

SYLLABUS

Introduction to Digital Logic

EE 101 / CSCI 110: Fall 2016

This course introduces digital logic design basics which are fundamental to all computers and other digital hardware. It covers number systems, Boolean algebra, and analysis and design of combinational and sequential circuits. You will learn practical design techniques along with theory and principles. The course focuses on paper-and-pencil design techniques but it will introduce basic computer aided design (CAD) tools and FPGAs in connected lab modules.

Instructor: Brandon Franzke

Email: franzke@usc.edu

Office: EEB 420

Hours: Monday 15:00 – 16:00, 19:45 – 21:00 and

Wednesday 15:00 – 16:00.

* if EEB is locked please send an email and I can meet you at the main door

Lecture

Monday and Wednesday

16:00 – 18:00 and 18:00 – 19:30

Piazza

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.

Class page: <https://piazza.com/usc/fall2016/ee101/home>

TAs and Graders

There are 2 TAs to help you with EE101 and lead discussion and lab sections. Each TA will lead one of the two Friday discussion sections. You may approach either TA with questions pertaining to EE101.

TA: Moises Herrera

Office: PHE 320

Office hours: Tuesday 16:00 – 18:00

Email: herrerab@usc.edu

TA: Albert Wang

Office: PHE 320

Office hours: Friday 12:30 – 14:00

Email: wang484@usc.edu

Grader: Harish S P

Office hours: none

Contact: e-mail to setup appointment

E-mail: settiker@usc.edu

Grader: Nishant Madan

Office hours: none

Contact: e-mail to setup appointment

E-mail: nishantm@usc.edu

Course materials

Online content (Blackboard): <http://blackboard.usc.edu>

References (**NOT** Required): "Digital Design with RTL Design, Verilog and VHDL", 2nd edition, Frank Vahid, 2010, (ISBN: 0470531088).

Course Outline

22 Aug	Analog vs. digital. Positional # systems.
24 Aug	Number conversion: binary, octal, hex. Binary codes: ASCII, BCD. Binary arithmetic.
29 Aug	Signed binary: Signed magnitude. 2's complement. Sign extension.
31 Aug	Logic functions and representations. Minterms and maxterms. Canonical sums/products.
05 Sep	No class: Labor Day, University holiday
07 Sep	Design goals and circuit design. Manipulations. 2-level implementations. Circuit synthesis. Canonical implementation.
12 Sep	Boolean algebras (T1-T5); (T6-T11); De Morgan's Theorem.
14 Sep	Simplified 2-level implementations. Karnaugh maps. Don't cares.
19 Sep	Circuit design. Implicants. Distinguished 1's and 0's cells.
21 Sep	Venn diagrams. DeMorgan's Laws and bubble pushing. Positive and negative logic. Active low signals.
26 Sep	Decoders. Muxes. ROMs.
28 Sep	Midterm 1 review.
30 Sep	Midterm 1, 17:00 – 19:00
03 Oct	Multiplexers, demultiplexers, and Adders.
05 Oct	Encoders. Priority encoders. Multiplexers (composition and width).
10 Oct	Adders. Multipliers.
12 Oct	Addition / subtraction. Overflow.
17 Oct	Comparators. XORs & parity.
19 Oct	Degenerate logic. Circuit optimizations. Propagation delay. Tristate logic.
24 Oct	Sequential logic. Bistable circuits.
26 Oct	Latches. Flip-flops.
31 Oct	Master/slave FF.
02 Nov	State machine overview and analysis.
04 Nov	Midterm 2, 17:00 – 19:00
07 Nov	State machine design and analysis. CPU design.
09 Nov	Datapath & ALU design. CPU design.
14 Nov	System design (vending machine).
16 Nov	Verilog introduction.
21 Nov	State machines and RTL coding.
23 Nov	No class: Thanksgiving, University holiday
28 Nov	Waveform analysis and debugging.
30 Nov	Final review

Final (cumulative)

Monday, December 12, 16:30 – 18:30, in SGM101
final exam exception #20161025-00017

Grading Procedure

Homework

Assigned weekly starting the second week. This is an introductory course and the homework is meant to supplement topics that we might not cover fully in class. Staying current with the class requires practice to master the concepts. Experience has shown that students who put in the effort on these homeworks, struggle with problems, and ask questions when they did not understand a problem did the best in this course.

