CS 2204     DIGITAL LOGIC & STATE MACHINE DESIGN     FALL 2017

SYLLABUS

1. **Professor** : Haldun Hadimioglu
   
   Office : 10.009 2MTC          haldun@nyu.edu          http://cse.poly.edu/haldun
   Tel : (646) 997-3101          Fax : (646) 997-3609

   NYU Tandon School of Engineering, Computer Science and Engineering
   Six MetroTech Center, Brooklyn, New York 11201

   ➢ My degrees : B.S. and M.S. in Electrical Engineering and Ph.D. degree in Computer Science
   ➢ Involved in the undergraduate Computer Engineering program administration
   ➢ Areas : Computer architecture, parallel (multi-core) processing, reconfigurable and nano systems

2. **Prerequisite** : CS1114 (C- required) or CS1133 (C- required).

3. **Course Objectives** : *What will you learn?* Number systems, combinational circuits, sequential circuits, programmable components and digital systems.

4. **Course Outcomes** : *What will you be able to do once the course is completed?* Perform arithmetic in different number systems, design and analyze combinational circuits with or without programmable components, design and analyze sequential circuits, including digital systems and use current digital design techniques and tools to develop digital systems.

5. **The course structure** :
   
   A **Computer Science and Engineering** Department course
   
   **Lecture Section** :
   ➢ **15468**, Tuesday and Thursday, 10:30 - 12:20
   
   **Lab Sections** :
   ➢ **A (15655)**, Friday 2:30 - 5:20
   ➢ **B (15656)**, Monday 9:30 - 12:20
   ➢ **C (15778)**, Thursday 1:30 - 4:20
   ➢ **D (15723)**, Friday 11:30 - 2:20

6. **Course web page** : NYU Classes :
   ➢ Course handout and lab files are at the course web site

7. **Textbook and manuals** :
   
   ➢ Author’s web site : [http://www.ddpp.com](http://www.ddpp.com) for additional material.

   **Chip manual** : Texas Instruments Digital Logic Pocket Data Book, 2007, SLL


8. **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 book describing how and why technical work in computer design and development is a small part of a larger picture that also includes emotions, ambitions and conflicting goals of many people involved:


9. **Why Digital Logic** : Digital Logic is about *digital hardware* which is literally everywhere today!

> Students who know hardware are good at **software = (Operating Systems + Applications).**

> Students who know hardware will **not** get caught by major hardware technology shifts.

10. **Course topic** : CS2204 is about *digital circuits* (logic circuits) that make up digital hardware.

> It emphasizes **designing chips** that contain *digital systems*, by using the **finite state machine** approach (microprocessors, GPUs, custom chips, memory chips, etc.)!

> A **game chip** which is a **digital system** is developed as a term project in the **lab**!

11. **What does industry want from college graduates**:

> **Good technical and non-technical skills + competency + grit**!

> **Good solid technical knowledge + learning fast + interpersonal skills.**

> **Adaptable, flexible and team player.**

> **Problem solver + system oriented in a global environment.**

> You are **creative** and have **learning** as your target! You **know how to learn fast**!

> You have **analytical and synthesis skills**

> You have team work skills : **Interacting** with people to solve problems!

> You have good **documentation skills**!

> You are a **critical thinker**! You **discover** and **explore**!

12. **Professor’s message**:

Learning is **not** easy! It requires **physical changes** in the brain = **Plasticity**! That is, neurons in your brain are **rewired** as you learn. Rewiring the brain is **not** easy. It requires constant attention to the subject studied. Therefore, students are asked that they **attend classes and labs and participate** in the work! Students are asked that they consider the learning and thinking style shown on the left below:
Students are suggested that they read the following book that describes the cycle on the left above: *Little Bets: How Breakthrough Ideas Emerge From Small Discoveries*, Peter Sims, Simon and Schuster, 2011.

### 13. The course format:

The course targets what industry wants and categorizes them as: *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!
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 finite 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 a global environment. They are needed in the technical world which is **team-based** and becoming more **global**.

