Computer Organization	Code & No:	CS 312
	Credits:	3 (3,0,1)
	Pre-requisite:	MATH 111 CS 210
	Co-requisite:	None
	Level:	6

Course Description:

This course introduces the students to the basics of computer organization: the internal structure and operation of a digital computer at the level of memory, registers, flow of control, and assembly language. This course has a theoretical and a practical component: computer organization will be studied at a theoretical level, and students will have the opportunity to practice their skills by studying the assembly language for a particular Reduced Instruction Set Computer.

Topics to be covered :

1) Introduction to computer organization
   - Organization and Architecture
   - Computer components
   - Computer function
   - Interconnection Structures
   - Bus Interconnection

2) Number Systems
   - Binary Numbers,
   - Decimal System
   - Binary System
   - Octal System
   - Converting between Binary and Decimal Hexadecimal Notation

3) Binary Arithmetic
   - Integer arithmetic operations
   - Logical operations
   - Review of signed/unsigned integers

4) Floating Point representation
   - IEEE 754 standard
   - Normalized and de-normalized numbers

- Rounding and accurate arithmetic
- Floating point instructions

5) Instruction set Design
   - Instruction representation.
   - Addressing modes.
   - Instructions for making decisions

6) Assembly Language : Machine and Assembly language programming
   - Assembly Language
   - Assemblers
   - Assembler function and design
   - x86 Microprocessor Assembly language programming

7) Boolean Functions and Logic Gates
   - Simplification of Boolean Function using K-map
   - Combinational Logic

8) Data-path
   - Data-path components
   - Single-cycle data-path
   - Implementing a register file

9) Control signals and control unit
   - ALU control
   - Single-cycle delay analysis and clock cycle
   - Multi-cycle instruction execution

10) Memory organization
   - SRAM
   - DRAM
   - Latency and bandwidth
   - Memory hierarchy
   - Cache memory

11) Reduced Instruction Set Computers (RISC)
   - Instruction Execution Characteristics
   - Reduced Instruction Set Architecture,
   - RISC versus CISC Controversy.

Course Aims:

1. Explain the basic concept of computer and its structure.

2. Give overview of the components of computer system
3. Identify the number systems.
4. Understand and use different data representations
5. Design and analysis combinational circuits
6. Use the assembly language to write drivers for different computer accessories
7. Understand how the data-path and control unit operate inside a CPU

Student Outcomes (SOs):

☒(a) An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline

☒(b) An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution

☒(c) An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs

☐(d) An ability to function effectively on teams to accomplish a common goal

☐(e) An understanding of professional, ethical, legal, security and social issues and responsibilities

☐(f) An ability to communicate effectively with a range of audiences

☐(g) An ability to analyze the local and global impact of computing on individuals, organizations, and society

☐(h) Recognition of the need for and an ability to engage in continuing professional development

☒(i) An ability to use current techniques, skills, and tools necessary for computing practice.

☐(j) An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices. [CS]

☐(k) An ability to apply design and development principles in the construction of software systems of varying complexity. [CS]

☐(j) An ability to use and apply current technical concepts and practices in the core information technologies of human computer interaction, information management, programming, networking, and web systems and technologies. [IT]

☐(k) An ability to identify and analyze user needs and take them into account in the selection, creation, evaluation, and administration of computer-based systems. [IT]

☐(l) An ability to effectively integrate IT-based solutions into the user environment. [IT]

☐(m) An understanding of best practices and standards and their application. [IT]

☐(n) An ability to assist in the creation of an effective project plan. [IT]

Course Learning Outcomes (CLOs):

1. Identify the basic components of computer system and understand the specification of a PC.
2. Convert numbers from one number system to another number system and describe the details of integer and floating point formats.
3. Design logic circuits by applying the concepts of Boolean Algebra and K-Maps.
4. Apply Assembly Language Programming skills to solve problems.
5. Describe the Instruction Set Architecture and data path of a simple processor.
6. Describe the concepts of RISC / CISC machines and parallel programming.

SOs and CLOs Mapping:

CLO/PLO	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CLO1	√													
CLO2	√													
CLO3			√						√					
CLO4		√												
CLO5		√							√					
CLO6	√													

No.	Topics	Weeks	Teaching hours
1	Introduction to Computer organization	2	6
2	Number Systems	1	3
3	Binary Arithmetic	1	3
4	Floating Point representation	1	3
5	Instruction set Design	1	3

6	Assembly Language : Machine and Assembly language programming	2	6
7	Boolean Functions and Logic Gates	2	6
8	Data-path	1	3
9	Control signals and control unit	1	3
10	Memory organization	1	3
11	Reduced Instruction Set Computers (RISC)	1	3
	Total	**14**	**42**

Textbook:

- Computer Organization and Architecture: Designing for performance by William Stallings, Pearson, Global Edition, 2016

Essential references:

- The Essentials of Computer Organization and Architecture by Linda Null and Julia Lobor, Jones and Bartlett, 4th Edition, 2015.