

SYLLABUS
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1. CS2204 Sections D (1224), E (1226), and F (1228) => Simply CS2204D

2. **Professor :** Haldun Hadimioglu

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3. **Main Topic :**

CS2204 introduces theory, design and analysis of **digital circuits**, which are building blocks of computers and micro-processors. Today, digital circuits are on **chips**, which are on **printed circuit boards** (PCBs). As developing ever cheaper, faster, more reliable, smaller, lighter and less power consuming digital circuits continues, one finds them virtually everywhere : washing machines, cars, DVDs, toasters, and even greeting cards.

4. **Prerequisite :**

The prerequisite is CS1114 (C- required). Knowing electricity which is covered in PH2004 is helpful for digital circuit design, analysis and also for lab sessions.

5. **Course web page :**

Handout and lab files of the course will be kept at the following URL : <http://cis.poly.edu/cs2204>

6. **Textbook and manuals :**

The book from the bookstore : Digital Design Principles and Practices, John F. Wakerly, 3/e updated, Prentice Hall, 2001 : <http://www.prenhall.com/wakerly> or <http://www.ddpp.com>

The TTL chip manual on line :

- LS TTL Data, On Semiconductor, 2000 : <http://onsemi.com/pub/Collateral/DL121-D.PDF>

The chip manual on course reserve in the library :

- Motorola FAST and LS TTL Data, 5<sup>th</sup> edition, 1992

7. **Exams :**

There will be 55-minute and 110-minute midterm exams and a three-hour final exam. The midterm exams will be taken simultaneously by students from sections D, E and F. The final exam will be taken by students from all six sections : A, B, C, D, E, and F. The exams will cover class and lab topics.

Students will be allowed to use their own material, i.e. their books, notebooks and handouts during the exams, hence, “**open book**” exams. **Showing work** (intermediate steps) is **required** to get full/partial credits on a question.

Remembering the following points will be helpful during exams : (i) checking notes and handouts before solving a problem, (ii) no multiple answers to a question, (iii) precise answers to questions, no answers like “the rest is similar,” (iv) answering the question asked, and (v) using exam booklet space well : start a new question on another page.

8. **CS2204 Lab :**

The lab is intended to help students understand subjects discussed in class better. Students also reinforce what they learn in the classroom by practicing in the lab, i.e. by actually designing digital circuits. The lab is also intended to emulate an engineering environment where engineers are teamed up to design digital circuits piece by piece under the guidance of a project manager. Just like a real hardware design environment, the lab will make use of current digital design tools and techniques, such as computer aided design (CAD), Field Programmable Gate Array (FPGA) prototyping and core-based design.

Digital circuits will be developed on CAD software *Xilinx Foundation 4.2i* and the FPGA prototyping board *Digilent Digilab XLA5 FPGA board*. The software which comes with the textbook will **not** be used for the course. The Xilinx URL is <http://www.xilinx.com>. The Digilent URL is <http://www.digilentinc.com>. There is also a web site that has been set up at Michigan State University to help Xilinx university users : <http://xup.msu.edu>.

The CS2204 lab is the **CIS Lab, 227RH**. Each section has three hours per week in the lab. Note that students cannot attend the lab of other sections. The PC lab 775JAB also has the Xilinx software installed. Besides, 227RH will be open to CS2204 students with a TA present when a lab session is not scheduled.

**Two**-student teams will be formed alphabetically in the second week of the semester. The team members will work on design experiments together until the end of the semester. The CS2204 lab will consist of **six** design experiments. Each experiment will take one to three weeks and make use of previous experiments. Consequently, experiments will be increasingly more complex.

The lab will **not** affect the term grade. However, the last three design experiments will be collected and comments will be made. Also, "lab attention" grades will be given, indicating student's motivation (lab attendance, arrival /exit times), concentration on the experiments, and how much they are able to work with their partners.

### 9. Homework :

There will be six homework assignments. The homework will be submitted by teams. The homework will **not** affect the term grade. **An assignment submitted late will not be accepted.** Students will need to visit the above Prentice-Hall web site to get the solutions of some of the textbook problems. Again, **showing work** (intermediate steps) is **required** to get full/partial credits on a question.

Each homework assignment will include **modified** exam questions and answers of past semesters to help understand chapters and solve homework problems. Students need to study them **before they solve homework problems**, not before exams. Also note that, these past exam questions are samples and do **not** give hints about exams this semester.

