

The University of Oklahoma
School of Electrical and Computer Engineering

Course: ECE 4613/CS 4613 Computer Architecture

Instructor: Dr. Ronald Barnes 405.325.1879; ron@ou.edu
Office Hours: 336 Devon Energy Hall
Time: Mon 9:30-11:00
 Tues 3:00-4:30
 and by appointment

TA: Lucy Fitzmorris
Office Hours: 345 Devon Energy Hall
Time: Mon 11:00-1:30, Thur 9:00-11:30

Grading Policy:

Exams: 60% (15% Midterm 1 15% Midterm 2 30% Final)
Projects: 30% (15% Final group project, report and presentation)
Homework: 10% (due most Fridays)

Catalog Description: Covers basic concepts of computer system design and communication between components, along with current and historical examples of computer architecture.

Course Objectives: Students will develop and understanding of the fundamentals of computer architecture. Students will appreciate current trends and constraints in this rapidly changing field. Students will implement (both individually and in teams) the basic concepts presented in lecture using industry standard hardware design tools. Students will communicate their design decisions and evaluations in written reports and oral presentations.

Text: David Patterson and John Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Morgan Kaufmann

Optional VHDL reference (good free online VHDL references also available):

Peter Ashenden, The Designer's Guide to VHDL, 3rd Edition, Morgan Kaufmann
or
Peter Ashenden, The Student's Guide to VHDL, 2nd Edition, Morgan Kaufmann

This course is an intensive introduction to the fundamentals of computer architecture. We will discuss the basic design, or architecture, of computing hardware. Computer systems involve architecture design at many levels. We will focus on the instruction set architecture (ISA) level (the interface between the software and computing hardware) and the microarchitecture level (the computing hardware itself). We will examine to some extent, the level above the instruction set (the programming language level) and the level below the microarchitecture (the logic gate level) in order to deepen our understanding of computing systems. This course has a demanding design component; you will implement some of the basic concepts presented in lecture using real hardware design tools.

Topics:

1. Introduction to Computer Abstractions
2. Instructions: Language of the Computer
3. Computer Arithmetic
4. Representation of Floating Point Values and Floating Point Arithmetic
5. Datapath Design
6. Control Path Design
7. Pipelined Datapath and Control
8. Data Hazards and Forwarding
9. Control Hazards and Prediction
10. Instruction-level Parallelism
11. Cache Memories
12. Virtual Memory
13. Exceptions and interrupts
14. Multiprocessor Architectures

ECE Educational Outcomes:

- d. an ability to function on multi-disciplinary teams
 - d1. Effectiveness in teamwork
 - d2. Understanding requirements
 - d3. Functional Decomposition
- g. an ability to communicate effectively
 - g1. Demonstrate ability to write technical summaries; reports and papers
 - g2. Demonstrate ability to communicate by presenting technical results to a variety of audiences
 - g3. Laboratory Demonstration
- i. a recognition of the need for, and an ability to engage in lifelong learning
 - i2. Ability to Engage in Lifelong Learning
- j. a knowledge of contemporary issues
 - j1. Awareness of Technical Frontiers and rapid technological change
- k. an ability to use the techniques, skills and modern tools necessary for engineering practice
 - k2. Skills
 - k3. Tools

CS Specific Outcomes of Instruction:

By the end of the semester, the students will increase their:

1. Ability to analyze a problem, and identify and define the computing requirements appropriate to its solution,
2. Ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs,
3. Ability to use current techniques, skills, and tools necessary for computing practice.

CS Student Outcomes:

-CAC Outcomes: b, c, i

Reasonable Accommodation Policy: Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

OU Academic Misconduct Code: Students will be held to the highest expectations of academic integrity. Unauthorized collaboration of any kind is *strictly* prohibited and will result in the filing of misconduct charges and imposing academic misconduct "admonitions". Copying of any kind on any assignment will not be tolerated. However, students are encouraged to work together on homework. **No collaboration of any kind is allowed on exams.**

The misconduct system for the College of Engineering is set forth in the Academic Misconduct Code. The Code is included as an appendix to the Faculty Handbook and is available from the Provost's student academic integrity page <http://integrity.ou.edu>. Your rights and responsibilities under the Academic Misconduct Code can be found there.

UOSA Honor Pledge: The University of Oklahoma Student Association has approved, with the concurrence of the Faculty Senate, a resolution encouraging the use of an integrity pledge on all major assignments. The Pledge reads:

On my honor, I affirm that I have neither given nor received inappropriate aid in the completion of this exercise.

This pledge, along with a student signature line, will be placed on quiz and exam sheets. A downloadable version of the pledge text is available at <http://www.ou.edu/honorcouncil/FAQ.html#Pledge>.

Religious Holidays: It is the policy of the University to excuse absences of students that result from religious observances and to provide without penalty for the rescheduling of examinations and additional required class work that may fall on religious holidays.

Adjustments for Pregnancy/Childbirth Related Issues: Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Please see www.ou.edu/content/eoo/pregnancyfaqs.html for commonly asked questions.

Title IX Resources: For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5) or the Sexual Assault Response Team 405-615-0013 (24.7) to learn more or to report an incident.

evaluate! – The University of Oklahoma’s online course and instructor evaluation system: The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these ratings are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty members use the evaluation feedback to improve their own teaching effectiveness and programs use the data to assess achievement of a set of learning outcomes. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously, evaluate courses on-line, and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions. Your feedback is appreciated.

Late submission policy: No late homework will be accepted. However, the lowest **two** homework grades will be dropped in the calculation of your final grade. Late project submissions will be penalized 10% per day. Exceptions due to illness or other extraordinary circumstances should be requested before the class in which the assignment is due.

Projects: This course features significant design and simulation projects using HDL Designer and ModelSim by Mentor Graphics. The first several projects (called machine problems or MPs) will be completed individually. The final project(s) will be completed in small teams.