

Fall 2023

## **ECE 451 - ADVANCED COMPUTER ARCHITECTURE**

Shaahin Angizi

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**Fall 2023**

**ECE 451 - Advanced Computer Architecture**

**General information:** 3 credit hours. M/W: 11:30 AM-12:50 PM. FMH 305

**Instructor:** Shaahin Angizi, ECE 325, (973)-596-3516, shaahin.angizi@njit.edu

**Office Hours:** M/W 2:30 PM-4:30 PM or by appointment.

**Required Text:** Lecture notes: primary references

**References:**

John L. Hennessy and David A. Patterson, *Computer Architecture: A Quantitative Approach*, ISBN: 012383872X.

Morris Mano, *Computer System Architecture*, ISBN: 0131755633

David A. Patterson and John L. Hennessy, *Computer Organization & Design, The Hardware/Software interface*, ISBN: 0123747503

**Catalog Description:** This course focuses on advanced concepts in computer systems design, and the interaction between hardware and software components at various levels (i.e., hardware/software codesign). It introduces common performance measures and tradeoffs used by hardware and software designers to facilitate comparative analysis. The main topics are: Technology challenges, Pipelining, Multicore architecture, Advanced memory technologies, Introduction to parallel computing, Conventional architecture for AI acceleration, Analog neuromorphic computing architecture, and Digital in-memory computing.

**Prerequisite:** Computer Organization and Architecture (ECE 353)

**Course Syllabus:**

- Lecture 0: Introduction
- Lecture 1: Technology Challenges
  - Power Wall
  - Memory Wall
- Lecture 2: Pipelining & Multi-core
  - Von-Neumann Model
  - Pipelining
  - Virtual Memory
  - Multi-Core

- Lecture 3: Advanced Memory Technologies
  - Volatile Main Memory
  - Main Memory in Multicore Systems
  - Non-volatile Magnetic Memories
- Lecture 4: Domain-Specific Architectures
  - Neural Networks
  - Acceleration in Von-Neumann Computing Architecture (ASIC, FPGA, GPU)
- Lecture 5: In-Memory Computing
  - Processing-in-non-Volatile Memory (Resistive Memory, e.g., spin-based memory)
  - Processing-in-Volatile Memory (DRAM)

<b>Grading Criteria:</b>	HomeWorks and Critical Reviews:	30%
	Research Project:	30% (15% Report +15% Presentation)
	Exams:	40% (20% Midterm + 20% Final)

**Collaboration:** You are allowed to collaborate with your classmates by discussing the materials and ideas on how to solve the homework. Such discussions should be done in speaking only. No written materials or code should be shared. The work you submit should be of your own making.

**Homework:** Homework will be assigned in the format of problem-solving or assigned reading. All homework must be completed on time and uploaded to NJIT Canvas.

**Submission / Late Submission / Make-up Policies:**

- All submissions must be uploaded to Canvas **prior** to the specified due date and time – no other form of submission can be accepted: please do not email your submissions.
- Late Work: useful to study but cannot be utilized for credit to be fair to all students.

**Honor Code:** The NJIT Honor Code will be upheld, and any violations will be referred to the Dean of Students for disciplinary action. “Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: <http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.”

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at [dos@njit.edu](mailto:dos@njit.edu)”