

## **BME 5151 “Intro to BioMEMS & Medical Microdevices”**

Department of Biomedical Engineering, University of Minnesota

### **Syllabus for Spring 2024**

Instructor: Prof. Steven Saliterman  
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Office Hours: Monday & Wednesday afternoons this spring 2024. Please call, text or email the day before or sooner to schedule a time.  
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Location: Zoom: <https://umn.zoom.us/j/5527833679>  
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**Lectures & Attendance:** Thursdays 3:35-5:30 p.m. in Molecular and Cellular Biology. Attendance is expected and sign-in will be required. See “Class Schedule” under “Syllabus” on the webpage below. This course is completely in-person, and there are no recordings or scheduled Zoom lectures. Attendance is taken. All of the questions on the examinations will come from material available on the course webpage. If you miss a class for a valid reason, please let Prof. Saliterman know by email, and review the lecture slides on the course webpage below.

**Website:** The webpage for this course is:

<https://saliterman.umn.edu/biomems-class/syllabus-lectures-and-handouts>.

The course has an international following and the Enterprise website was created for open access to content (password needed for some copyrighted material). Our use of Canvas will be limited to activities related to projects if desired by the TA, and for the SRT.

**Credits:** 2

**Prerequisites:** While preference is given to BME upper-division students and graduate students, anyone may take the course. The class size is limited to ~50 students.

### **Course Goals and Objectives**

Students will become acquainted with the following topics:

- Nano- and Microfabrication of Silicon & Polymers.
- Microfluidics - Design, Transport, and Electrokinetics.

- Biosensors, Microsensors, Quantum Dots and Nanoparticles.
- Lab, Organ and Body-on-a-Chip Systems.
- Microactuators & Drug Delivery.
- Clinical Laboratory Medicine & Micro Total Analysis Systems.
- Genomics and Proteomics - Gene and Protein Chips.
- Clinical Applications & Point-of-Service Devices.
- Biocompatibility, FDA & ISO 10993.

### **Supplemental Reading:**

Relevant journal articles pertaining the lecture content are posted on the course webpage for your optional review. I highly recommend these if you are having difficulty understanding the lectures, and for additional background (especially if you are a graduate student). The password for the supplemental reading material is on our Canvas Home page.

### **Optional Reading:**

*Fundamentals of BioMEMS and Medical Microdevices* by Steven S. Saliterman. Selected chapters are on the website under *Supplemental Reading*.

**Examinations:** See the Class Schedule spreadsheet for dates and times. Tests must be taken in person or in the DRC for students registered with the program. There is no remote testing. Students requiring additional time and special accommodations should arrange to take their examinations in the DRC. The time in the DRC must overlap the ordinarily scheduled class time.

If you are unable to take an examination at the scheduled time for a valid reason, there will be a single makeup exam for all who missed the original exam (different than the original). This will be scheduled by the TA sometime after the original examination. Prof. Saliterman will correspond with you personally with your test results.

If you fail a test, it is possible to study again and retake the examination at the time and place of the scheduled makeup examination.

**Homework:** Reading Assignments – 40 pages/week and Team Presentation

### **Class Time**

90% lecture, 10% discussion,

**Paper:** None

### **Project**

These are team presentations of about four members. You will propose a new bioMEMS device, or expand upon a previously published device or useful methodology. Discuss the purpose of your concept, and if appropriate, the theory (what principles are at work),

fabrication (materials and techniques), testing, limitations, and biocompatibility of your device. Your team will present a 20 min. Power Point talk (no paper is necessary) at the end of the semester. Include references, and be prepared to ask and answer questions. See “Team Presentation” under “Assignments” on the course webpage. Please send your finished presentation as a PDF document to Prof. Saliterman the day after your presentation.

**Grading:** See *Graded Course Work* on the course webpage under *Syllabus* items.

If you are having difficulties with the material, please let Dr. Saliterman or the TA know. We will meet with you and set up whatever is necessary for you to improve. Special grading consideration will be given to under-graduate students in the course. The examinations are essay style, and not open book. Do not bring study materials or calculators into the examination room.

**Course Conflicts:** Please notify the instructor if you have a course or final examination conflict.

**Role in the Biomedical Engineering Curriculum**

The courses required for the Bachelor of Biomedical Engineering degree program are designed to meet the Program Educational Objectives (PEOs), as defined by the BME Department (BMED), and the Student Outcomes (SOs), as defined by the Accreditation Board for Engineering and Technology (ABET). Achieving the PEOs and SOs is necessary to maintain program accreditation by ABET. For a full description of the PEOs, the SOs, and the accreditation of the program, please refer to the BMEN website ([bme.umn.edu/undergrad/index.html](http://bme.umn.edu/undergrad/index.html)) and the ABET website ([www.abet.org/forms.shtml](http://www.abet.org/forms.shtml)).

