GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Computer Applications

Level: Post Graduate

Course / Subject Code : MC01094021

Course / Subject Name : Fundamental of Computer Organization

w. e. f. Academic Year:	2024-25
Semester:	1
Category of the Course:	Core Course

Prerequisite:	Basic mathematics, introductory computer science, and foundational knowledge of digital electronics.
Rationale:	The "Fundamental of Computer Organization" course is designed to provide students with a comprehensive understanding of the foundational concepts in digital electronics and computer science. These topics are essential for anyone pursuing a career in computer engineering, information technology, or related fields. The rationale behind this course is to equip students with the necessary skills and knowledge to understand and design digital systems, which are the backbone of modern computing devices. By covering number systems and their conversions, basic and advanced logic gates, Boolean algebra, and the basic structure of computers, students will gain a solid foundation that will enable them to understand how computers process, store, and retrieve information. Furthermore, the course delves into the intricate details of register transfer languages, microoperations, and the memory system, which are crucial for understanding the internal workings of a computer. This in-depth knowledge is vital for designing efficient and effective computing systems. Focusing on practical aspects such as Karnaugh maps and memory performance considerations ensures students can apply theoretical concepts to real-world problems. By the end of the course, students will be well-prepared to tackle advanced topics in computer science and engineering, contributing to technological innovations and the development of sophisticated digital solutions.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	perform conversions between different number systems (binary, decimal, octal, hexadecimal) and design basic logic circuits using fundamental logic gates (AND, OR, NOT, NAND, NOR).	R, U, A
02	apply Boolean algebra laws and De Morgan’s Theorems to simplify complex logical expressions and design optimized digital circuits using Karnaugh maps.	R, U, A

03	describe the fundamental components of a computer system, including data representation, the basic operational concepts, bus structures, and performance metrics of different computer types.	R, U
04	explain the concepts of register transfer language and microoperations, and describe the execution of instructions, memory-reference instructions, and addressing modes in a computer system.	R, U
05	Explain the various types of memory systems, including RAM, ROM, cache, and virtual memory, and evaluate their performance considerations and the role of secondary storage and RAID in computer architecture.	R, U

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
2	0	2	3	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	UNIT I: NUMBER SYSTEM AND LOGIC GATES Number System: Decimal System, Two-state Devices, Counting in Binary System, Binary Addition and Subtraction, Converting Decimal Number to Binary Numbers, Use of Complements to represent negative numbers in binary and other number systems, Octal and Hexadecimal Number System. Basic Logic Gates: Logic Gates, Logical Multiplication, AND Gate and OR Gate, Complementation and Inverts Evaluation of logical Expression, Evaluation of an Expression containing Parenthesis. NAND Gates and NOR Gates.	4	15
2.	UNIT II FUNDAMENTAL CONCEPTS OF BOOLEAN ALGEBRA: Basic Laws of Boolean Algebra, De Morgan's Theorems, Basic Duality of Boolean Algebra, Derivation of a Boolean Algebra, Interconnecting Gates Sum of Products And Product of Sums, Derivation of POS Expression Derivation of 3 input variables expression	8	25

	Map Simplification Techniques: Karnaugh Maps – 2, 3, 4 Variables, Don't Care Conditions, De Morgan's Theorems, Sum of Products, Product of Sum.		
3.	UNIT III BASIC STRUCTURE OF COMPUTERS : Computer Types, Functional unit, Basic OPERATIONAL concepts, Bus structures, Software, Performance, multiprocessors and multi computers. Data Representation. Fixed Point Representation. Floating – Point Representation. Error Detection codes.	6	20
4.	UNIT III: REGISTER TRANSFER LANGUAGE AND MICROOPERATIONS : Register Transfer language.Register Transfer Bus and memory transfers, Arithmetic Mircrooperatiaons, logic micro operations, shift micro operations, Arithmetic logic shift unit. Instruction codes. Computer Registers Computer instructions – Instruction cycle. Memory – Reference Instructions. Input – Output and Interrupt. Instruction formats. Addressing modes.	8	25
5.	THE MEMORY SYSTEM : Basic concepts semiconductor RAM memories. Read-only memories Cache memories performance considerations, Virtual memories secondary storage. Introduction to RAID.	4	15
	Total	**30**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	50	30	-	-	-

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Morris Mano, "Computer System Architecture",Third Edition, Pearson Publications
2. P.K. Sinha, "Computer Fundamentals",Sixth Edition, BPB Publications
3. Computer Installation and Servicing By D Balasubramanium | Tata McGraw Hill Education Private Limited
4. Malvino And Leach, "Digital Computer Electronics",Third Edition, Tata McGraw-Hill Education

Logisim is an open-source simulation software (https://logisim.en.softonic.com/) which can be used to perform the simulation experiments.

The proposed list of experiments is as below –

1. **Basic Logic Gates Implementation**
    - Design and simulate basic logic gates (AND, OR, NOT) using Logisim.
    - Verify the truth tables for each gate using different input combinations.
2. **NAND and NOR as Universal Gates**
    - Implement and simulate NAND and NOR gates as universal gates.
    - Construct AND, OR, and NOT gates using only NAND and NOR gates.
3. **Boolean Expression Simplification and Circuit Design**
    - Simplify a given Boolean expression using Boolean algebra.
    - Design and simulate the simplified logic circuit in Logisim.
4. **Karnaugh Map Simplification**
    - Use a Karnaugh map to simplify a 3-variable Boolean expression.
    - Design the simplified circuit in Logisim and verify its functionality.
5. **Half Adder and Full Adder Design**
    - Design and simulate a half adder circuit using basic logic gates.
    - Expand the design to simulate a full adder and test it with all possible input combinations.
6. **4-Bit Binary Adder/Subtractor**
    - Design and simulate a 4-bit binary adder using full adders.
    - Extend the design to create a 4-bit adder/subtractor circuit and simulate it in Logisim.
7. **Multiplexer and Demultiplexer Design**
    - Design and simulate a 4-to-1 multiplexer.
    - Design a 1-to-4 demultiplexer circuit and test its functionality in Logisim.

8. **Design of a 2-Bit Magnitude Comparator**
   - Implement and simulate a 2-bit magnitude comparator using logic gates.
   - Test the circuit with different pairs of binary inputs to verify the comparison results.
9. **Sequential Circuits: Flip-Flops**
   - Design and simulate basic flip-flops (SR, D, JK) using Logisim.
   - Test the behavior of each flip-flop with different input sequences.
10. **4-Bit Binary Counter**
   - Design and simulate a 4-bit binary counter using D flip-flops.
   - Observe and record the counting sequence in Logisim.
11. **Shift Register Design**
   - Implement a 4-bit shift register using D flip-flops.
   - Simulate the shift left and shift right operations in Logisim.
12. **Memory Simulation: RAM Module**
   - Design and simulate a simple RAM module in Logisim.
   - Test read and write operations to the RAM module with different addresses.

CO- PO Mapping:

Semester 1	**Course Name: Fundamental of Computer Organization**							
	POs							
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	-	2	-	-	-	-
CO2	3	3	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-
CO5	2	1	-	-	-	-	-	-
	2.8	**2.25**	**-**	**2**	**-**	**-**	**-**	**-**

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

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