

Computer Organization and Architecture

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1 Introduction

(3 Hours/6 Marks)

1.1 Computer organization and architecture

1. Define computer architecture. [2] (**75 Ch**) [1.5] (81 Bh) [1] (**72 Ch**)
2. Define computer organization. [1.5] (**81 Bh**) [1] (**72 Ch**)
3. Differentiate between computer organization and architecture. [2] (**71 Ch**, 78 Ka) [3] (72 Ka)
4. Explain the design goals and performance metrics for a computer system regarding its organization and architecture. [5] (76 Ash)

1.2 Structure and function

1. Define structure and function of a computer system. [4] (80 Ba)
|→ Explain about the structural and functional viewpoint of a computer. [4] (**79 Bh**)
2. Explain the functional view and four types of operations used in computer. [6] (68 Ch)

1.3 Designing for performance

1. What are the driving factors behind the need to design for performance? [4] (71 Shr)
2. How can we maintain a performance balance between processor and memory? [2] (**72 Ch**)
|→ What is performance balance and why it is required? [3] (70 Asa)

1.4 Interconnection structures

1. Explain the Interconnection structures of computer. [6] (75 Ash)
|→ Definition [2] (73 Shr)
|→ Explain different types. [4] (73 Shr)
2. Explain the interconnection of CPU with Memory and I/O devices along with different operations over them. [3+3] (**70 Ch**)

1.5 Bus interconnection

1. What do you understand by Bus Interconnection. [2] (71 Shr)
2. What does the width of address bus represent in a system? [2] (**75 Ch**, **71 Ch**)
3. Explain different elements of bus design. [2] (**79 Bh**) [3] (70 Asa)
4. Discuss the limitations of using single bus system to connect different devices. [2] (**75 Ch**, **72 Ch**)
5. Compare and explain the bus structure of typical computer system. [4] (78 Ka)
6. Explain different types of bus arbitration and compare them. [6] (**78 Bh**)
7. Why is bus hierarchy required? [2] (**71 Ch**)
8. Discuss about the usage of a Multiple Hierarchical Bus Architecture over single bus system. [6] (**80 Bh**)

1.6 PCI

1. What is PCI? [1] (76 Ash)
|→ Describe PCI bus configuration. [3] (81 Ba)

2 Central Processing Unit

(10 Hours/18 Marks)

2.1 CPU Structure and Function

1. Explain the component of CPU. [2] (**78 Ch**)
2. Draw the instruction cycle state diagram with example. [6] (**76 Ch**)
|→ Draw instruction cycle, state diagram with interrupt and explain it. [6] (**74 Ch**)
|→ Explain instruction cycle state diagram. [3] (81 Ba)
|→ Explain instruction cycle state diagram with interrupt handling. [2] (80 Ba) [3] (**81 Bh**)
|→ Explain the computer functions with different cycles. [3] (72 Ka)
3. Explain the general organization of register in CPU. [6] (**71 Ch**)

2.2 Arithmetic and Logic Unit

1. Design a 1-bit ALU which can perform addition, AND, OR, and X-OR operations. Explain the different types of instruction formats. [4+4] (**80 Bh**)
2. Design a 2-bit ALU that can perform subtraction, AND, OR and XOR. [8] (**75 Ch**)
3. What are the stages of ALU design? Explain with the example of 2-bit ALU performing addition, subtraction, OR and XOR. [8] (70 Asa)

