

EE4353 VLSI Nanotechnology
EE5318 Electronic Materials Processing

Spring 2021~~0~~-(Revised)
University of Texas at El Paso

Instructor: David Zubia, Ph. D. Office Hours:
Office: ~~335 Engineering Annex~~ Online _____ M 10:30-
12:00, W 10:30-12:00
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Course Description:

This course deals with the science and technology needed to fabricate semiconductor devices. The course will include lectures, hands-on laboratories and computer simulations. The course will cover important fabrication processes needed to manufacture electronic devices. The relationships between manufacturing conditions, structure and performance will be highlighted for each process to gain a deeper appreciation of each process. Emphasis is placed on conceptual understanding and problem solving.

Semiconductors and electronic devices are used in circuits to make complex analog and digital functions such as amplifiers (for audio, high-frequency, wireless, etc) and microprocessors. This course is fundamental to the manufacturing of electronic devices and will benefit persons from different backgrounds including, physics, chemistry, materials science, mechanical engineering and electrical engineering.

Topic for Graduate Students:

Graduate students will be part of an “advanced fabrication/simulation team”. The Advanced Team will have the task of assisting the course instructors to improve the fabrication and simulation processes as needed. This might require the Advanced Team to learn the material ahead of the rest of the class to assist the course instructors with fabrication procedures during scheduled labs. Deliverable: 1-page report describing contribution to improving the process and/or assisting the TA.

Learning Objectives:

After completion of this course, students should be able to:

- Understand the principles of fabrication processes including; Crystal Growth, Substrate Preparation, Diffusion, Thermal Oxidation, Ion Implantation, Lithography, Etching, and Thin Film Deposition.
- Apply the principles of fabrication processes and their integration to create functional semiconductor structures.
- Apply concepts important to efficient fabrication of semiconductor devices including Yield, Statistical Process Control, and Design of Experiments.
- For Graduate Students: Setup of laboratory experiments or computer exercises and assist with fabrication or simulation of semiconductor devices.

Topics Covered:

- MOSFET Fundamentals Review
- Simulation of Fabrication Processes
- General and Cleanroom Laboratory Safety
- Wafer Cleaning
- Thermal Oxidation
- Lithography
- Etching
- Thin Film Deposition
- Dopant Diffusion
- Ion Implantation
- Process Integration (If time permits)

Textbooks:

Silicon VLSI Technology, Plummer, Prentice Hall, 2000

Semiconductor Devices: Physics and Technology, 3rd Edition, S. M. Sze and M. K. Lee, Wiley, 2012

Course Work Evaluation:

	<u>Value</u>
Problems	<u>30%</u>
Exam <u>1</u>	<u>20%</u>
Exam <u>2</u>	<u>20%</u>
Exam <u>3</u>	<u>20%</u>
<u>Process Integration Assignment</u>	<u>10%</u>
Total	<u>100%</u>

Grading and Policies:

A: 90%-100% B: 80%-<90% C: 70%-<80% D: 60%-<70% F: 0-<60%

Late course work will not be accepted.

No make-up work will be given.

Lab Work Evaluation: (The nanofabrication facility will not be used during the spring 2021 semester due to COVID-19. Instead, simulation assignments will be given)

	<u>Value</u>
Attendance	60% 0 absences, 50% 1 absence, 40% 2 absences, 30% 3 absences, 0% \geq 4 absences
Demonstrate Oxidation	10%, 0% no effort
Demonstrate Lithography	10%, 0% no effort
Demonstrate Etching	10%, 0% no effort
<u>Demonstrate Deposition</u>	<u>10%, 0% no effort</u>
Total	100%

Lab Safety Training: (The nanofabrication facility will not be used during the spring 2021 semester due to COVID-19. Instead, simulation assignments will be given)

All students will be required to register and complete UTEP's Lab Safety Training before entering the cleanroom. The Lab Safety training will be given during class in the first week. Click on the following link to register for the Lab Training: <http://ehs.utep.edu/training.html>

Cleanroom Safety and Rules: (The nanofabrication facility will not be used during the spring 2021 semester due to COVID-19. Instead, simulation assignments will be given)

All students will be required to attend the Cleanroom Safety and Rules training session before entering the cleanroom. The training session will be given during class in the first week.

Academic Dishonesty:

Incidents of academic dishonesty will be referred to the Director of Electrical Engineering and the Dean of Students. <http://studentaffairs.utep.edu/Default.aspx?alias=studentaffairs.utep.edu/dos>

The descriptions and definitions of academic dishonesty can be found at: <http://admin.utep.edu/hoop> Look under Student Affairs and then Chapter one, section 1.3.1.

If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass.

UTEP ECE DEPARTMENT SYLLABUS ADDENDUM

Course models

Most ECE courses will follow either **fully-online** or **hybrid** models. Hybrid models will provide a virtual off-campus component and an in-person on-campus component. To follow social distancing guidelines on campus, faculty will arrange staggered attendance schedules. Laboratory classes will be offered online and/or in-person, in small groups and in spaces adequate to health and safety guidelines. For additional details, read the syllabus and consult your professor.

