

SYLLABUS

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NYU Tandon School of Engineering, Computer Science and Engineering
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- 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

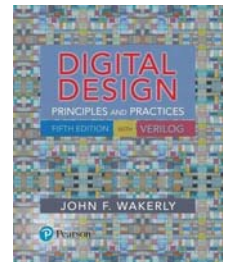


2. Prerequisite : CS1114 (C- required) or CS1133 (C- required).

3. Textbook and manuals :

The textbook : *Digital Design Principles and Practices*, John F. Wakerly, 5th edition, Pearson, 2018. ISBN : 13-9780134460093

- Author's web site : <http://www.wakerly.org.DDPP> for additional material.



4. What is asked from college graduates :

- **Good technical and non-technical skills + competency + grit !**
- **Adaptable, flexible and team player !**
- **Problem solver + system oriented in a global environment !**

You may have also heard the following :

- You are **creative** and have **learning** as your target ! You **know how to learn fast !**
- **Good solid technical knowledge + learning fast + interpersonal skills**
- 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 !** You are **lifelong learner !**

5. How to be successful in your college years and after graduation :

- Knowledge is **infinite** and it consists of pieces of information that are **dependent** on each other in infinite ways.
- Learning is **not** instant ! 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** effort
- Applying/using what is learned is **not** instant ! One needs time to apply/use the knowledge acquired, meaning additional rewiring in the brain is needed.

Otherwise, students try to recover by themselves. They just take exams. Professors cannot help them since these students are not around. It gets worse for students as the semester progresses and so no one can do anything = It becomes a **vicious cycle**

- **Those students who need help are not around to get help !**

6. Why Digital Logic : Digital Logic is about **digital hardware** which is used by all digital devices !

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

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

8. 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.

9. Course topics : 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.) !!



10. The course format :

The course targets items listed in (4) 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 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 is **global**.

11. The course structure :

A **Computer Science and Engineering** Department course

Lecture Section :

➤ **16967**, Tuesday and Thursday, 9:00 -10:50

Lab Sections :

➔ **A (17144)**, Friday 2:30 - 5:20

➔ **B (17145)**, Monday 2:30 - 5:20

➔ **D (17204)**, Friday 11:30 - 2:20

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

13. 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 Vivado 2018.2* 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 Vivado **WebPACK 2018.2**, on their laptops to work on the term project.
- The term project is distributed to 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).

14. Homework :

There are six homework assignments. The homework is submitted by teams.

- Students are expected to **show the work** (intermediate steps) to get full 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.

15. Exams : There are **two** 110-minute midterm exams and a 2-hour final exam on 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, u
 - ➔ 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

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

10% Labs

20% Exam I

25% Exam II

45% Final Exam

- To earn 15% for the Labs, students must work well together (attendance, concentration and cooperation) and do the term project and homework well. Its calculation will be shown in the lab.
- 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.

17. 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.

18. 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 :

Days	Subject	Textbook Chapter(s)
Sep 4	Introduction. Course overview	1
Sep 4, 5, 11, 13	Number systems and binary arithmetic. Coding, error detection and correction	2 and 8
Sep 18, 20, 25, 27, Oct 2, 4, 11	Overview of digital hardware. Gates. Combinational circuit analysis and design by using popular combinational circuits and gates. Verilog hardware description language	1, 3, 4, 5, 6, 7, 8 and 14
Oct 18	EXAM I : It is tentative. It can be earlier or later	HW : 1, 2
Oct 16, 23, 25, 30, Nov 1	Synchronous sequential circuit fundamentals, analysis and design by using popular sequential circuits. Digital systems : Introduction to state machine design, Datapath and Control Unit design. State machine in Verilog	1, 9, 10, 11, 12, 13
Nov 20	EXAM II : Cumulative : It is tentative. It can be earlier or later	HW : 1 - 4
Nov 8, 13, 15, 27	Switching Algebra. Combinational circuit fundamentals, analysis and design by using gates and Switching Algebra, Karnaugh maps	1, 3, 5
Nov 29, Dec 4, 6	Synchronous sequential circuit components, flip-flops, sequential circuit analysis and design by using flip-flops	1, 10, 11, 12, 13
Dec 11	Semiconductor memory chips, ROMs and RAMs. Combinational programmable logic devices, PLA and PAL. FPGAs	1, 6 and 15
Dec 13	Future projections. Questions and answers	All chapters
TBA	Final exam : Cumulative. All the above chapters	HW : 1 - 6

19. 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) *Fundamentals of Logic Design*, C. H. Roth, Jr. and L. L. Kinney, 7th edition, Cengage Learning, 2014. ISBN : 978-1-133-62847-7.
 - b) *Fundamentals of Digital Logic with VHDL Design*, S. Brown and Z. Vranesic, 3rd edition, McGraw-Hill, 2014. ISBN : 978-00-733-80544.
 - c) *Digital Design*, M. Moris Mano and Michael D. Cileto, 5th edition, Prentice-Hall, 2013.
 - d) *Digital Design : A Systems Approach*, William J. Dally and R. Curtis Harting, Cambridge University Press, 2012.
- 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 : *Dealers of Lightning : Xerox Parc and the dawn of the Computer Age*, Michael A. Hiltzik, Harper Business, 1999.

Students are also suggested that they read the following book that describes learning by mistakes : *Little Bets: How Breakthrough Ideas Emerge From Small Discoveries*, Peter Sims, Simon and Schuster, 2011.

20. CS 2204 ABET a-k Outcomes :

- a) Students apply mathematics & engineering knowledge to design & analyze advanced circuits.
- c) Students design a digital system that meets the desired chip count, speed and cost constraints.
- 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.

21. 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.

f) If a student experiences problems, including health/personal problems, he/she immediately contact **Deanna Rayment** who is the Coordinator of Student Advocacy, Compliance and Student Affairs. Her contact information is :

- **deanna.rayment@nyu.edu**
- **(646) 997-3046**
- **LC 240C**

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) Some students do not know/follow NYU-SOE and CS2204 rules and regulations nor seek advice from Tandon 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.

22. 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). *Please do this at the start of the semester.*