

# ITS62704

**Computer Architecture and Organization SCHOOL OF COMPUTER SCIENCE BACHELOR DEGREE PROGRAMMES**

ASSIGNMENT 1 (30%)

**(MLO Assessed: MLO1) (Individual - Weightage 30%) January 2025 Semester**

## Learning Outcomes (ML01)

* + Demonstrate an understanding of the key building blocks of a computer system.
  + Evaluate the functionality of these building blocks using simulation tools.
  + Use effective communication skills to explain the concepts of computer architecture in appropriate contexts.

## Group Formation

This is a group assignment for teams of five, depending on number of student present in class size. All members must actively participate, share ideas, and engage in discussions to complete the task. Silent members will face a half-mark penalty. Avoid plagiarism—copy-pasting is prohibited, and plagiarized work will receive zero mark.

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| --- | --- | --- | --- |
| **NAME OF GROUP MEMBERS** | | | |
| **S/N** | **Name** | **Student ID** | **Signed** |
| **1.** | **Group Leader…** |  |  |
| **2.** |  |  |  |
| **3.** |  |  |  |
| **4.** |  |  |  |
| **5.** |  |  |  |

### Student Declaration:

* + I understand what plagiarism is and its consequences, as explained by our lecturer.
  + This project is our team work, with proper acknowledgment of any sources used.

**PART A**

## Assignment Question

**Scenario**

Understanding the Communication Skills and Building Blocks of an **Introduction to Computer Architecture & Describing Logic Circuits** (Truth Tables, Gates Operations) (Implement Circuits from Boolean Expression -Logic Diagrams, Boolean Theorems, DeMorgan’s Theorems))

### Objective:

The objective of this assessment is to evaluate the ability to understand, analyze, and demonstrate the essential components of a computer system, specifically the architecture of a simple computer. This project will combine communication skills with technical knowledge by simulating the working of a simple computer and explaining its components in an effective and expressive manner. Where it is divided into two part. **PART A is Research and Development Questions** and **PART B assigned to design a circuit that controls the lighting system in a parking garage, based on the occupancy of four parking spots.**

**Note: -** If students do their R&D Part A by themselves, which could be very helpful for Part B on design a circuit that controls the lighting system in a parking garage.

# Group Assessment: - Part A 20 Marks

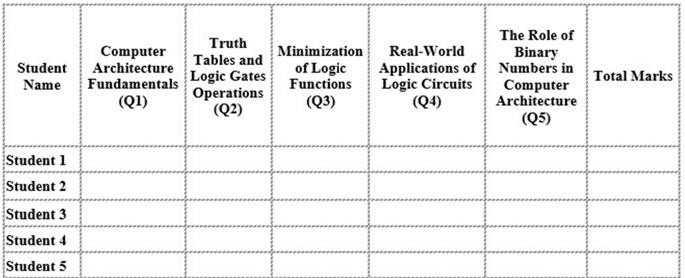
**Research and Development Questions**

1. **Computer Architecture Fundamentals 4 Marks** Research how modern computer architectures differ from early designs and explain the key advancements in instruction set architecture (ISA) that have improved performance. Provide real-world examples of CISC and RISC architectures, and discuss their advantages and trade-offs
2. **Truth Tables and Logic Gates Operations 4 Marks** Create truth tables for the AND, OR, NOT, NAND, and NOR gates, and analyze how these gates can be combined to form complex circuits. Design a logic circuit using only NAND gates to implement an XOR function, and explain your design process.
3. **Minimization of Logic Functions 4 Marks** Research methods for logic minimization, such as Karnaugh maps and the Quine-McCluskey method. Use a Karnaugh map to minimize the following function: F(A, B, C, D) = Σ(1, 3, 4, 7, 8, 9, 10, 11, 15). Explain the minimization process step-by-step and discuss why minimization is important in circuit design.
4. **Real-World Applications of Logic Circuits 4 Marks** Explore the role of logic circuits in real-world systems such as microprocessors, memory units, or control systems, and choose a specific application (e.g., arithmetic logic unit or multiplexers) to describe how logic circuits are utilized in that application.
5. **The Role of Binary Numbers in Computer Architecture 4 Marks**

Investigate the role of binary number systems in computer architecture, and describe the processes of binary addition, subtraction, multiplication, and division. How is binary arithmetic implemented in an arithmetic logic unit (ALU)?

**PART A.**

**Student Mark Table: Group Assessment – Part A**

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**Marking Rubric for PART A in Research and Development**

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| --- | --- | --- | --- | --- |
| **Assessment Criteria** | **EXCELLENT**  **(4 Marks)** | **GOOD**  **(3 Marks)** | **SATISFACTORY**  **(2 Marks)** | **NEEDS**  **IMPROVEMENT**  **(1 Mark)** |
| **1. Computer Architecture Fundamentals**  **(Q1)** | Comprehensive research with clear explanations of modern computer architectures, CISC, RISC, ISA, and  comparison of architectures with real- world examples. | Good understanding of computer architectures, CISC, RISC, with  examples; minor details missing in comparison or explanation. | Basic understanding with incomplete or unclear explanation of architectures; few or no real-world examples. | Limited or incorrect explanation of architectures; few or no examples. |
| **2. Truth Tables and Logic**  **Gates Operations (Q2)** | Accurate truth tables for all gates; correct XOR design using NAND gates with a detailed explanation. | Mostly accurate truth tables with minor mistakes; correct XOR function design, but unclear explanation. | Incomplete or partially incorrect truth tables; XOR design may be incorrect or poorly explained. | Major errors in truth tables and XOR function design; explanation is unclear or missing key steps. |
| **3. Minimization of Logic Functions**  **(Q3)** | Detailed research and step-by-step explanation of minimization methods using Karnaugh maps to minimize the given function correctly. | Good explanation of minimization methods with minor mistakes in Karnaugh maps or function minimization. | Limited explanation of minimization methods and unclear or incorrect Karnaugh map application. | Inaccurate or incomplete explanation; Karnaugh maps incorrectly applied or missing. |
| **4. Real-World Applications of Logic Circuits**  **(Q4)** | In-depth exploration of logic circuits in microprocessors, memory units, control systems, etc.; clear description of one specific application (ALUs, multiplexers). | Good exploration of logic circuits in real-world systems; lacks depth in explaining one application. | Basic understanding of logic circuits in real-world applications; brief or unclear description of an application. | Minimal or incorrect explanation of logic circuits; application not well-developed or missing. |
| **5. The Role of Binary**  **Numbers in Computer**  **Architecture (Q5)** | Thorough explanation of binary systems and their role in computer architecture; clear binary arithmetic and ALU implementation. | Good explanation of binary systems and arithmetic; some minor missing details in ALU  implementation. | Basic explanation of binary numbers and arithmetic, lacking sufficient clarity on their role in the ALU. | Limited or incorrect understanding of binary numbers; minimal or inaccurate explanation of binary arithmetic and ALU. |