### 10. Attendance :

Attendance is required. Attendance will be recorded in every lab session and randomly during lectures.

### 11. Term Grade :

The term grade is based on the weights of the exams :

**20% Exam I**  
**35% Exam II**  
**45% Final Exam**

Students are expected to solve exam questions as they are shown in past exam solutions and in class. This also means they need to show their work, i.e. intermediate steps.

While the Lab and the homework do **not** affect the term grade directly, having a good lab performance and doing the homework are important. They are taken into account when a student's term grade is near a grade "border." Also considered is student's attendance record. If they are **all** good, the grade will be raised.

Finally, depending on the class performance, the professor may change the term grade computation. For example, if the attendance is low during lectures, it may directly affect the term grade ! Thus, students are strongly suggested that they fulfill the requirements of the course, i.e. the lab, lectures and homework assignments.

### 12. Office Hours :

The professor has an **open-door** policy that if he is not busy, students can ask question in his office. If the door is closed, he might be in the lab as there are six three-hour lab sessions a week. If a student wants to see the professor at a certain time, an appointment has to be made with the professor beforehand.

Students can use email for short non-emergency cases. An email message without student's name and section will not be answered. The professor receives his email messages on photon, **not** utopia and students will receive their messages from the professor on utopia. Also, broadcast messages will be sent to class to make announcements. Students are strongly requested that they **see** the professor and teaching adjuncts (TAs) to ask questions, instead of sending email.

### 13. Additional Assistance :

There are six teaching adjuncts to help students for the course : the lectures, the homework, and the lab. The TAs' names are as follows : **Nikhil Joshi, Sapan Shenoy, Jeff Tao, Haobo Wang, Bo Yang** and **Peng Yao**. TA assignments and their contact information will be given in class and lab handouts later.

### 14. Material Coverage :

All chapters except two will be covered, some partially, some completely this semester. Students will be given additional material in class. The **tentative** schedule is as follows :

Days	Subject	Chapter(s)
Sep 8	Introduction.	1
Sep 8, 13, 20, 22	Number systems and binary arithmetic.	2.1 - 2.8, 2.10 - 2.12
Sep 27, 29, Oct 4, 6	Switching Algebra. Gates. Combinational circuit fundamentals, analysis and design	4.1 - 4.3
Oct 20	EXAM I : 55 minutes long	Chp : 1, 2*, 4* ; HW : 1, 2 ; Labs : 1, 2, 3
Oct 12, 13	Karnaugh maps	4.3
Oct 13, 18, 20	Semiconductor technology. Integrated circuit logic families. TTL SSI gate network implementations	3.1 - 3.2, 4.5, 5.1 - 5.2,
Oct 25, 27, Nov 1, 3	Popular combinational circuits.	5.4 - 5.11
Nov 10	EXAM II : cumulative. 110 minutes long	Chp : 1, 2*, 3*, 4*, 5* ; HW : 1 - 4 ; Labs : 1 - 4
Nov 8, 15, 17, 22	Sequential circuit principles. Flip-flops. Sequential circuit analysis. Practical sequential circuits. Synchronous sequential circuit design principles	7.1 - 7.3, 8.1, 8.2, 8.4, 8.5, 7.4, 8.6 - 8.8
Nov 29, Dec 1, 6	Semiconductor memory chips, ROM and RAM. Combinational programmable logic devices, PLA and PAL, Sequential PLDs	10.1 - 10.3, 5.3, 8.3
Dec 8	Introduction to VHDL Language & Programming	4.7, 5*, 6*
Dec 8	Coding, error detection and correction.	2.14 - 2.15
TBA	Final exam : cumulative	All above chapters ; HW : 1- 6 ; Labs : 1 - 6

\* means the chapter is partially covered.

### 15. References :

The following references are recommended with respect to their relevance to the course and the textbook :

