CS404 – Computer Organization & Architecture DETAILED NOTES IN EASY WAY

1.Structure of Desktop Computer and CPU Organization

Most Important Question

RGPV me frequently pucha jata hai.

*Is answer ko likhne par aasani se **3–4 pages** bhar sakte ho.*

Structure of Desktop Computer and CPU Organization

Introduction

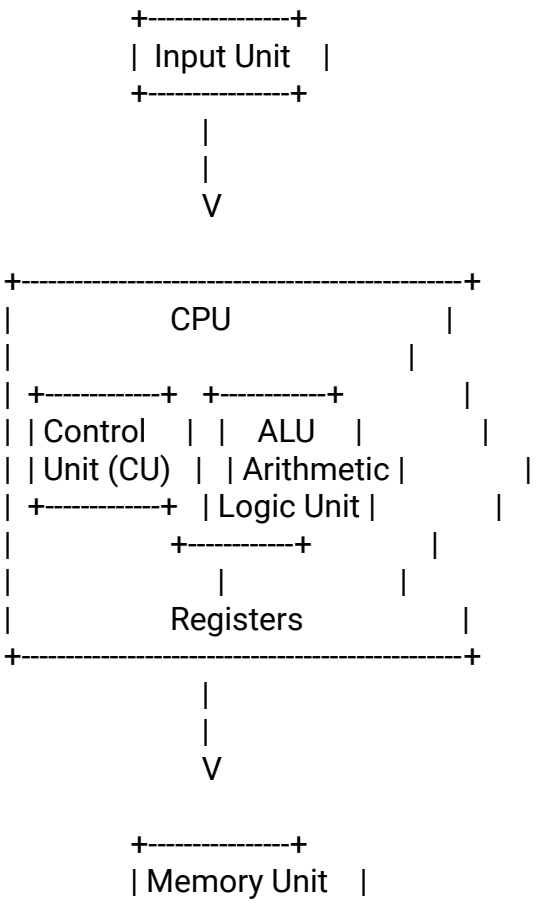
Computer ek electronic device hai jo data ko input ke roop me leta hai, usse process karta hai aur meaningful information ke roop me output deta hai.

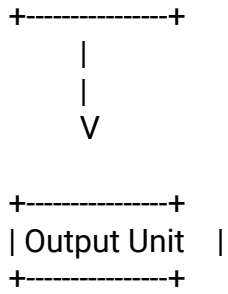
Desktop Computer ke main components hote hain:

- Input Unit
- CPU (Central Processing Unit)
- Memory Unit
- Output Unit

In sabhi units ka coordination CPU karta hai.

Block Diagram of Desktop Computer





Components of Desktop Computer

1. Input Unit

Input Unit user se data aur instructions receive karti hai.

Examples

- Keyboard
- Mouse
- Scanner
- Webcam

Functions

- User input accept karna
- Data ko machine language me convert karna
- CPU ko bhejna

Advantages

- Easy interaction
- Fast data entry

---

2. Central Processing Unit (CPU)

CPU ko computer ka brain kaha jata hai.

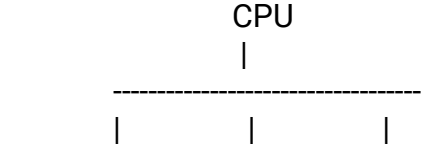
Ye computer ke sabhi operations ko control aur execute karta hai.

Main Functions

- Instruction fetch karna
- Instruction decode karna
- Instruction execute karna
- Result store karna

CPU Organization

CPU ke three major components hote hain:



| | |
Control Unit (CU) ALU Registers

---

1. Control Unit (CU)

Control Unit CPU ka controlling part hota hai.

Ye computer ke sabhi units ko control karta hai.

Functions

- Instruction fetch karna
- Instruction decode karna
- Execution control karna
- Memory aur I/O devices ko coordinate karna

Example

Traffic Police jaise road par vehicles control karta hai.

Waise hi Control Unit computer ke operations control karti hai.

---

2. Arithmetic Logic Unit (ALU)

ALU arithmetic aur logical operations perform karta hai.

Arithmetic Operations

- Addition
- Subtraction
- Multiplication
- Division

Logical Operations

- AND
- OR
- NOT
- XOR

Example

5 + 10 = 15

Ye calculation ALU perform karega.

---

3. Registers

Registers CPU ke andar present high-speed memory locations hote hain.

