

School of Applied Technologies



COURSE SYLLABUS MEMS1092

Course Number/Name:	MEMS1092/Intro to MEMS Lab	Section Number:		CRN:	
Class Day(s):		Class Time:			
Class Location:		Course Credits:	1hr Lab		
Prerequisite: Corequisite:	MEMS1002 (Theory) is recommended as a co-requisite or complete before the lab course				
Instructor:		Email:			
Web Address: [Optional]					
CNM Phone/Voice Mail:		Other:			
Office Hour(s):			Office Location:		

Texts & Supplies

Required text: None – all materials are web-based pdfs, streaming lectures, animations and video. Lab materials will be provided.

Supplies: Flash drive to save work is recommended. Notebook to keep notes.

Course Description

Focuses on Microelectromechanical systems (MEMS) including micro and nano-enable systems and covers how these tiny devices are made in this emerging high technology field. Fabrication and material basics are covered including hands-on labs both in the classroom environment and in a research clean room located on the campus of UNM. No books are required, and all reference materials are provided online including reading, animations, and streaming lecture educational materials. Lab exercises will be done in the classroom and/or at UNM’s MTTC clean room.

Student Learning Outcomes

Upon successful completion of this course the student should be able to:

1. Describe crystallography principals including the use of Miller indices, the meaning of amorphous, crystalline and polycrystalline structures, and how to tell the difference between (100) and (111) crystal silicon planes.
2. Describe the role crystal structure plays in isotropic and anisotropic etching.
3. Demonstrate an understand of concepts learned in the cantilever lab unit and how it relates to MEMS
 - a. Demonstrate an understanding of frequency, resonance, video data acquisition and analysis
 - b. Write a formal lab report
 - c. Describe how to apply cantilever principles to MEMS devices
4. Demonstrate an understanding of thin film oxide deposition and oxide etch rates through the observation of light interaction with thin films.
5. Demonstrate a comprehension of Clean Room Safety and Protocol
 - a. Define MSDS and demonstrate how to use the information to be safe
 - b. Define the NFPA diamonds and be able to apply the information to ascertain risk of exposure
 - c. Understand and demonstrate UNM MTTC Cleanroom Protocol and Safety Procedures
 - d. Demonstrate essentials of proper wafer handling techniques
6. Describe the process of basic mask making, silicon oxide deposition, photolithography and subsequent etching to create a 1x “art” wafer.
 - a. Define how patterning using photolithography is done
 - b. Describe wet and dry etch basics including the difference between anisotropic/isotropic etching
 - c. Describe deposition methods including oxidation, CVD, evaporation and sputter
7. Define the terminology and jargon used in the processing and fabrication of MEMS devices: resist, etch, wet etch, DRIE, RIE, sink, hood, exhaust, scrubber, BOE, HF, develop, developer, mask, reticle, alignment, bake, bake plate, HMDS, oven, SRD, QDR, dehydration, adhesion, photo speed, aligner, contact printing, inspection, HEPA, DI water, Liquid N2, acid, base, caustic, solvent...

The preceding outcomes will be accomplished through a series of in-class, hands-on educational “kits” provided by the Southwest Center for Microsystems Education as well as trips to the UNM MTTC clean room for safety training and the “art” wafer activity. Students will design and process a wafer in the cleanroom.

Attendance/Tardy/Withdrawal/Drop Policies

Since this is a hybrid course, part online and part face to face, participation in this course includes coming to the face-to-face classes as well as participating in online discussions and email threads. Much of the work is done in class, so not showing up to class will also affect your ability to complete activities and take quizzes.

To avoid interrupting or distracting the class, students are expected to be prompt for each class. Class will begin promptly at the time scheduled. Students who arrive to class more than 15 minutes late will be marked tardy. 2 tardies will equal one absence. **It is the student’s responsibility to drop/withdraw from the course in order to avoid a grade of “F.”** [Important dates](http://www.cnm.edu/depts/enrollment/registration/importantdatesanddeadlines.php), deadlines and the last day to drop this course can be found at <http://www.cnm.edu/depts/enrollment/registration/importantdatesanddeadlines.php>

“Snow Days”

In the event CNM is on a delayed schedule, classes meeting prior to the announced start time will not meet. Classes scheduled to meet for 45 minutes or more after the announced start time or starting at or after the announced start time will meet. In the event CNM closes during the last week of the class, the final grades for students may be calculated on all work assessed up to that point in the course. For students whose final assessment results could influence their grade in the class, an alternative time may be arranged individually.

Grading

The following will be used to determine your grade in this course:

The following scale is used to assign course grades:

	%
Assessments	20
Assignments: Lab reports and activity write ups	70
Participation	10
Total	100

Percentile Range	Grade
91-100	A
81-90	B
71-80	C
61-70	D
Below 61	F

Note: A final grade of “D” or “F” is not acceptable for this course if it is required for graduation or as a prerequisite for other courses. A final grade of “D” or “F” requires repeating this course.

