SYLLABUS

Instructors:

1. Irith Pomeranz --- lectures
   email: *pomeranz@purdue.edu*
2. Mark Johnson --- labs
   website: https://engineering.purdue.edu/Mark-Johnson (email, office hours)
3. Bob Givan --- administrative issues
   website: *http://engineering.purdue.edu/~givan/* (email, telephone, office hours/zoom room info)

For most instructor communication, please use the Piazza site (see below) as that will increase the number of instructors who can see and respond to your inquiry. If an administrative question goes unanswered, email Professor Givan directly with ECE 270 in the subject line. Repeat this email if necessary.

Course Description: An introduction to digital logic design and hardware engineering with an emphasis on practical design techniques and circuit implementation.

Purpose of Course: ECE 270 serves as a prerequisite for upper-division Computer Engineering courses (e.g., ECE 337, ECE 362, ECE 437, ECE 477). It provides sophomore-level students with a basic overview of digital hardware engineering. Concepts and techniques introduced in this course will be expanded and used in subsequent Computer Engineering courses.

Required Background: Basic understanding of circuits (voltage, current, Ohm's Law) and electrical components (resistors, capacitors, switches, diodes, MOSFETs).

Course Web Site URL: See course BrightSpace lecture section on http://purdue.brightspace.com

Course E-mail Address: Address questions to the relevant topics on Piazza at https://piazza.com/purdue/spring2022/ece270/home

Campus Emergencies: In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Should such an emergency occur, information will be posted on the course web site Message Board.

Changing Lab Divisions: You must attend the lab division of ECE 270 lab for which you have registered. All lab division changes must be finalized during the first week of classes.

Text: *Digital Design Principles and Practices – 5th Ed.*, John F. Wakerly, Prentice Hall, 2017 (the 4th edition is also acceptable). Your learning will be maximized if you read the text assignments prior to coming to lecture.

Materials Required for Purchase: In addition to the course text listed above, you will need to purchase the following materials:

- **A TI-30X IIS calculator** – the only calculator approved by the ECE curriculum committee
- **Master Parts Kit** (available at https://elexp.com/pages/purdue) – *only needed if you have not previously purchased the kit for another ECE lab course*
- **Additional digital chips** – Available from EE 162 or online electronics stores.
- **Digilent Analog Discovery 2 (AD2)** – Available from digilent.com

Coronavirus Preparations: This course will be delivered in person. If you are required to be quarantined or isolated, take lab kit materials with you and continue the course as usual. If you are incapacitated due to COVID-19 or any other illness, contact your designated teaching assistant and plan for what to do.

Computer Account: Only your Purdue computer account will be needed for obtaining materials for the class, and this is the only account you will use for communicating with staff.

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Homework: Homework will be periodically assigned via BrightSpace and graded primarily for completion of reasonable quality attempts (See course website for assignments and due dates).

Laboratory: The weekly lab meetings for this course will be held in room EE 065. The lab experiments have been designed to reinforce the lecture material; thus, it is very important that you ***attend lecture regularly and do the assigned reading from the course text*** in order to successfully complete the laboratory portion of this course. Quizzes will be given at the beginning of your scheduled lab period to help keep you on track. A separate document details the *Laboratory Policies and Procedures.* The Digilent AD2 will be needed only for labs 1 – 8.) You are expected to complete all exercises in this class on your own with no interaction with other students.

Lecture Policies: Lectures will be delivered in person during the allotted lecture meeting, and recorded as well as technically possible and provided via the BrightSpace course site.

Learning Outcomes and Objectives: A student who successfully fulfills the course requirements will have demonstrated:

1. an ability to analyze and design CMOS logic gates
2. an ability to analyze and design combinational logic circuits
3. an ability to analyze and design sequential logic circuits
4. an ability to analyze and design computer logic circuits
5. an ability to realize, test, and debug practical digital circuits

Exams: There will be three EVENING midterm exams given on the dates shown below. It is your responsibility to reserve these dates immediately and any subsequent conflict will be expected to defer to this class unless emergent. <u>Contact Professor Givan immediately with any pre-existing conflict</u> or when one emerges that cannot be deferred. <u>We also reserve the possibility of using the final exam slot for this course for additional or makeup examination</u>; do not plan to leave campus before our final exam window. Your exam grade will be the average of your course examinations.

1. Thu 02/24 06:30p - 07:30p WTHR 200 (260 seats) and CL50 224 (248 seats)
2. Thu 03/24 06:30p - 07:30p WTHR 200 (260 seats) and CL50 224 (248 seats)
3. Thu 04/21 06:30p - 07:30p CL50 224 (248 seaats) and LILY 1105 (224 seats)

Exam Rules: Exams will be closed book, closed notes, no devices of any kind.

Course Grade: Your three exams are equally weighted and averaged together to compute your average exam grade. Your course grade will be determined by the weighted average of your average exam grade (45%), lab grade (45%), and homework grade (10%). Thresholds for grades will be no higher than 90/80/70/60 for A/B/C/D respectively, with + and – modifiers applied at the borders of grade ranges. We may lower these thresholds if material proves more difficult than anticipated but these will also be our targets in designing evaluative material.

Your lab grade percentage will be computed as an 80/20 weighted average of your lab-experiment average and your lab-quiz average, as follows:

80 x (sum of lab experiment scores) / (total possible lab experiment points) +

20 x (sum of lab quiz scores) / (total possible lab quiz points)

Incompletes and Conditional Failures: A grade of "I" or "E" will be given *only* for cases in which there are ***documented*** medical or family emergencies that prevent a student from completing required course work by the end of the semester. Note that University Regulations stipulate that a student must be passing in order to ***qualify*** for a grade of "I" or "E".