Ye temporary data store karte hain.

Registers ki speed RAM se bhi zyada hoti hai.

Types of Registers

Program Counter (PC)

Next instruction ka address store karta hai.

Instruction Register (IR)

Current instruction store karta hai.

Memory Address Register (MAR)

Memory address store karta hai.

Memory Data Register (MDR)

Data store karta hai.

Accumulator (AC)

Intermediate result store karta hai.

Working of CPU

CPU ka working cycle 4 steps me hota hai.

Instruction Fetch
↓
Instruction Decode
↓
Instruction Execute
↓
Store Result

Step 1: Fetch

Instruction memory se fetch ki jati hai.

Program Counter next instruction ka address provide karta hai.

Step 2: Decode

Control Unit instruction ko decode karti hai.

Instruction ka meaning samjha jata hai.

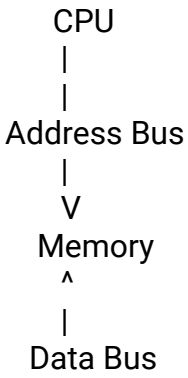
Step 3: Execute

ALU required operation perform karta hai.

Step 4: Store

Result memory ya register me store kar diya jata hai.

Relationship Between CPU and Memory



CPU memory se data read aur write karta hai.

Advantages of CPU Organization

1. Fast processing speed
2. Accurate calculations
3. Efficient execution of instructions
4. Better control of system
5. High performance computing

Disadvantages

1. High power consumption
2. Costly hardware
3. Complex design
4. Failure causes system halt

Applications

- Personal Computers
- Laptops
- Smartphones
- Banking Systems
- Servers
- Scientific Computing

Conclusion

Desktop Computer Input Unit, CPU, Memory Unit aur Output Unit se milkar bana hota hai. CPU computer ka sabse important component hai jo Control Unit, ALU aur Registers se milkar bana hota hai. CPU instructions ko fetch, decode aur execute karke computer system ko efficiently operate karta hai.

RGPV Exam Writing Tip (14 Marks)

Answer likhte waqt ye sequence follow karo:

 Definition

 Block Diagram of Desktop Computer

 CPU Diagram

 Input Unit

 CPU Components (CU, ALU, Registers)

 Working of CPU

 CPU-Memory Relationship

 Advantages

 Conclusion

 Is format me likhne par answer **3–4 pages** aasani se cover karega aur 14 marks ke liye perfect rahega.

2.Stack Organization

 Most Important Topic

RGPV me Stack Organization par 7 marks aur 14 marks dono questions aate hain.

*Ye answer aasani se **3–4 pages** cover karega.*

Stack Organization

Introduction

Computer Organization me Stack ek special memory structure hai jo data ko store aur retrieve karne ke liye use kiya jata hai.

Stack **LIFO (Last In First Out)** principle par kaam karta hai.

Iska matlab jo data sabse last me insert hoga wahi sabse pehle remove hoga.

Definition

"A Stack is a linear data structure in which insertion and deletion of data are performed from one end called TOP, following the Last In First Out (LIFO) principle."

Real Life Example

Books ki stack ko imagine karo.

Top Book First Removed

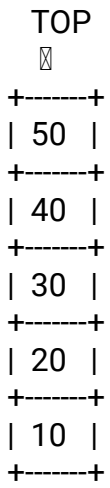
Book 4
Book 3
Book 2

Book 1

Jo book sabse last me rakhi gayi thi, wahi sabse pehle niklegi.

Isi principle ko Stack kehte hain.

Stack Organization Diagram



Components of Stack Organization

1. Stack Memory

Data ko store karne ke liye use hoti hai.

---

2. Stack Pointer (SP)

Stack ka most important register hota hai.

Ye stack ke TOP element ka address store karta hai.

---

3. TOP

Stack ka uppermost element.

Saare insertion aur deletion operations TOP se perform hote hain.

Operations on Stack

Stack me do basic operations hote hain:

1. PUSH Operation

2. POP Operation

PUSH Operation

Definition

Stack me naya element insert karne ki process ko PUSH kehte hain.

Example

Initially Stack:

TOP

```
+----+
| 30 |
+----+
| 20 |
+----+
| 10 |
+----+
```

PUSH(40)

After PUSH:

TOP

```
+----+
| 40 |
+----+
| 30 |
+----+
| 20 |
+----+
| 10 |
+----+
```

Algorithm for PUSH

Step 1: Check Overflow
Step 2: Increment Stack Pointer
Step 3: Insert Element
Step 4: Update TOP

POP Operation

Definition

Stack se top element remove karne ki process ko POP kehte hain.

