Southern Illinois University Carbondale
ECE 557 Syllabus Spring 2016

Instructor: Dr. S. S. Ahmed
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Office: ENGR E-222
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Office Hours: MWF 10:00 – 11:00 a.m. and 12:00 – 1:00 p.m. (or by appointment)
Lecture: MW, 4:00 – 5:15 p.m., ENGR A-310
Lab: N/A

Prerequisite: ECE 345 or PHY 425 or instructor consent

Textbook:
The subject matter for this course will be heavily drawn from the research literature and extensive references will be provided in the class notes. A useful book: Dragica Vasileska, Stephen M. Goodnick, and Gerhard Klimeck. Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation, 1st Edition, CRC Press, June 2, 2010.

Other Useful Books:

Course Topics (Tentative):

Grading/Evaluation:

Homework 50%
Project 25%
Final Exam 25%

Letter grade: A: 90-100 B: 80-89 C: 70-79 D: 60-69 F: <60
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Topical Outline (Tentative):

Introduction:
Different classes of semiconductor devices
What is meant by TMS (theory-modeling-simulation)?
Why modeling and simulation?
Multiscale modeling: Why modular approach?
Device modeling: Industry and Academia

Computers and computing:
Computer hardware, Linux clusters, Top supercomputer centers in the world
Computer software:
(a) Operating system: Linux operating system, shell commands and shell scripting, X11, accessing Linux machine from Windows, cygwin
(b) Editing text with the vi editor
(c) Development tools: C/C++, FORTRAN; Makefile, debug, XML, parallel programming, CVS/subversion, valgrind, doxygen, scripting with Tcl/Python
(d) Publishing tools: data visualization, Illustrator (image creation and editing), LaTeX, IEEE and APS author guides
(e) Software deployment using Rappture

Essential numerical methods:
Finding roots, integration, differentiation
Solving differential equations:
Discretization into a matrix equation, solving matrices, eigenvalues and eigenvectors
Polynomial fitting
Monte Carlo method

Fundamentals of carrier transport:
Drude’s model
Landauer’s model and ballistic transport
Wave equations
Quantum transport equations
Boltzmann Transport Equation
Drift-Diffusion model
Hydrodynamic model
Ballistic model

Modeling electrostatics
Poisson’s equation
Analytical solution
Numerical solution: Discretization, Boundary conditions, Matrix inversion

1 lectures 2.2%
5 lectures 11%
4 lectures 8.8%
3 lectures 6.6%
4 lectures 8.8%
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**Solving continuity equations:**  
- Numerical solutions of the electron-hole continuity equations  
 3 lectures  6.6%

**Electronic bandstructure calculation:**  
- Numerical solution of Schrödinger equation  
- Wave packet dynamics  
- Periodic potential and the Kronig-Penny model  
- Bandstructure calculation using the tight-binding method:  
  - Theory, implementation, case study on a graphene lattice  
  - Electron density of states and effective mass  
 5 lectures  11%

**Modeling scattering processes and carrier mobility:**  
- Phonon modes  
- Perturbation theory  
- Scattering rate calculation  
- RTA and Rhode’s iterative method for mobility modeling  
- Various mobility models  
 5 lectures  11%

**Phonon transport and thermoelectrics:**  
- Thermal conductivity  
- Self-heating in semiconductor devices  
- ZT figure-of-merit of thermoelectric devices  
 3 lectures  6.6%

**Fundamentals of optical processes:**  
- Optical transition rate  
- Internal and external quantum efficiency  
- Efficiency droop and lumen depreciation  
 3 lectures  6.6%

**Commercial and non-commercial semiconductor device modeling tools:**  
- 4 lectures  8.8%
Classroom Policies:
A. Syllabus is subject to change at the instructor’s discretion. Students are responsible for all announcements made in class and/or posted to D2L.
B. Attendance Policy: Attendance will be taken at random throughout the semester, and it may be counted toward the final grade.
C. Late Homework/Missed Exams: Late homework is not accepted. If an exam is missed for a legitimate reason, a grade will be assigned based on the remaining homework/exams.
D. Mobile Technology Policy: N/A.
IMPORTANT DATES *
Semester Class Begins: 01/19/2016
Last day to add a class (without instructor permission): 01/24/2016
Last day to withdraw completely and receive a 100% refund: 01/31/2016
Last day to drop a course using SalukiNet: 04/03/2016
Last day to file diploma application (for name to appear in Commencement program): 02/12/2016
Final examinations: 05/09–05/13/2016
Note: For outreach, internet, and short course drop/add dates, visit Registrar’s Academic webpage http://registrar.siu.edu/

