

BMEN 4320 - Biomedical Microelectromechanical Systems

Course Syllabus

Class Time:

Lecture via ZOOM: Tuesday & Thursday 4:00 PM - 5:20 PM;

Lab (in person): Tuesday (301) & Thursday (302) 5:30PM - 8:20PM and Friday 11:30AM - 2:20PM (303) & 2:30PM - 5:20PM (304)

Classroom: NTDP K140 for the in-person lab of BMEN 4320

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

Office: K240B

Office Hours: Monday 1:30 pm – 3:30 pm by appointment via email for ZOOM meeting

Email: huaxiao.yang@unt.edu

TAs office hours:

Jiafeng Liu: jiafengliu@my.unt.edu

Office: K249

Office hours: Tuesday and Thursday 3-5pm

Dovile Strimaityte: dovilestrimaityte@my.unt.edu

Office hours: Monday and Wednesday 10am-12pm

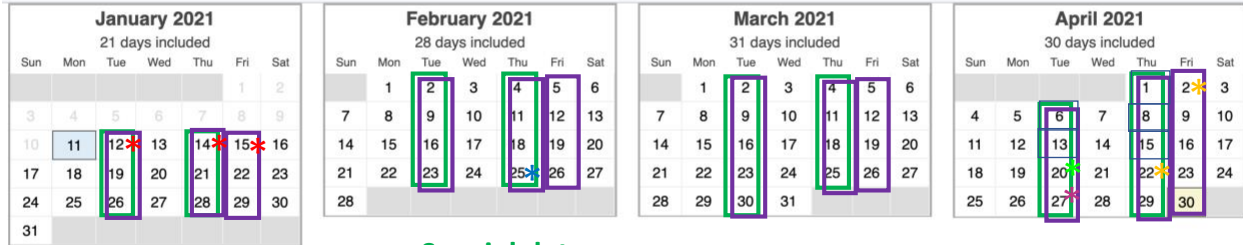
ZOOM link for Lecture: **ZOOM link for Lecture:** Join URL:

<https://unt.zoom.us/j/88349456913?pwd=c1ZoMlo5Q2JXQTlmdGtIME9zWXU1Zz09>

ZOOM class policy: Turn on your camera for sharing your live-video all the time with everyone in the class during the lecture, also your camera video must be on when you are having midterm and final exams with the browser lockdown.

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:



Special dates:

- * 1/12, 1/14, and 1/15 no labs
- * 2/25 Midterm exam
- * 4/2 no classes, 4/22 Reading day
- * 4/20 Question and Answer day for final exam
- * 4/27 final exam
- 4/1, 4/6, 4/8, 4/13 and 4/15 group presentations

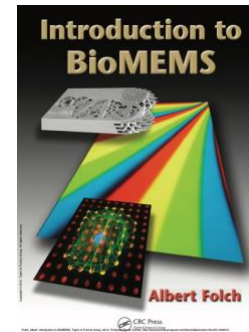
 Lecture of BMEN 4320 & 5324

 Lab of BMEN 4320

Recommended textbook: Introduction to BioMEMS, by Albert Folch, Taylor & Francis Group, 2012

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 in special weeks):



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	Micropatterning of substrates and cells: Self-assembled monolayers, chemically-bound biomolecules, biocompatible/biodegradable polymers
Lecture 6&7&8	Microfluidics: Introduction to microfluidics, properties of biological fluids in microchannels, mathematical modeling of fluid flow
Lecture 9&10	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 11&12&13	Cell-based chips for biotechnology: Miniature enzymatic assays, DNA microarrays, optical detection methods amenable to miniaturization

Lecture 14&15&16	BioMEMS for cell biology: Enabling the control of cell-substrate, cell-cell, and cell-medium interactions
Lecture 17&18&19	Tissue microengineering: Introduction to biomimetic substrates and microscaffolds for tissue engineering applications
Lecture 20&21&22	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 and Student Curiosity Committee (SCC), 3 students per group, 18 minutes+2 minutes Q&A, dates: 4/1, 4/6, 4/8, 4/13, 4/15, group 2 is the group 1's SCC.... Group 1 is group 15's SCC. A scoring and criteria sheet will be used.
- Midterm exam, 3/04/2021, 75 min, 8 questions (including 2 open-ended questions), close book, browser lockdown with camera-on
- Final exam, 4/27/2021, 75 min, ~8 questions (including 2 open-ended questions), close book, browser lockdown with camera-on

No Plagiarism, No Cheating in the exams!

Requirements of the group presentation

1. 3 students are assigned randomly into one group, switching between groups is allowed with proper justifications, early group meetup and discussion is highly encouraged;
2. Each group presents 12+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 scope of areas in this course;
5. Student curiosity committee (SCC) formation and function: group 2 is group 1's SCC.... Group 1 is group 15's SCC, SCC provides suggestive comments to the instructor for scoring according to the criteria of group presentation;
6. Criteria of group presentation: 1) PowerPoint layout and contents (5 points); 2) Presentation and connections (5 points); 3) Question and Answer (5 points)

Lab Project: Stencil design and fabrication for cardiomyocytes micropatterning and characterization

Scientific goal: Achieving the stencil-based bioMEMS techniques for cell micropatterning to achieve the geometric confined cell growth and function

Skill learning goal: Learning and mastering practical bioMEMS design, fabrication, and application

Expected outcomes: 1) Designed stencil for cell micropatterning; 2) Fabricate stencil using laser-cutting or soft-lithography or 3D printing; 3) Micropatterning cardiomyocytes with varied geometric confinements.

Tasks of each lab session (May change accordingly with notification in one week before each class):

Week	Task	Supplies and Software needed
1	No lab	
2-4	Stencil design	AutoCAD
5-7	Stencil fabrication	TBD
8-12	Cell culture and micropatterning	Culture hood, cell culture medium, water bath
13-14	Cell imaging and data analysis	Microscope with imaging capacity, ImageJ analysis (MACRO)

Evaluation of final project report (100 points):

1. Use the template of the final project report (10 points)
2. A clear review of project-related background and limitations of current models (30 points)
3. Clear summary and analysis of all the experiment results (40 points)
4. Significant discussion according to the data analysis and comparison between control and treatment groups and published results from the references (20 points)

No Plagiarism in the lab reports!

Grading Policies:

Attendance	10%
Quiz	5%
Homework	15%
Midterm Exam	15%
Presentation	15%
Final Exam	20%
Performance in the lab session	5%
Final project report	15%
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.**

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.

Statement on Face Covering

Face coverings are required in all UNT facilities. This course has been approved for an exception to the face-covering requirement to facilitate student learning. Portions of the class are to be delivered without face coverings. Times when face coverings can be removed will be indicated during each class period. If you are unable to wear a face covering or do not feel you can safely attend class without your face covering due to a disability, please contact the Office of Disability Access to request an accommodation. UNT face covering requirements are subject to change due to community health guidelines. Any changes will be communicated by your instructor.