Example

Before POP

TOP

```
+----+
| 40 |
+----+
| 30 |
+----+
| 20 |
```

+----+
| 10 |
+----+

After POP

TOP

+----+
| 30 |
+----+
| 20 |
+----+
| 10 |
+----+

Removed Element = 40

Algorithm for POP

Step 1: Check Underflow
Step 2: Read Top Element
Step 3: Decrement Stack Pointer
Step 4: Return Element

Working of Stack Organization

Suppose Stack Empty hai.

PUSH(10)

10

PUSH(20)

20
10

PUSH(30)

30
20
10

POP()

30 remove hoga.

20
10

Ye LIFO principle ko prove karta hai.

Stack Pointer (SP)

Definition

Stack Pointer ek register hai jo stack ke TOP location ko indicate karta hai.

Example

Address Data

1000 10
1001 20
1002 30 ← SP

SP = 1002

Memory Representation of Stack

Address Data

1000 10
1001 20
1002 30
1003 40 ← TOP

Stack Pointer TOP location ko point karta hai.

Advantages of Stack Organization

1. Fast Access

Insertion aur deletion fast hota hai.

---

2. Simple Structure

Implementation easy hai.

---

3. Efficient Function Calls

Subroutine aur recursion me use hota hai.

---

4. Memory Management

Temporary data efficiently store hota hai.

---

5. Expression Evaluation

Arithmetic expressions evaluate karne me use hota hai.

Disadvantages of Stack Organization

1. Fixed Size

Overflow problem aa sakti hai.

---

2. Limited Access

Sirf TOP element access hota hai.

---

3. Memory Waste

Unused locations waste ho sakti hain.

Applications of Stack

Function Calls

Program execution ke dauran.

Recursion

Recursive functions me.

Expression Evaluation

Postfix aur Prefix expressions.

Undo Operation

MS Word aur editors me.

Browser History

Back button implementation.

Stack Overflow

Definition

Jab stack full ho aur PUSH operation perform kiya jaye.

Example

Stack Full
+
PUSH Operation
=
Overflow

Stack Underflow

Definition

Jab stack empty ho aur POP operation perform kiya jaye.

Example

Empty Stack
+
POP Operation
=
Underflow

Stack Organization vs Queue Organization

Stack	Queue
LIFO	FIFO
Insert/ Delete at TOP	Insert Rear, Delete Front
Uses Stack Pointer	Uses Front & Rear
Faster Access	Sequential Access

Viva Questions

Q1. What is Stack?

A stack is a linear data structure that follows LIFO principle.

Q2. What is Stack Pointer?

Register that stores address of top element.

Q3. What is PUSH?

Insertion operation in stack.

Q4. What is POP?

Deletion operation in stack.

Q5. What is LIFO?

Last In First Out.

Frequently Asked RGPV Questions

2 Marks

1. Define Stack.
2. What is Stack Pointer?
3. Define PUSH.
4. Define POP.

---

5 Marks

1. Explain Stack Organization.
2. Explain PUSH and POP operations.
3. Explain Stack Pointer.

---

7 Marks

1. Explain Stack Organization with diagram.
2. Explain Stack Overflow and Underflow.
3. Explain memory representation of Stack.

---

14 Marks

1. Explain Stack Organization with neat diagram and operations.
2. Explain PUSH and POP operations with suitable examples.
3. Discuss Stack Organization, Stack Pointer and applications.

Conclusion

Stack Organization Computer Architecture ka ek important concept hai jo LIFO principle par kaam karta hai. Isme data insertion aur deletion TOP position se hoti hai. Stack function calls, recursion, expression evaluation aur memory management me widely use hota hai. Iski simplicity aur fast access ki wajah se ye computer systems me bahut important role play karta hai.

□ RGPV Exam Tip (14 Marks)

Answer me ye sequence follow karo:

 Definition

 LIFO Concept

 Diagram

 Components

 PUSH Operation

 POP Operation

 Stack Pointer

 Overflow & Underflow

 Advantages

 Applications

 Conclusion

Is format me answer **3–4 pages** aasani se cover karega aur 14 marks ke liye ideal hai.