- a) Fundamentals of Logic Design, 4/e, Charles H. Roth, Jr., West Publishing, 1992.
- b) Switching Theory and Logic Design, F. J. Hill and G. R. Peterson, 3<sup>rd</sup> edition, John Wiley, 1981.
- c) Digital Logic Circuit Analysis and Design, V. P. Nelson, et. al., Prentice-Hall, 1995.
- d) The Practical Xilinx Designer Lab Book, David Van den Bout, Prentice-Hall, 1999.
- e) Structured Logic Design with VHDL, J. R. Armstrong and J.G. Gray, Prentice-Hall, 1993.
- f) The Designer's Guide to VHDL, P. J. Ashenden, Morgan Kaufman, 1996.
- g) The Student's Guide to VHDL, P. J. Ashenden, Morgan Kaufman, 1998.
- h) Digital Systems Design Using VHDL, C. H. Roth, Jr., PWS Publishing, 1998.
- i) Stephen Brown and Zvonko Vranesic, "Fundamental of Digital Logic with VHDL Design," McGraw-Hill, 2000.
- j) Digital Design Essentials, Richard S. Sandige, Prentice-Hall, 2002.
- k) Introduction to Logic Design, 2/e, Sajjan G. Shiva, Marcel Dekker, 1998.
- l) Digital Logic and State Machine Design, 3/e, David J. Comer, Saunders College Publishing, 1995.

- m) Digital Logic : Applications and Design, John M. Yarbrough, West Publishing Company, 1997.
- n) Contemporary Logic Design, Randy H. Katz, Benjamin/Cummings, 1994.

#### 16. Reminders about the course:

a) Students are required to pay attention to the classes and labs and not disturb others by 1) coming to the class/lab on time, 2) staying in the classroom/lab, not going out and coming back frequently, 3) not talking and 4) turning off their cell phones and notebook computers. Otherwise, students will be asked to leave the classroom/lab.

b) Topics in the first five weeks of the semester are covered in **less** detail in some earlier courses and even in High School. They are also easier to learn. This gives the false impression that the rest of the semester is similar. It is **not** the case. In the remaining eight weeks, the topics are very different which students need to keep in mind. Otherwise, they would realize it too late and cannot catch up with the professor, finding themselves in a situation where getting a good grade is not possible.

c) Another reason for a low grade on CS2204 is missing classes and labs. Even if one gets the notes, it will not help 100%. This is because, first, the notes are not perfect. Second, someone taking the notes may not write down the verbal comments and suggestions made by the professor. Third, attending classes and labs forms better memory because of visual (writing down the notes) and hearing (listening to the professor) inputs. In addition, during lectures and labs, the professor refers to earlier lectures and labs (past topics, comments, suggestions, etc.) which refreshes students' memory and further reinforces their knowledge. Overall, students will learn more and remember more.

d) Students are advised that they **concentrate on learning**, not on grades (tests). This guarantees a good experience on the course and a solid foundation for the follow up courses. If a student falls behind, the student has to make up (learn) quickly, without thinking about the grade.

e) Missing an exam or a lab is **not** a minor case. A careful assessment is made to excuse a student or to grant an incomplete to a student. Only the professor makes the decision. The decision can be negatively affected by the information on the student provided by the academic department and the Student Development Office. One of the requirements to excuse a student is that at the time the student is not able to take the exam/lab, he/she be in good standing in class, i.e. has good attendance, a good homework performance, a good lab performance and a good exam performance. That is, the professor wants to see that the student has been committed to the course and learning the material has been his/her main objective.

A student who is excused from a midterm exam/lab will **not** be given a make-up exam/lab. The weight of the midterm exam will be distributed to the other exams at the discretion of the professor. The professor will decide how the student will make up the missed lab session, after discussing it with the student.

f) For a course, the semester is over when the final exam is over. Students will **not** be given extra work, a project, a make-up exam or any other kind of special treatment to raise their grade during or after the semester.

g) It has been observed that a student pays unnecessary penalty, because he/she does not know/follow Polytechnic University rules and regulations and course rules. They also do not seek advice from Polytechnic staff. Students are, therefore, strongly suggested that they speak with the professor, the personnel of the Student Development Office and the Special Services Office when they experience difficulties/problems.

h) Students are strongly recommended that they **not** make assumptions and decisions on the course without asking the professor : exams, lectures, labs, the homework and attendance.

#### 17. ABET Core Competencies :

CS2204 addresses the following ABET competencies :

- a) Students apply mathematics knowledge (Switching Algebra) and engineering knowledge (combinational and sequential circuits) to design and analyze advanced circuits.
- c) Students design a digital system that meets the desired chip count, timing and cost constraints.
- d) Students from electrical engineering, computer engineering and computer science form teams to work on the term project.
- e) Students identify, formulate and solve circuit problems.
- g) Students gain the ability to communicate effectively by forming teams and interacting with the professor and TAs.
- j) Students gain knowledge of contemporary issues in circuit design and project management.
- k) Students gain techniques, skills and modern engineering tools necessary for engineering practice by applying them on the term project.