CS2204 DIGITAL LOGIC & STATE MACHINE DESIGN SPRING 2012

SYLLABUS

1. Professor : Haldun Hadimioglu

Office : 10.009 2MTC

Tel : (718) 260-3101
Fax : (718) 260-3609

haldun at photon dot poly dot edu
http://cis.poly.edu/haldun

2. Course format :

Lectures : 3 hours/week
Lecture Section : **2677**

Labs : 3 hours/week
Lab Sections :
⇨ **A** (**2678**, Thursday 9 - 11:50)
⇨ **B** (**2679**, Tuesday 9 - 11:50)
⇨ **C** (**2680**, Friday 1 - 3:50)
⇨ **D** (**2681**, Friday 4 - 6:50)

3. Prerequisite : CS1114 (C- required) or CS1133 (C- required).

4. Course web page : http://cis.poly.edu/cs2204
⇨ Course handout and lab files are at the course web site

5. CS2204 is the **first** course to **design digital hardware** !

6. 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, 2007, SLL
⇨ **http://focus.ti.com/lit/ug/scyd013b/scyd013b.pdf**
➜ Motorola FAST and LS TTL Data, 5th edition, 1992 : **On reserve in the library**

7. Professor's message :

➜ *Target l**earning** and **thinking**, **not** the **grade** nor **pattern matching** (problem solutions) !*
⇨ *Do **not** go for memorizing patterns (problem solutions)*

➜ *Knowledge is **not** finite **nor** independent pieces of patterns*

➜ *Knowledge is a **hierarchy** of unmeasurable width and depth of interconnected entitities*

➜ *Knowledge generates knowledge : Knowledge helps us **think** which leads us to discover new knowledge*

➜ *Knowledge also helps us solve **problems*** by means of ***thinking***
⇨ *Learning means one acquires knowledge which helps for both **thinking** and **solving problems***

➜ *Lectures are **interdependent**, labs are **interdependent** and courses are **interdependent***

8. Benefitting from the course for the years before and after graduation :

➜ *Do **not** go for **passing** the course, but **learning***

➜ Industry and academia look for graduates who can **solve problems**, are **systems oriented** and **creative**
- ⇨ In order to accomplish those you need to have
  - ➢ Analytical skills, synthesis skills and team work skills
- ⇨ For these three skills, you will need to develop **critical thinking** and **personal skills** for which you need to do the following
  - ➢ **Learning is your target** !
  - ➢ If you study **past exams**, without studying the book and others, you do **pattern matching**, not thinking !
    - ⇛ You need to study **books**, **notes**, **handouts** !
  - ➢ If you **miss classes** and **labs**, you are not learning enough !
- ⇨ **You interact with people to work on a problem, to exchange ideas, to help, etc.** !

➜ All of these are possible by doing the following
- ⇨ You **care** for the course and show with your own actions.
- ⇨ You take the course to **learn**, not to pass !
- ⇨ You take the course for its **content**, not for the grade !
- ⇨ You **attend** classes and labs and **do** the homework and term project !

➜ Then, you will enjoy the course and appreciate it which will make you more interested in the course !

➜ After graduation, the most common way you will be judged is how you write
- ⇨ Concentrate on **documentation** !
  - ➢ Homework and exams help you practice writing : Students show work, not just the final answer

➜ Students understand and satisfy the **goals** of the course which are *intellectual*, *technical* and *non-technical* :

1) The *intellectual* goals are that students **learn how to learn fast** and are **critical thinkers**. This is necessary during one's lifetime.
- ➢ The more you learn, the better for you. That is, do not go for the grade !

2) *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 :** *Theory, design* and *analysis* of **digital circuits**. Digital circuits are building blocks of **digital systems** such as microprocessors and computers
  - ⇛ Digital system fundamentals are covered in the context of state machine design and the term project.

3) The *non-technical* goals include acquiring and improving skills needed for **interacting with** and **managing people** in various environments. They are needed in the technical world which is **team-based** and becoming more **global**.