3.Instruction Format :

Most Important Topic

RGPV me Instruction Format par direct 7 marks aur 14 marks ke questions puchhe jaate hain.

*Ye answer **3–4 pages** aasani se cover karega.*

Instruction Format

Introduction

Computer kisi bhi task ko perform karne ke liye instructions ka use karta hai. CPU in instructions ko fetch, decode aur execute karta hai.

Har instruction ek predefined format me store hoti hai jise **Instruction Format** kehte hain.

Instruction Format CPU ko batata hai:

- Kya operation perform karna hai?
- Kis data par perform karna hai?
- Data kahan store hai?

Definition

"Instruction Format is the arrangement of bits in an instruction that specifies the operation to be performed and the operands involved in the operation."

Need of Instruction Format

Instruction Format ki zarurat isliye hoti hai:

1. Operation Specify Karne Ke Liye

CPU ko pata chale ki addition, subtraction ya multiplication karna hai.

2. Operand Location Batane Ke Liye

Data kahan hai ye identify karne ke liye.

3. Efficient Execution

Instruction execution ko fast aur systematic banane ke liye.

General Instruction Format

```
 ---------------------------------
| Opcode | Address/Operand Field  |
 ---------------------------------
```

Components of Instruction Format

Instruction do major parts se milkar banti hai:

1. Opcode Field

Opcode = Operation Code

Ye batata hai ki CPU ko kaunsa operation perform karna hai.

Examples

Opcode	Operation
ADD	Addition
SUB	Subtraction
MUL	Multiplication
DIV	Division
MOV	Data Transfer

Example

`ADD R1,R2`

Yahan ADD opcode hai.

2. Operand (Address) Field

Operand field data ya address ko specify karta hai.

Example

`ADD R1,R2`

R1 aur R2 operands hain.

Structure of Instruction

```
 ---------------------------------
| Opcode | Operand 1 | Operand 2 |
 ---------------------------------
```

Example

`ADD R1,R2`

Opcode = ADD

Operand 1 = R1

Operand 2 = R2

Types of Instruction Formats

Instruction formats operand count ke basis par classify kiye jaate hain.

---

1. Three Address Instruction Format

Structure

```
 ----------------------------------
| Opcode | Address1 | Address2 | Address3 |
 ----------------------------------
```

Example

`ADD R1,R2,R3`

Meaning:

`R1 = R2 + R3`

Advantages

- Fast execution
- Less instructions required

Disadvantages

- Instruction size large hota hai

---

2. Two Address Instruction Format

Structure

```
 ---------------------------
| Opcode | Address1 | Address2 |
 ---------------------------
```

Example

`ADD R1,R2`

Meaning:

`R1 = R1 + R2`

Advantages

- Smaller instruction size

Disadvantages

- Extra instructions required ho sakti hain

---

3. One Address Instruction Format

Structure

```
 ---------------------
| Opcode | Address |
 ---------------------
```

Example

`ADD X`

Accumulator-based operation.

`AC = AC + X`

Advantages

- Compact format

Disadvantages

- Accumulator dependency

---

4. Zero Address Instruction Format

Structure

```
 ---------
| Opcode |
 ---------
```

Example

`ADD`

Stack based systems me use hota hai.

Working

Top Element
+
Second Element
=
Result

Comparison of Instruction Formats

Feature	3 Address	2 Address	1 Address	0 Address
Operands	3	2	1	0
Speed	High	Medium	Medium	Low
Size	Large	Medium	Small	Very Small
Complexity	High	Medium	Low	Low
Example	R1=R2+R3	R1=R1+R2	AC=AC+X	Stack ADD

Instruction Cycle

Instruction Format CPU me following steps se execute hoti hai.

Fetch

Decode

Execute

Store Result

Step 1: Fetch

Instruction memory se fetch hoti hai.

Step 2: Decode

Opcode identify kiya jata hai.

Step 3: Execute

ALU operation perform karta hai.

Step 4: Store

Result register ya memory me store hota hai.

Example of Instruction Execution

Instruction:

`ADD R1,R2`

Suppose:

R1 = 20

R2 = 10

Execution:

`20 + 10 = 30`

Result:

`R1 = 30`

Advantages of Instruction Format

1. Organized Execution

Instructions systematically execute hoti hain.

2. Easy Decoding

CPU easily instruction samajh sakta hai.

3. Fast Processing

Efficient execution hoti hai.

