

COURSE SYLLABUS

1 ECE 3445 - Computer Architecture

2 Meeting Information

4 credits, 5 contact hours Two 75-minute lectures and a 110-minute lab meeting

a. **Section All:**

Lecture: TR 10:00 - 11:15 AM (Section 001) or 1:00 - 2:15 PM (Section 002), **Tolentine Hall 418**

Lab: F09:00 - 11:00 AM (Section 001) or 12:30 - 2:20 PM (Section 002), **CEER 206**

3 Course Instructor(s), TA(s)

a. **Section All:**

Class Instructor: [Xiaofang Maggie Wang](#)

Office Hours: TR 11:50 AM - 12:50 PM, or by appt.

Lab Instructor: [Edward Hepler](#)

Office Hours: , or by appt.

TA: None

4 Textbook

David A. Patterson and John L. Hennessy, *Computer Organization and Design MIPS Edition: The Hardware/Software Interface (5th Edition)*, Morgan Kaufmann, 2013. ISBN: 9780124077263. **REQUIRED.**

a. **Other Supplemental Materials:** References will be posted in blackboard.

5 Specific Course Information

a. **Catalog Description**

Computer architecture is the science and art of selecting and interconnecting hardware components to create a computer that meets functional, performance, power, and cost goals. This course examines in-depth the inner-workings of modern computer hardware design and the design tradeoffs at the hardware-software interface. The MIPS processor is employed as an example throughout the course. The topics include instruction set architecture, MIPS assembly programming, integer and floating-point arithmetic circuits, processor datapath and control design, pipelining, memory hierarchy, I/O and storage devices, multi-core processor design, etc. An integral component of this course will be a sequence of hands-on hardware laboratory assignments where you will step-by-step design and implement the single-cycle and pipelined 32-bit MIPS processors. The Altera DE10 FPGA development board, and Quartus and ModelSim will be used in the lab for you to design, build and test the processors.

b. **Prerequisites:** ECE 2042 & 2043, ECE 2044 & 2045; **Co-requisites:** None

c.

6 Course-specific Goals

- a. After a successful completion of the course, the student will understand from the engineering's perspective how a computer hardware system works and will be able to design and implement pipelined processors and their basic peripherals from basic logic gates on an FPGA board. Students will also be able to understand and evaluate various factors that affect computer system performance.

b.

ABET Student Outcomes						
1	2	3	4	5	6	7
X					X	

The above student outcomes are defined by the Accreditation Board for Engineering and Technology (ABET) as:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7 List of Covered Topics

1. Course overview
2. Computer technology evolution
3. Instruction set architecture (ISA) overview
4. MIPS processor instruction set
5. Binary addition/subtraction
6. ALU design
7. Sequential and parallel multipliers
8. Floating-point arithmetic
9. Understanding computer performance
10. Single-cycle MIPS processor: Datapath
11. Single-cycle MIPS processor: Control
12. Multi-cycle MIPS processor: Datapath
13. Multi-cycle MIPS processor: Control
14. Ideal pipelined MIPS processor datapath and control
15. Pipelining: data hazards and solutions
16. Pipelining: branch hazards and solutions
17. Memory introduction and memory technologies
18. Cache
19. Virtual memory
20. Introduction to parallel computer architecture

8 Tentative Schedule

Tentative schedules for all sections follow. Be sure to refer to the schedule for your specific section, if more than one is provided.

Tentative Schedule for **All Sections**

Date	Topics	Homework Assignment	Textbook
Aug. 24 & 26	Introduction	None	
Aug. 31 & Sept. 02	Stuff..	HW1	
...			

9 Grading Policy

Homework assignments: 20Lab: 30Midterm 20Final 30

Letter grade scale: A(93–100), A–(90–92), B+(87–89), B(83–86), B–(80–82), C+(77–79), C(73–76), C–(70–72), D+(67–69), D(63–66), D–(60–62), F(<60)

10 HW Assignment and Laboratory Report Submission Policy

Weekly homework assignments will be posted in the blackboard, and are normally due by the end of day on Tuesday unless announced otherwise. Please scan your homework solutions into a single PDF file, and submit it in the blackboard. Please include your last name in the name of the PDF file, e.g. HW1-Wang.

You will lose 20

The specific information related to lab requirements can be found through the lab folders in Blackboard.

11 Attendance Policy

Students are expected to attend all the class meetings and are responsible for all the materials covered in class including handouts and class notes. Students should inform the instructor if they

plan to be late or absent from class.

Whenever possible, students should inform the instructor if they plan to be late or absent from class. In all cases, documentation is required to petition for *excused* absences to the Associate Dean for Student and Strategic Programs, Dr. Stephen Jones. The excused absence form is posted at: <https://www1.villanova.edu/villanova/engineering/resources/undergraduates.html>.

