

BMEN 5324 - Applications of Biomedical MEMS

Course Syllabus

Class Time and Place:

Tuesday and Thursday, 4:00PM - 5:20PM in NTDP B190

Instructor: Dr. Huaxiao “Adam” Yang, Assistant Professor, Department of Biomedical Engineering

Office: K240B

Office Hours: Wednesday 1:30 pm – 3:30 pm by appointment *via* email either in person or on Zoom

Email: huaxiao.yang@unt.edu

TAs office hours:

Jiafeng Liu: jiafengliu@my.unt.edu

Office: K249

Office hours: Tuesday and Thursday 3-5pm

Course Description: Comprehensive introduction to the science and technology of miniaturization and its applications in biomedical engineering. Methods and tools to create submicron electromechanical and fluidic architectures, with hands-on lab practice and software modeling. Different types of lithography methods will be presented and different techniques such as chemical etching and reactive ion etching will be discussed. Applications in bio micro-electro-mechanical systems (BioMEMS) will also be discussed in different subjects, such as biosensors, microfluidics, and BioMEMS for diagnosis and tissue engineering.

Arrangement and Special Dates:

No Class days:

March 14-18, 2022 Spring break (no classes including lecture and lab sessions)

May 6, 2022 Reading day (no classes)

Important Exam's days:

Middle term Exam: Match 3rd 2022 (Close book, in person)

Final term exam: Week of May 7 to 13, TBD

Student presentation days:

Group 1 ---- April 19th

Group 2, 3, 4 ---- April 21st

Group 5, 6, 7 ---- April 26th

Group 8, 9, 10 ---- April 28th

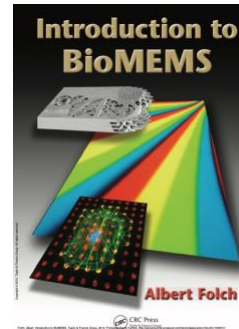
Class review and Q&A days:

May 3rd and 5th

Recommended textbook: Introduction to BioMEMS, by Albert Folch, Taylor & Francis Group, 2012, NO Textbook needed

Additional readings: Review on PDMS Microfluidics (Whitesides), Review on Single-Molecule Lab on a Chip (Huang), Review on Micropatterning (Folch)

Lecture coverage (may be varied or modified in some weeks):



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| Lecture 1 | It's a small world: Dimensions and scaling challenges involved in going from macro to micro to nano |
| Lecture 2 | How do we make small things? Introduction to micropatterning, micromachining, and micromolding with an emphasis on biomaterials restrictions |
| Lecture 3&4&5&6 | Micropatterning of substrates and cells: Self-assembled monolayers, chemically-bound biomolecules, biocompatible/biodegradable polymers |
| Lecture 7&8&9&10 | Microfluidics: Introduction to microfluidics, properties of biological fluids in microchannels, mathematical modeling of fluid flow |
| Lecture 11&12 | Molecular biology on a chip: Chromatographic separations on a chip, DNA prisms, deterministic lateral displacement, isoelectric focusing, free-flow electrophoresis, mass spectrometry, PCR chips |
| Lecture 13&14&15 | Cell-based chips for biotechnology: Miniature enzymatic assays, DNA microarrays, optical detection methods amenable to miniaturization |
| Lecture 15&17&18 | BioMEMS for cell biology: Enabling the control of cell-substrate, cell-cell, and cell-medium interactions |
| Lecture 19&20&21 | Tissue microengineering: Introduction to biomimetic substrates and microscaffolds for tissue engineering applications |
| Lecture 22&23 | Microfabricated implants and biosensors: Implantable microelectrodes, microtweezers |

Evaluation and Requirements for lecture:

- TBD quiz, usually announced on Tuesday for the Thursday quiz, open book, usually 1~2 open-ended questions
- Student presentations, 2 students per group, 21 minutes+3 minutes Q&A
- Midterm exam, 80 min, 8 questions (including 2 open-ended questions), close book
- Final exam, 80 min, ~8 questions (including 2 open-ended questions), close book,

No Plagiarism, No Cheating in the exams!