2.3 Instruction Formats

1. What do you mean by instruction format? [4] (**72 Ch**)
2. What are the different types of instructions? [3] (**71 Ch**)
3. Explain Instruction Format with its types? [2] (71 Shr)
4. What are the most common fields in an instruction. [2] (**68 Ch**)
5. Write down the code to evaluate in three address, two address, one address and zero address instruction format.
 - a. $Y = (A-B/C) * [D + (E * G)]$ [8] (**81 Bh, 76 Ch**)
 - b. $N = ((P-Q \times R)/S) + (T/U) + V \times W$ [8] (81 Ba)
 - c. $X = \frac{A-B+C \times (D \times E-F)}{G+H \times K}$ [8] (80 Ba)
 - d. $X = ((A+B)/C) + (D-E)$ [8] (**79 Bh**)
 - e. $Y = (A-B/C) \times (D+E \times G)/F$ [8] (78 Ka)
 - f. $Y = (W+X) * (Y-Z)$ [8] (76 Ash)
 - g. $Y = (A+B)/C + D/(E * F)$ [8] (**75 Ch**)
 - h. (*In present sources, operation is not given. If found, please contact*) [8] (75 Ash)
 - i. $X = (P+Q) \times (R+S)$ [8] (**74 Ch**)
 - j. $Y = A * (B+D/C) + (G * E)/F$ [8] (73 Shr)
 - k. $X = (A-B * F) * C + D/E$ [8] (**72 Ch**)
 - l. $Y = (A+B) * (C+D) + G/E * F$ [8] (72 Ka)
 - m. $X = (A+B) \times (C+D)$ [5] (**71 Ch**) [6] (**68 Ch**, 71 Shr)
 - n. $Y = A/B + (C \times D) + F(H/G)$ [8] (**70 Ch**)
 - o. $Y = A + (B * C) + D$ [8] (**68 Ba**)
 - p. $Y = AB + (F/G) + CD$ [8] (**67 Asa**)

2.4 Data Transfer and Manipulation

1. Explain data transfer instruction with example. [4] (**81 Bh**)
2. Explain different types of data manipulation instructions with example. [8] (**78 Bh**)
|→ What are the three types of data manipulation instructions used in computer? Explain. [8] (**67 Asa**)

2.5 Addressing Modes

1. What is addressing mode? [2] (**80 Bh,76 Ch,68 Ch**)
2. Differentiate between Immediate and direct addressing modes. [4] (**81 Bh**)
3. Write down the need for addressing modes. [2] (**74 Ch**)
4. Comparison of different types of addressing modes. [6] (**76 Ch**) [8] (76 Ash) [10] (72 Ka)
|→ with adv/disadv. [10] (78 Ka)
|→ with algorithm as well as adv/disadv. [8] (**68 Ba**)
5. Write down different types of addressing mode and:
|→ Explain with adv/disadv. [8] (81 Ba, 80 Ba) [10] (**70 Ch**)
|→ Explain with suitable example. [6] (**80 Bh, 79 Bh,74 Ch**) [8] (**68 Ch**, 70 Asa)
[10] (73 Shr)
6. Following instructions are give:
a. LDA 2000H
b. MVI B, 32H
c. STAX D
d. MOV A, B
Which addressing modes are used in the above instructions? Explain briefly about them.
7. Describe the operation of LD (load) instruction under various addressing modes with syntax. [4] (**71 Ch**)

2.6 RISC and CISC

1. Comparison between RISC and CISC architecture. [6] (**78 Bh,72 Ch**, 75 Ash)

2.7 64 – Bit Processor

3 Control Unit

(6 Hours/10 Marks)

- 3.1 Control Memory**
- 3.2 Addressing sequencing**
- 3.3 Computer configuration**
- 3.4 Microinstruction Format**
- 3.5 Symbolic Microinstructions**
- 3.6 Symbolic Microprogram**
- 3.7 Control Unit Operation**
- 3.8 Design of Control Unit**

4 Pipeline and Vector processing

(5 Hours/10 Marks)

- 4.1 Pipelining
- 4.2 Parallel Processing
- 4.3 Arithmetic Pipeline
- 4.4 Instruction Pipeline
- 4.5 RISC Pipeline
- 4.6 Vector Processing
- 4.7 Array Processing

5 Computer Arithmetic

(8 Hours/14 Marks)

5.1 Addition Algorithm

1. Explain the floating-point addition and subtraction process
|→ with example. [3+3] (**81 Bh, 79 Bh, 78 Bh**) [7] (73 Shr)
|→ with flowchart and example. [6] (78 Ka) [10] (**74 Ch**)
2. Draw a flowchart of floating point subtraction. [4] (70 Asa)

