Stony Brook University

Department of Electrical and Computer Engineering
EEO219 Digital logic design (Labs)
Syllabus
Last updated August 22, 2023

Important Note: Every effort will be made to avoid changing the course schedule, but the possibility exists that unforeseen events will make syllabus changes necessary. It is your responsibility to check Blackboard for corrections or updates to the syllabus. Any changes will be clearly noted in course announcements or through Stony Brook email.

Part 1: Course Information

Course title: Digital Logic Design (Labs)

Course catalog # and section: EEO219, Sec L31

Credit hours: 1

Semester: Fall 2023

General education designation(s) (SBC):   N/A

Prerequisites or co-requisite: EEO218 or equivalent

Instructor name: Dmitri Donetski

Instructor's Stony Brook email, phone number, and time zone: dmitri.donetski@stonybrook.edu, **631-632-8411 (office), EST (New York)**

Office hours: Tuesday, Thursday, 1-3PM EST in Zoom accessed with the following link:

https://stonybrook.zoom.us/j/93433786494?pwd=QnZVQUFqSktsZnpiTWQyWkFUM2J5dz09

Meeting ID: 934 3378 6494
Passcode: 892092

Course Description: The set of lab experiments to reinforce the knowledge and illustrates concepts presented in EEO218.

Goal: Development of practical skills in circuit design, simulation of signal waveforms and debugging errors necessary for accomplishment of advanced course projects.   **Required Course Materials:**

1. A windows laptop or desktop with a webcam is required for running the design and simulation software, a free student version of Active-HDL from Aldec, Inc., and documentation

2. A dedicated lab kit to be ordered with electronic parts retailer Mouser.com ($35 + shipping)
   https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=73112d0791

3. An USB-based logic analyzer/pattern generator (LA/PG) with a sampling rate of at least 100 MS/s for generation of test signals and measurements of signal waveforms. Also the LA/PG is used for powering circuits assembled with CMOS logic gates. You can select one logic analyzer from two models supported in EEO219:

a)   MSO-19 from Link Instruments ($249)

https://www.linkinstruments.com/mso19.html

The unit is simple (fewer settings), it has an analog input (oscilloscope) useful for debugging errors and a higher maximum sampling rate for digital inputs (200 MS/s) however the number of inputs/outputs is limited to 8. It is a better choice for students with no experience with digital circuits. The lab manuals includes screenshot examples for MSO-19.

b)   Digital discovery from Digilent (~$200 academic price or $229 regular price for the base set with no high speed differential probes). 16 inputs/outputs, 100 MS/s maximum sampling rate, more options/settings, recommended to students with some experience. It would be a better choice in long term use with more advanced projects.

https://store.digilentinc.com/digital-discovery-portable-usb-logic-analyzer-and-digital-pattern-generator/

Analog discovery2 from other online lab courses can be used as well.

Alternative (lower cost) models of logic analyzers are not recommended due to lack of the pattern generator function and issues with software.

Recommended Reading:

M. Morris Mano, Michael D. Ciletti, "Digital Design with an introduction to the Verilog HDL…", Pearson, 6th or 5th edition. 6th ed: 2018, ISBN-10: 0134549899, 0134529561, ISBN-13: 9780134549897, 9780134529561, 5th ed.: 2013, ISBN-10: 0132774208, ISBN-13: 9780132774208.

Additional reading/Bibliography:

1. F. Vahid, Digital Design with RTL Design, VHDL, and Verilog, 2nd ed, 2010, ISBN-13: 978-0470531082, ISBN10: 0470531088
2. D.M. Harris, S.L. Harris, Digital Design and Computer Architecture, 2nd ed., 2012, ISBN-13: 9780123944245, ISBN-10: 0123944244
3. J. Wakerly, Digital Design: principles and practices, with Verilog, 5th ed., 2017, ISBN-13: 9780134460093, ISBN-10: 013446009X

Course Delivery Mode and Structure:

This is an online version of the lab portion of the 1st course on design of digital systems ESE118 offered on campus. All course materials (lab assignments and instructions) will be posted on the Blackboard. The course program includes 10 lab experiments to be conducted in the period of one semester. The experiment schedule of the online version will be kept synchronous with that

of the campus course. The lab materials will be posted once a week in Mondays by the end of the day.

