

**The University of Texas at Tyler  
Department of Electrical Engineering**

EENG 4320-060: Computer Architecture and Design

**Syllabus**

**Catalog Description:**

Introduction to computer architecture, RISC/CISC, processors, data path, control, ALU; pipelining, memory, cache, I/O, digital logic; micro architecture, instruction sets, addressing modes; operating systems, virtual memory, processes, assembly language.

**Class Meetings and Modality:** This is a virtual class. A new lecture video will be uploaded on Canvas by 12:00pm every Wednesday. Each lecture will be accompanied by a slide set.

**Prerequisites:** COSC 1337 – The Object-Oriented Paradigm and EENG 4307 – Microprocessors and Embedded Systems

**Credits:** 3 (3 hours lecture; 0 hours laboratory work)

**Texts(s):** David A. Patterson and John L. Hennessy, *Computer Organization and Design MIPS Edition: The Hardware/Software Interface*, Sixth Edition (Morgan Kaufmann, 2020); ISBN 978-0128201091. The 5<sup>th</sup> Edition of this book will also work.

**Instructor:** Muhammad Ikram; Ph.D., P.E.  
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**Office Hours:** Virtual – Wed. 3pm to 4:30pm, Fri. 11am to 12:30pm (Central Standard Time); Virtual meeting link will be provided in Canvas.

**Topics Covered:** (paragraph of topics separated by semicolons)

Introduction to Computer Architecture: structured computer organization, hardwired and programmed control, example computer families; Computer Systems: processors, memory organization, cache design, I/O organization; Digital Logic: circuits, memory, buses, hardware for integer and floating point operations; Microarchitecture: microprogramming, microinstructions, data path and control unit design; Instruction Set Architecture: opcodes, addressing modes, instruction formats and types; Operating Systems: virtual memory, processes; Assembly Language: macros, assemblers, linking and loading.

**Evaluation Methods:** (only items in dark print apply)

1. Examinations / Quizzes
2. Homework
3. Report
4. Computer Programming
5. Project
6. Presentation
7. Course Participation
8. Peer Review

**Course Learning Outcomes<sup>1</sup>:** By the end of this course students will be able to:

1. Explain a contemporary issue in computer architecture referring to relevant codes and standards as appropriate [3].
2. Evaluate the performance of a computer system given the hardware specifications [1].
3. Justify the need to design multicore processors to improve computer performance [1].

4. Solve design problems at the digital logic, microarchitecture, instruction set architecture level and explain the function of each level [1].
5. Convert decimal numbers to IEEE floating point numbers [1].
6. Contrast the differences between a RISC versus CISC architecture [1].
7. Discuss relevant professional ethics related to the professional practice of modern technology e.g., product reliability, effect on environment, teamwork ethics etc. [3]
8. Recognize how the memory hierarchy (registers, cache, RAM, disk) impacts performance [1].
9. Outline how pipelining is used to improve processor performance [1].
10. Describe the architecture of a superscalar processor [1].
11. Describe the impact of multicore processors on society [3].
12. Incorporate information gained by independent learning from technical reference manuals and other sources to implement a project (write subroutines in assembly language) and enhance reports [3,4].

<sup>1</sup>Numbers in brackets refer to method(s) used to evaluate the course learning outcome.

**Relationship to Student Outcomes (only items in dark print apply)<sup>2</sup>:** This course supports the following Electrical Engineering Student Outcomes, which state that our students will possess:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics [3-6, 8-10].
2. 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.
3. an ability to communicate effectively with a range of audiences.
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts [1, 7, 11].
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions [2].
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies [12].

<sup>2</sup>Numbers in brackets refer to course learning outcome(s) that address the Program Outcome.

**Contribution to Meeting Professional Component:**

| Component                       | Semester hours |
|---------------------------------|----------------|
| Mathematics and Basic Sciences  |                |
| Engineering Sciences and Design | <b>3</b>       |
| General Education Component     |                |

