

## CSCE 2214 Computer Organization

### Catalog Description:

Students will study the design and implementation of a standard Reduced Instruction Set Computer (RISC) and memory hierarchy. The course offers a detailed analysis of (1) instruction set encodings, (2) efficient pipelined implementation of the instruction set including data and control hazards introduced by pipelining instruction execution, and (3) memory hierarchy including cache and virtual memory. The laboratory component allows students to apply classroom theory by designing and implementing a complete working pipelined CPU and developing functions in assembly language through a simulator.

**Corequisite:** Lab component.

**Prerequisites:** CSCE 2114: Digital Design (with a grade of “C” or better)

### Required Textbook:

- “Computer Organization and Design MIPS Edition: The Hardware/Software Interface,” by David A. Patterson and John L. Hennessy, 6th Edition, Morgan Kaufmann, ISBN: 978-0128201091
- The Zybook version is required for this class: Zybook ISBN: 979-8-203-03500-4, Zybook code: UARKCSCE2214PengFall2023

### Recommended Reference:

- “Computer Architecture: A Quantitative Approach,” by David A. Patterson and John L. Hennessy, 6th Edition, Morgan Kaufmann, ISBN: 978-0128119051
- “Computer Systems: A Programmer’s Perspective,” by Randal Bryant and David O’Halloron, 3rd Edition, Pearson, ISBN: 978-0134092669

**Goals:** The goal of the class is to develop the skills to analyze and design both hardware and software components of a computer, and to evaluate the performance of a computer.

### Topics Covered:

- Arithmetic and ALU Design
- ISA Design and Encodings
- Logical/Control Flow Ops, Branching
- Stacks, Arrays & Pointers
- Procedures & Function Calls
- Data Path Design
- Pipelining and Parallelism
- Memory Hierarchies and Caches
- Virtual Memory

### Evaluation Methods and Grading:

Grades in this class will be determined by a weighted average of the following:

Attendance and Participation: 10%  
Homework and Zybook Assignments: 25%  
Lab Assignment and Reports: 15%  
Two Midterm Exams: 20%  
Final Exam (cumulative): 30%

Only exam grades may be curved. We will use the following scale to assign final grades:

A: [90, 100] B: [80, 90), C: [70, 80), D: [60, 70), F: below 60%

Special note: I do not inflate or round grades. Grade inflation is a kind of lying about your ability. But, for a variety of reasons, some faculty members find it useful to inflate grades, and so do some of their students. Thus, in the remote case that you expect me to inflate your grade, drop this course now or change your expectations. Based on this philosophy, I do not touch your grade unless there is a mistake, and your TA has full authority on your assignment and lab grading. Zero is always a zero even after curving.

### **Academic Honesty:**

As a core part of its mission, the University of Arkansas provides students with the opportunity to further their educational goals through programs of study and research in an environment that promotes freedom of inquiry and academic responsibility. Accomplishing this mission is only possible when intellectual honesty and individual integrity prevail.

Each University of Arkansas student is required to be familiar with and abide by the University's 'Academic Integrity Policy' which may be found at [honesty.uark.edu/policy](https://honesty.uark.edu/policy). Students with questions about how these policies apply to a particular course or assignment should immediately contact their instructor.

### **Attendance Policy and COVID Considerations**

The University of Arkansas will primarily offer in-person instruction in the 2022-2023 academic year. Most of the university's academic programs have essential in-person components. Class attendance is the responsibility of each student and expected. If you are absent, it is your responsibility to obtain assignments, notes, and any class information given.

For any valid excused absence request, you must obtain a written proof before the class. If you have COVID-19 symptoms, DO NOT COME TO CLASS. Just send the instructor an email and your first absence in the semester will be excused. If you must quarantine, self-isolate, or miss more than one class during the semester because of COVID-19 or other illness, obtain a doctor's note or any proof record after you recovers to avoid attendance penalties.

Class information (lecture slides, recordings) will be provided to students who must miss class due to COVID-19 or other excused absences on a short-term basis. Contact the CEA Center to determine if you think that you have a disability that permits you from participating in person. Accommodations will be made accordingly.

