

The University of Texas at Tyler
Department of Electrical Engineering

EENG 4331: VLSI Design (Elective)

Syllabus

Catalog Description:

MOS transistor theory; CMOS manufacturing technology; Design and fabrication of digital integrated circuits; EDA tools for design of VLSI circuits; Physical Design Flow; Low Power IC Design; Design rules for VLSI Design; CMOS Logic Design; datapath circuits and subsystem design issues; Testing and verification of Integrated circuits. Three hours of lecture each week.

Prerequisites:

EENG 3302 Digital Systems, EENG 3306 Electronic Circuit Analysis I

Credits:

3 (3 hours lecture, 0 hours laboratory per week)

Text(s):

N. H. E. Weste and D. Harris. *CMOS VLSI Design*. 4th Edition. Pearson-Addison-Wesley, 2011. ISBN 978-0321-547743

Additional Material:

Class Notes; Journal Articles; Online Certification

Course Coordinator:

Kazi Rashed, Senior Lecturer

Topics Covered: (paragraph of topics separated by semicolons)

VLSI CAD Tools; Fabrication of Integrated Circuits; Modeling Submicron Transistors; Static and Dynamic Logic Gate Design; Datapath design; Subsystem design; Delay, Power Characterization; Clock Distribution; Physical Design; Interconnect Modelling; Testing and Verification Issues.

Evaluation Methods: (only items in dark print apply):

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

Course Learning Outcomes¹: By the end of this course students will be able to:

1. Describe the processing steps for creating a CMOS Integrated Circuit. [1,2]
2. Analyze different operating regions for MOSFET through current equations. [1,2]
3. Model digital circuits using Register-to-Transfer Logic (RTL) programming. [4,5]
4. Design a static CMOS Logic gate. [1]
5. Analyze different nanoscale devices. [1]
6. Optimize the device sizing for a complex logic circuit using the concept of logical effort. [1,2]
7. Determine the delay in CMOS circuits. [1]
8. Characterize a CMOS logic gate utilizing SPICE simulation data. [4,5]
9. Implement transistor-level schematic of compound CMOS logic gates. [2]
10. Assess the design challenges of implementing dynamic logic circuits in submicron technologies. [1]
11. Analyze different memory architectures in the transistor-level. [1,2]
12. Identify the issues with testing complex logic circuits. [1,2]
13. Understand the issues with designing devices and circuits using nanotechnology. [1]
14. Describe the steps involved in physical design flow. [1,7]
15. Explore the current research trend in VLSI Design. [6]

¹Numbers in brackets refer to method(s) used to evaluate the course learning outcome.

Relationship to Student Outcomes (only items in dark print apply)²: This course supports the following Electrical Engineering Student Outcomes, which state that our students will possess:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics [1,2,9,10].
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors [4,5,6,11,12].
3. An ability to communicate effectively with a range of audiences [15].
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts [14].
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions [3,8].
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies. [13].

²Numbers in brackets refer to course learning outcome(s) that address the Program Outcome.

Contribution to Meeting Professional Component: (in semester hours)

Mathematics and Basic Sciences:		hours
Engineering Sciences and Design:	3	hours
General Education Component:		hours

Prepared By:
Edited By:

Prabha Sundaravadivel, Assistant Professor

Date:

22 August 2018

The University of Texas at Tyler
Department of Electrical Engineering

Course: EENG 4331.031 – VLSI Design (Elective)

COURSE OUTLINE

Course Coordinator:

Dr. Kazi Rashed
 Senior Lecturer, Department of Electrical Engineering
Office: HEC A212
Email: krashed@uttyler.edu
Office Hours: TBD
 Email and Discussion Boards.

Class Location/Time:

Hybrid Model: Synchronous zoom classes and/or in-person.

