# COMP 3410: Computer Organization & Architecture – Fall 2022

## Contact Information:


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| **Office:** Dunn Hall 320 | **Department Office:** Dunn Hall 375 |
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| **TA/GA: TBD** | |


The best way to contact me is through email – I usually respond within 24 hours.

## Office Hours:

I am usually around between 9:30 to 11:30 am (M, Tu, Thr, F, Sat). You can drop by any time. My classes are in the afternoons (M – Thr). It is best to email me to set up an appointment (zoom or in-person) in advance.

## Lecture Meeting Times/Locations:

82741 - COMP 3410 – 001 MW 2:20 - 4:20 pm Dunn Hall 124

## Catalog Description:

**COMP 3410 –** Basic concepts in assembly language programming, including logic, comparing and branching, interrupts, macros, procedures, arrays, program design, testing, debugging, loading, and linking; combinational, arithmetic and logical circuits ALU; memory circuits, latches, flip-flops, registers; computer structure; fetch-execute cycles, clocks and timing; microprogramming and microarchitecture; data path, timing, sequencing; cache memory organization; RISC architectures.
PREREQUISITE: COMP 2150

## Course Website:

You can find the course materials (lecture notes, assignments, codes written during lecture, sample codes, grades, etc.) at the University of Memphis LMS (Canvas) at Dashboard (instructure.com)

## Topics Include:

1. Introduction
   - Computer systems and computer organization;
2. Number systems and arithmetic for computers;
   - Number conversion, arithmetic overflow handling,
   - Floating points
3. ARM instruction set architecture and operations;
4. Digital logic and processor design;
   - Logic gates and modular ALU design
   - Combinational and sequential logic and control
5. Performance and pipelining
   - Building a datapath
   - Pipelined datapath and control
   - Handling of data hazards
   - Parallelism via Instruction
6. Memory hierarchy and cache organization
   - Memory technologies
   - Basics of Caches and performance improvement
   - Cache mapping and memory hierarchy

## Course outcome for COMP3410 (Computer Organization and Design)

(1) Understand the key components within a computer system and organization.
(2) Understand number systems and implement binary arithmetic with overflow handling and floating-point numbers.
(3) Implement assembly language for ARM processor ISA and operations.
(4) understand digital logics, data path, and control using logic gates, combinational and sequential components
(5) Analyze instructions, data path, and control complexity for performance assessment
(6) Analyze the cause of pipeline hazards and implement ways to overcome them.
(7) Understand memory hierarchy and apply the principle of locality in cache design.

### Required Text:

- zyBook: Computer Organization and Design, ARM Edition by David Patterson and John Hennessy
- Sign in or create an account at zybooks.com
- Enter zyBook code
  MEMPHISCOMP3410YuFall2022

- Click Subscribe (you must register using your Memphis.edu email address)
  You will need this book for the in-class exercises and zyBooks assignments

### Evaluation:

| Items | Points |
|---|---|
| **Homework Assignments (HW)** | **200** |
| **zyBooks-Exercises (ZB)** | **100** |
| **In-Class exercises (IC)** | **200** |
| **Quizzes (3) (@100 each)** | **300** |
| **Final** | **200** |
| **Total** | **1000** |

Some of the zyBook exercises consist of in-class and take-home portions. You must submit the in-class portion to get the assignment's total (in-class + take-home) grade. Missing the in-class part will result in a zero for that zyBook exercise assignment.

**Grading Scale:** Letter grades will be determined as follows:

| A | B | C | D | F |
|---|---|---|---|---|
| 100 -> 89 | 88 -> 76 | 75 -> 65 | 64 -> 60 | 59 -> 0 |
| **A+ ≥ 97%** | **B+ 85–88%** | **C+ 71–75%** | **D+ 62–64%** | **F ≤ 59%** |
| **A 92–96%** | **B 80–84%** | **C 67 –70 %** | **D 60–62%** | |
| **A– 89 –91%** | **B– 76–79%** | **C– 65 –67 %** | | |

**Final Exam: based on:** Fall 2022 Final Exams - Registrar - The University of Memphis
W, Dec 7, 1:00 - 3:00p at DH 124 (same as the lecture room)

## Assignments:

Throughout the semester, you will have various assignments to reinforce the concepts discussed in the lecture. This class does not have an assigned laboratory section. Instead, you will have exercises (in-class and zyBooks) during lectures to practice your understanding. Therefore, you will not do well in this course unless you work on assignments persistently.

The assignments fall into three categories: in-Class : (200 pts), ZyBooks (ZB) Exercises (100 pts), Homework Assignments (HW) (200 pts)

1. In-Class (200 pts) consists of (in-class, code-along) exercises to reinforce the current topic discussed immediately. Attendance is also indirectly taken through canvas submission. There is absolutely no makeup for the in-Class coding exercise.
2. ZyBooks (ZB) exercises (100 pts) are from the required zyBook textbook. Please check your course LMS (Canvas) regularly for the posting and due dates details
3. Homework (HW) Assignments (200 pts): HW assignments will allow you to explore the topic more deeply and in-class exercises. Please check your course LMS (Canvas) regularly for the posting and due dates details

You must regularly check the course LMS (Canvas) site (https://memphis.instructure.com/) for all the assignment posting and due dates. Unfortunately, there is no makeup for the missing assignments.

