

NEW ECE COURSE / FALL 2013

ECE 493-001/593M-001 Technology of Integrated Circuits

Instructor: Dr. Shaikh S. Ahmed

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Office Hours: TTH 10:00 a.m. – 1:00 p.m. (or by appointment)

Lecture: TTH 3:35 – 4:50 p.m., ENGR A-420

Total Credit Hours: 3

Prerequisite: ECE 345 or ECE 447

Text Book: The subject matter for this course will be heavily drawn from the literature and extensive references will be provided in the class notes. A list of useful books is provided in the following:

- 1) *Semiconductor Material and Device Characterization* by Dieter Schroder, Wiley-IEEE Press, 3rd edition (January 30, 2006), ISBN-10: 0471739065, ISBN-13: 978-0471739067
- 2) *Introduction to Micro Fabrication* by Sami Franssila, Wiley 2nd edition, 2010, ISBN: 978-0-470-74983-8

Tentative Outline:

The economic driving forces:

Moore's law and more-than-Moore; IC industry: organogram and operation

Materials for state-of-the-art integrated circuits:

Semiconductor crystals, tubular and monolayer materials, organic materials, heterostructures, wafers and notations

Micro- and nano- fabrication technologies:

Wafer technology, Basic processing steps in IC fabrication, Selective doping techniques including diffusion and ion implantation, Nanolithography, Etching, Contacts and interconnects, Spontaneous formation and ordering of nanostructures, Methods of nanotube and thin-film growth, Chemical and biological methods for fabrication, Fabrication of electromechanical (MEMS) systems, IC assembly and packaging.

Semiconductor device and circuit characterization:

Electrical Characterization: Wafer mapping using four point probe, Doping and Line width profiling, Measurement of contact resistance, threshold voltage, channel length and width, Oxide charges and interface traps measurements using CV profiling, Defects characterization using DLTS, Carrier lifetime using photoconductance decay; Optical characterization: Microscopy and Spectroscopy, Ellipsometry, Fourier transform infrared spectroscopy (FTIR), Photoluminescence spectroscopy (PL), Raman spectroscopy, Acoustic microscopy; Electron Beam Microscopy (High Resolution Imaging): SEM, EMP, TEM, AES, SPM; Particle Beam Analysis (Dopants and Impurities): Secondary ion mass spectrometry (SIMS), Rutherford backscattering spectrometry (RBS), Neutron activation analysis (NAA), AFM; X-ray Techniques (Contamination and Physical Defects): X-Ray fluorescence (XRF), X-Ray photoelectron spectroscopy (XPS), X-Ray diffraction (XRD)

Reliability of devices and ICs:

ICs in harsh environments, hot carriers, NBTI, electromigration, electrostatic discharge, IC power and hot-spot cooling using thermoelectrics

Future directions:

Computing

Communication

Emerging IC technologies: biochips, energy harvesting, sensors, organic ICs

Grading: HW (30%), Midterm examination (25%), Final examination (30%), Final paper (15%)

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.

Mobile Technology Policy: N/A

University Policies

A. Incomplete Grades: 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 a time period designated by the instructor but not to exceed one year from the close of 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, not to exceed one year, or graduation, whichever comes first, the incomplete will be converted to a grade of F and the grade will be computed in the student's grade point average. Students should not reregister for courses in which an INC has been assigned with the intent of changing the INC grade. Re-registration will not prevent the INC from being changed to an F.

B. Academic Integrity: You are expected to submit your original work and adhere to the academic policies as stated in the SIU Student Conduct Code: <http://srr.siu.edu> (listed under Additional Links). Any act of academic dishonesty, cheating, or plagiarism in any form, including anonymous internet sources used in student papers, will be reported. These acts are taken seriously and the consequences may range from failing an assignment to expulsion from the university.

C. SIU Email: Your SIU email account is an official form of University communication. Your instructor will use SIU email as a primary means of electronic communication with students. Please make sure that you maintain a valid password and acquire the habit of regularly checking your SIU email account for important instructor and University announcements. You may view the official SIU Student Email Policy at: <http://policies.siu.edu/policies/email.html>.

D. Emergency Procedures: SIU is committed to providing a safe and healthy environment for study and work. Because some health and safety circumstances are beyond our control, we ask that you become familiar with SIU Emergency response Plan and building Emergency Response Team (BERT) program. Emergency response information is available on posters in buildings on campus, available on BERT's website at <http://www.bert.siu.edu/>, the SIU Department of Public Safety's website www.dps.siu.edu (disaster dropdown and video, "Shots Fired"), and in the Emergency Response Guideline pamphlet. Know how to respond to each type of emergency. 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. The Building Emergency Response Team will provide assistance to your instructor in evacuating the building or sheltering within the facility.

E. Supplementary Assistance: SIU is committed to assisting students with disabilities. With the cooperation of SIU's Disability Support Services (DSS), each student who qualifies for reasonable supplementary assistance has the right to receive it. Students requesting supplementary assistance must first register with DSS in Woody Hall, B-150, 618-453-5738 or 618-453-2293 (TTY), by email DSS@siu.edu, or <http://disabilityservices.siu.edu/>. Notice: If you have any type of special need(s) or disability for which you require accommodations to promote your learning in class, please contact me as soon as possible. The Office of Disability Support Services (DSS) offers various support services and can help you with special accommodations. You may wish to contact DSS to verify your eligibility and options for accommodations related to your special need(s) or disability.

Student Services

A. Learning Support Services: The Center for Learning Support Services (CLSS) assists students of all cultures, abilities, backgrounds and identities with enhancing their self-management and interdependent learning skills. Programs offered by CLSS include: group study sessions; math tutoring; academic coaching; early intervention program; and study skills seminars. For additional information please contact CLSS in Woody Hall, Room A-313, 618-453-2925, or www.tutoring.siu.edu.

B. Writing Center: The Writing Center offers free tutoring services and assistance with improving writing skills to all SIU undergraduate students and faculty. For center locations and hours, to schedule an appointment online, and to view information regarding the Online Writing Lab (OWL) contact the Writing Center at 618-453-1231 (Morris Library location); 618-453-2927 (Trueblood location), or www.write.siu.edu.

C. Saluki 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. To make a referral to Saluki Cares click, call or send: <http://salukicare.siu.edu/index.html>; 618-453-5714, or siucares@siu.edu.