

## **Advanced VLSI Design**

EEE 6323

**Class Periods:** Tuesday | Period 7 (1:55 PM - 2:45 PM) and  
Thursday | Period 7 - 8 (1:55 PM - 3:50 PM)

**Location:** Online

**Academic Term:** Spring 2022

### ***Instructor:***

Name: Swarup Bhunia

Email Address: [swarup@ece.ufl.edu](mailto:swarup@ece.ufl.edu)

Office Phone Number: 352-392-5989

Office Hours: Friday 2-3pm or by appointment

### ***Teaching Assistant/Peer Mentor/Supervised Teaching Student:***

Please contact through the Canvas website

- TBD

### ***Course Description***

Advanced very large scale integrated circuit design, testability, and performance evaluation. Use of industrial VLSI software. Building an advanced CMOS VLSI circuit.

### ***Course Pre-Requisites / Co-Requisites***

EEE 5322 - VLSI Circuits and Technology

Students with foundational knowledge in digital circuit design would be eligible to meet the prerequisite.

Instructor's permission needed.

### ***Course Objectives***

To develop a basic understanding of CMOS integrated circuit design. To develop foundational knowledge in system on chip (SoC) architecture and design, including low power, secure and testable SoC design methods. To develop proficiency in analysis, design and implementation of CMOS circuits. To develop a basic understanding of design considerations to maximize chip success.

### ***Materials and Supply Fees***

Not Applicable

### ***Required Textbooks and Software***

- Title: CMOS VLSI Design 4e: A circuits and systems perspective
- Neil H.E. Weste, David Harris
- 2010, 4<sup>th</sup> Edition, Pearson
- ISBN-10: 9789332542884

In addition, handouts developed by instructor may be downloaded from Canvas.

### ***Recommended Materials***

- Title: Digital Integrated Circuits, A Design Perspective
- Author: Jan. M. Rabaey, A. Chandrakasan, and B. Nikolic
- 2003, 2<sup>nd</sup> Edition, Prentice Hall
- ISBN-10: 0130909963

**Computer and Software Required:** Workstations in the NEB 2nd floor ECEL lab with CADENCE Design system will be used throughout the course. All students are required to have a Gator link account and use Canvas for course handouts, grade information, course notices, etc., see e-learning support services

**Course Study Requirements:** Students are responsible to study all in class materials including those written on the

board and presented orally, all Class Handouts all assigned readings, all projects and homework. Absence from class can result in missing materials tested on exams.

### **Course Schedule**

- Week 1: Syllabus, Introduction to AVLSI, CMOS gate design review / Lecturer: Swarup Bhunia
- Week 2: Layout, DC and Transient Analysis, PUN graph example, Logical Effort / Lecturer: Swarup Bhunia / Homework 1
- Week 3: Multi-stage logic and networks, power dissipation and analysis / Lecturer: Swarup Bhunia / Review paper assigned
- Week 4: Circuit Families and advanced circuit families / Lecturer: Swarup Bhunia / Homework 1 solution
- Week 5: Arithmetic circuits and advanced arithmetic circuits, finite state machine (FSM) design / Lecturer: Swarup Bhunia / Homework 2
- Week 6: Power dissipation and power analysis, timing analysis / Lecturer: Swarup Bhunia / Exam 1
- Week 7: Power dissipation and power analysis, timing analysis / Lecturer: Swarup Bhunia / Homework 2 solution
- Week 8: Low-power design / Lecturer: Swarup Bhunia / Exam 1 solution
- Week 9: Low-power and robust design / Lecturer: Swarup Bhunia / Homework 3
- Week 10: Digital design flow / Lecturer: Swarup Bhunia / Review paper due
- Week 11: System on chip (SoC) architecture, intellectual property (IP) integration / Lecturer: Swarup Bhunia / Homework 3 solution
- Week 12: SoC security 1 (security policies, security architecture) / Lecturer: Swarup Bhunia / Exam 2
- Week 13: SoC security 2 (security design and verification) / Lecturer: Swarup Bhunia / Exam 2 solution

AVLSI Final Design project, Report Due Monday April 25, 2022, there will be design demos in the NEB lab on and after April 22, 2022.

Group Review Article: Due Monday March 21, 2022.

### **Attendance Policy, Class Expectations, and Make-Up Policy**

The instructor prefers extensive interaction with students in the class on the course topics presented in the class. Hence, attendance is highly recommended. There is a no wireless device policy (no cell phones, smart phones, computers, tablets, etc.) during exams. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>. Excused absences must be in compliance with university policies in the Graduate Catalog (<https://catalog.ufl.edu/graduate/regulations/>) and require appropriate documentation.

**Make Up Exam Policy:** Students are expected to attend exams at the scheduled times. Exams can be made up if there is a genuine medical emergency with a doctor's or clinic medical note or a family emergency with some documentation. Students are NOT excused from exams for job interviews and early holiday travel home. Students with other non-emergency exam scheduling issues must obtain permission from the instructor prior to missing an exam.

### **Evaluation of Grades**

The grade for each student will be evaluated based on the following: Homework Sets (3), One Final project, Two Exams: Exam1, Exam 2, and One Review Paper on System on Chip design.

| Assignment        | Total Points                  | Percentage of Final Grade |
|-------------------|-------------------------------|---------------------------|
| Homework Sets (3) | 100 total                     | 15%                       |
| Final Project     | 100 point total for all parts | 30%                       |
| Exam 1            | 100                           | 20%                       |

|   |     |      |
|---|-----|------|
| Exam 2                                  | 100 | 20%  |
| Review Paper (Group or Individual Work) | 100 | 15%  |
|   |     | 100% |

### **Grading Policy**

| Percent      | Grade | Grade Points |
|--------------|-------|--------------|
| 90.0 - 100.0 | A     | 4.00         |
| 87.0 - 89.9  | A-    | 3.67         |
| 84.0 - 86.9  | B+    | 3.33         |
| 81.0 - 83.9  | B     | 3.00         |
| 78.0 - 80.9  | B-    | 2.67         |
| 75.0 - 79.9  | C+    | 2.33         |
| 72.0 - 74.9  | C     | 2.00         |
| 69.0 - 71.9  | C-    | 1.67         |
| 66.0 - 68.9  | D+    | 1.33         |
| 63.0 - 65.9  | D     | 1.00         |
| 60.0 - 62.9  | D-    | 0.67         |
| 0 - 59.9     | E     | 0.00         |

More information on UF grading policy may be found at:

<http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020#grades>

### **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.ua.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.ua.ufl.edu/public-results/>.

### **In-Class Recording**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***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 Conduct Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. 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
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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>

### ***Campus Resources:***

#### ***Health and Wellness***

##### **Covid-19 Protocols:**

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email [covid@shcc.ufl.edu](mailto:covid@shcc.ufl.edu)) to be evaluated for testing and to receive further instructions about returning to campus.

- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the UF Health Screen, Test & Protect website for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

### **U Matter, We Care:**

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

**Counseling and Wellness Center:** <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

### **Sexual Discrimination, Harassment, Assault, or Violence**

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)

### **Sexual Assault Recovery Services (SARS)**

Student Health Care Center, 392-1161.

**University Police Department** at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

### Academic Resources

**E-learning technical support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Connections Center**, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

**Library Support**, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Teaching Center**, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.  
<https://teachingcenter.ufl.edu/>.

**Writing Studio, 302 Tigert Hall**, 846-1138. Help brainstorming, formatting, and writing papers.  
<https://writing.ufl.edu/writing-studio/>.

**Student Complaints Campus:** <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

**On-Line Students Complaints:** <http://www.distance.ufl.edu/student-complaint-process>.