The ECE Department recognizes that students with health conditions or international students facing travel restrictions may encounter difficult situations. Virtual classes may be recorded to offer needed study flexibility and to allow students to review course material if it's helpful.

Required COVID-19 Training

Before the semester starts, the ECE Department requires all its students to complete a training module, which includes a video developed in large part by students and hosted by the President of the Student Government Association. Follow the link to this module:

[Link to COVID-19 Training](#)

Before you come to campus

Before coming to campus all ECE students should conduct a **daily self-screening** to ensure that they are symptom-free before coming to campus. The screening includes taking your temperature and assessing for the following symptoms:

- Fever or chills
- Cough
- Shortness of breath or difficulty breathing
- Fatigue
- Muscle or body aches
- Headache
- New loss of taste or smell
- Sore throat
- Congestion or runny nose
- Nausea or vomiting
- Diarrhea



Source: [Link to Image Source](#)

If you have any of these symptoms, you must **stay at home**, seek medical attention, and report to your professor. If you show any of the following signs, **seek emergency medical care immediately**:

- Trouble breathing
- Persistent pain or pressure in the chest
- New confusion
- Inability to wake or stay awake
- Bluish lips or face

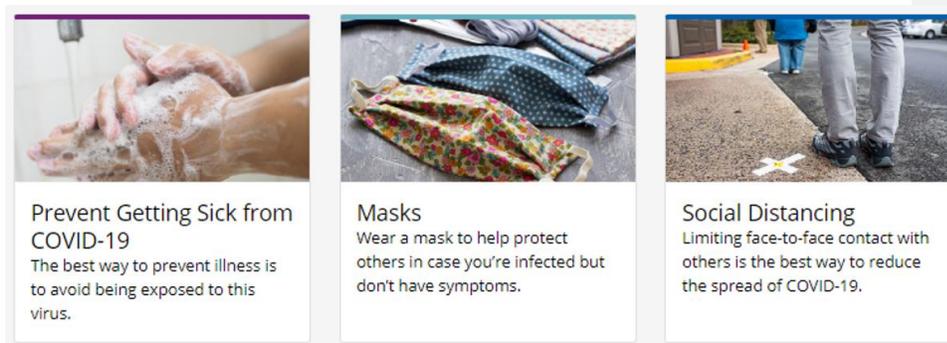
In addition, everyone **MUST** complete a COVID-19 screening before coming to campus. The link for reporting is

[Link to Screening Website](#)

This screening includes three required questions:

- In the last 5 days have you (or someone you live with) experienced any one of the COVID-19 symptoms above?
- If you have been tested for COVID-19 in the past 2 weeks, was the result positive?
- In the last 2 weeks, have you spent 15 minutes or more within 6 feet of anybody that you know has tested positive for COVID-19?

Before coming to campus, wash your hands, and pack a hand sanitizer bottle and a clean face mask.



Source: [Link to Image Source](#)

While on campus

UTEP is now requiring that *everyone* on the campus wear a CDC-approved face covering over the mouth and nose in all public spaces. This requirement includes classrooms, building entrances and exits, lobbies and lounges, as well as in hallways, stairwells, restrooms and elevators. UTEP will maintain and adjust its face-covering requirement as the pandemic evolves.

While on campus, ECE faculty will wear a face mask when giving in-person instruction. Likewise, students on campus will wear face masks in classrooms and laboratories and maintain social distancing (6 feet). Anyone refusing to face covering or to social distance themselves will be asked to leave the premises. Any escalation situations will be considered a public disruption and may require actions such as calling the UTEP campus police department and reporting the case to the Chair of the ECE Department and the Office of Student Conduct and Conflict Resolution (OSCCR).

One of the most effective ways of avoiding catching the corona virus, flu, or common cold is to wash your hands thoroughly after touching surfaces in common areas of places with high traffic. If this is not possible, use hand sanitizer as often as needed.

COVID-19 Testing on Campus

UTEP will test for COVID-19 in the fall. This will help us to rapidly identify individuals who have COVID-19 and do not have symptoms so they can isolate and avoid spreading it to others. The testing will focus on faculty, staff, and students who are on campus. Help us stop the spread of the corona virus and agree to participate in this voluntary testing program. Get tested when invited for testing at one of several on-campus locations.

Resources

UTEP Return to Campus Presentation [Link to Return to Campus Presentation](#)

UTEP Counseling and Psychological Services: 747-5302 or [Link to Counseling and Psychological Services](#)

UTEP Student Health and Wellness Center: [Link to Student Health and Wellness Center](#)

UTEP COVID-19 website: [Link to UTEP COVID-19 Website](#)

El Paso Strong statistics website: [Link to El Paso Strong Statistics Website](#)

El Paso COVID 19 information website: [Link to El Paso COVID-19 Information Website](#)

Ciudad Juarez COVID-19 resources website: [Link to Ciudad Juarez COVID-19 Resources Website](#)

US Centers for Disease Control and Prevention website: [Link to US Centers for Disease Control and Prevention Website](#)