5.2 Subtraction Algorithm

5.3 Multiplication Algorithm

1. Draw a flowchart for Booth's multiplication algorithm for signed multiplication. [4] (78 Ka) [5] (**81 Bh**)
2. Explain booth's algorithm. [3] (**70 Ch**) [4] (**80 Bh, 68 Ch, 67 Asa**, 72 Ka) [5] (**76 Ch**)
|→ with example and give hardware requirement diagram. [10] (75 Ash)
|→ Explain with hardware algorithm with diagram. [5] (**72 Ch**)
|→ Write the algorithm. [5] (76 Ash, 71 Shr)
3. Design a booth multiplication algorithm hardware. [4] (**71 Ch**)
4. Multiply using Booth's multiplication algorithm.
|→ -6 x 7 [5] (**81 Bh, 80 Ba**)
|→ -7 x 3 [6] (**74 Ch**)
|→ -6 x 12 [6] (72 Ka)
|→ 10 x (-7) [6] (81 Ba)
|→ 10 x (-5) [5] (**76 Ch**)
|→ 5 x -6 [4] (**72 Ch**)
|→ (9) x (-3) [5] (71 Shr)
|→ 23 x -21 [4] (**68 Ch**)
|→ 9 x 4 [6] (**80 Bh**)
|→ 8 x 4 [5] (76 Ash)
|→ 8 x 9 [3] (**70 Ch**)
|→ 6 x 7 [4] (**67 Asa**)
|→ -7 x -10 [4] (78 Ka)
|→ -6 x -11 [6] (**75 Ch**)
|→ -5 x -9 [5] (**72 Ch**)

5.4 Division Algorithm

1. How division operation can be performed? Explain with its hardware implementation. [10] (70 Asa)
2. Draw the flowchart for Restoring Division. [4] (81 Ba, 72 Ka)
3. Draw the flowchart for Non-restoring Division. [4] (**79 Bh**)
|→ Explain signed binary division algorithm. [4] (73 Shr)
4. Explain non-restoring division algorithm. [3] (**75 Ch**) [5] (**78 Bh**)
|→ with flowchart. [5] (80 Ba)
|→ with flowchart and example. [8] (**70 Ch**)

5. Draw the flowchart for division of floating point numbers. [4] (**72 Ch,71 Ch**)
6. Explain floating point division algorithm. [6] (**68 Ch**)
7. Compare restoring division algorithm with non restoring algorithm. [4] (71 Shr) [6] (**80 Bh**, 76 Ash, 75 Ash)
 \rightarrow with example. [6] (**76 Ch**) [8] (**68 Ba**)
8. Divide using restoring division.
 $\rightarrow \frac{11}{5}$ [6] (81 Ba)
 $\rightarrow 13/5$ [6] (**79 Bh**)
 $\rightarrow 10/3$ [7] (**75 Ch**)
9. Divide using non-restoring algorithm.
 $\rightarrow 12/5$ [5] (80 Ba)
 $\rightarrow 10/5$ [5] (**78 Bh**)
 $\rightarrow 15/4$ [4] (73 Shr)

5.5 Logical Operation

6 Memory System

(5 Hours/8 Marks)

- 6.1 Microcomputer Memory
- 6.2 Characteristics of memory systems
- 6.3 The Memory Hierarchy
- 6.4 Internal and External memory
- 6.5 Cache memory principles
- 6.6 Elements of Cache design
 - 6.6.1 Cache size
 - 6.6.2 Mapping function
 - 6.6.3 Replacement algorithm
 - 6.6.4 Write policy
 - 6.6.5 Number of caches

7 Input-Output organization

(6 Hours/10 Marks)

7.1 Peripheral devices

7.2 I/O modules

7.3 Input-Output interface

7.4 Modes of transfer

7.4.1 Programmed I/O

7.4.2 Interrupt-driven I/O

7.4.3 Direct Memory access

7.5 I/O Processors

7.6 Data Communication Processor

8 Multiprocessors

(2 Hours/4 Marks)

8.1 Characteristics of multiprocessors

8.2 Interconnection Structures

8.3 Interprocessor Communication and Synchronization