CS2204 DIGITAL LOGIC & STATE MACHINE DESIGN FALL 2008

SYLLABUS

1. Professor : Haldun Hadimioglu

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2. Lecture Section : **A (1093)**

Lab Sections :

- ⇨ **A** (**1094**, Tuesday 3 - 5:50)
- ⇨ **B** (**1095**, Friday 2 - 4:50)
- ⇨ **C** (**1096**, Monday 2 - 4:50)
- ⇨ **D** (**1097**, Friday 9 - 11:50)

3. Prerequisite : CS1114 (C- required).

4. Course web page : http://cis.poly.edu/cs2204

⇨ Course handout and lab files are at the course web site

5. Textbook and manuals :

The textbook: *Digital Design Principles and Practices*, John F. Wakerly, 4th edition, Prentice Hall, 2006. ISBN : 0-13-173349-4.

⇨ Author's web site : **http://www.ddpp.com** for additional material.
⇨ The course ID to access CS2204 OneKey CourseCompass will be given in class

Chip manuals :

➜ Texas Instruments Digital Logic Pocket Data Book, 2003, SLL : **http://focus.ti.com/lit/ug/scyd013b/scyd013b.pdf**
➜ LS TTL Data, On Semiconductor, 2000 : **http://www.onsemi.com/pub/Collateral/DL121-D.PDF**
➜ Motorola FAST and LS TTL Data, 5th edition, 1992 : **On reserve in the library**

6. Goals : The course has *intellectual*, *technical* and *non-technical* goals :

⇨ The *intellectual* goal is that students **learn how to learn**. This is a necessity in the workplace.
➢ The more you learn, the better for you. Going for a grade is against this goal.

⇨ *Technical* goals are for a successful technical career : acquiring skills to be **systems oriented** and a **problem solver** as well as acquiring the necessary course content which is *digital logic* :
➢ **Main technical topic :** CS2204 covers *theory*, *design* and *analysis* of **digital circuits**. They are building blocks of **digital systems** such as microprocessors and computers. Digital circuits and systems are on **chips** and chips are on **printed circuit boards** (PCBs).
⇛ Ever better digital circuits (faster, cheaper, smaller, lighter, less power consuming, more reliable) are continually developed : computers, iPhones, cars, DVDs, toasters and even greeting cards.
⇛ Fundamentals of digital systems are covered in the context of the term project.

⇨ The *non-technical* goals include acquiring and improving skills needed for **interacting with** and **managing people** in various environments. This is needed in the technical world which is becoming more **global** and more **team-based**, and also in life in general.

7. A successful course experience : In order to benefit from the course as much as possible, i.e. to achieve the goals of the course, students need to be **committed** to the course, need to be a part of it. Learning the material, not getting a good grade, needs to be their important objective.

⇨ **Attending classes** and **labs** and **doing the work** are needed.
➢ **Students cannot make up a missed lecture or lab** even if they study the notes a lot.

8. CS2204 Lab : Students work on a term project in the lab, learn practical aspects of digital logic and apply them.

The term project is developing a **game chip** :

- ⇨ The lab helps students understand subjects discussed in class better. Practicing in the lab, i.e. actually designing digital circuits, reinforces and complements what students learn in the classroom. *Students who attend labs are faster at solving problems.* Also, the lab emulates an engineering design environment where engineers are teamed up to design digital circuits piece by piece under the guidance of a project manager.

- ⇨ The lab introduces current digital design tools and techniques, such as computer aided design (CAD), Field Programmable Gate Array (FPGA) prototyping, top-down, team-oriented, core-based design. Digital circuits are 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 is **not** used for the course.

- ⇨ The CS2204 lab is the **CIS Lab, 227RH**. Each section has two hours and 50 minutes a week in the lab. 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.

- ⇨ Lab sessions start with a presentation by the professor. Then, students work on their experiments. The term project is distributed to **six** design experiments, each making use of previous experiments. Consequently, experiments are increasingly more complex. **3**- or **4**-student teams are formed by the *third* week of the semester. Team members work on design experiments and do the homework assignments together until the end of the semester. If a student does **not** attend lectures or labs, he/she will not join a team.

