

Course Title: Microelectronic Processing and Characterization I

Course Prefix: ELEG

Course No.: 3041

Section No.: 01

Department of | Electrical and Computer  
Engr

College of | Engineering

Instructor Name:

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Office Hours: | M 1:00 to 2:00pm; T 1:00 to 3:00pm; W 1:00 to 3:00pm

Virtual Office Hours: |

Course Location: | *NENGR BLDG Room 221*

Class Meeting Days & Times: | M 2:00pm-4:50p

Catalog Description: | ELEG 3041.

Prerequisites: | ELEG 3033 or (see Co-requisite below)

Co-requisites: | ELEG 3033

**Required Text:** | None

**Recommended Text/Readings:**

Laboratory Handouts

Recommended book: Sorab K. Ghandhi, VLSI Fabrication Principles: Silicon and Gallium Arsenide; 2<sup>nd</sup> Edition, John Wiley & sons, New York 1994 (ISBN 0-471-580058)

Stanley A. Wolf and Richard N. Tauber, Silicon Processing for the VLSI Era Volume 1-Process Technology, Lattice Press, 1999 (ISBN 0-961-672161)

Peter Van Zant, Microchip Fabrication; McGraw-Hill, 2004 (ISBN 0-07-143241-8)

**Access to Learning Resources:**

PVAMU Library:

phone: (936) 261-1500;

web: <http://www.tamu.edu/pvamu/library/>

University Bookstore:

phone: (936) 261-1990;

web: <https://www.bkstr.com/Home/10001-10734-1?demoKey=d>

**Course Goals or Overview:**

The goal of this course is to provide students with knowledge of semiconductor wafer processing and hands on experiments with semiconductor device characterization.

**Course Outcomes/Objectives**

At the end of this course, the student will

- 1 | Be able to understand wafer processing, role of acids, alkali and solvents in wafer processing, understand Material Safety Data Sheets, laboratory safety procedures and clean room attires.
- 2 | Be able to use simulation software to implement Photolithography, Mask Design, Chemical Etch, Diffusion,

- 3 Metallization to design simple semiconductors structures like a diode and MOS capacitor
- 4 Be able to use 4-point probe to measure resistivity and perform doping calculations
- 5 Be able to understand MOS structures under accumulation, depletion and inversion bias
- 6 Be able to use laboratory equipment to perform I-V (current-voltage) characterization of off-the-shelf devices: diodes, MOSFETS
- 7 Be able to program ATE (Automatic Test Equipment) like Agilent 4155 and Keithley SMU KI236 and KI237 for automatic data acquisition. Interpretation of device data and troubleshooting
- 7 Self study project of one of the several commercial devices: structural design and applications. Audio-visual presentation is required

## Course Requirements & Evaluation Methods

This course will utilize the following metrics to determine student grades and proficiency of the learning outcomes for the course.

**Exams** – Laboratory tests designed to measure skills and knowledge obtained to conduct experiment and analyze data

**Experiment Demo** – Demonstration of proper operation of the experimental outcome in each lab session. Instructor signature is required on a demo sheet after the demonstration

**Projects** – Designed to measure ability to make oral presentation of material to class (audio-visual)

**Laboratory Reports** – A formal laboratory report is required for each experiment. Pre-lab work will be required for some laboratory experiments

**Attendance** – A significant downgrade occurs after two missed class/lab. sessions

### Grading Matrix

Topics	Value (percentages)
Exams (3 exams)	20%, 20%, 20%
Laboratory Reports with signed-off demo sheets	20%
Project & Presentation (audio-visual)	10%
Quizzes (announced and un-announced)	10%
Total:	100%

#### Grade Determination:

A = 90% or better

B = 80 – 89 %

C = 70 – 79 %

D = 60 – 69 %

F = Less than 60%

### Course Procedures

#### Submission of Assignments (Laboratory Reports):

All pre-lab (if required) and final lab reports should be submitted by the due date. Each formal laboratory report is due in the following week after the lab work is finished (Some lab experiments may require two lab sessions). Lab reports are due before the class. A penalty of 20% will be assessed for being one week late. After that the lab reports will not be accepted. A total of 7 lab reports are expected.