SPRING SEMESTER HOLIDAYS
Martin Luther King, Jr.’s Birthday Holiday 01/18/2016
Spring Break 03/12—03/20/2016
WITHDRAWAL POLICY ~ Undergraduate only
Students who officially register for a session may not withdraw merely by the stopping of attendance. An official withdrawal form needs to be initiated by the student and processed by the University. For the proper procedures to follow when dropping courses and when withdrawing from the University, please visit http://registrar.siu.edu/catalog/undergraduatecatalog.html

INCOMPLETE POLICY ~ Undergraduate only
An INC is assigned when, for reasons beyond their control, students engaged in passing work are unable to complete all class assignments. An INC must be changed to a completed grade within one semester following the term in which the course was taken, or graduation, whichever occurs first. Should the student fail to complete the course within the time period designated, that is, by no later than the end of the semester following the term in which the course was taken, or graduation, whichever occurs first, the incomplete will be converted to a grade of F and the grade will be computed in the student's grade point average. For more information please visit: http://registrar.siu.edu/grades/incomplete.html

REPEAT POLICY
An undergraduate student may, for the purpose of raising a grade, enroll in a course for credit no more than two times (two total enrollments) unless otherwise noted in the course description. For students receiving a letter grade of A,B,C,D, or F, the course repetition must occur at Southern Illinois University Carbondale. Only the most recent (last) grade will be calculated in the overall GPA and count toward hours earned. See full policy at http://registrar.siu.edu/catalog/undergraduatecatalog.html

GRADUATE POLICIES
Graduate policies often vary from Undergraduate policies. To view the applicable policies for graduate students, please visit http://gradschool.siu.edu/about-us/grad-catalog/index.html

DISABILITY POLICY
Disability Support Services provides the required academic and programmatic support services to students with permanent and temporary disabilities. DSS provides centralized coordination and referral services. To utilize DSS services, students must come to the DSS to open cases. The process involves interviews, reviews of student-supplied documentation, and completion of Disability Accommodation Agreements. http://disabilityservices.siu.edu/

PLAGIARISM
Student Conduct Code http://srr.siu.edu/student_conduct_code/

SIU ONLINE
http://www.lib.siu.edu/about

SAFETY AWARENESS FACTS AND EDUCATION
Title IX makes it clear that violence and harassment based on sex and gender is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: http://safe.siu.edu

ALUKI CARES
The purpose of Saluki Cares is to develop, facilitate and coordinate a university-wide program of care and support for students in any type of distress—physical, emotional, financial, or personal. By working closely with faculty, staff, students and their families, SIU will continue to display a culture of care and demonstrate to our students and their families that they are an important part of the community. For Information on Saluki Cares: (618) 453-5714, or siucares@siu.edu, http://salukicares.siu.edu/index.html

EMERGENCY PROCEDURES
Southern Illinois University Carbondale is committed to providing a safe and healthy environment for study and work. We ask that you become familiar with the SIU Emergency Response Plan and Building Emergency Response Team (BERT) programs. Emergency response information is available on posters in buildings on campus, available on BERT’s website at www.bert.siu.edu, Department of Safety’s website at www.dps.siu.edu (disaster drop down) and the Emergency Response Guideline pamphlet. Instructors will provide guidance and direction to students in the classroom in the event of an emergency affecting your location. It is important that you follow these instructions and stay with your instructor during an evacuation or sheltering emergency.

INCLUSIVE EXCELLENCE
SIU contains people from all walks of life, from many different cultures and sub-cultures, and representing all strata of society, nationalities, ethnicities, lifestyles, and affiliations. Learning from and working with people who differ is an important part of education as well an essential preparation for any career. For more information please visit: http://www.inclusivexcellence.siu.edu/

LEARNING AND SUPPORT SERVICES
Help is within reach. Learning support services offers free tutoring on campus and math labs. To find more information please visit the Center for Learning and Support Services website:
Tutoring: http://tutoring.siu.edu/
Math Labs http://math.siu.edu/courses/course-help.php

WRITING CENTER
The Writing Center offers free tutoring services to all SIU students and faculty. To find a Center or Schedule an appointment please visit http://write.siu.edu/

AFFIRMATIVE ACTION & EQUAL OPPORTUNITY
Our office's main focus is to ensure that the university complies with federal and state equity policies and handles reporting and investigating of discrimination cases. For more information visit: http://diversity.siu.edu/

ADDITIONAL RESOURCES AVAILABLE:

SIU ONLINE: http://online.siu.edu/