Mental Health: Please take care of your well-being. Even in a pandemic, academic pursuits should be enjoyable or, at the very least, not something that causes intense sadness or anxiety.

> **If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack https://purdue.welltrack.com/**. Sign in and find information and tools at your fingertips, available to you at any time.
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> **If you need support and information about options and resources**, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.
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> **If you find yourself struggling to find a healthy balance between academics, social life, stress**, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.
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> **If you're struggling and need mental health services**: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Professionalism and Academic Honesty: The temptation to cheat is particularly prevalent in large- enrollment courses such as this one. You must resist this temptation. A large part of the educational process is simply developing the *discipline* and *mindset* required to contribute in a given technical area once you graduate. For your own benefit, *you should not copy the work of any other student* (past or present). To a large extent, your grades are recognized by a future employer or educator as an indicator of your level of understanding. The primary task of the course staff is to help every student to understand the material as well as possible. Our secondary task is to accurately gauge your understanding of that material by issuing a grade for your work. **For the purposes of this class, we broadly define academic dishonesty as being any attempt by a student to improve a grade beyond his or her own *personal* understanding of the material in question.** Evidence of lack of personal understanding often manifests itself in the form of work that is substantially similar to that of other students (i.e., copied). To ascertain levels of similarity, we use computer software to analyze the submitted work of the entire class. When we find inordinate similarity between the work of two or more students, we act on it. All *documented* cases of academic dishonesty (such as copying homework) will result in, *at minimum*, a zero score for all work in question and a single letter grade drop for the final course grade for each student involved. More egregious instances of academic dishonesty (such as cheating on an exam) will result in immediate failure of the course. All cases of academic dishonesty will be reported to the ECE Associate Head and the Office of Student Rights and Responsibilities.

Examples of Cheating: Contrary to popular belief (and to typical student behavior), there are indeed absolutes that apply to integrity and honesty. Examples of activities that are "cheating" include **(but are not limited to)** the following:

- "collaborating" with other students on course work before it is due for submission
- helping other students on course work before it is due for submission
- seeking help from other students on course work before it is due for submission
- copying the work of another student (past or present) and representing that work as your own
- obtaining an assignment solution from a web site instead of doing it yourself
- divulging the contents of an exam to students who have not yet taken it
- obtaining information about an exam prior to taking it
- having someone else take an exam for you
- bringing “cheat sheets” in any shape/form with you to an exam
- using a cell phone or other electronic device to share information during an exam
- using a pen camera, cell phone, or any other device to photograph exam materials
- modifying a graded lab or homework paper and submitting it for reevaluation
- using another student’s (past or present) lab or homework files
- discussing the lab practical exam before all students have completed it
- copying and/or redistributing any of the copyrighted materials posted on the course web site
- publicly posting solutions to homework problems or lab experiments

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. Students are also encouraged to inform the course staff about their own mistakes ***before*** they are detected by the course staff. Depending on the severity of the circumstance, a penalty may still be imposed, **but we will always make sure it is better than if it is found by the course staff.**

Group work: We recognize that effective teamwork is important for any future employment or research position that students go on to. The best way to prepare to be a good team member is to be individually competent in the subject and motivated to contribute substantially to the joint effort. Therefore, unless explicitly allowed, all course work (e.g., homework, prelabs, labs, quizzes, exams) is to be done individually. You may not work in any way with other students in the class on any assignments before they have been turned in.

Lecture and Lab Outline:

The following reflects an approximation of the topics we intend to cover, but the order of coverage and number of lectures per topic are still under development as this course has a new instructor.

Learning Outcome	***Lecture and Lab Topics***
1. An ability to analyze and design CMOS logic gates (8 lectures)	Number systems, base conversion, switching algebra, basic electronic components and concepts, logic signals, CMOS logic circuits, logic levels and noise margins, current sourcing and sinking, transition time, propagation delay, power consumption and decoupling, Schmitt triggers, transmission gates, three-state and open-drain outputs
2. An ability to analyze and design combinational logic circuits (8 lectures)	Combinational circuit analysis and synthesis, mapping and minimization, timing hazards, XOR/XNOR functions, programmable logic devices, hardware description languages, combinational building blocks: decoders, encoders, and multiplexers
3. An ability to analyze and design sequential logic circuits (9 lectures)	Bi-stable elements, set-reset and data latches, data and toggle flip-flops, state machine structure and analysis, clocked synchronous state machine synthesis, state machine design examples: sequence generators, counters and shift registers, and sequence recognizers
4. An ability to analyze and design computer logic circuits (11 lectures)	Signed number notation; radix addition and subtraction; adder, subtractor, and comparator circuits; carry look-ahead adder circuits; multiplier circuits; BCD adder circuits; simple computer top-down specification, instruction execution tracing, bottom-up realization, basic extensions, and advanced extensions
5. An ability to realize, test, and debug practical digital circuits (~13 lab experiments)	Demonstration of Basic Logic Functions, Measurement of Gate Electrical Characteristics, Measurement of Gate Timing Characteristics, Implementation of Dual and Complement Functions, Investigation of Timing Hazards, Introduction to Sequential Circuits, Use of Stateful Logic Devices, Introduction to the Programmable Logic Devices, Scrolling 7-Segment Display, Digital Combination Lock with Pseudo-Random Combination, Arithmetic Circuits, Computer Elements,