9:30 – 10:50 AM TR

Grading Policy:

Homework	15%	No. of Homework - 3
Participation	5%	Engagement through Discussion Boards and email
Labs/ Mini Projects	20%	No. of. Assignments – 4
Reading Assignments	10%	2 Research Papers
Mid Term Exam	20%	October 8, 2020
Final Exam	30%	November 19, 2020
Total	100%	

Semester Schedule:

Week	Date	Topics	Homework	Lab/ Mini Project	Mode of Delivery
1	24-Aug-2020	Course Overview, MOS Transistor Theory, MOSFET I-V and C-V Characteristics			Synchronous Zoom class
2	31-Aug-2020	Introduction to VLSI CMOS Logic Gates, CMOS Manufacturing	Hw1		Synchronous Zoom class
3	7-Sep-2020	CMOS Design issues	Hw1 due	Lab 1	Synchronous Zoom class
4	14-Sep-2020	Introduction to Verilog and EDAs (LT SPICE)		Lab 1 due	Synchronous Zoom class

5	21-Sep-2020	Power Estimation, Interconnect Modeling	Hw2		Synchronous Zoom class
6	28-Sep-2020	Low Power Design, Delay Characterization	HW-2 due		Synchronous Zoom class
7	5-Oct-2020	Mid-Term Exam			Online
8	12-Oct-2020	Combinational Circuit Design, Static and Dynamic Logic Circuit Families		Lab 2	In-person / Synchronous Zoom class
9	19-Oct-2020	Sequential Circuit Design		Lab 2 due	In-person / Synchronous Zoom class
10	26-Oct-2020	Datapath Subsystem		Lab 3	In-person / Synchronous Zoom class
11	2-Nov-2020	Memory Design	Hw 3	Lab 3 due	In-person / Synchronous Zoom class
12	9-Nov-2020	Design for Testing, Verification	Hw 3 due	Lab 4	In-person / Synchronous Zoom class
13	16-Nov-2020	Final Exam			Online
14	23-Nov-2020	Thanksgiving Break			
15	30-Dec-2020	Research Paper 1 Review		Lab 4 due	Synchronous Zoom class
16	7-Dec-2020	Research Paper 2 Review			Synchronous Zoom class

Mode of Delivery:

Hybrid Model. The semester will begin with synchronous zoom classes. Students are expected to login through zoom to attend the lectures. At the end of each class, the recorded lectures will be posted in Canvas. After Mid-Term Exam, the mode of delivery will be reevaluated. If the student has any concerns or would like to share their feedback on the lectures, email the Instructor anytime.

Flexible Online Office Hours:

This course will have extended office hours. Students can meet with the Instructor during the office hours (Office hours TBD) using the course zoom link. However, if students are not available during the mentioned office hours, they are strongly encouraged to schedule a meeting with the Instructor anytime.

Computer Equipment Policy:

In order to take this class, integrated laboratory sessions and quizzes/exams, you will need the following items as specified below:

- Windows 10 Computer or Mac running Windows virtualization software
- High-speed Internet connection
- Webcam (internal or external)
- NI Multisim software

Type	Minimum	Recommended
Web Camera	640×480 resolution	1280×720 resolution
PC Users	Windows Vista	Windows 10 (10 S is not supported)
Mac Users	OS X 10.5 or higher	OS X 10.13 High Sierra
Internet Download Speed	.768 Mbps	1.5 Mbps
Internet Upload Speed	.384 Mbps	1 Mbps
RAM	1024 MB	2 GB
Ports	1935, 843, 80, 443, 61613, UDP/TCP	1935, 843, 80, 443, 61613, UDP/TCP

Homework:

There will be a total of 3 assignments. Homeworks will be in the form of problems, theory questions, and a take home quiz to test the understanding of basic concepts. Homework will be assigned by Monday as per the schedule and will be due on Friday of the following week. No late homework will be accepted. Homework problems/ questions may be discussed with other students, but the final submission should be an original and independent solution.

Lab/Mini Project:

Four labs or mini projects will be assigned throughout the semester. The topics to be covered here are: Verilog programming and Circuit design. The following software are to be used for the lab assignments:

1. ModelSim Student Edition - https://www.mentor.com/company/higher_ed/modelsim-student-edition
2. LTSpice - <http://www.analog.com/en/design-center/design-tools-and-calculators/ltspice-simulator.html>

Research Reading Assignments:

Two research papers will be assigned by the Mid-Term week. Students are expected to read them and make a 10-minute presentation for each paper. This presentation can be done during the regular class meeting time. The total of 20-minute presentation will have 10% weightage.

Exam:

This course will have MidTerm and Final exam. The MidTerm exam will have 20% weightage and Final exam will have a 30% weightage.

Academic Integrity:

Students should be aware that absolute academic integrity is expected of every student in all undertakings at the University of Texas at Tyler. A plagiarism check will be done all the reports submitted by students. Copied or unoriginal solutions will result in a “0” in that course component. An evidence of a pattern in academic dishonesty will lead to strong university-imposed penalties.

