SYLLABUS: ECE 5194.14
Group Studies in Semiconductor Material and Device Characterization
(Updated September 10, 2018)
Spring 2019

Course Description: This course will mainly cover several characterization techniques based on optical, electrical and chemical/physical methods that are used for semiconductor materials and devices. Electrical methods will be mostly covered. It will be discussed how material and device parameters, such as resistivity, carrier and doping density; contact resistance, Schottky barrier, series resistance carrier lifetime, and mobility are measured using these methods.

Prerequisite: ECE 3030

Units: 3 credit hours.

Lecture Hours: MWF, 10:20-11:15 PM

Learning Goals:

- Be familiar with the semiconductor material and device characterization techniques.
- Be familiar with mostly the electrical characterization methods that are by far the most ubiquitous in the modern semiconductor industry
- Be familiar with the relevant figure of merits; affecting material quality and device performance
- Be competent in characterizing semiconductor materials and devices
- Be familiar with applicability and limitations of these characterization techniques

Instructor: Prof. Shamsul Arafin
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Textbook:
Required: Semiconductor Material and Device Characterization, Third Edition; Dieter K. Schroder; ISBN: 9780471739067; Online ISBN: 9780471749097, John Wiley & Sons, Inc.

Grading:

Midterm-1	25%
Midterm-2	25%
Final Exam	30%
Homework	20%

You are allowed to drop one homework with the least score.

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Exams: Exams are closed book. You will be allowed a single cheat sheet, 8.5" by 11", with handwritten notes only, on one side only. Scientific/graphic calculators are allowed. No internet-enabled devices are permitted. No cooperation on the examination is allowed. I am required to report any academic misconduct to the Committee on Academic Misconduct (COAM).

Missed exams: Any missed mid-term exams will result in a zero grade unless arrangements are made in advance. Suitable circumstances include illness, death in the immediate family, and situations of comparable gravity. In such cases, *if and only if arrangements are made in advance*, a make-up mid-term exam can be arranged. Midterms dates are announced well in advance, so plan your job interviews and such around them.

Reaching me: You may reach me during office hours, or make an appointment by email if you cannot make my office hours.

Final Exam
Our final exam will be on May. xx 2019 from 2:00 PM-3:45 PM. No make-up or early exams allowed.

Disabilities Statement
Any student who feels s/he may need an accommodation based on the impact of a disability should contact the instructor privately to discuss specific needs. Please contact the OSU Office for Disability Services for assistance in verifying the need for accommodations and developing accommodation strategies.

Academic Misconduct Statement
Any student found to have engaged in academic misconduct, as set forth in the Code of Student Conduct Section 3335-23-04, Prohibited Conduct, will be subject to disciplinary action by the university. Academic misconduct is any activity that tends to compromise the academic integrity of the university, or subvert the educational process.

Student Conduct
Students are expected to abide by the provisions in the Code of Student Conduct. The University's Code of Student Conduct and Sexual Harassment Policy are available on the OSU Web page.

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COURSE OUTLINE

Topic	# of lectures
Overview, motivation	1
Resistivity: four point probe, wafer mapping, resistivity profiling	3
Carrier and doping density: CV, Hall, measurement errors and precautions, optical techniques including free carrier absorption, PL, infrared spectroscopy, lateral profiling	6
Contact resistance, metal semiconductor contacts, Schottky barriers and electromigration	5
Series resistance, channel length and width, threshold voltage and hot carriers: PN junction diodes, solar cells, BJT, MOSFET	4
Defects: generation-recombination, capacitance, DLTS	4
Carrier lifetime: surface generation/recombination velocity, recombination lifetime: optical and electrical measurements	6
Mobility: conductivity, Hall effect, magnetoresistance, MOSFET	4
Optical characterization: Microscopy, ellipsometry, transmission, reflection, light scattering, modulation spectroscopy, interferometric spectroscopy, linewidth, PL and Raman spectroscopy	6
Chemical and physical characterization: electron beam techniques including SEM, TEM; scanning probe microscopy	2