Most of the proposed circuits have design elements defined by student ID numbers which make them slightly different. First, the circuits are to be designed on paper using conventional approaches. Next, the designs have to be entered to Active HDL CAD tool on the schematic level using libraries of logic gates and with Verilog Hardware Description Language (HDL) with instructions and supporting examples. At this stage signal waveforms will be simulated, design errors will be identified and corrected. For efficient work the design details (schematics entered into the CAD tool and simulated waveforms) have to be copied into the prelab report and emailed to the instructor for quick review.   Prelab assignments are supplied with checklists and grading rubrics. Approved circuits can be prototyped (wired on a breadboard) for experimental signal tests and measurements.

Experimental signal waveforms will be compared to simulated ones for quick identification of wiring errors and solving other problems. Finally, signal waveforms of debugged circuits can be obtained, measurements of requested signals can be made and documented for final reports.

For a credit legends showing logic analyzer channel numbers and displayed generated and measured signals have to be provided.

Getting various challenges at simulation and experimental stages is normal. If you get stuck with a problem you can not resolve, make screen shoots with PrtScreen followed by Ctrl+V into MSWord with design details including error messages in the console and file hierarchy windows and email to the instructor as a single PDF file. In problems with experiments take a close photo of the circuit layout with wiring and signal waveforms, provide signal description. Emailing a single PDF file is the best way to get a quick help as I can review the file in PDF format in my cellphone PDF viewer without file downloading.

The final reports with experimental data can be delayed with no penalty for lateness (please notify me about problems). One should remember that all final reports will have to submitted by the end of the semester and the final grades will have to be posted by the final week.

Students must be mindful of all course expectations, deliverables and due dates, especially because the online portion of the course requires significant time management. All assignments and course interactions will utilize internet technologies. See "Technical Requirements" section for more information.

How We Will Communicate:
Course-related questions should be posted in the General Questions Forum in the course Discussion board. For personal/private issues, email me directly. If you use Blackboard's **email tool** from the course site, it will automatically include your full name, course name and section when you send me an email. **Please allow between 24-48 hours for an email reply.** Your Stony Brook University email must be used for all University-related communications. You must have an active Stony Brook University email account and access to the Internet. All instructor correspondence will be sent to your SBU email account. **Plan on checking your SBU email**

account regularly for course-related messages. To log in to Stony Brook Google Mail, go to http://www.stonybrook.edu/mycloud and sign in with your NetID and password.

Regular announcements will be posted on Bb and automatically sent by email.

Regular communication is essential in online classes. Logging in once a day, checking the discussion board and participating with your peers ensures that you are able to remain an active member of the class and earn full points.

Technical Requirements:

This course uses Blackboard for the facilitation of communications between faculty and students, submission of assignments, and posting of grades and feedback. The Blackboard course site can be accessed at https://blackboard.stonybrook.edu

If you are unsure of your NetID, visit https://it.stonybrook.edu/help/kb/finding-your-netidandpassword for more information. You are responsible for having a reliable computer and Internet connection throughout the term.

Caution! You will be at a disadvantage if you attempt to complete coursework on a tablet or running Windows under VM or Parallels on a Mac PC. It may not be possible to operate the software required for your assignments.

Students should be able to use email, a word processor, spreadsheet program, and presentation software to complete this course successfully.

The following list details a minimum recommended computer set-up and the software packages you will need to have access to, and be able to use:

- PC with Windows 10 (recommended)
- Macintosh (with 8 GB RAM or higher to run Windows under VM or Parallels for EEO219)
- Intel Core i5 or higher
- 250 GB Hard Drive
- Latest version of Chrome or Firefox; Mac users may use Chrome or Firefox. (A complete list of supported browsers and operating systems can be found on the My Institution page when you log in to Blackboard.)
- High speed internet connection
- Word processing software (Microsoft Word is available to SBU students)
- Headphones/earbuds and a microphone (recommended)
- Webcam with a microphone (required)
- Printer (optional)
- Ability to download and install free software applications and plug-ins (note: you must have administrator access to install applications and plug-ins).

