

CENG 244L Intro to Digital Systems Laboratory, SDSM&T, Spring 2014

Laboratory Room & Times: EP336/342 Tu from noon-1:50 pm (-51) & 2-3:50 pm (-52)

Instructor: Dr. Thomas Montoya, EP325, Tel: 394-2459, e-mail: Thomas.Montoya@sdsmt.edu

Office Hours: noon-1 pm MWF, or when available.

WWW: See link from <http://montoya.sdsmt.edu>. The course web page will be heavily utilized for posting **assignments**, examples, solutions, ... E-mail will be utilized to notify students of course-related information and events (**check daily**). Your first.last@Mines.sdsmt.edu address will be used.

Catalog Description: This course is designed to provide computer engineering, electrical engineering, and computer science students with an understanding of the basic concepts of digital systems and their hardware implementation. Topics covered include combinational logic circuits, sequential logic circuits, and CPU control.

CENG 244 Prerequisite: MATH 102 (College Algebra) or equivalent.

CENG 244 Corequisite: CENG 244L

Text: *Digital Design*, Fifth Edition, M. Morris Mano and Michael D. Ciletti, Prentice Hall, 2013, ISBN-10: 0-13-277420-8 • ISBN-13: 978-0-13-277420-8.

Lab Policies:

- Attendance is **required**. All laboratories must be completed by **every individual** at a passing level to pass the class. If you miss a laboratory, contact instructor to arrange to make up the work.
- Missing or failing to complete a laboratory during the scheduled periods for other than verified situations (e.g., Doctor's letter, jury duty) or sanctioned school events will incur a **10% penalty**.
- Late laboratory assignments will incur up to a 10% /week penalty in addition to any other penalties. Laboratories more than 4 weeks late are considered failing and will result in failing the course.
- Students are encouraged to discuss laboratory assignments with classmates. However, blatant copying, plagiarism, ... (without proper referencing) is not acceptable and will be penalized.
- A principal purpose of these labs is to gain practical hands-on experience with digital circuits. **DO NOT** allow yourself to be a 'secretary' during labs!
- Complete preliminary laboratory work in your logbook **prior** to the scheduled laboratory session. To avoid disrupting laboratory work, **do not** enter laboratory until preliminary work is completed.
- **Safety-** see *ECE Department General Laboratory Safety Policy* (posted on the course web page).
- Laboratory logbook guidelines (see Figure 1 for examples):
 - (a) Why keep a laboratory logbook? There are many reasons- 1) intellectual property issues (e.g., patents), 2) jog memory as to how an experiment or test was conducted, 3) institutional memory (e.g., help the person who inherits your old job get up to speed), 4) invaluable for writing up articles, reports, papers etc., and 5) professionalism. They may be kept informally by individuals or formally. At some corporations, you must check out logbooks from a secured library and follow rigid style/content guidelines. The goal of a logbook is that another person should be able to duplicate the work done in the laboratory without outside references.
 - (b) Each person will keep and use a bound logbook (**NO** spiral bound notebooks) for laboratory work. Expect to use ~100 pages.
 - (c) **All** entries should be in **ink** (black/blue preferred) and **only on the fronts of pages** (any work on the back of pages will be ignored). Backs of pages may be used as scratch paper. **No** pencil

entries, erasing, obliterating, or using white-out to obscure any entries (intellectual property issues). Errors should simply be crossed out with a single line (no big deal).

- (d) On cover, prominently put **CENG 244L-xx** (appropriate section #), **Spring 2014**, and **your name**. Also, put contact information (e.g., address/e-mail/phone #) on or inside the front cover in the event that you misplace your logbook.
- (e) Make a **Table of Contents** (TOC) on the first page with labeled columns- Lab number, Title, Date(s), and Page numbers (both start-finish).
- (f) After the TOC, insert *ECE Department General Laboratory Safety Policy*. Attach one sheet per logbook page. After reading, initial each page to indicate your acceptance and understanding.
- (g) **All** pages, whether used or not, in the logbook should be consecutively numbered in upper right hand corner. Never tear out pages (intellectual property issues), have loose pages/materials, or insert multiple pages that are not each attached to a logbook page.
- (h) Start each lab by attaching the lab assignment sheet in the logbook. Next, do the preliminary work (show completely in the logbook!). In experimental portion of laboratory, **lab partner(s)**, **equipment list** (description, brand, & model #s), time & date ... should be listed, as applicable. Also, circuit(s) & test instrument(s) being used for measurements should be drawn/specified.
- (i) Get professor or teaching assistant (TA) to initial your logbook after the preliminary section (i.e., at the beginning of the lab period), and after the experimental section. This allows us to check your circuits/values and spot problems while you can still take remedial action.
- (j) Writing/figures/graphs must be legible (spread out, don't squish lines together) and of a readable size (large)- if we cannot read your work, you will not receive credit. As applicable, they should be titled, labeled (i.e., names / units on axes), scaled (i.e., numbers on axes), and clearly drawn.
- (k) Figures, graphs, printouts ... can be attached/pasted into logbook. The bottom of a figure/graph should be oriented toward the bottom or right hand side of the page.
- (l) Answers should be boxed/double underlined, in decimal format (if numbers), and the variables, values & units (if any) included. Use lead zeros for fractional answers, e.g., 0.4 not “.4”.
- (m) Where applicable, use conventional engineering units such as microfarads, millivolts, picoseconds, gigahertz, ... Answers without applicable units are incomplete.
- (n) Logbooks are not supposed to be a mystery, just ask if you have questions!

