1. General:

Meeting Time: Wednesday: 7:10 pm – 9:50 pm
Location: KAUF 215
Instructor: Dr. Helmut Baumgart,
Office hours: Wednesday: 4:00pm – 7:00pm in KH 231-E and by appointment
E-mail: hbaumgar@odu.edu,
Office phone: (757) 269-7710 (at ODU-Applied Research Center, Thomas Jefferson National Accelerator Labs, Newport News)

2. Course Description:

This is a most useful course if you are working with semiconductor materials or devices and if you are involved with measurements in Solid State Electronics projects.
It will give you a good overview of most of the characterization techniques in the semiconductor industry and teach you the fundamental techniques that are applied on a daily basis in modern semiconductor electronics R&D labs around the world. The success of semiconductor microelectronics would not have been possible without the simultaneous development of very sophisticated measurement tools & techniques needed to monitor complex processing steps and to assess compliance of electrical device parameters with design specification. We distinguish broadly between:
Electrical measurements
Optical measurements
Electron and ion beam measurements
X-ray and probe measurements
The prerequisite for this course is a previous course in semiconductor device physics,
You should be familiar with the basic semiconductor devices: p-n junctions, metal-semiconductor devices, and MOS devices

3. Course and Learning Objectives:

The objective of this course is to obtain a good understanding of most of the characterization techniques and metrology tools used in the semiconductor industry and Solid State Laboratories. Today most experimental Masters and PhD thesis work in solid state electronics is being conducted with these characterization techniques.

The major emphasis will be on electrical characterization, since these characterization techniques are most frequently used.

Due to their crucial importance in R&D, optical techniques, as well as electron beam, ion beam, and X-ray methods will also be discussed in detail.

This course will cover the following material:
Optical Characterization

1. Optical Microscopy
2. Ellipsometry
3. Transmission, Reflection
4. Photoluminescence
5. Emission Microscopy

Physical and Chemical Characterization

1. Scanning Electron Microscopy
2. Auger Electron Spectroscopy
3. Transmission Electron Microscopy
4. Voltage Contrast
5. Secondary Ion Mass Spectrometry
6. Rutherford Backscattering
7. X-Ray Fluorescence
8. X-Ray Photoelectron Spectroscopy
9. Probe Microscopy

Electrical Characterization:

1. Resistivity
2. Carrier/Doping Densities
3. Contact Resistance
4. Series Resistance
5. Fixed Oxide trapped and mobile Oxide Charge
6. Interface Trapped Charge
10. Capacitance –Voltage Measurements and MOS Capacitors

4. Required Main Text Book:


5. Additional Reading References:


6. Student Evaluation:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm Paper Project:</td>
<td>40%</td>
</tr>
<tr>
<td>Comprehensive Final Term Paper:</td>
<td>40%</td>
</tr>
<tr>
<td>Powerpoint Presentation of final Term Paper:</td>
<td>20%</td>
</tr>
</tbody>
</table>

7. Grading:

≥ 95% = A; ≥ 90% = A-; ≥ 85% = B+; ≥ 80% = B; ≥ 75% = B-; ≥ 70% = C+; ≥ 65% = C; ≥ 60% = C-; ≥ 55% = D; < 50% = F

8. Class attendance:

Mandatory

9. Blackboard:

I shall post all my lecture notes and all my MS Powerpoint Viewgraphs on Blackboard where you’ll also find Notes, the course Syllabus, Assignments, Modules & Messages:

10. Academic Integrity and ODU Honor Code:

As engineers you will be responsible for upholding the canons of ethics of the profession. The Honor System at ODU is based upon the integrity of the individual. This system assumes that the student will accept his or her role in the University community with a feeling of self-respect and duty. The Honor Pledge (attested by signature) requires that each piece of work submitted by a student is to be his/ her own work unless prepared under other conditions specified by the instructor.
11. Disability:

Students with documented learning disabilities should see the instructor during the first week of class to make proper arrangements.