The total homework score sums your best homework scores (as a percentage) after removing the lowest two scores. Homeworks are due at the beginning of the discussion class or lecture class on the posted due date. Late homework will be accepted with a 10% deduction per day for up to 2 days only if the solutions are not distributed. Late homework can be submitted by sliding under my office door except on the day of lecture/discussion. Late homework can be submitted at the beginning of the class on the lecture/discussion days. Homework will not be accepted after solutions are posted or distributed. Usually solutions are posted 1 to 2 days after the due date. If you cannot make it to a lecture you can turn it in early or have a friend turn it in.

Students may discuss homework problems among themselves but each student must do his or her own work. Cheating warrants an F in the course. Turning in identical homework sets counts as cheating.

Weekly exam

13 weekly exams. Closed book. 15 minutes per exam at the start of each Wednesday lecture session. No make-up exams. Each exam is worth 10 points. Missed exams earn an automatic 0. The total weekly exam score sums your 10 best weekly exam scores. Class attendance is mandatory. Unexcused absences get an automatic exam score of zero for that session's exam grade.

Discussion/Lab

Discussion sections will be a mix of review/example problems and small lab exercises. Lab exercises will consist of small logic designs using a digital training board, FPGA boards, and logic simulators. These lab exercises are meant to give students an opportunity to work with actual hardware and provide concrete examples to the pencil and paper designs discussed in lecture. FPGA boards will be checked out to every pair of students. You are responsible for keeping these safe and undamaged. Lost or damaged boards will need to be paid for by the student to whom it was checked out.

Exams

All exams will be closed book. The two midterms will be taken in the Quiz section (which is the only time we will use that slot) tentatively scheduled for the given dates. There will be no calculators allowed, just bring a few pencils and an eraser. You must show how you arrived at your answers to receive full credit. Any cheating may result in an "F" in the course and will be referred to Student Affairs for other penalties. Make up exams will only be given for valid medical or family emergency excuses (proof required).

Course Grade

HW	10% (lowest 2 thrown out)	A	if 90 – 100 points
Weekly Exams	20% (best 10 scores)	B	if 80 – 89 points
Labs	15%	C	if 70 – 79 points
MT1	15%	D	if 60 – 69 points
MT2	20%	F	if 0 – 59 points
Final	20%		

Attendance and Participation

Attendance is mandatory to all lectures and discussions. There are weekly exams and no make-ups. Unexcused absences result in an automatic exam score of zero.

Cheating

Not tolerated on homework or exams. Penalty ranges from F on exam to F in course to recommended expulsion.

Academic Conduct

Plagiarism

Presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards <https://scampus.usc.edu/1100-behavior-violating-university-standards-andappropriate-sanctions>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity <http://equity.usc.edu> or to the Department of Public Safety <http://capsnet.usc.edu/departments/public-safety/online-forms/contactus>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men <http://www.usc.edu/studentaffairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

Academic Integrity

Academic integrity is critical the assessment and evaluation we perform which leads to your grade. In general, all work should be your own and any sources used should be cited. Gray-areas occur when working in groups. Telling someone how to do the problem or showing your solution is a VIOLATION. Reviewing examples from class or other sources to help a fellow classmate understand a principle is fine and encouraged. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, contains the University Student Conduct Code in Section 10, while the recommended sanctions are located in Appendix A. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

Academic Accommodations

Any student requiring academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in GFS 120 and is open 08:30 – 17:00, Monday through Friday. The phone number for DSP is (213) 740-0776.