Technical Assistance:

If you need technical assistance at any time during the course or to report a problem with Blackboard you can:

- Phone: 631-632-9800 (client support, Wi-Fi, software and hardware)
- Submit a help request ticket: https://it.stonybrook.edu/services/itsm
- If you are on campus, visit the Walk-Up Tech Support Station in the Educational Communications Center (ECC) building.
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Part 2: Course Learning Objectives and Assessments

Upon completion of the course, students will be able to:

1. read schematic and understand digital circuit functionality: obtain state diagram and output signal waveforms describing circuit behavior, estimate and measure signal propagation delays.
2. design combinational and sequential digital circuits from logic gates, standard building blocks using schematic entry and provided Verilog HDL examples in the CAD tool.
3. locate and correct design errors from analysis of simulated waveforms.
4. debug wiring errors and identify other circuit problems using logic analyzer/pattern generator

How to Succeed in this Course:

- Create your study schedule ahead of deadlines and do your best effort to follow it. Communicate with the instructor, ask questions.
- Allocate more time than you expect you will need for course activities. How much time should students devote to an online course? Time on task information, see NY State Education Department: http://www.nysed.gov/college-universityevaluation/distanceeducation-program-policies

EEO219 Prelab and Lab assignments should be completed in the weeks shown below.

EEO218 assignments (Quizzes, HWs and Lectures) are not applicable to EEO219.

Part 3: Course Schedule:					
Mondays Quizzes due	**Fridays HW due**	Lectures in EEO218 (not required for EEO219)	Prelabs (simulations) and Lab experiments in EEO219	Pages, 6th ed.	

1	Lecture 1 8/28	Lecture 2 9/1	Binary numbers, base conversion. Addition and subtraction. 2's complements. Logic operations and gates.	Installation of the Active-HDL. Ordering the lab kit and the logic analyzer/pattern generator	1-37
2	No Lecture	Lecture 3 9/8 HW1	Boolean algebra. Standard forms. Two-level implementations. Critical path, racing, static glitches	Prelab for Lab 1. Simulation in Active-HDL from Aldec	40-76
3	Lecture 4 9/11 Quiz 1	Lecture 5 9/15 HW2	Logic maps. Minimization. Form conversion. AOI and OAI implementations. Incompletely specified functions. Binary codes. Code converters	Lab 1. Board and logic analyzer. Propagation delays.	83-120
4	Lecture 6 9/18 Quiz 2	Lecture 7 9/22 HW3	Multiplexers, demultiplexers. Transmission gate. Implementation of switching functions with mutliplexers.	Lab 2. Two-level implementations	175-189, 625-637
5	Lecture 8 9/25 Quiz 3	Lecture 9 9/29 HW 4	Decoders, encoders. Implementation of switching functions with decoders. Reflective Gray codes. Parity bits. Codes for error detection and correction.	Lab 3. Design with multiplexers	121--140
6	Lecture 10 10/2 Quiz 4	**Midterm 1** 10/6	Review. Design problems.	Lab 4. Design with decoders	156-170
7	No Lecture	Lecture 11 10/13	Adders. Subtractors. Overflow detection.	No lab	Ch. 1-4 review
8	Lecture 12 10/16 Quiz 5	Lecture 13 10/20 HW5	CMOS static, dynamic, PTL implementations. Introduction to Verilog HDL. SR- and D—latches. Critical racing.	Lab 5. Encoder for flash ADC	246-260