- ⇨ The lab **affects** the term grade. Students must be present and working well on the assigned topic with their partners in the lab. Attendance is recorded in every lab session. See part (11) below for the Lab grade.

9. Homework : There will be six homework assignments. The homework will be submitted by teams. **An assignment submitted late will not be accepted.** Author's web site has solutions of some of the textbook problems.

- ⇨ *Students who do homework are faster at solving problems.* **Showing work** (intermediate steps) is **required** to get full/partial credits on a question. The homework is graded by a TA. Although, the homework will **not** affect the term grade, it can help raise grades as explained in part (11) below.

- ⇨ Homework assignments include **modified** past exam questions and answers of to help learn chapters and solve homework problems. Students need to study them **before they solve homework problems**, not before exams. Note that, these past exam questions are samples and do **not** give hints about exams this semester.

10. Exams : There will be **two** 110-minute midterm exams and a three-hour final exam. *The exams will cover class and lab topics.*

- ⇨ For CS2204, both the final answer, and the steps, the **approach**, to get the final answer are important.
  - ➢ These steps are given in class and past exam solutions. Therefore, students are expected to solve exam questions as such. This means **showing work** (showing intermediate steps given in past exam solutions and in class) is required to get full credits on a question. Solving in this way also helps students acquire and improve their documentation skills, critical for technical work.
    - ⇛ In order to facilitate this, the exams are **open book** exams : students can use their own material, i.e. their books, notebooks and handouts during the exams. Simply, students have to refer to notes and handouts as they solve an exam problem

- ⇨ In addition, remembering the following is needed during exams : (i) No multiple answers to a question, (ii) precise answers to questions, no answers like "the rest is similar," (iii) answering the question asked, and (iv) using the exam booklet space well : start a new question on a new page.

11. Term Grade : *Labs and homework considerably affect the term grade* whose numerical calculation is as follows :

5% Labs **20%** Exam I **30%** Exam II **45%** Final Exam

- ⇨ To earn 5% for the Labs, students must work well in the lab (attendance, concentration and cooperation) as described in the *CS2204 Lab and Engineering Fundamentals* handout.

- ⇨ The homework does **not** affect the term grade directly but it is taken into account when a student's term grade is near a grade "border." Also, taken into account are attendance and lab performance. If they are good, the grade is raised. Finally, the professor may change the term grade computation. Thus, students are strongly suggested that they fulfill the requirements of the course, i.e. labs, lectures and homework assignments.

12. Office Hours : The professor has an **open-door** policy that if he is not busy, students can ask questions in his office. If the door is closed, he might be teaching or at a meeting. If a student wants to see the professor at a certain time, he/she makes an appointment with the professor.

- ⇨ Students can use email for short non-emergency cases. Students need to a Polytechnic computer and include their name and section in their email. Also, broadcast messages will be sent to class to make announcements. In general, students are strongly suggested that they **see** the professor and teaching assistants (TAs) to ask questions, **instead of** sending email.

- ⇨ There are TAs to help students in the lab. TA assignments and their contact information will be given in class and lab handouts later in the semester.

13. Material Coverage : All chapters 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 2	Introduction. Course overview	1
Sep 2, 4, 9, 11	Number systems and binary arithmetic	2.1 - 2.7, 2.10 - 2.12
Sep 16, 18, 23, 25, 30	Switching Algebra. Gates. Combinational circuit fundamentals, analysis and design	4.1 - 4.3
Oct 9	EXAM I	HW : 1, 2 ; Labs : 1 - 4
Oct 2, 7, 16, 21, 23, 28	Synchronous sequential circuits : Flip-flops, popular sequential circuits, sequential circuit analysis and design	7.1 - 7.4, 8.1 - 8.2, 8.4 - 8.8
Nov 6	EXAM II : Cumulative	HW : 1 - 4 ; Labs : 1 - 8
Oct 28, 30, Nov 4, 11	Popular combinational circuits	6.4 - 6.10
Nov 13, 18, 20	Karnaugh maps	4.3
Nov 20, 25, Dec 2	Semiconductor memory chips, ROM. Combinational programmable logic devices, PLA and PAL	6.3, 8.3, 9.1 - 9.4, 9.6
Dec 2	Coding, error detection and correction. Hamming Code	2.14 - 2.15
Dec 4	Introduction to the VHDL Language & Programming	5, 6, 7, 8
TBA	Final exam : Cumulative	All above chapters ; HW : 1- 6 ; Labs : 1 - 13

