Department of Electrical Engineering, COEC
ELEE 6399-01 / ELEE 4368-01
Electrokinetics for Microsystem
Fall 2018

Instructor
Dr. Nazmul Islam, Associate Professor
Electrical Engineering;
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Phone: 956-665-7228 (W)

Class times: M, W: 5:55 pm - 7:10 pm; room EENGR 1.274

Office Hour: T Th 10:00 – 12:00 pm
W 2:00pm – 3:00pm (By Appointment Only)

Course Topics:

The course will start with the basics of MEMS (Micro Electro Mechanical Systems) technology. It will cover the MEMS and micro/nano-fabrication. It will also provide a state-of-the-art knowledge on both theoretical and applied aspects of the electrical manipulation of colloidal particles and fluids in microsystems and will include following topics: dielectrophoresis, electrohydrodynamics, and electrokinetics in microsystems.

Following topics will be covered:

- Introduction to MEMS
- Materials for MEMS and microfluidics (silicon substrate, Polydimethylsiloxane-PDMS)
- MEMS device fabrication: photolithography, sputtering, oxidation, E-beam evaporation and chemical vapor deposition (CVD).
- Review on Essential Electrical and Mechanical Concepts
- Electrostatic sensing and actuation
- Piezoresistive, capacitive and MEMS transducers
- Electrokinetics and MEMS microfluidics basics for Microsystem
- Electrophoresis and di-electrophoresis (DEP)
- AC Electroosmosis and AC Electrothermal techniques and applications
- Bio-MEMS and Lab-on-a-chip (LOC) technology.


Course Learning Outcomes

- Ability to analyze the fundamental concepts of MEMS.
- Knowledge about microfabrication technologies
- Ability to understand fundamental sensing and actuation methods
- Ability to analyze the fundamental concepts of Electrokinetics.
- Ability to analyze different electrokinetics techniques in microsystem.

Course Description:

“Electrokinetics” refers to the study of electrically driven mechanical motion of charged particles or fluids. Electrokinetics is a branch of MEMS technology. MEMS is a rapidly growing field that builds on the existing silicon processing infrastructure to create micron-scale devices. Unlike conventional integrated circuits, these devices can have many functions, including sensing, actuation, and communication. Just like microelectronics, MEMS technology will permeate our everyday lives in the coming decades. This course is an introduction to this exciting new field. The course will cover a wide range of topics, including: MEMS, electrokinetics, microsensors and actuators, microfabrication processes, mechanical and electrical characteristics, microfluidics devices and applications.

Grading criteria:

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<tr>
<td>Homeworks</td>
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<tr>
<td>Quizzes</td>
<td>15%</td>
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<tr>
<td>Midterm 1</td>
<td>20%</td>
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<tr>
<td>Paper review &amp; Projects</td>
<td>25%</td>
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<td>Final Exam</td>
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Extra Credit will be based on Quizzes grade. Letter grade for this course will be assigned according to the following scale:

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<tr>
<th>Grade</th>
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<tr>
<td>A</td>
<td>&gt;= 90</td>
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<td>B</td>
<td>80 - 89</td>
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<td>C</td>
<td>70 - 79</td>
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<td>D</td>
<td>60 - 69</td>
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<td>F</td>
<td>&lt; 60</td>
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Relationship of course to Program Outcomes

This course will help students to meet the following student learning outcomes. It will be demonstrated that the student
1. will be able to use knowledge of mathematics, basic sciences and engineering to analyze (identify, formulate, and solve) problems in electrical engineering.
3. will be able to design electrical devices, systems or processes that meet given specifications.
5. will be able to communicate ideas effectively in graphical, oral and in written media.
6. will understand the professional responsibility of an engineer and how engineering solutions impact safety, economics, ethics, politics, and societal and cultural issues

Make-Up Policy

Make-ups for missed Exam/Quiz will be given only in case of a documented emergency. Students must contact the instructor prior to the Exam/Quiz and they must provide official documentation (hospital records, etc.). Students who do not contact the instructor and do not provide official
documentation will not be given a make-up exam and will receive "0" points for the missed Exam/Quiz.

UTRGV Policy Statements

**STUDENTS WITH DISABILITIES:** Required on all syllabi. Do not modify.
Students with a documented disability (physical, psychological, learning, or other disability which affects academic performance) who would like to receive academic accommodations should contact **Student Accessibility Services (SAS)** as soon as possible to schedule an appointment to initiate services. Accommodations can be arranged through SAS at any time, but are not retroactive. Students who suffer a broken bone, severe injury or undergo surgery during the semester are eligible for temporary services.

**Pregnancy, Pregnancy-related, and Parenting Accommodations**
Title IX of the Education Amendments of 1972 prohibits sex discrimination, which includes discrimination based on pregnancy, marital status, or parental status. Students seeking accommodations related to pregnancy, pregnancy-related condition, or parenting (reasonably immediate postpartum period) are encouraged to contact Student Accessibility Services for additional information and to request accommodations.

**Student Accessibility Services:**
Brownsville Campus: Student Accessibility Services is located in Cortez Hall Room 129 and can be contacted by phone at (956) 882-7374 (Voice) or via email at ability@utrgv.edu. Edinburg Campus: Student Accessibility Services is located in 108 University Center and can be contacted by phone at (956) 665-7005 (Voice), (956) 665-3840 (Fax), or via email at ability@utrgv.edu.

**MANDATORY COURSE EVALUATION PERIOD:** Required on all syllabi. Do not modify.
Students are required to complete an ONLINE evaluation of this course, accessed through your UTRGV account (http://my.utrgv.edu); you will be contacted through email with further instructions. Students who complete their evaluations will have priority access to their grades. Online evaluations will be available on or about:

- Module 1: October 4 – 10
- Module 2: November 29 – December 5
- Full Fall Semester: November 15 – December 5

**ATTENDANCE:** Recommended on all syllabi; may be modified by the instructor as long as it is not inconsistent with UTRGV policy.
Students are expected to attend all scheduled classes and may be dropped from the course for excessive absences. UTRGV’s attendance policy excuses students from attending class if they are participating in officially sponsored university activities, such as athletics; for observance of religious holy days; or for military service. Students should contact the instructor in advance of the excused absence and arrange to make up missed work or examinations.

**SCHOLASTIC INTEGRITY:** Recommended on all syllabi.
As members of a community dedicated to Honesty, Integrity and Respect, students are reminded that those who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and expulsion from the University. Scholastic dishonesty includes but is not limited to: cheating, plagiarism (including self-plagiarism), and collusion; submission for credit of any work or materials that are attributable in whole or in part to another person; taking an examination for another person; any act designed to give unfair advantage to a student; or the attempt to commit such acts. Since scholastic dishonesty harms the individual, all students and the integrity of the University, policies on scholastic dishonesty will be strictly enforced (Board of Regents Rules and Regulations and UTRGV Academic Integrity Guidelines). All scholastic dishonesty incidents will be reported to the Dean of Students.

**SEXUAL HARASSMENT, DISCRIMINATION, and VIOLENCE:** Required on all syllabi. Do not modify.
In accordance with UT System regulations, your instructor is a “Responsible Employee” for reporting purposes under Title IX regulations and so must report any instance, occurring during a student’s time in college, of sexual assault, stalking, dating violence, domestic violence, or sexual harassment about which she/he becomes aware during this course through writing, discussion, or personal disclosure. More information can be found at www.utrgv.edu/equity, including confidential resources available on campus. The faculty and staff of UTRGV actively strive to provide a learning, working, and living environment that promotes personal integrity, civility, and mutual respect that is free from sexual misconduct and discrimination.