4. Better Hardware Design

CPU architecture simplify hoti hai.

Disadvantages

1. Complex Design

Large instruction formats complex hote hain.

2. More Memory Requirement

Long instructions zyada memory consume karti hain.

3. Hardware Cost

Complex instruction formats costly ho sakte hain.

Applications

- Microprocessors
- Embedded Systems
- Personal Computers
- Mobile Devices
- Digital Signal Processors

Viva Questions

Q1. What is Instruction Format?

Arrangement of bits in an instruction.

Q2. What is Opcode?

Operation code specifying the operation.

Q3. What is Operand?

Data or address on which operation is performed.

Q4. What are the types of Instruction Formats?

Three Address, Two Address, One Address and Zero Address.

Q5. Which instruction format is used in stack organization?

Zero Address Instruction Format.

Frequently Asked RGPV Questions

2 Marks

1. Define Instruction Format.

2. What is Opcode?
3. What is Operand?
4. Define Zero Address Instruction.

---

5 Marks

1. Explain Instruction Format.
2. Explain Opcode and Operand Fields.
3. Explain Three Address Instruction.

---

7 Marks

1. Explain different Instruction Formats.
2. Compare One Address and Two Address Instructions.
3. Explain Instruction Cycle.

---

14 Marks

1. Explain Instruction Format with neat diagram.
2. Discuss different types of Instruction Formats with examples.
3. Compare Three Address, Two Address, One Address and Zero Address Instruction Formats.

One-Minute Revision

 Instruction Format = Structure of Instruction

 Opcode = Operation Code

 Operand = Data/Address

 Types:

- Three Address
- Two Address
- One Address
- Zero Address

 Instruction Cycle:
Fetch Decode Execute Store

Conclusion

Instruction Format CPU ko batata hai ki kaunsa operation perform karna hai aur kis operand par karna hai. Opcode aur Operand fields iske main parts hote hain. Different instruction formats CPU architecture ko efficient aur organized banate hain. Computer Organization me ye ek fundamental aur frequently asked topic hai.

 RGPV Exam Tip (14 Marks)

Answer me:

 Definition

 Diagram

 Components

 Types of Instruction Format

 Comparison Table

 Instruction Cycle

 Example

 Advantages & Disadvantages

 Conclusion

Likho. Isse answer **3–4 pages** aasani se cover ho jayega aur 14 marks ke liye strong rahega

Arithmetic Logic Unit (ALU)

Most Important Topic

ALU Computer Organization ka core component hai.

RGPV me ALU par direct 7 marks aur 14 marks ke questions frequently aate hain.

*Ye answer **3–4 pages** aasani se cover karega.*

Arithmetic Logic Unit (ALU)

Introduction

Computer me saare arithmetic aur logical operations perform karne ke liye ek special unit hoti hai jise **Arithmetic Logic Unit (ALU)** kehte hain.

ALU CPU ka ek important component hai aur ye computer ke processing operations ko execute karta hai.

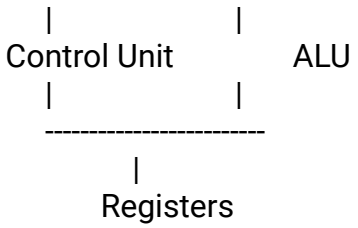
Jab bhi addition, subtraction, comparison ya logical decision lena hota hai to ALU ka use hota hai.

Definition

"Arithmetic Logic Unit (ALU) is a digital circuit inside the CPU that performs arithmetic operations and logical operations on data."

Position of ALU in CPU

```
        CPU
         |
-----------------------
```



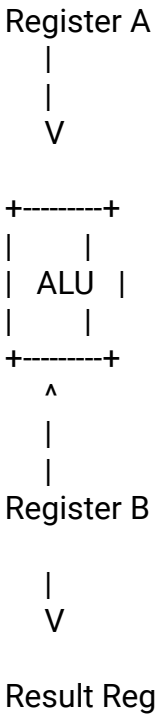
Why ALU is Important?

ALU ke bina CPU calculations perform nahi kar sakta.

Functions

- Mathematical calculations
- Logical decisions
- Data comparison
- Bit manipulation

Block Diagram of ALU



Components of ALU

ALU mainly following components se milkar bani hoti hai:

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1. Arithmetic Circuit

Arithmetic operations perform karta hai.