### 14. 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**, emulated on a **reconfigurable chip**:

- The lab reinforces and complements what students learn in the classroom. Also, the lab emulates the engineering design environment where engineers team up to design digital circuits piece by piece under the guidance of a project manager and senior engineers.
- The lab introduces current digital design tools and techniques, such as CAD tools to design hardware, **reconfigurable chips** (field programmable gate array, **FPGA** chips), top-down, team-based, core-based design.
- The CAD tool is the *Xilinx ISE 14.7* CAD tool and the FPAG board is the *Digilent NEXYS-4 DDR FPGA board with an Artix-7 FPGA chip*. Students install a smaller version of the ISE 14.7, **WebPACK 14.7**, on their laptops to work on the term project.
- The term project is distributed to **three** experiments (phases), each making use of previous experiments. 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.
- The lab affects the term grade. All four experiments are collected one per team and graded if submitted on time. Students are expected to show they are good teammates. Attendance is recorded in every lab session. Not attending lectures or labs may result in being separated from the team. How to determine the lab grade is given in the lab in the second week.
- The lab is **227RH** which is a **CSE** lab. Each section has two hours and 50 minutes a week in the lab. Lab sessions start with a presentation by the professor. Then, students work on the current
experiment. Students need to attend their lab section to work with their teammates. Also, the lab is available to students with a TA present (open lab hours).

15. Homework:
There are six homework assignments. The homework is submitted by teams.
- Students are expected to show the work (intermediate steps) to get full/partial credits on a question. Showing work helps students improve their documentation. The homework is graded by TAs. Although, the homework does not affect the term grade, it can help raise grades as explained below.
- Homework assignments have relevant questions and answers to help learn chapters and solve homework problems. Students need to study them before they solve homework problems, not before exams.

16. Exams:
There are two 110-minute midterm exams and a 2-hour final exam, covering class and lab topics.
- Students are expected to show the work (intermediate steps) to get full/partial credits on a question. That is, both the final answer and the steps to get it, the approach, are important.  
  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, handouts and lab material 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:
  ✪ No multiple answers to a question, precise answers to questions, no answers like “the rest is similar,” answering the question asked, use the exam booklet space well: For example, start a new question on a new page.
Overall, students are expected to show their technical knowledge and documentation

17. Term Grade:
The numerical term grade calculation is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Labs</th>
<th>Exam I</th>
<th>Exam II</th>
<th>Final Exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>15%</td>
<td>20%</td>
<td>25%</td>
<td>40%</td>
</tr>
</tbody>
</table>

- To earn 15% for the Labs, students must work well together (attendance, concentration and cooperation) and do the term project and homework 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.

18. Office Hours:
The professor has an open-door policy that if he is not busy, students can ask questions in his office. If a student wants to see the professor at a certain time, he/she makes an appointment with the professor.
- Students are requested that they see the professor to ask questions. Broadcast messages will be sent to the class to make announcements. Please 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.

19. Material Coverage:
All chapters of the textbook are covered, some partially and some completely. Students are given additional material in class. The tentative schedule is as follows:
20. CS 2204 ABET a-k Outcomes:
   a) Students apply mathematics knowledge & engineering knowledge to design & 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.

22. Reminders about the course:
Students need to read and remember web pages whose links are also provided at the course web site:
   1) NYU Code of Conduct web page: http://engineering.nyu.edu/files/SACCofC2-2-16.pdf, including academic misconduct, which is a part of the Student Code of Conduct document.
   2) NYU-SOE Life web page with links to Student Affairs, Public Safety, Students Resources and other: http://engineering.nyu.edu/life.

In addition, students need to keep the following in mind:
   a) Keeping contact with the professor and discussing personal matters in professor’s office help you considerably
   b) 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.

c) Students must realize that every action they take has consequences. Making assumptions and decisions on the course (the exams, lectures, labs, the homework and attendance) without asking the professor often lead to problems for students.

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:

➢ The notes taken from the board may not be correct.
➢ Someone taking the notes may not write down all the verbal comments and suggestions made by the professor.
➢ 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.
➢ 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.

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. 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, needs to immediately contact **Judith Simonsen** who is the Coordinator of Student Advocacy and Compliance at Student Affairs. Her email address is js6244@nyu.edu. Her number is (646) 997-3046. Her office number is LC 240C.
```

f) 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.

g) Some students do not know/follow NYU-SOE and CS2204 rules and regulations nor seek advice from Polytechnic staff. 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 for a better experience.

23. **Moses Center Statement of Disability** :

If you are a student with a disability who is requesting accommodations, please contact New York University’s Moses Center for Students with Disabilities at (212) 998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at RH 042 in Brooklyn ((646) 997-3451) and 726 Broadway on the 2nd floor in Manhattan ((212) 998- 4980).