

Recitations help students understand subjects discussed in class better.

- ⇒ The recitation covers **new** topics besides covering lecture topics in detail. It also presents practical aspects of topics covered during the lecture. In addition, the recitations are intended to discuss homework assignments.
 - *Students who attend recitations are faster at solving problems.*
- ⇒ The recitations are given in **three** different sections. Each section has one hour and 50 minutes a week. Recitation sessions are given by the teaching assistant (TA). Students **cannot** attend the recitation of other sections. Attendance is taken during recitation hours.
- ⇒ Students in each section form **3-** or **4-**member teams by the end of the *third* week of the semester. Team members do the homework assignments together until the end of the semester.

9. Homework : There will be seven homework assignments. The homework will be submitted by teams. **An assignment submitted late will not be accepted.**

- ⇒ *Students who do homework are faster at solving problems.* Students are suggested to study the textbook problems that are on the textbook CD, besides the ones given in the textbook. **Showing work** (intermediate steps) is **required** to get full/partial credits on a question. The homework is graded by the TA. Although, the homework will **not** affect the term grade, it can help raise grades as described below.
- ⇒ Homework assignments include **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.

10. Exams : There will be **two** 110-minute midterm exams and a three-hour final exam. *The exams will cover class and recitation 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 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. Textbook simulators : The textbook CD has a number of simulator software packages. Some simulate assembly language program execution, such as PCSPIM and MARS. The others simulate the CPU hardware, such as the MIPS SDE-LITE and Xilinx FPGA CAD software.

- ⇒ The simulators help students better understand assembly language programming which is different from high-level programming, such as programming in C++. They also help students better understand hardware design, including CPU design and what computer hardware does when it runs programs. However, these simulators will **not** be discussed in class nor recitations.

12. Term Grade : The term grade is as follows :

20% Lower of Exam I & Exam II **30%** Higher of Exam I & Exam II **50%** Final Exam

- ⇒ 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 is attendance. 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.

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 are sent to 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.

14. Material Coverage : All chapters, except Chapters 6 and 7, will be covered, some partially, some completely this semester. Students will be given additional material in class. The **tentative** schedule is as follows :

Day(s)	Subject	Chapters
Sep 8, 10	Introduction. Computer systems overview. Layered computer design	1, B
Sep 15, 17, 22, 24, 29, Oct 1, 6	The architecture of the EMY computer	2, 3, B
Oct 20	EXAM I	HW : 1 - 2
Oct 6, 8	Digital system design fundamentals	4, B, C, D
Oct 13, 15, 22	The organization of the EMY computer. EMY CPU design. Hardwiring	4, B, C, D
Nov 10	EXAM II : Cumulative	HW : 1 - 4
Oct 27, 29, Nov 3	EMU CPU design. Microprogramming. Performance measures	4, B, C, D, 1
Nov 3, 5, 12, 17	Pipelining	4, B
Nov 17, 19, 24, Dec 1, 3	Semiconductor memory. Memory Hierarchies	5, B, C
Dec 8	High-speed binary arithmetic	3, C
TBA	Final Exam : Cumulative	All above chapters

15. The theme of the course :

a) Most digital products we use today are **digital systems**, such as microprocessors, computers, calculators and iPhones. Digital systems consist of **digital circuits**, such as ADDers, MUXes, DCDs, registers. Digital circuits are built from two basic components : Gates and flip-flops. Thus, today’s digital products contain gates and flip-flops.