Operations

- Addition

- Subtraction
- Multiplication
- Division
- Increment
- Decrement

---

2. Logic Circuit

Logical operations perform karta hai.

Operations

- AND
- OR
- NOT
- XOR
- NAND
- NOR

---

3. Accumulator Register

Intermediate results store karta hai.

Example

`5 + 10 = 15`

Result temporary Accumulator me store ho sakta hai.

---

4. Status Register (Flags)

Operation ke result ke according flags set hote hain.

Types of Flags

Carry Flag (CF)

Carry generate hone par set hota hai.

Zero Flag (ZF)

Result zero ho to set hota hai.

Sign Flag (SF)

Negative result par set hota hai.

Overflow Flag (OF)

Overflow condition par set hota hai.

Arithmetic Operations Performed by ALU

---

1. Addition

Example

```
  1010
+ 0101
-------
  1111
```

Decimal:

`10 + 5 = 15`

---

2. Subtraction

Example

```
  1010
- 0011
-------
  0111
```

Decimal:

`10 - 3 = 7`

---

3. Multiplication

Example

`5 × 4 = 20`

---

4. Division

Example

`20 ÷ 4 = 5`

---

5. Increment

`5 + 1 = 6`

---

6. Decrement

`5 - 1 = 4`

Logical Operations Performed by ALU

AND Operation

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

OR Operation

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

NOT Operation

A	NOT A
0	1
1	0

XOR Operation

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0

Working of ALU

Suppose:
R1 = 20

R2 = 10
Instruction:

`ADD R1,R2`

Step 1

Data registers se ALU me aata hai.

Step 2

ALU addition perform karta hai.

`20 + 10 = 30`

Step 3

Result destination register me store hota hai.

`R1 = 30`

ALU Operation Flow

```
Input Data
    |
    V
 Registers
    |
    V
   ALU
    |
    V
 Result Register
```

Advantages of ALU

1. High Speed

Calculations bahut fast perform hoti hain.

---

2. Accuracy

Accurate results provide karta hai.

---

3. Efficient Processing

CPU performance improve karta hai.

---

4. Logical Decision Making

Comparisons aur decision operations perform karta hai.

---

5. Multipurpose Unit

Arithmetic aur logical dono operations perform karta hai.

Disadvantages of ALU

1. Limited Functionality

Sirf calculations aur logic perform karta hai.

---

2. Complex Hardware

Advanced ALU design expensive hoti hai.

---

3. Power Consumption

High-speed ALU zyada power consume karti hai.

Applications of ALU

Computers

Desktop aur Laptop me.

Smartphones

Mobile processors me.

Embedded Systems

ATM Machines, Washing Machines.

Scientific Calculations

Research aur engineering applications.

Servers

High-performance computing.

Difference Between ALU and Control Unit

Performs operations	Controls operations
Calculates results	Issues control signals
Arithmetic & Logic	Coordination
Data Processing	System Management

Viva Questions

Q1. What is ALU?

Arithmetic Logic Unit is a part of CPU that performs arithmetic and logical operations.

Q2. What are arithmetic operations?

Addition, subtraction, multiplication and division.

Q3. What are logical operations?

AND, OR, NOT and XOR.

Q4. Why is ALU important?

Because all calculations are performed by ALU.

Q5. Is ALU part of CPU?

Yes.

Frequently Asked RGPV Questions

2 Marks

1. Define ALU.
2. What are logical operations?
3. What is Carry Flag?
4. What is Accumulator?

---

1. Explain ALU.
2. Explain arithmetic operations of ALU.
3. Explain logical operations of ALU.

---

7 Marks

5 Marks

1. Explain ALU with block diagram.
2. Explain ALU operations with examples.
3. Discuss status flags in ALU.

---

14 Marks

1. Explain Arithmetic Logic Unit (ALU) with neat diagram and working.
2. Discuss arithmetic and logical operations performed by ALU.
3. Explain ALU architecture, components and applications.

Topic	Frequency
ALU Architecture	□ □ □ □ □
ALU Operations	□ □ □ □ □
Arithmetic Operations	□ □ □ □
Logical Operations	□ □ □ □
Status Flags	□ □ □

One-Minute Revision

 ALU = Arithmetic Logic Unit

 Part of CPU

 Performs:

- Addition
- Subtraction
- Multiplication
- Division

 Logical Operations:

- AND
- OR
- NOT
- XOR

 Uses Registers for input and output

 Improves CPU performance

Conclusion

Arithmetic Logic Unit (ALU) CPU ka sabse important processing component hai jo arithmetic aur logical operations perform karta hai. Ye computer ke decision making aur calculation tasks ka main center hota hai. Fast processing, accuracy aur efficiency ke karan ALU computer architecture ka essential part hai.