#### Formatting Documents:

Microsoft Word is the standard word processing tool used at PVAMU. If you're using other word processors, be sure to use the "save as" tool and save the document in either the Microsoft Word, Rich-Text, or plain text format.

#### Exam Policy

All laboratory experiments and the exams should be undertaken as scheduled. No makeup examinations will be allowed except under documented emergencies (See Student Handbook). Students can continue to use the laboratory space after hours if the lab access is available.

## 16 WEEK CALENDAR

<b>Week One:</b> Topic <b>January 14, 2019</b>	Introduction to Microelectronic processing and Characterization laboratory, ELEG 3041. Verification of pre-requisites and co-requisites, brief discussion of the following: course syllabus, formal laboratory report, pre-Labs, post-lab questions and assignments, working in a group, tour of the lab, grading policy, university policy, Note: The description of following three sheets. These are required to be attached to each lab report: 1. Student Grade Sheet 2. Student Cover Sheet 3. Student Demo Sign-Off Sheet  <b>Lab #1:</b> Wafer Processing: Wafer Identification, Wafer RCA Cleaning, Piranha Cleaning, MSDS, Silicon Run Video (Web search required)
<b>Week 2 (Off)</b> <b>Jan 21</b>	January 21, 2019: Dr. Martin Luther King, Jr Day
<b>Week Three:</b> Topic Jan 28	<b>Lab #1:</b> continued Wafer Processing: Wafer Identification, Wafer RCA Cleaning, Piranha Cleaning, MSDS, Silicon Run Video (Web search required). Prelabs required
<b>Week Four:</b> Topic <b>Feb 4, 2019</b>	<b>Lab1</b> Continued: MSDS, Clean Room Procedure. <b>Report#1</b> due
<b>Week Five:</b> Topic Feb 11	<b>Lab#1 Report due; Start Lab#2</b> Introduction to ICLAB Simulation Software. Use DOSBOX. Photolithography Processes; Mask Design, Photoresist Spin and Coat, Bake, Exposure, Etch. <b>Prelabs required</b>
<b>Week Six:</b> Topic <b>Feb 18</b>	<b>Lab #2</b> Continued Photolithography Processes.
<b>Week Seven:</b> Topic Feb 25	<b>Lab#2 Report due; Start Lab #3</b> Simulated Fabrication of p-n Diode using ICLAB simulation software. - <b>Test 1 (topics of lab1 &amp; lab2)</b>
<b>Week Eight:</b> Topic March 4, 2019	<b>Lab#3 continued</b> Simulated Fabrication of Diode. Prelabs required
<b>Week Nine:</b> Topic <b>March 11, 2019</b> <b>Spring Break</b> <b>March 11- 16</b>	Spring Break
<b>Week Ten:</b> Topic March 18	<b>Lab#3 Report due Lab #4 continued</b> Dry and Wet Oxidation Growth. Time and (Furnace) Temperature effects on Oxide Growth.
<b>Week Eleven:</b> Topic March 25	<b>Lab #4 Report due; Test 2</b>
<b>Week Twelve:</b> Topic <b>April 1, 2019</b>	<b>Lab #5:</b> Introduction to Automatic Test Equipment (ATE): HP 4145B, HP 4155 –SMUs, visit lab room 241, 2 <sup>nd</sup> floor ECE Bldg

**Week Thirteen:** Topic **Lab #5 continued:** Resistor and diode Characterization Using ATE, Troubleshooting  
April 8

**Week Fourteen:** Topic **Lab Report 5 due; Start lab#6** MOSFET Characterization (for labs 9,10,11) due  
April 15,2019

**Week Fifteen:** Topic **Lab #6 continued**  
April 21, 2019

**Week sixteen** Topic **Lab 6 Report due**  
April 28

**Final Exam**

# University Rules and Procedures

## **Disability statement (See Student Handbook):**

Students with disabilities, including learning disabilities, who wish to request accommodations in class should register with the Services for Students with Disabilities (SSD) early in the semester so that appropriate arrangements may be made. In accordance with federal laws, a student requesting special accommodations must provide documentation of their disability to the SSD coordinator.