9. CS2204 Lab :

Students learn practical aspects of digital logic and apply them by working on a term project in the lab. 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 the 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) tools, field programmable gate array (FPGA) prototyping, top-down, team-oriented, core-based design. The game chip will be developed on *Xilinx ISE 12.4* CAD tool and the *Digilent NEXYS-2 FPGA board*. Students will install a smaller version of the ISE 12-4, **WebPACK 12.4**, on their laptops to work on the project.

- ⇨ The lab is **227RH** which is a **CSE** lab. Each section has two hours and 50 minutes a week in the lab. Students cannot attend the lab of other sections. Also, 227RH will be open to CS2204 students with a TA present (open lab hours) starting week 4.

- ⇨ 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. All six experiment designs will be collected one per team and graded. **Late submissions will not accepted.** Students must be present and work well with their partners in the lab. Attendance is recorded in every lab session. If a student does **not** attend lectures or labs, he/she will be separated from the team.

- ⇨ Lab sessions start with a presentation by the professor. Then, students work on their experiments. The lab **affects** the term grade. How to determine the lab grade will be given in the lab.

10. Homework :

There will be six homework assignments. The homework will be submitted by teams. **A late submission will not be accepted.** The CourseCompass web site has solutions of some of the textbook problems.

- ⇨ *Students who do the 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 below.

- ⇨ Homework assignments have **modified** past exam questions and answers 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.

11. Exams :

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

- ⇨ **Showing work** (showing intermediate steps) is required to get full credits on a question. That is, both the final answer and the steps to get it, the **approach**, are important.
  - ➢ These steps are given in class and past exam solutions. Therefore, students are expected to solve exam questions as such. Showing the approach also helps students acquire and improve their **documentation** skills, critical for the technical world.
    - ⇛ In order to facilitate this, the exams are **open book** exams : Students can use their own material, i.e. their books, notebooks, homework and handouts during the exams. Note that once the exam starts there is **no** sharing.
  - ⇛ **Students must prepare for the exams as if they are closed book exams !**

- ⇨ In addition, remembering the following is needed during the 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 : For example, start a new question on a new page.

12. 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) and do their term project well.

- ⇨ 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. lectures, labs and homework assignments.

13. 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. But, they are strongly suggested that they **see** the professor to ask questions, instead of sending email. If email is sent, a Polytechnic email address must be used and student's name and section must be included. Broadcast messages will be sent to the class to make announcements. Note that grades are **not** given out to students via email or telephone. Students need to see the professor to learn their grades.

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

14. Material Coverage :

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

Days	Subject	Chapter(s)
Jan 24	Introduction. Course overview	1
Jan 24, 26, 31, Feb 2	Number systems and binary arithmetic	2.1 - 2.7, 2.10 - 2.12
Feb 7, 9, 14, 16, 21	Switching Algebra. Gates. Combinational circuit fundamentals, analysis and design	4.1 - 4.3
Mar 1	EXAM I	HW : 1, 2 ; Labs : 1 - 4
Feb 23, 28, Mar 6, 8, 20	Synchronous sequential circuits : Flip-flops, popular sequential circuits, sequential circuit analysis and design	7.1 - 7.7, 8.1 - 8.2, 8.4 - 8.8
Mar 29	EXAM II : Cumulative	HW : 1 - 4 ; Labs : 1 - 8
Mar 22, 27	Digital systems : Introduction to state machine design	7.3 - 7.7, 8.7 - 8.8
Apr 3, 5, 10, 12, 17	Popular combinational circuits. Karnaugh maps	4.3, 6.4 - 6.10
Apr 17, 19, 24	Semiconductor memory chips, ROM. Combinational programmable logic devices, PLA and PAL. Coding, error detection and correction. Hamming Code	6.3, 8.3, 9.1 - 9.4, 9.6, 2.14 - 2.15
Apr 26	Introduction to the VHDL language and programming	5, 6, 7, 8
TBA	Final exam : Cumulative	All the above chapters ; HW : 1 - 6 ; Labs : 1 - 13

