

## Microfluidics and BioMEMS

**EML 4930**            Section 6219 (Class 29632)  
**Class Periods:**    MWF4, 10:40 – 11:30 am  
**Location:**        BEN 328  
**Academic Term:**   Spring 2023

### Instructor

- Z. Hugh Fan, Ph. D.
- Office location: LAR 223
- E-mail address: hfan@ufl.edu
- Telephone: (352)-846-3021
- Office Hour: R7, 1:55 – 2:45 pm

### Teaching Assistant

- None

### Course Description

Variable content in mechanical engineering not offered in other courses. Credits: 3

### Course Pre-Requisites

EGN 3353C or consent of instructor

### Course Objectives

This course is to introduce the concept of miniaturization. At the end of the course, the student will be able to

- Know the materials and methods for microfabrication,
- Understand the principles of microfluidics,
- Comprehend a variety of biological applications of microfluidic and biomedical MEMS devices, and
- Analyze the phenomena observed in microdevices.

### Co-listing Statement

This course is co-listed with BME 5580. A student taking the graduate course version of the course is expected to review the microfluidics literature and summarize the research trends. This is above and beyond students taking the undergraduate version.

**Materials and Supply Fees:** None

### Required Textbooks and Software

Recommended textbooks:

- M. Madou, “Fundamentals of Microfabrication: The Science of Miniaturization”, 2nd Edition, CRC Press, ISBN: 0849308267
- Albert Folch, “Introduction to BioMEMS”, 1st Edition, CRC Press, ISBN: 9781439818398
- Nam-Trung Nguyen and Steve Wereley, “Fundamentals and Applications of Microfluidics”, 2nd Edition, Artech House, ISBN: 1580539726

Class notes and handouts will be available at <http://elearning.ufl.edu/>

### Recommended Materials

Reading assignment and the recommended materials are posted on the course website, <http://elearning.ufl.edu/>

### Course Schedule

The detailed course schedule is available at <http://elearning.ufl.edu/>, though the high-level lecture topics are listed below:

1. Miniaturization (5 h)
2. Microfabrication (7 h)
3. Microfluidics (15 h)
  - a. Pumping (5 h)
  - b. Valving and mixing (2 h)
  - c. Integration (5 h)
  - d. Simulation (3 h)
4. Applications (12 h)

- a. Detection (2 h)
  - b. DNA & protein analysis (2 h)
  - c. Virus and Cells (2 h)
  - d. Medical diagnostics (2 h)
  - e. Drug discovery (2 h)
  - f. Commercial examples (2 h)
5. A lab is provided to practice microfabrication and study microfluidic phenomena.

### **Attendance Policy, Class Expectations, and Make-up Policy**

Attendance is strongly recommended. During class, cell phones must be turned off or muted. Late arrivals should be minimized; if you are late, be considerate when you get into the classroom. No late assignments will be accepted. Makeup exams are not normally allowed.

### **Evaluation of Grades**

40% on the during-term exam #1, 40% on the during-term exam #2, and 20% on the lab. There is no final exam.

**Grading Scale:** 90-100: A; 87-89: A-; 84-86: B+; 80-83: B; 77-79: B-; 74-76: C+; 70-73: C; 67-69: C-; 64-66: D+; 60-63: D; 57-59: D-; and 0-56: E. More information on UF grading policy may be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

### **Students Requiring Accommodations**

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

### **Course Evaluation**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing online evaluations. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open: <https://gatorevals.ua.ufl.edu/>. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

### **In-Class Recording**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### **University Honesty Policy**

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic

misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### **Commitment to a Safe and Inclusive Learning Environment**

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following: Your academic advisor or Graduate Program Coordinator; Jennifer Nappo, Director of Human Resources, 352-392-0903, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu); Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu); Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu).

### **Software Use**

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### **Student Privacy**

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

### **Campus Resources:**

#### Health and Wellness

#### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

#### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [ix@ufl.edu](mailto:ix@ufl.edu)

#### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

#### **COVID-19**

- According to the UF guideline, you are welcome to wear masks during class and within buildings.
- Please follow the Centers for Disease Control and Prevention (CDC) guidance for Alachua County, [https://covid.cdc.gov/covid-data-tracker/#county-view?list\\_select\\_state=Florida&data-type=CommunityLevels&null=CommunityLevels&list\\_select\\_county=12001](https://covid.cdc.gov/covid-data-tracker/#county-view?list_select_state=Florida&data-type=CommunityLevels&null=CommunityLevels&list_select_county=12001)
- If you are sick, please stay home. If you are ill and need immediate care, please call your primary care provider or the UF Student Health Care Center at 352-392-1161.

#### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.

<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus**: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf).

**On-Line Students Complaints**: <http://www.distance.ufl.edu/student-complaint-process>.