⇒ CS2214 covers digital systems. To study them, a computer containing three smaller interconnected digital systems is designed : the CPU, memory and I/O controller. Also, state machine design for the control of a digital system is presented in detail. Note that CS2204 covers digital circuits.

b) The CS2214 computer, EMY, is a MIPS-microprocessor-based computer. To simplify the design process, we follow a top-down (layered) design technique where initial design steps (higher layers) are relatively simple and as we move down, layers become increasingly complex. The layers we focus on in varying details are from top to bottom, application, architecture, organization, logic and transistor layers.

c) The digital system we concentrate on heavily is the CPU (the processor) of the EMY computer. The CPU is the most important unit of the computer.

d) Our major design steps are as follows :

- ⇒ We first determine the **application** set aimed for the EMY, where the application layer is the top layer.
- ⇒ We determine the **architecture** of the EMY, i.e. the register set, data types, **machine language instructions**, etc. based on the application layer.
- ⇒ We move on to the next level below which is the **organization (microarchitecture)** layer, first, we design the **hardwired** CPU. Then, a slower but cheaper way of realizing the EMY CPU is done : the **microprogrammed** CPU. Both designs are based on the architecture.
- ⇒ We study **performance measures** used to evaluate computer systems. These measures help us see if our architectural and organizational decisions are sound.
- ⇒ We improve the performance of the EMY CPU by pipelining (the organization layer).
- ⇒ Finally we discuss **memory** subsystem design alternatives to improve the capacity of the computer (the organization layer).

16. References : Students are suggested that they study recent computer architecture books since the field advances rapidly. The following references are recommended with respect to their relevance to the course and the textbook :

- a)** *MIPS RISC Architecture*, G. Kane and J. Heinrich, Prentice-Hall, 1992.
- b)** *See MIPS Run*, D. Sweetman, Morgan Kaufmann, 1999.
- c)** *MIPS Assembly Language Programming*, R. L. Britton, Prentice-Hall, 2004.
- d)** *Introduction to Computing Systems : From Bits & Gates to C & Beyond*, Y. N. Patt & S. J. Patel, 2nd edition, McGraw-Hill, 2004.

- e) *Digital Design & Computer Architecture*, D. M. Honey & S. L. Harris, Morgan Kaufman, 2007.
- f) *Computer Organization*, V. C. Hamacher, Z. G. Vranesic and S. G. Zaky, 5th edition, McGraw-Hill, 2002.
- g) *Introduction to Logic and Computer Design*, A. B. Marcovitz, McGraw-Hill, 2007.
- h) *Logic and Computer Design Fundamentals*, M. M. Mano and C. R. Kime, 4th edition, Prentice-Hall, 2008.
- i) *Computer Organization and Architecture : Designing for Performance*, W. Stallings, 8th edition, Prentice-Hall, 2010.
- j) *CPU Design : Answers to Frequently Asked Questions*, C. M.R. Thimmannagari, Springer, 2005
 ⇒ 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.

17. Reminders about the course :

Students are required to read the handout prepared by the Dean of Student Affairs at the CS2214 web site : *NYU-Poly Student Affairs Syllabus Addendum*. This handout is also on MyPoly under "Polytechnic Community -> Policies & Rules." Other material for students to read include *University Code of Conduct* at the Poly web site : Under "Current Students. In addition, keep the following in mind :

- a) 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.
- b) To concentrate on learning, students need to pay attention to classes and recitations and not disturb others by i) coming to the class/recitation on time, ii) staying in the classroom/recitation, not going out and coming back frequently, iii) not talking and iv) turning off their cell phones and notebook computers.
- c) A reason for a low grade is **missing classes** and **recitations**. 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 and TA. Third, attending classes and recitations forms better memory because of visual (seeing the writing on the board), audio (listening to the professor and TA) and tactile (writing down the notes) inputs. In addition, during lectures and recitations, the professor and TA refer to earlier lectures and recitations (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 exams.
- d) 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 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 recitation 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.
- e) 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.
- f) 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 TA, the personnel of the Student Development Office, and the Counseling Center when they experience difficulties/problems.
- g) Students are strongly suggested that they **not** make assumptions and decisions on the course without asking the professor : About the exams, lectures, recitations, the homework and attendance.

18. ABET Core Competencies : CS2214 addresses the following ABET competencies :

- a) Students apply mathematics, science and engineering knowledge to design and analyze advanced systems.
- c) Students design a digital system that meets the desired speed, space and cost constraints.
- e) Students identify, formulate and solve engineering problems.