9	**Lecture 14 10/23 Quiz 6**	**Lecture 15 10/27 HW6**	Metastability. Setup time. CMOS Master–slave D-flip-flop. Preset and clear.	Lab 6. Adders	261-316, 326-330
10	**Lecture 16 10/30 Quiz 7**	**Lecture 17 11/3 HW7**	Analysis and design of synchronous Finite State Machines. Mealy and Moore outputs.	Lab 7. Latches and flip-flops	352-365
11	**Lecture 18 11/6 Quiz 8**	**Lecture 19 11/10 HW8**	Max clock frequency. Counters. Registers. Register-based counters. Hang-up states. State decoding.	Lab 8. Sequence generator	430-540
12	**Lecture 21 11/13 Quiz 9**	**Lecture 22 11/17 HW9**	Register Transfer Level design. Datapath and controller. Algorithmic State Machine chart. Review. Design problems.	Lab 9. Counter	Ch. 4-8 review
13	**Midterm 2 11/20**	**No Lecture**		No lab	300-305
14	**Lecture 24 11/27**	**Lecture 25 12/1 HW10**	Serial Peripheral Interface. Inter-Integrated Circuit interface. Data scrambling. Cycling Redundancy Check.	Lab 10. Datapath and controller for ADC with serial output	378-424
15	**Lecture 26 12/4 Quiz 10**	**Lecture 27 12/8**	Field Programmable Gate Arrays. Flash, static, dynamic memories. Review for the final exam	Bonus for EEO219. Datapath and controller project (simulation only)	Assigned reading
			Final exam in EEO218 (TBA)		

Part 4: Grading, Attendance, and Late Work Policies

Viewing Grades on Blackboard: Lab reports *will be graded within 1 week of being submitted.* In this course, you will be assessed on the following:

Activity/Assignment	Points	Due Date
10 Prelab reports emailed to the instructor for a review of circuit schematics and signal waveforms before circuit assembly	60	Wednesdays, end of the day, EST
10 Experiment reports	40	Sundays, end of the day, EST
Total	100	

Attendance Policy: *When requested by the school, the last day of student attendance is determined from the records of student access to Bb.*

Late Work Policy: *Late weekly prelab reports (see the lab schedule) are accepted with a 50 % penalty. All final reports will have to be submitted by the end of the semester.*

Letter Grades: Final grades assigned for the course will be based on the percentage of total points earned and are assigned as follows:

Letter Grade	Points or Percentage
A	>90
A-	89-85
B+	84-80
B	79-75
B-	74-70

C+	69-65
C	65-60
C-	59-55
D+	54-50
D	49-45
F	< 44

The reports should include the projects goals, circuit schematics, simulated and measured waveforms, supplementary descriptions of signals and a brief summary. The supplementary text should have sufficient details for assessment of reports by a person not familiar with the course. Selected student works will be used for the course assessment after the end of the semester. The supplementary text will be graded with the following rubric:

Lab report supplementary text Grading Rubric

Interpretation Points	Quality of reports	Frequency
Exemplary 10 points	The comment is accurate, relevant and properly attributed. Adds substantial learner presence to the course and stimulates additional thought about the issue under discussion. Collegial and friendly tone.	Reports submitted throughout the semester on or before deadlines.
Accomplished 6 points	The comment lacks at least one of the above qualities, but is above average in quality. Makes a significant contribution to our understanding of the issue being discussed.	
Developing 4 points	The comment lacks two or three of the required qualities. Comments which are based solely upon personal opinion or personal experience often fall within this category.	Requested submission dates are not met.
Needs work 2 point	The comment presents little information. However, may provide social presence and contribute to a collegial atmosphere.	

Part 5: University and Course Policies

University Policies:

Student Accessibility Support Center Statement:

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, 128 ECC Building, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website:
https://ehs.stonybrook.edu/programs/firesafety/emergencyevacuation/evacuation-guide-people-physical-disabilities and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Important Note: Any form of academic dishonesty, including cheating and plagiarism, will be reported to the Academic Judiciary.

Critical Incident Management:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Course Policies:

Understand When You May Drop This Course:

It is the student's responsibility to understand when they need to consider withdrawing from a course.

Refer to the Stony Brook Academic Schedule for dates and deadlines for registration:
http://www.stonybrook.edu/commcms/registrar/calendars/academic_calendars.

Undergraduate Course Load and Course Withdrawal Policy   **Incomplete**

Policy:

Under emergency/special circumstances, students may petition for an incomplete grade. Circumstances must be documented and significant enough to merit an incomplete. If you need to request an incomplete for this course, contact me for approval as far in advance as possible.

Course Materials and Copyright Statement:

Course material accessed from Blackboard, SB Connect, SB Capture or a Stony Brook Course website is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a violation of the Federal copyright law, as well as a violation of Stony Brook's Academic Integrity.