Course Goals: The objective of this course is to provide students with an understanding of the basic concepts associated with the analysis and design of combinational and sequential circuits. Combinational circuits include AND, OR, NOT, NAND, and NOR logic gates, adders, code converters, and memory devices. Sequential circuits include flip-flops, registers, counters, and programmable logic devices.

Student Learning Outcomes:

Upon completion of this course, students should demonstrate the ability to:

1. Convert numbers between binary and decimal, binary and hexadecimal, and decimal and binary coded decimal notation.
2. Perform the mathematical operations of addition, subtraction, multiplication, and division using signed and unsigned binary numbers.
3. Analyze combinational logic circuits using AND, NOT, OR, NOR, NAND, and XOR logic gates.
4. Design combinational logic circuits using truth tables and Karnaugh maps.
5. Program EPROMs and PALs.
6. Analyze sequential logic circuits and prepare timing diagrams using Flip-Flop Characteristic Tables.

7. Design sequential logic circuits using state diagrams, state tables, and Flip-Flop Excitation Tables.
8. Construct logic circuits in the laboratory using student trainer boards.
9. Design and construct digital control and data processing circuits using ASM charts to define digital hardware algorithms

Evaluation: The laboratory grade is worth 25% of the overall grade. Further, **all** laboratories must be completed at a passing level to pass the course. The overall laboratory grade will be based on a combination of logbook(s) and possibly technical memorandum(s)/report(s). Announcements on when to turn-in logbooks or write & submit technical memorandum(s)/report(s) will be made as warranted. Typically, laboratories will be grouped together for grading (e.g., Labs 1 & 2). For grading, the grouped labs and any technical memorandum(s)/report(s) will be weighted equally.

Grading scale: 100 > A > 90, 89 > B > 80, 79 > C > 70, 69 > D > 60, F < 60.

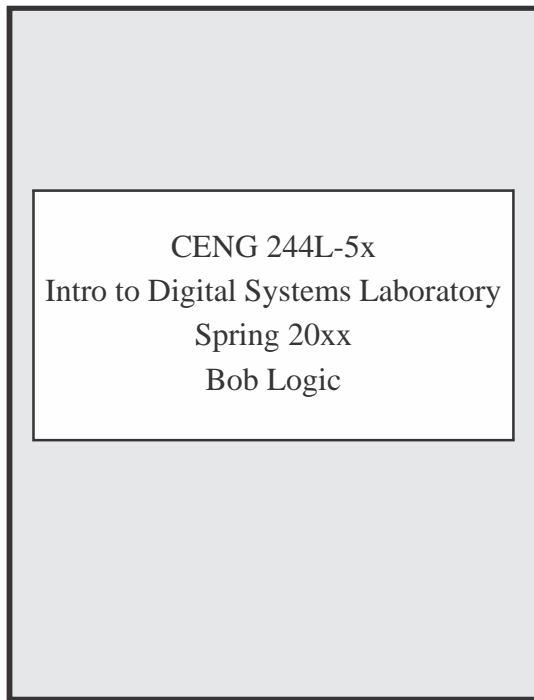
ADA: Students with special needs or requiring special accommodations should contact the instructor and/or the campus ADA coordinator, Jolie McCoy, at 394-1924 at the earliest opportunity.

Freedom in learning: Under Board of Regents and University policy student academic performance may be evaluated solely on an academic basis, not on opinions or conduct in matters unrelated to academic standards. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. Students who believe that an academic evaluation reflects prejudiced or capricious consideration of student opinions or conduct unrelated to academic standards should contact the dean of the college which offers the class to initiate a review of the evaluation.

Electronic Devices Policy: Please turn off your cell phone before class/lab starts. No text messaging in class/lab. No headphones. No other use of any other electronic/computer media is allowed during class time other than that directly related to the course.

Tentative Laboratory Schedule

Lab	Date(s)	Topics
0	1/21	Overview & intro to use of logbooks; lab policies; lab safety
1	1/28	Introduction to Logic Gates
2	2/4	Logic Circuits
3	2/11	Boolean Expressions and Simplifications
4	2/18	Karnaugh Maps
5	2/25	NAND/NOT Implementation
6	3/4	Binary Math
3/11		Spring Break
7	3/18	Multiplexers
8	3/25	Keypad Encoder/Decoder
9	4/1	Counters
10	4/8	Serial Adder
11	4/15	Sequential Counter
12	4/22	PAL Programming
	4/29	make-up day (if needed)



Cover

i

Lab #	Description/Title	Date(s)	Pages
0	Lab Safety	mm-dd-yy	1-5
1	Introduction to Logic Gates	mm-dd-yy mm-dd-yy	6-7 8-14
2	Logic Circuits	mm-dd-yy	15-19
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	.		
	.		

First sheet in logbook

6

CENG 244L Intro to Digital Circuits (Spring 20xx)
Laboratory 1 Introduction to Logic Gates

Introduction

Preliminary
1. -----
2. -----
3. -----

Procedure/Tasks
1. -----
2. -----

3. -----

4. -----

Conclusion

Sample of lab cover page

Lab 1- Intro to Logic gates cont. mm-dd-yyyy 7

Preliminary
1. -----
2. -----

Prof./TA initials: _____

Procedure (mm-dd-yy)
Lab Partners Present- Joe Truth, Ray Boolean, Julie Karnaugh

Equipment List-	Description	Model	Quantity
	Fluke Multimeter	FL77	1
	.		
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1. Set-up circuit as shown in Fig. 1 below.

Sample of lab work

Figure 1 Laboratory Logbook examples