15. References :

Students are suggested that they study **recent** digital logic books since the field advances rapidly. 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) *Fundamentals of Logic Design*, C. H. Roth, Jr., and L. L. Kinney, 6th edition, Cengage Learning, 2010.

c) *Introduction to Logic Design*, Alan B. Marcovitz, 3rd edition, McGraw-Hill, 2010.

d) *Digital Principles and Logic Design*, A. Saha and N. Manna, Jones and Bartlett, 2010.

e) *Sequential Logic : Analysis and Synthesis*, Joseph Cavanagh, CRC Press, 2006.

f) *Introduction to Logic and Computer Design*, A. B. Marcovitz, 3rd edition, McGraw-Hill, 2010.

g) *Fundamentals of Digital and Computer Design with VHDL*, R. S. Sandige and M. L. Sandige, McGraw-Hill, 2010.

⇨ 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 just a 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.

16. Reminders about the course:

Students are required to read the web pages whose links are provided with at the course web site :

1) **NYU-Poly Code of Conduct web page : http://www.poly.edu/academics/code-of-conduct**

2) **NYU-Poly Life page web page with links to Health+Wellness, Campus Safety, Students Resources and other**. In addition, keep the following in mind :

a) A successful course experience : To enjoy the course as much as possible and **be ready for the follow up courses**, students need to be **committed** to the course

⇨ **Attending classes** and **labs** and **doing the work** are needed.
➢ Lectures are **dependent** on each other and labs are also **dependent** on each other.

⇨ **Study** the notes, books, handouts. But, just reading does not mean studying ! Also, do the homework and term project !
➢ **Do not study past exams, without studying books, notes and handouts**.

b) Students must realize that every action they take has consequences. They also should **not** make assumptions and decisions on the course (the exams, lectures, labs, the homework and attendance) without asking the professor. An assumption that is often made by students is that every course is the same. This is not the case !

c) 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 : The topics are different and harder in the remaining eight weeks. Note also that the course becomes even harder starting with the 9th week.

d) Students are asked that the professor does his assigned job : **Teaching** ! Any time the professor is not

doing it means students are not benefitting from the course. Examples of when the professor is **not** doing teaching include discussions involving submitting late homework, late attendance, missing exams, etc.

e) 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 taken from the board may not be correct. 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 (seeing the writing on the board), audio (listening to the professor) and tactile (writing down the notes) 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 and remember more. Finally, since their memory is fresh, students save time when they study for exams.

f) 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. The professor makes the decision. The decision is made also based on the information by the student's academic department and the Student Affairs 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** given a make-up exam. The weight of the midterm exam is distributed to the other exams at the discretion of the professor. The make-up exam for the final exam will be harder than the one given to the whole class.

If a student experiences **any** problem, including health/personal problems, he/she must immediately contact Judith Simonsen who is the director of the Student Development Office : jsimonse@poly.edu. Her number is (718) 260-3197.

g) For a course, the semester is over when the final exam is over. Students are **not** 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.

h) It has been observed that a student pays unnecessary penalty, because he/she does not know/follow NYU-Poly and CS2204 rules and regulations. They also do not seek advice from Polytechnic staff. Therefore, students, especially, **transfer students**, are strongly suggested that **they speak with the professor**, the TAs, the major advisor, the personnel of the Student Affairs Office, and the Counseling Center.

i) Always keep contact with the professor. Discuss personal matters in professor's office.

17. ABET Outcomes :

CS2204 addresses the following ABET **a-k** outcomes :

a) Students apply mathematics knowledge and engineering knowledge to design and analyze advanced circuits.

c) Students design a digital system that meets the desired chip count, speed and cost contraints.

e) Students identify, formulate and solve circuit problems.

k) Students gain techniques, skills and modern engineering tools necessary for engineering practice by applying them on the term project.