Requirements of the group presentation

1. 1 to 2 students are assigned randomly into one group, switching between groups is allowed at rare cases, early group meetup and discussion is highly encouraged;
2. Each group presents 22+2 mins (Q&A) on a designated date and time;
3. Presentation needs to include: a) background and problems, b) research methods/approaches, c) results, d) conclusion and discussion, e) references (at the end or in the presentation), each student is at least in charge of one section;
4. Obtain instructor's permission about the topic and key publication(s) within the

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| Relevance and significance in the technologies of biomedical applications and translations (<u>10 points</u>) | Layout and format of Presentation content (<u>20 points</u>) (1. Background 2. Methods 4. Results 5. Discussion 6. References | Speakers' performance (20 points) (good diction; good articulation; good transition between speakers; good teamwork; good punctuality) | Question and Answer (10 points) (understand the questions, answer properly, clearly, and confidently, good team support) |
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scope of areas in this course;

5. The format of the presentation include: introduction, methods, results, conclusions, and references. Please find the score sheet as follows for the specific criteria of presentation.

Grading Policies:

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| Attendance | 10% |
| Quiz | 5% |
| Homework | 15% |
| Midterm Exam | 20% |
| Presentation | 20% |
| Final Exam | 30% |
| Total | 100% |
| A – 90-100% | |
| B – 80-90% | |
| C – 70-80% | |
| D – 60-70% | |
| F - < 59% | |

Additional Comments:

- Students are expected to read the materials assigned thoroughly and search-related literature using PubMed and Google Scholar.
- Students are encouraged to discuss class material and lab reports to better understand concepts. However, all the lab reports you submit must be of your own. Direct copying of a solution (from a friend or a book) will be considered plagiarism and a violation of the University Honor Code.
- Lab reports are to be turned in at the beginning of the class on the due date. Late submission will not be accepted.
- All students are responsible for announcements made in the lecture on the student access website or via the class email list.

Withdraws: Note that students wishing to drop the course must take appropriate action (Details can be found in the following link: <http://essc.unt.edu/registrar/schedule/withdraw.html>). It is your responsibility to make sure all of the requisite paperwork is submitted. Ceasing attendance does not automatically drop you from the course.

Americans with Disabilities Act: 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.**

Class Attendance:

100% attendance is required, however, absences may be permitted if 1) Notify at least one week before the date of absence with well justifications and related materials (if apply) according to the attendance policy at UNT (<https://policy.unt.edu/policy/06-039>); 2) Emergent absences due to medical issues or family events, and an explanation email is required by the student or legal guardian thereafter; 3) Late attendance policy: if you are late for the class less than 5 min, there is no penalty. More than 5 min late and less than 25 min late for the class, it is considered "Late". More than 25 min late, it is considered "Absent". The attendance sheet will be handed out at the beginning of each lecture, please remember to sign your name in print and signature, and date/time carefully.

Late submission of the lab report

The penalty of late submission: Up to 3 days late 50% reduction, up to 1 week 75% reduction of lab report grade unless certain verified rare cases. Assignments and lab reports will not be accepted after one week of the due date.

Course Evaluation

Student Perceptions of Teaching (SPOT) is the student evaluation system for UNT and allows students the ability to confidentially provide constructive feedback to their instructor and department to improve the quality of student experiences in the course.

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) (<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, are more important.

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.

Academic Integrity Policy

Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University.

ADA Policy

UNT makes reasonable academic accommodations for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one's specific course needs. Students may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website (<https://disability.unt.edu/>).

Prohibition of Discrimination, Harassment, and Retaliation (Policy 16.004)

The University of North Texas (UNT) prohibits discrimination and harassment because of race, color, national origin, religion, sex, sexual orientation, gender identity, gender expression, age, disability, genetic information, veteran status, or any other characteristic protected under applicable federal or state law in its application and admission processes; educational programs and activities; employment policies, procedures, and processes; and university facilities. The University takes active measures to prevent such conduct and investigates and takes remedial action when appropriate.

Emergency Notification & Procedures

UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.