## Participation/Attendance: (zyBooks and in-Class exercise)

It is essential to attend the classes regularly. The course will keep building on itself and move pretty quickly. Therefore, it would be best to get a good handle on each concept after discussing it. Frequently, you will need to submit in-class work, and I will also use that for attendance.
You must bring your laptop with the assigned zyBook textbook for this course. Some in-class exercises may be from the zyBooks chapters. If you miss the lecture and cannot submit the in-class portion, you will receive no marks for the assigned zyBooks exercise. There is absolutely NO Extention for the missing (in-class or take-home portion) zyBooks assignments

## Email:

Please check your University of Memphis (@memphis.edu) email regularly (daily), as that is my primary means of communicating with you outside of class.

## Late/Makeup Policy:

All assignments (including zyBooks, and in-class exercises) are expected to be completed and turned in on schedule. Each assignment will have specified due dates. Your TA/GA will not accept late assignments except in extreme circumstances. Likewise, you can have makeup quizzes and exams only under extreme circumstances. If circumstances warrant a late work submission or a makeup quiz/exam, get in touch with me with documented proof of your situation no more than one week from the due date.

## Plagiarism/Cheating Policy:

An essential part of learning is getting plenty of practice with it yourself. All assignments (unless specifically indicated otherwise) are expected to be done in individual effort. If I determine that you have copied something directly from a book, the Internet, or some other source, you will receive a failing grade on the assignment and (at my discretion) in the course. If I determine that you have copied another student's work, this will happen to both you and the person from whom you copied. The first-time offender will receive a warning through a face-to-face meeting and an email. For the 2nd occurrence, you will be asked to see the department chairperson. The Office of Student Conduct will also receive a copy of this incident for further disciplinary action. Please don't put me in this situation.

## Important: Fall 2022 Dates and Deadlines - Registrar - The University of Memphis

## Getting Help:

Although I expect you to do your work individually, I encourage you to seek help if you get stuck:

- Talk to me! I'm very willing to sit down and provide hints without giving away the solution.
- Contact your course TA\GA.
- Online help: I generally have an open zoom open line on Sat 9:30 to 12noon. Please come prepared with specific questions

## Student Disabilities:

If you have a disability that may require assistance or accommodations, or if you have any questions related to any room for testing, note taking, reading, etc., please speak with me as soon as possible. You must officially contact the Student Disability Services Office (678-2880) to request such accommodations/services (http://www.memphis.edu/drs/ )

## Course Schedule: (subject to change):

| Date | Topics | Text | Quizzes | Assignments (HW) |
|---|---|---|---|---|
| 22-Aug | Introduction, Computer Abstr and technology, course outline | 1.1 - 1.5 | | |
| 24-Aug | Inside the CPU, Semi tech, performance | 1.6 - 1.8 | | |
| 29-Aug | Language for the computer: Instructions/Numbers | 2.1 | | |
| 31-Aug | Binary data | 2.2-2.5 | | HW1 (review from Book Exec) |
| 5-Sep | **Labor day / No Class** | | | |
| 7-Sep | ARM ISA (operation of HW) | 2.1 - 2.2 | | HW2 ISA, Performance, Binary Data, |
| 12-Sep | ARM (Operant of HW) | 2.3 - 2.5 | **Q1: (09/12)** | |
| 14-Sep | ARM programming | 2.6 - 2.15 | | |
| 19-Sep | ARM programming | | | |
| 21-Sep | Arithmetric for Computer | 3 | | HW3: ARM programming |
| 26-Sep | "+ - / * overflows" | 3.1 - 3.4 | | |
| 28-Sep | Floating points | 3.5, 3.10-12 | | |
| 3-Oct | CPU, logic circuits | 4.1-4.2 | | |
| 5-Oct | Gates, TrueTable, Logic equation | 8.1 - 8.2 | | HW4: ALU, logics |
| 10-Oct | **Fall Break/No Class** | | | |
| 12-Oct | Combination / Sequential Logic | 8.2 - 8.9 | **Q2: (10/12)** | |
| 17-Oct | data path and control | 4.3- 4-4 | | |
| 19-Oct | Single_Cycle datapath/control | 4.4 | | HW5: Data Path, Control |
| 24-Oct | Overview of pipelining | 4.5 | | |
| 26-Oct | Pipelined datapath, control) | 4.6 | | |
| 31-Oct | Pipelined data hazard | 4.7 | | |
| 2-Nov | Pipelined Control hazard, exception | 4.8, 4.9 | | HW6: Pipeline data/control |
| 7-Nov | Parallelism (intro) | 4.10 | | |
| 9-Nov | Memory Hierarchy/Cache Org | 5.0 | **Q3: (11/09)** | |
| 14-Nov | Memory Org | 5.1 - 5.2 | | |
| 16-Nov | Cache Mapping | 5.3 | | HW7: Memory, Cache, performance |
| 21-Nov | Cache performance | 5.4 | | |
| 23-Nov | **Thanksgiving / No Class** | | | |
| 28-Nov | TBD | | | |
| 30-Nov | **Last day of class** | | | |

Final Exam: W, Dec 7, 1:00 – 3:00p (DH 124)

Please check and verify the date/time/location when we are closed to the exam time.

- Quiz 1: Computer Organization, Key components, performance, Number conversion, Arithmetic (Ch 1. 19)
- Quiz 2: ALU, sequential logic, and controls Ch 4, 8
- Quiz 3: Datapath (single and multiple cycles), Memory Hierarchy Ch 4, 5
- Final Exam: (Comprehensive, some MIPS prog, with focus on Ch 4 – 5 )