The SOs that this course is meant to at least partially achieve:

- (1) An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- (2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- (3) An ability to communicate effectively with a range of audiences.
- (4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments.
- (7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course	Title	1	2	3	4	5	6	7	8	9
5151	BioMEMS	H	H	H	H			H		

Where H = high priority, M = medium priority and L=low priority.

## **University Policies**

### **Academic Freedom and Responsibility**

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled\*.

Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help. Contact the instructor, the Department Chair, your adviser, the associate dean of the college, or the Vice Provost for Faculty and Academic Affairs in the Office of the Provost.

\*Language adapted from the American Association of University Professors "Joint Statement on Rights and Freedoms of Students".

### **Appropriate Student Use of Class Notes and Course Materials**

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community.

### **Board of Regents Policy on Equity, Diversity, Equal Employment Opportunity, and Affirmative Action**

Please see this important information on the University of Minnesota's Board of Regents Policy on Equity, Diversity, Equal Employment Opportunity, and Affirmative Action:

[https://regents.umn.edu/sites/regents.umn.edu/files/2024-01/policy\\_diversity\\_equity\\_inclusion\\_and\\_equal\\_opportunity.pdf](https://regents.umn.edu/sites/regents.umn.edu/files/2024-01/policy_diversity_equity_inclusion_and_equal_opportunity.pdf)

### **Disability Accommodations & Diversity**

The University of Minnesota views disability as an important aspect of diversity, and is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (DRC) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

If you have, or think you have, a disability in any area such as, mental health, attention, learning, chronic health, sensory, or physical, please contact the DRC office on your campus

(UM Twin Cities - 612.626.1333) to arrange a confidential discussion regarding equitable access and reasonable accommodations.

Students with short-term disabilities, such as a broken arm, can often work with instructors to minimize classroom barriers. In situations where additional assistance is needed, students should contact the DRC as noted above.

If you are registered with the DRC and have a disability accommodation letter dated for this semester or this year, please contact your instructor early in the semester to review how the accommodations will be applied in the course.

If you are registered with the DRC and have questions or concerns about your accommodations, please contact your access consultant/disability specialist.

Additional information is available on the DRC website:  
<https://diversity.umn.edu/disability/> or e-mail [drc@umn.edu](mailto:drc@umn.edu) with questions.

### **Grade Definitions**

The University of Minnesota's "Grading and Transcripts" policy can be reviewed here:  
<http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>

### **Makeup Work for Legitimate Absences**

Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in local, state, or national elections.

For complete information, please see: <http://policy.umn.edu/education/makeupwork>.

### **Mental Health and Stress Management**

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you.

You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: <http://www.mentalhealth.umn.edu>.

### **Scholastic Dishonesty**

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on

assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: [http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf)) If it is determined that a student has cheated, the student may be given an "F" or an "N" for the course, and may face additional sanctions from the University.

The College of Science and Engineering expects the highest standards of honesty and integrity in the academic performance of its students. Any act of scholastic dishonesty is regarded as a serious offense, which may result in expulsion. Aiding and abetting a student in an act of dishonesty is also considered a serious offense.

### **Sexual Harassment**

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting.

For additional information, please consult Board of Regents Policy:

[https://regents.umn.edu/sites/regents.umn.edu/files/policies/Sexual\\_Harassment\\_Sexual\\_Assault\\_Stalking\\_Relationship\\_Violence.pdf](https://regents.umn.edu/sites/regents.umn.edu/files/policies/Sexual_Harassment_Sexual_Assault_Stalking_Relationship_Violence.pdf)

### **Student Conduct Code**

The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community.

As a student at the University, you are expected adhere to Board of Regents Policy: Student Conduct Code.

To review the Student Conduct Code, please see:

[http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student\\_Conduct\\_Code.pdf](http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf).

### **Use of Personal Electronic Devices in the Classroom**

Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom.

For complete information, please reference: <http://policy.umn.edu/education/studentresp>.

The Office for Community Standards has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty:

<https://communitystandards.umn.edu/avoid-violations/avoiding-scholastic-dishonesty>.

If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class -- e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

**Workload**

University of Minnesota undergraduates are expected to spend 2 hours in out-of-class preparation for each in-class hour; expect on average, to spend about 4 hours per week on this course.