Attendance:

Attendance will be 5% weightage.

Academic Integrity:

Students should be aware that absolute academic integrity is expected of every student in all undertakings at The University of Texas at Tyler. Failure to comply can result in strong university-imposed penalties. **All lab reports and assignments will be verified using plagiarism checking software and violations will result in a grade of zero for the lab report or assignment at a minimum, and possibly stronger penalties such as a failing grade in the course and a scholastic dishonesty report submitted to the university.**

Proctoring

The assessments in this online course will be proctored using ProctorU or two-way interactive Zoom sessions. Beyond the cost of initial equipment needed (e.g. a camera for your computer), there will not be any additional cost for proctoring. You will need to create a ProctorU account and install the ProctorU extension before attempting any assessment.

To create a ProctorU account, follow the ProctorU tool within Canvas. Please make sure you are using the current version of Chrome or Firefox and download the ProctorU extension available at <http://bit.ly/proctoruchrome> or <https://www.proctoru.com/firefox>.

In order to use ProctorU, you will need the following:

- High-speed Internet connection
- Webcam (internal or external)
- Windows, Mac, or Chrome Operating System
- Up-to-date Chrome or Firefox browser and ProctorU extension installed
- Valid photo ID
- Quiet environment to take your assessment

You can visit the Test Taker Resource Page for additional information at <https://bit.ly/ProctorMe>

Accommodation:

If you have a disability, including a learning disability, for which you request disability support services/accommodation(s), please contact the Disability Support Services office, so that the appropriate arrangements may be made. In accordance with the Federal Law, a student requesting disability support services/accommodation(s) must provide appropriate documentation of his/her disability to the Disability Support Services Counselor. For more information, call or visit the Student Accessibility and Resources Center located in the University Center, Room 3150. The Telephone number is 903.566.7079. Additional information may also be obtained at the following UT Tyler website: <https://www.uttyler.edu/disabilityservices/>

How to be Successful in this course:

The main focus of the Instructor is to help students learn the significant VLSI concepts. Some of the ways to be successful in this course are:

- Attend all the lectures during the class meeting time. Though the lectures will be recorded and published in Canvas, attending the live classes will help the students to interact with the Instructor and clarify their questions.
- Follow the deadlines. The course has 3 homework, 4 labs, 2 exams and reading assignment for assessment. Each of these have a weightage in the overall grade.
- Avoid plagiarism. In the event of any plagiarism, the particular assignment will not be graded resulting in "0". Its important that you submit original assignments to get credit for your work.
- WE ARE HERE TO HELP. With all the uncertainty for the semester, the Instructors have decided to start the semester with synchronous zoom classes. This mode of delivery will be reevaluated based on student's feedback. The Instructors are doing their best to achieve the Course Learning Outcomes. If you have any questions or concerns related to this course, email the Instructor anytime or clarify the same during the class meeting hours or office hours.

UT Tyler Honor Code

Every member of the UT Tyler community joins together to embrace: Honor and integrity that will not allow me to lie, cheat, or steal, nor to accept the actions of those who do.

Students Rights and Responsibilities

To know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link: <http://www.uttyler.edu/wellness/rightsresponsibilities.php>

Campus Carry

We respect the right and privacy of students 21 and over who are duly licensed to carry concealed weapons in this class. License holders are expected to behave responsibly and keep a handgun secure and concealed. More information is available at <http://www.uttyler.edu/about/campus-carry/index.php>

UT Tyler a Tobacco-Free University

All forms of tobacco will not be permitted on the UT Tyler main campus, branch campuses, and any property owned by UT Tyler. This applies to all members of the University community, including students, faculty, staff, University affiliates, contractors, and visitors.

Forms of tobacco not permitted include cigarettes, cigars, pipes, water pipes (hookah), bidis, kreteks, electronic cigarettes, smokeless tobacco, snuff, chewing tobacco, and all other tobacco products.

There are several cessation programs available to students looking to quit smoking, including counseling, quitlines, and group support. For more information on cessation programs please visit www.uttyler.edu/tobacco-free.

Grade Replacement/Forgiveness and Census Date Policies

Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated. Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.uttyler.edu/registrar>. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar.

Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions of which students need to be aware. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

State-Mandated Course Drop Policy

Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date).

Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

Disability/Accessibility Services

In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA) the University of Texas at Tyler offers accommodations to students with learning, physical and/or psychological disabilities. If you have a disability, including a non-visible diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or you have a history of modifications or accommodations in a previous educational environment, you are encouraged to visit <https://hood.accessiblelearning.com/UTTyler> and fill out the New Student application.

The Student Accessibility and Resources (SAR) office will contact you when your application has been submitted and an appointment with Cynthia Lowery, Assistant Director of Student Services/ADA Coordinator. For more information, including filling out an application for services, please visit the SAR webpage at <http://www.uttyler.edu/disabilityservices>, the SAR office located in the University Center, # 3150 or call 903.566.7079.

Student Absence due to Religious Observance

Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

Student Absence for University-Sponsored Events and Activities

If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement

It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation

Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.

Student Standards of Academic Conduct

Disciplinary proceedings may be initiated against any student who engages in scholastic dishonesty, including, but not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

i. "Cheating" includes, but is not limited to:

- copying from another student's test paper;
- using, during a test, materials not authorized by the person giving the test;
- failure to comply with instructions given by the person administering the test;
- possession during a test of materials which are not authorized by the person giving the test, such as class notes or specifically designed "crib notes". The presence of textbooks constitutes a violation if they have been specifically prohibited by the person administering the test;
- using, buying, stealing, transporting, or soliciting in whole or part the contents of an unadministered test, test key, homework solution, or computer program;
- collaborating with or seeking aid from another student during a test or other assignment without authority;
- discussing the contents of an examination with another student who will take the examination;
- divulging the contents of an examination, for the purpose of preserving questions for use by another, when the instructor has designated that the examination is not to be removed from the examination room or not to be returned or to be kept by the student;
- substituting for another person, or permitting another person to substitute for oneself to

- take a course, a test, or any course-related assignment;
 - paying or offering money or other valuable thing to, or coercing another person to obtain an unadministered test, test key, homework solution, or computer program or information about an unadministered test, test key, home solution or computer program;
 - falsifying research data, laboratory reports, and/or other academic work offered for credit;
 - taking, keeping, misplacing, or damaging the property of The University of Texas at Tyler, or of another, if the student knows or reasonably should know that an unfair academic advantage would be gained by such conduct; and
 - misrepresenting facts, including providing false grades or resumes, for the purpose of obtaining an academic or financial benefit or injuring another student academically or financially.
- ii. “Plagiarism” includes, but is not limited to, the appropriation, buying, receiving as a gift, or obtaining by any means another’s work and the submission of it as one’s own academic work offered for credit.
 - iii. “Collusion” includes, but is not limited to, the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any section of the rules on scholastic dishonesty.
 - iv. All written work that is submitted will be subject to review by plagiarism software.

UT Tyler Resources for Students

- [UT Tyler Writing Center](mailto:writingcenter@uttyler.edu) (903.565.5995), writingcenter@uttyler.edu
- [UT Tyler Tutoring Center](mailto:tutoring@uttyler.edu) (903.565.5964), tutoring@uttyler.edu
- The Mathematics Learning Center, RBN 4021, this is the open access computer lab for math students, with tutors on duty to assist students who are enrolled in early-career courses.
- [UT Tyler Counseling Center](tel:903.566.7254) (903.566.7254)

Important Covid-19 Information for Classrooms and Laboratories

Students are required to wear face masks covering their nose and mouth, and follow social distancing guidelines, at all times in public settings (including classrooms and laboratories), as specified by [Procedures for Fall 2020 Return to Normal Operations](#). The UT Tyler community of Patriots views adoption of these practices consistent with its [Honor Code](#) and a sign of good citizenship and respectful care of fellow classmates, faculty, and staff.

Students who are feeling ill or experiencing symptoms such as sneezing, coughing, or a higher than normal temperature will be excused from class and should stay at home and may join the class remotely. Students who have difficulty adhering to the Covid-19 safety policies for health reasons are also encouraged to join the class remotely. Students needing additional accommodations may contact the Office of Student Accessibility and Resources at University Center 3150, or call (903) 566-7079 or email saroffice@uttyler.edu.

Recording of Class Sessions

Class sessions may be recorded by the instructor for use by students enrolled in this course. Recordings that contain personally identifiable information or other information subject to FERPA shall not be shared with individuals not enrolled in this course unless appropriate consent is obtained from all relevant students. Class recordings are reserved only for the use of students enrolled in the course and only for educational purposes. Course recordings should not be shared outside of the course in any form without express permission.