14. References : Students are suggested that they study recent digital logic books since the field advances fast. The books below are recommended with respect to their relevance to the course and the textbook :

a) *Switching Theory and Logic Design*, F. J. Hill and G. R. Peterson, 3rd edition, John Wiley, 1981.
b) *Digital Logic Circuit Analysis and Design*, V. P. Nelson, et. al., Prentice-Hall, 1995.
c) *Contemporary Logic Design*, Randy H. Katz, 2/e, Benjamin/Cummings, 2005.
d) *Introduction to Logic Design*, Alan B. Marcovitz, 2/e, McGraw-Hill, 2005.
e) *Fundamental of Digital Logic with VHDL Design*, Stephen Brown and Zvonko Vranesic, 2/e, McGraw-Hill, 2005.
f) *Digital Design Essentials*, Richard S. Sandige, Prentice-Hall, 2002.
g) *Sequential Logic : Analysis and Synthesis*, Joseph Cavanagh, CRC Press, 2006.
h) *Digital Systems Design Using VHDL*, C. H. Roth, Jr. & L. K. John, 2nd edition, Thomson Learning, 2007.
i) *Introduction to Logic and Computer Design*, A. B. Marcovitz, McGraw-Hill, 2007.

⇨ A book giving insight on microprocessor design from the concept phase to the production phase : *The Pentium Chronicles : The People, Passion, and Politics Behind Intel's Landmark Chips*, R. P. Colwell, John Wiley, 2005.

⇨ A book describing how and why technical work involved in computer design and development is a just small part of a larger picture with emotions, ambitions and conflicting goals of many people involved : *Dealers of Lightning : Xerox Parc and the dawn of the Computer Age*, Michael A. Hiltzik, Harper Business, 1999.

15. Reminders about the course:

Please read the material for students at the Poly web site, including those available under "Current Students" and the *Poly NYU Syllabus Addendum* on MyPoly under "Polytechnic Community -> Policies & Rules." In addition :

a) Topics of the first five weeks of the semester are covered in **less** detail in earlier courses and are easier to learn. This gives the false impression that the rest of the semester is similar. It is **not** the case : remaining eight weeks, the topics are different and harder. If students realize this late, they may not be able to catch up with the professor.

b) Students are strongly suggested 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 needs to try to make up (learn) quickly, without thinking about the grade.

c) To concentrate on learning, students need to pay attention to classes and labs and not disturb others by i) coming to the class/lab on time, ii) staying in the classroom/lab, not going out and coming back frequently, iii) not talking and iv) turning off their cell phones and notebook computers.

d) A reason for a low grade is **missing classes** and **labs**. Even if one gets the notes, it does **not** help. This is because, first, the notes are not perfect. Second, someone taking the notes may not write down all 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 audio (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 learn more and remember more. Finally, since their memory is fresh, students save time when they study for the exams.

e) Missing an exam 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 is made also based on the information by the student's 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, 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 : 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 is **not** be given a make-up exam. The weight of the midterm exam is distributed to the other exams at the discretion of the professor.

f) For a course, the semester is over when the final exam is over. Students are **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 and course rules and regulations. They also do not seek advice from Polytechnic staff. Students are, therefore, strongly suggested that **they speak with the professor**, the TAs, the personnel of the Student Development Office, and the Counseling Center when they experience difficulties/problems.

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

16. 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 contraints.
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 profesor 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.