All students are expected to take the exams in the classroom or CEA facilities. If a student cannot do so, permission to take the exam online or skip one midterm can be granted on a case-by-case basis with written proof. All students must take the final to complete the course with no exception.

### **Vaccinations**

The UA strongly encourages everyone who is eligible and able, to become fully vaccinated. A vaccination incentive program has been implemented on the Fayetteville campus. We fully understand that there are students who do not wish to receive a vaccination at this time, can't receive a vaccination for medical or other reasons, and others who simply do not want to participate. While state law prohibits requiring it, COVID-19 vaccination is encouraged as our primary means of mitigating the spread of the virus. Those who receive vaccination protect themselves from serious illness, hospitalization, and in some cases even death, while protecting those around them, supporting our plans to have a more traditional in-person fall semester and hopefully avoid interruptions in the school year.

### **Technology/Software Requirements**

Students must own or rent a mobile computing device (laptop/ipad) for this course. Access to a reliable Internet connection is required for this course. A problem with your Internet access may not be used as an excuse for late, missing, or incomplete coursework. If you experience problems with your Internet connection while working on this course, it is your responsibility to find an alternative Internet access point, such as a public library or Wi-Fi hotspot.

### **Recording of Class Lectures**

By attending this class, student understands the course may be recorded and consents to being recorded for official university educational purposes. Be aware that incidental recording may also occur before and after official class times.

### **Unauthorized Use and Distribution of Class Materials**

Third parties may attempt to connect with you to buy your notes and other course information from this class. Instructors may record the class and make the class available to students through Blackboard. These recordings may be used by students ONLY for the purposes of the class.

I will consider distributing course materials to a third party without my authorization a violation of my intellectual property rights and/or copyright law as well as a violation of the University of Arkansas' academic integrity policy. Students may not download, store, copy, alter, post, share, or distribute in any manner all or any portion of the class recording, e.g. sharing a clip of a class recording to one person is a violation of this provision.

Continued enrollment in this class signifies your intent to abide by the policy. In situations where class materials are used to gain an academic advantage, it may also be considered a violation of the University of Arkansas' academic integrity policy.

### **Emergency Preparedness:**

Many types of emergencies can occur on campus; instructions for specific emergencies such as severe weather, active shooter, or fire can be found at [emergency.uark.edu](http://emergency.uark.edu). The University of Arkansas has a campus-wide alert system for any hazardous conditions that may arise on campus. To learn more and to sign up: <http://safety.uark.edu/emergency-preparedness/emergency-notification-system/>

### **Inclement Weather:**

If the university is officially closed, class will not be held. When the university is open, you are expected to make a reasonable effort to attend class, but not if you do not feel that you can get to campus safely. Any changes to due dates or the class schedule will be communicated via email to your uark email address.

### **Academic Support:**

University of Arkansas [Academic Policy Series 1520.10](#) requires that students with disabilities are provided reasonable accommodations to ensure their equal access to course content. If you have a documented disability and require accommodations, please contact me privately at the beginning of the semester to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through the Center for Educational Access (contact 479-575-3104 or visit <http://cea.uark.edu> for more information on registration procedures).

### **Class/Laboratory Schedule:**

- Meets either 3 times a week for 50 minutes or 2 times a week for 1 hour 15 minutes for 15 weeks.
- Homework assignments are due approximately every 2 weeks.
- Laboratory designs of microprocessor are due approximately every 2 weeks.

### **Relationship of course to ABET Computer Engineering Student Outcomes:**

- CE1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
- CE2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- CE6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
- CE7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

### **Relationship of course to ABET Computer Science Student Outcomes:**

- CS1. An ability to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
- CS2. An ability to design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
- CS6. An ability to apply computer science theory and software development fundamentals to produce computing-based solutions.

**Relationship of course to ABET Computer Science Topics:**

- T6. Computer architecture and organization.
- T10. The study of computing-based systems at varying levels of abstraction.