**Course Schedule:**

| Week | Lecture | Dates    | Topic  | 6 <sup>th</sup> Ed |
|------|---------|----------|--|--------------------|
| 1    | 1       | Aug. 24  | Introduction;<br>Components and performance of computers | 1                  |
| 2    | 2       | Aug. 31  | Performance of computers;<br>Language of the computer    | 1, 2               |
| 3    | 3       | Sept. 7  | Instructions and their types                             | 2                  |
| 4    | 7       | Sept 14  | Instructions   | 2                  |
| 5    | 9       | Sept. 21 | Computer arithmetic                                      | 3                  |

|    |    |                  |                                       |      |
|----|----|------------------|---------------------------------------|------|
|    |    | Week of Sept. 26 | Mid-term Exam                         |      |
| 6  | 10 | Sept. 28         | Computer arithmetic; Processor        | 3    |
| 7  | 12 | Oct. 5           | Data path; Pipelining overview        | 4    |
| 8  | 14 | Oct. 12          | Pipelining and its hazards            | 4    |
| 9  | 16 | Oct. 19          | Types of hazards and their control    | 4    |
| 10 | 18 | Oct. 26          | Memories and memory hierarchy         | 5    |
| 11 | 20 | Nov. 2           | Memory cache and memory design        | 5    |
| 12 | 22 | Nov. 9           | Improving cache memory design         | 5    |
| 13 | 24 | Nov. 16          | Virtual machines; Parallel processors | 5, 6 |
|    |    | Week of Nov. 21  | No class – Thanksgiving               |      |
| 14 | 25 |                  | Parallel processors                   | 6    |
| 15 | 26 | Nov. 30          | Course review                         |      |
|    |    | Dec. 5 – 10      | Exam – Exact date TBD                 |      |

### **Assessment:**

- Quizzes – 20%
- Midterm Exam – 20%
- Homework and project – 30%
- Final Exam – 30%

### **Grading Scale:**

Grades will be assigned based on the total score as per the distribution below:

|    |            |
|----|------------|
| A: | 90% – 100% |
| B: | 80% – 89%  |
| C: | 70% – 79%  |
| D: | 60% – 69%  |
| F: | 0% – 59%   |

Any deviation from the above policy such as scaling or curving to calculate the individual item or final scores will be at the sole discretion of the instructor and performed by the instructor uniformly for all students in the class section.

### **Attendance and Make-up Policy:**

The progressive nature of the class means that perfect attendance is recommended if a good grade is desired. Makeup quizzes, exams or projects will only be provided for valid and legitimate absences and at the sole discretion of the instructor.

### **Course communication:**

Course communication will take place by e-mail and by announcements on UT-Tyler's Learning Management System (LMS). University policy requires that official e-mail communication be sent only to Patriot e-mail accounts.

### **Academic misconduct:**

Academic misconduct that comes to light will be dealt through the formal discipline process. Examples of academic misconduct include (but are not limited to) submitting the work of others as one's own, copying from others during quizzes, and doing work intended to be submitted by another person.

### **General Policies of the University of Texas at Tyler**

**Grade Replacement/Forgiveness and Census Date Policies:** Students repeating a course for grade forgiveness (grade replacement) must file a Grade Replacement Contract with the Enrollment Services Center (ADM 230) on or before the Census Date of the semester in which the course will be repeated.

Grade Replacement Contracts are available in the Enrollment Services Center or at <http://www.uttyler.edu/registrar>. Each semester's Census Date can be found on the Contract itself, on the Academic Calendar, or in the information pamphlets published each semester by the Office of the Registrar.

Failure to file a Grade Replacement Contract will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates are eligible to exercise grade replacement for only three course repeats during their career at UT Tyler; graduates are eligible for two grade replacements. Full policy details are printed on each Grade Replacement Contract.

The Census Date is the deadline for many forms and enrollment actions that students need to be aware of. These include:

- Submitting Grade Replacement Contracts, Transient Forms, requests to withhold directory information, approvals for taking courses as Audit, Pass/Fail or Credit/No Credit.
- Receiving 100% refunds for partial withdrawals. (There is no refund for these after the Census Date)
- Schedule adjustments (section changes, adding a new class, dropping without a "W" grade)
- Being reinstated or re-enrolled in classes after being dropped for non-payment
- Completing the process for tuition exemptions or waivers through Financial Aid

**State-Mandated Course Drop Policy:** Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Academic Calendar for the specific date).

Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Enrollment Services Center and must be accompanied by documentation of the extenuating circumstance. Please contact the Enrollment Services Center if you have any questions.

**Disability Services:** In accordance with federal law, a student requesting accommodation must provide documentation of his/her disability to the Disability Services counselor. If you have a disability, including a learning disability, for which you request an accommodation, please contact the Disability Services office in UC 3150, or call (903) 566-7079.

**Student Absence due to Religious Observance:** Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences by the second class meeting of the semester.

**Student Absence for University-Sponsored Events and Activities:** If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

**Social Security and FERPA Statement:** It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

**Emergency Exits and Evacuation:** Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by University Police, Fire department, or Fire Prevention Services.