, fabrication steps), and conclusions (expected results and accomplishments).

The quizzes and exam will be open book and open notes.

Course Policies

Attendance and/or Participation

Students are expected to attend class. Courses will not be recorded. Students missing class should do their best to contact the instructor prior. Accommodations will be met for students who are absent because of participation in approved Institute activities.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech’s Honor Code and the student Code of Conduct.

Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Pre- &/or Co-Requisites

BMED 3310 (or equivalent). The minimum requirements are undergraduate mathematics, namely one year of calculus, exposure to ordinary differential equations, linear algebra and general familiarity with desktop computing. If the student, has not completed BMED 3310, the instructor will determine eligibility.

Collaboration, Group Work, and Use of Generative AI

The use of AI is permitted for writing one literature report. If AI is used, the student should make it clear at the beginning of the report what was used and to the extent. AI cannot be used for other assignments. Collaborations are encouraged for the final project.

Extensions, Late Assignments, & Re-Scheduled/Missed Exams

Late assignments will be accepted with a 20% penalty if submitted within a week after the deadline. Assignments submitted after that will be assigned a 50% penalty. Students who are absent because of participation in approved Institute activities (such as field trips, professional conferences, and athletic events) will be permitted to make up the missed assignment during their absence. The student should notify the instructor prior to the date they are absent.

Campus Resources for Students

Undergraduate Student Academic Success Resources:

- Academic Support: Academic Success and Advising (a unit in the Office of Undergraduate Education & Student Success) provides free support for your courses. Students can attend scheduled supplemental review (PLUS) sessions, stop by Drop-In Tutoring, or schedule a one-on-one appointment through Knack. To explore what options work best for you, please visit us online at success.gatech.edu/tutoring, email us at tutoring@gatech.edu, or come see us at Clough Undergraduate Learning Commons, Suite 283.

Graduate Student Academic and Professional Success Resources:

A list of resources for graduate students is given on the Office of Graduate and Postdoctoral Education website. Specific information for current graduate students includes

- Academic Resources such as the Communications Center, Language Institute, Library, Catalog, Registrar, resources for conducting research, Advocacy and

Conflict Resolution resources, and how to manage unexpected situations that may impact your academic performance;

- Student Resources such as Campus Services, Child Care/Family programs, Health & Wellness, Career Services, and the Student Resource Guide; and
- *Professional Development such as the programming from the Career Center and other professional development resources and events"*

Student Well-Being:

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being (student-resource-guide (gatech.edu)