

**EEE 6428: Nanoscale Devices for VLSI Technology
(Spring 2021, MWF 4th period)**

Instructor:

Dr. Jing Guo
Office location: 551 NEB
Telephone: 392-0940
E-mail address: guoj@ufl.edu
Class Web site: UFL elearning canvas website
Office Hours: TBD

Course Description: (3 credits) Understand nanoscale devices in future very large scale integration (VLSI) technologies; 10nm-scale transistors, ballistic nanotransistors, new materials for transistors, molecular transistors, nanowires, and nanotransistor circuit models.

Course Pre-requisites: EEE 4420/EEE 5426 "Intro to Nano Devices" or EEE5400 "Future of Microelectronic Technology"

Course Objectives: To understand state-of-the-art and future nanotransistors in VLSI technologies.

Recommended Materials:

- (1) Class notes and handouts
- (2) Title: Quantum Transport: Atom to Transistor (required)
Author: S. Datta
Publication date and edition: Cambridge University Press, 2005
- (3) Title: Nanoscale Transistors: Device Physics, Modeling, and Simulation (Recommended)
Author: M. Lundstrom and J. Guo
Publication date and edition: Springer, 2005

Topics:

Overview of MOS field effect transistor
Device model of double gate MOSFETs and FINFETs
Ballistic silicon transistor
Quasiballistic transistor
Nanowire transistor
Molecular scale transistor
Basic concepts of Schrödinger Equation
Self-Consistent Electrostatics
Bandstructure of new channel materials (III-V material)
2D Nanomaterials for Flexible Electronics (graphene)
Quantum effects in FINFET

Online Course Recording

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

F2F Course Policy in Response to COVID-19

We will have face-to-face instructional sessions to accomplish the student learning objectives of this course. In response to COVID-19, the following policies and requirements are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- You are required to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Failure to do so will lead to a report to the Office of Student Conduct and Conflict Resolution.
- This course has been assigned a physical classroom with enough capacity to maintain physical distancing (6 feet between individuals) requirements. Please utilize designated seats and maintain appropriate spacing between students. Please do not move desks or stations.
- Sanitizing supplies are available in the classroom if you wish to wipe down your desks prior to sitting down and at the end of the class.
- Follow your instructor's guidance on how to enter and exit the classroom. Practice physical distancing to the extent possible when entering and exiting the classroom.
- If you are experiencing COVID-19 symptoms (Click here for guidance from the CDC on symptoms of coronavirus), please use the UF Health screening system and follow the instructions on whether you are able to attend class. Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms.
- Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. Find more information in the university attendance policies.

Attendance Policy, Class Expectations, and Make-Up Policy

This class will be presented online using Zoom and requires access to a working webcam and stable internet connection. I prefer that students keep their camera on during the class so that I can see you as I would during normal face-to-face classes. Studies show that if we can see each other's faces then we will have more engagement, more student success, and more faculty success. However, this is not a requirement. I understand if on certain days you can't have your camera on due to internet bandwidth limitations, other family members, health issues, or any other reasons.

Excused absences must be in compliance with university policies in the Graduate Catalog (<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#attendance>) and require appropriate documentation.

Grading:

- (1) 15% homework and in-class quizzes.
- (2) 20% Research paper presentation: Each student will choose a research paper, preferably related to their term project, in the field of nanoscale device technology and present it in class. The presentations will be graded based on 1) the presenter's ability to clearly describe the problem, explain the solution, and evaluate the (experimental or simulation) results, 2) the quality of answers provided to the questions, and 3) the content of the slides.
- (3) 30% Midterm Exam: The exam is based on class notes including oral comments, problems solved in classroom and homework and quiz problems. The students are responsible for the above materials.
- (4) 35% Final Project: It consists of 30% final presentation, and 5% peer review participation. Final presentation: Half of the final presentation should be overview of the research field for the project, and the other half shall clearly identify a problem, perform calculation, modeling, or simulation, and reach **your own conclusion** on the nanoscale device studied in the project.

Make-Up Exam Policy: If you have a University-approved excuse and arrange for it in advance, or in case of documented emergency, a make-up exam will be allowed and arrangements can be made for making up missed exam. University attendance policies can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx> The student must submit a written petition to the instructor two weeks prior to the scheduled exam and the instructor must approve the petition.

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules,

disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>