Late/Make-up/Re-take Policies

Makeup Assessments

Assessments are not all weighted the same (some are worth more than others). Online assessments are typically available for one week – so there is no excuse to missing a one. Don’t wait until the last minute. If you have a legitimate excuse, the instructor may extend the time and / or reset the assessment on a case by case basis.

In class assessments will not be allowed to be made up. Under legitimate circumstances, a makeup quiz and/or special assignment can be requested to make up for the lost points.

Late Assignments

- Assignments are due on the due date.
- Online assignments have a submission cutoff date two days after the due date (48hrs).
- If an assignment is turned in late (but within 48 hours of the due date and time), 10% may be deducted.
- Assignments will not be accepted after the 48 hours unless a legitimate appeal has been made and accepted.

Course Codes & Policies

Student Behavior:

As a member of this classroom and lab, students are responsible for understanding and adhering to the CNM codes and policies that govern and prescribe acceptable student behavior. The codes and policies of this course are governed by the Academic Policies found on pp. 40-43 of the [CNM 2009-2011 Catalog](#) and the Student Code of Conduct found on pp. 298-310 of the [CNM 2009-2011 Catalog](#) accessed at <http://www.cnm.edu/coursecatalog/index.php>

If a student behaves in a manner that is disruptive or not safe to the educational process or violates any other provisions of the Code of Conduct, this behavior will (generally) first be addressed by the instructor. If the behavior continues, or escalates, this behavior will be reported to the Dean of Students for appropriate disciplinary action. If a student demonstrates behavior that is a violation of the Code of Conduct, CNM instructors may require the student to leave the classroom. Should this occur, the incident will be reported to the Dean of Students for further disciplinary action.

If safety protocols are violated at the MTTC cleanroom, or you do not pass the safety exam, you will not be allowed to participate in the cleanroom activities.

Academic Dishonesty:

Academic dishonesty hurts everyone involved. Forms of dishonesty are collaboration if individual work is required (i.e., exams); receiving assistance from others on take-home quizzes and exams if these require individual work; sharing completed assignments unless sanctioned by the instructor. Plagiarizing others work and presenting it as your own – all assignments which include information obtained from other sources must have the information cited and/or referenced. The Dean of Students will be notified of any instances of academic dishonesty.

Student Resources/Advisement/Graduation

Special Needs:

Special Services is a department that can provide students with documented disabilities the accommodations they might need. It is also a department that can help students who think they might have a disability. Students needing accommodation in an academic setting must contact [Special Services](#) at 224-3259 or at <http://www.cnm.edu/depts/ss/index.php>

The School of Applied Technology (AT) academic advisor is located at Main Campus in Ted Chavez Hall, Room 100, (224-3712). The AT advisor specializes in the programs offered through AT and is available to assist you in planning your schedule, evaluating your program of studies and completing graduation audits/checklists.

AT has a [listing of resources](#) and links for advisement and graduation that can be found at http://www.cnm.edu/depts/at/about/at_resources.php

The Achievement Coach (224-3340) is available to all AT students. The Achievement Coach's main job is to help students find the answers to questions concerning classes and issues involving college and life. The Achievement Coach helps with the following: program and course information, campus and community supports, balancing school, family and work, life changes and obstacles, and graduation information.

Tentative Class Schedule

Syllabus & Class Schedule: The syllabus and class schedule are subject to change by the instructor. Changes will be made with as much advance notice as possible.

All materials for this course and class schedule is provided on the Distance Learning site and in class. Course units will be made available throughout the semester – you will always have at least one week to complete an assignment from when it is made available.

Important dates, deadlines, and the last day to drop this course can be found at <http://www.cnm.edu/depts/enrollment/registration/importantdatesanddeadlines.php> and includes holidays.

There will be an opportunity to participate in a clean room experience at the University of New Mexico's MTTC Cleanroom. This requires the successful completion of a MTTC Cleanroom Safety and Protocol Learning prep module and:

1. attendance to a MTTC Safety Lecture (required)
2. attendance to the Fab Tour (required)
3. passing of a written safety exam (required) with passing grade of 80% or higher.

Once these requirements are met, the student will be able to participate in the cleanroom experience. The lecture, tour and experience will be held during the week. More than one session may be scheduled to meet the students needs – timing will be negotiated during the face-to-face class meetings.

Hands-on in class activities (face-to-face) will be held in N214 on the main campus (North Building). Parking is free on Fridays and Saturdays. We will have additional activities off site (tours, MTTC cleanroom experience) – specifics will be provided.

Electronic Devices in Class

All cellular telephones, pagers and beepers must be turned off or switched to silent or vibrate mode. During class, all pagers and cell phones are to be placed in your backpack or purse and not on the table or desk. Electronic entertainment devices are to be turned off and head phones removed. You may use your electronic devices to work on class assignments and surf the internet for additional information. It's like a job – you may use electronics for job related activities during work hours – not for personal, entertainment use.

Printing

PaperCut is an element of the sustainability effort at CNM. Its purpose is to reduce paper usage. Each student has an online account with an allotment of 150 pages of free printer pages per term. If this allotment runs out, additional pages may be purchased by the student. For more information, go to the PaperCut website: <http://cnm.edu/papercut>.