Excused absences do not count towards a failure in the course for first year students. Absence from class does not release the student from assigned work. Students who miss an in-class obligation such as an exam, a presentation, etc., due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement. In the case of illness or injury, the form must be submitted within 24 hours of missing a class. The University's list of excused absences for all students includes the following:

1. Participation in NCAA athletic competitions
2. Participation in special academic events such as: conferences, field trips, project competitions, etc., and in official university business such as student representatives attending meetings related to university governance
3. Attendance at significant events of the immediate family such as: funerals, weddings, etc.
4. Religious holidays - see the University's policy on Religious Holidays
5. College-approved participation in placement activities such as: job interviews, graduate school interviews, job fairs
6. Legally required absence such as: jury duty, court appearance, short-term military service
7. Documented serious illness or disability

12 Examination Policy

The College of Engineering has adopted the following general examination guidelines:

1. Students must arrive before the start of the examination. Under exceptional circumstances a student may need to arrive late, but he/she can enter the examination room no later than five (5) minutes after the start of the exam.
2. Cell phones must be turned off until the student exits the examination room.
3. The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an examination.
4. Each student must write and sign the following statement, "I have neither given nor received any unauthorized assistance in the completion of this examination."
5. For online examinations, the instructor may implement video proctoring or other measures to ensure academic integrity. For consent purposes, the instructor will inform students in advance if (s)he plans to use any form of video-proctoring and whether the examination will be recorded.

13 Academic Integrity Policy

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work

habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs. The University's academic integrity policy can be found on the following web page:

<https://www1.villanova.edu/villanova/provost/resources/student/policies/integrity.html>.

14 Adherence to the Student Code of Conduct

Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to university regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

15 Online Expectations

To foster a professional environment, please wear appropriate clothes, mute if you are not talking to cut down on background noise, refrain from eating, and select an appropriate setting when we are meeting online.

16 Inclusive Classroom

This classroom is a place where you will be treated with respect; we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment to allow all among us to learn and flourish.

17 Students with Disabilities

It is the policy of the university to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability (non-physical) please register with the office of Learning Support Services (LSS) by emailing Learning.support.services@villanova.edu or by phoning 610-519-5176 as soon as possible. Registration is *required* in order to receive accommodations.

The Office of Disability Services (ODS) collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact and register with Gregory Hannah, advisor to students with disabilities at 610-519-3209 or visit the office on the second floor of the Connelly Center.

18 Tutoring Services

Villanova's tutoring services include The Writing Center, The Learner's Studio, and The Center for Speaking and Presentation. These services are offered free of charge to students. Drop in as-needed or book a regular weekly session to supercharge your academic success. Sessions can be 30 or 60 minutes in length.

Register for an account and book sessions in advance at villanova.mywconline.com. If you don't see your class listed, request a tutor for a missing subject at: tutorrequest.villanova.edu For more information, contact Juliana Struder at juliana.studer@villanova.edu or at 610-519-5862.

19 Electronics Policy

The use of electronic devices, such as phones, laptops, tablets, calculators, etc., during class is generally allowed, unless their use causes a disturbance to others. During examinations, the use of any electronic device is prohibited, unless it is expressly authorized by the instructor.

Students are prohibited from making any audio or visual recordings (including taking photographs) of lectures, discussions, or other classroom activities, unless a student (1) has written permission in advance from the instructor, or (2) is permitted to record under terms and conditions as approved by the University's Office of Disability Services or Learning Support Services. Students who have received approval to record classes as an academic accommodation must provide supporting documentation from the Office of Disability Services or Learning Support Services in advance of any recording. Students may use authorized recordings only for the purposes of individual study in the course, and may not disseminate or share them with a wider audience without explicit permission.

20 Copyright Policy

The materials used in Villanova University courses ("Course Materials") generally represent the intellectual property of course instructors, third parties and/or the university which may not be disseminated or reproduced in any form for public distribution (e.g., sale, exchange, etc.) without the written permission of the course instructor. Course materials include all written or electronic documents and materials, including syllabi, current and past examination questions/answers, and presentations such as lectures, videos, slides, etc., provided by a course instructor. Course materials may only be used by students enrolled in the course for academic (course-related) purposes.

Published course readings (book chapters, articles, reports, etc.) available in "Blackboard" are copyrighted materials. These works are made available to students through licensed databases or fair use. They are protected by copyright law, and may not be further disseminated or reproduced in any form for distribution (e.g. uploading to websites, sale, exchange, etc.) without the permission of the copyright owner.

Follow these links for more information on [Intellectual Property](#), [Copyright](#), and [Computer Acceptable Use](#).

21 Professorial Duties

It is important to note that teaching is one of the many duties that professors perform as part of their job responsibilities. In addition to teaching, professors perform research, advise graduate students, edit journals and review journal articles, serve on committees for the university and professional societies, travel to conferences to remain abreast of current developments and to present their results... to name just a few commitments.