Online Communication Guidelines and Learning Resources:

Maintain professional conduct both in the classroom and online. The classroom is a professional environment where academic debate and learning take place. I will make every effort to make this environment safe for you to share your opinions, ideas, and beliefs. In return, you are expected to respect the opinions, ideas, and beliefs of other students—both in the face-to-face classroom and online communication. Students have the right and privilege to learn in the class, free from harassment and disruption. The course follows the standards set in the Student Code of Conduct, and students are subject to disciplinary action for violation of that code. If your behavior does not follow the course etiquette standards stated below, the grade you receive for a posting may suffer. I reserve the right to remove any discussion messages that display inappropriate language or content.

Online Etiquette:

- Offensive language or rudeness will not be tolerated. Discuss ideas, not the person.
- Avoid cluttering your messages with excessive emphasis (stars, arrows, exclamations).
- If you are responding to a message, include the relevant part of the original message in your reply, or refer to the original post to avoid confusion;
- Be specific and clear, especially when asking questions.
- Use standard punctuation and capitalization. Using all UPPERCASE characters gives the appearance of shouting and makes the message less legible;
- Remember that not all readers have English as their native language, so make allowances for possible misunderstandings and unintended discourtesies.

Online Classes Require Better Communication:

It is important to remember that we will not have the non-verbal cues that occur in a face-to-face classroom. I cannot see the confused, frustrated, or unhappy expressions on your face if you encounter problems. You MUST communicate with me so that I can help. To make the experience go smoothly, remember that you're responsible for initiating more contact, and being direct, persistent, and vocal when you don't understand something.

Instructor roles:

The instructor will serve as a "guide" in online classroom. While I will not respond to every post, I will read what is posted, and reply when necessary. Expect instructor posts in the following situations:

- To assist each of you when it comes to making connections between discussion, lectures, and textbook material.
- To fill in important things that may have been missed. • To re-direct discussion when it gets "out of hand."
- To point out key points or to identify valuable posts.

Part 6: Student Resources

Academic and Major Advising (*undergraduate only*): Have questions about choosing the right course? Contact an advisor today. Phone and emails vary-please see website for additional contact information; website: https://www.stonybrook.edu/for-students/academic-advising/

Academic Success and Tutoring Center *(undergraduate only)*: https://www.stonybrook.edu/tutoring/

Amazon @ Stony Brook: Order your books before classes begin. Phone: 631-632-9828; email: Bookstore_Liaison@stonybrook.edu; website: http://www.stonybrook.edu/ bookstore/

Bursar: For help with billing and payment. Phone: 631-632-9316; email: bursar@stonybrook.edu; website: http://www.stonybrook.edu/bursar/

Career Center: The Career Center's mission is to support the academic mission of Stony Brook University by educating students about the career decision-making process, helping them plan and attain their career goals, and assisting with their smooth transition to the workplace or further education. Phone: 631-632-6810; email: sbucareercenter@stonybrook.edu; website: http://www.stonybrook.edu/careercenter/

Counseling and Psychological Services: CAPS staff are available by phone, day or night. http://studentaffairs.stonybrook.edu/caps/

Ombuds Office: The Stony Brook University Ombuds Office provides an alternative channel for confidential, impartial, independent and informal dispute resolution services for the entire University community. We provide a safe place to voice your concerns and explore options for productive conflict management and resolution. The Ombuds Office is a source of confidential advice and information about University policies and procedures and helps individuals and groups address university-related conflicts and concerns. http://www.stonybrook.edu/ombuds/

Registrar: Having a registration issue? Let them know. Phone: 631-632-6175; email: registrar_office@stonybrook.edu; http://www.stonybrook.edu/registrar/

SBU Libraries: access to and help in using databases, ebooks, and other sources for your research.

- Research Guides and Tutorials: http://guides.library.stonybrook.edu/
- Getting Help: https://library.stonybrook.edu/research/ask-a-librarian/

Student Accessibility Support Center: Students in need of special accommodations should contact SASC. Phone: 631-632-6748; email: sasc@stonybrook.edu; https://www.stonybrook.edu/sasc/

Support for Online Learning: https://www.stonybrook.edu/online/

Writing Center: Students are able to schedule face-to-face and online appointments. https://www.stonybrook.edu/writingcenter/