## **Academic misconduct (See Student Handbook):**

You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with your Student Handbook, especially the section on academic misconduct. Students who engage in academic misconduct are subject to university disciplinary procedures.

## **Forms of academic dishonesty:**

1. Cheating: deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not mastered; giving or receiving aid unauthorized by the instructor on assignments or examinations.
2. Academic misconduct: tampering with grades or taking part in obtaining or distributing any part of a scheduled test.
3. Fabrication: use of invented information or falsified research.
4. Plagiarism: unacknowledged quotation and/or paraphrase of someone else's words, ideas, or data as one's own in work submitted for credit. Failure to identify information or essays from the Internet and submitting them as one's own work also constitutes plagiarism.

## **Nonacademic misconduct (See Student Handbook)**

The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor's ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. Such incidents will be adjudicated by the Dean of Students under nonacademic procedures.

## **Sexual misconduct (See Student Handbook):**

Sexual harassment of students and employers at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating this policy will be subject to disciplinary action.

## **Attendance Policy:**

Prairie View A&M University requires regular class attendance. Excessive absences will result in lowered grades. Excessive absenteeism, whether excused or unexcused, may result in a student's course grade being reduced or in assignment of a grade of "F". Absences are accumulated beginning with the first day of class.

## **Student Academic Appeals Process**

Authority and responsibility for assigning grades to students rests with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the Undergraduate Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.

# Technical Considerations for Online and Web-Assist Courses

## Minimum Hardware and Software Requirements:

- Pentium with Windows XP or PowerMac with OS 9
- 56K modem or network access
- Internet provider with SLIP or PPP
- 8X or greater CD-ROM
- 64MB RAM
- Hard drive with 40MB available space
- 15" monitor, 800x600, color or 16 bit
- Sound card w/speakers
- Microphone and recording software
- Keyboard & mouse
- Netscape Communicator ver. 4.61 or Microsoft Internet Explorer ver. 5.0 /plug-ins
- Participants should have a basic proficiency of the following computer skills:
  - Sending and receiving email
  - A working knowledge of the Internet
  - Proficiency in Microsoft Word
  - Proficiency in the Acrobat PDF Reader
  - Basic knowledge of Windows or Mac O.S.

**Netiquette (online etiquette):** students are expected to participate in all discussions and virtual classroom chats when directed to do so. Students are to be respectful and courteous to others in the discussions. Foul or abusive language will not be tolerated. When referring to information from books, websites or articles, please use APA standards to reference sources.

**Technical Support:** Students should call the Prairie View A&M University Helpdesk at 936-261-2525 for technical issues with accessing your online course. The helpdesk is available 24 hours a day/7 days a week. For other technical questions regarding your online course, call the Office of Distance Learning at 936-261-3290 or 936-261-3282

## Communication Expectations and Standards:

All emails or discussion postings will receive a response from the instructor within 48 hours.

You can send email anytime that is convenient to you, but I check my email messages continuously during the day throughout the work-week (Monday through Friday). I will respond to email messages during the work-week by the close of business (5:00 pm) on the day following ***my receipt*** of them. Emails that I receive on Friday will be responded to by the close of business on the following Monday.

## Submission of Assignments:

Assignments, Papers, Exercises, and Projects will distributed and submitted through your online course. Directions for accessing your online course will be provided. Additional assistance can be obtained from the Office of Distance Learning.

## Discussion Requirement:

Because this is an online course, there will be no required face to face meetings on campus. However, we will participate in conversations about the readings, lectures, materials, and other aspects of the course in a true seminar fashion. We will accomplish this by use of the discussion board.

Students are required to log-on to the course website often to participate in discussion. It is strongly advised that you check the discussion area daily to keep abreast of discussions. When a topic is posted, everyone is required to participate. The exact use of discussion will be determined by the instructor.

**It is strongly suggested** that students type their discussion postings in a word processing application and save it to their PC or a removable drive before posting to the discussion board. This is important for two reasons: 1) If for some reason your discussion responses are lost in your online course, you will have another copy; 2) Grammatical errors can be greatly minimized by the use of the spell-and-grammar check functions in word processing applications. Once the post(s) have been typed and corrected in the word processing application, it should be copied and pasted to the discussion board.