 RGPV Exam Tip (14 Marks)

Answer me likho:

 Definition

 Block Diagram

 Components

 Arithmetic Operations

 Logical Operations

 Working Example

 Advantages

 Applications

 Difference with Control Unit

 Conclusion

Is format me answer **3–4 pages** aasani se cover karega aur full marks ke chances bahut badh jayenge.

Bus Structure

Most Important Topic

*RGPV me **Bus Structure**, **Types of Bus**, aur **Bus Organization** par frequently 7 marks aur 14 marks ke questions aate hain.*

*Ye answer **3–4 pages** aasani se cover karega.*

Bus Structure

Introduction

Computer System me CPU, Memory aur Input/Output devices ke beech data transfer karne ke liye ek communication path ki zarurat hoti hai. Is communication path ko **Bus** kaha jata hai.

Bus ek set of wires ya lines hoti hai jo data, address aur control signals ko transfer karti hai.

Bus ke bina CPU aur Memory ek dusre se communicate nahi kar sakte.

Definition

"A Bus is a communication pathway consisting of a set of wires used for transferring data, addresses and control signals among different components of a computer system."

Need of Bus Structure

Bus Structure ki zarurat isliye hoti hai:

1. Communication

CPU, Memory aur I/O devices ke beech communication karne ke liye.

2. Data Transfer

Data transfer ko easy banane ke liye.

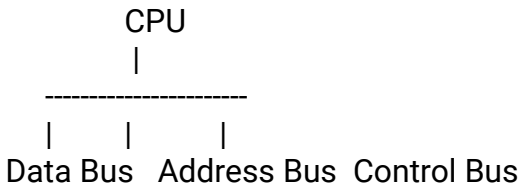
3. Resource Sharing

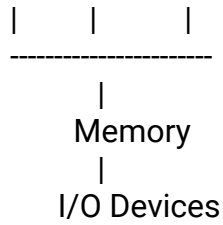
Multiple devices same communication channel use kar sake.

4. Cost Reduction

Alag-alag wiring ki requirement kam ho jati hai.

General Bus Structure





Components of Bus Structure

Bus Structure mainly 3 types ki buses se milkar banta hai:

1. Data Bus
2. Address Bus
3. Control Bus

---

1. Data Bus

Definition

Data Bus actual data transfer karti hai CPU, Memory aur I/O devices ke beech.

Characteristics

- Data carry karti hai
- Bidirectional hoti hai
- CPU aur Memory dono data send aur receive kar sakte hain

Example

CPU Data Bus Memory

Agar CPU memory se data read karega to data bus use hogi.

Diagram

CPU DATA BUS Memory

---

2. Address Bus

Definition

Address Bus memory location ka address transfer karti hai.

Characteristics

- Address carry karti hai
- Usually Unidirectional hoti hai
- CPU se Memory ki taraf jati hai

Example

Agar CPU ko Memory Location 500 access karni hai:

`Address = 500`

Address Bus ye address memory ko bhejegi.

Diagram

`CPU → Address Bus → Memory`

---

3. Control Bus

Definition

Control Bus control aur timing signals transfer karti hai.

Functions

- Read Signal
- Write Signal
- Interrupt Signal
- Clock Signal

Example

CPU Memory ko batata hai:

`READ Operation`

ya

`WRITE Operation`

Control Bus ke through.

Diagram

`CPU → Control Bus → Memory`

Working of Bus Structure

Suppose CPU ko Memory se data read karna hai.

Step 1

CPU Address Bus par memory address bhejta hai.

`Address = 1000`

Step 2

CPU Control Bus par READ signal bhejta hai.

`READ`

Step 3

Memory Data Bus ke through data CPU ko bhejti hai.

`Data = 25`

Flow Diagram

```
CPU
 |
 | Address Bus
 V
Memory Address

CPU
 |
 | Control Bus
 V
READ Signal

Memory
 |
 | Data Bus
 V
CPU
```

System Bus

Data Bus + Address Bus + Control Bus milkar **System Bus** banate hain.

```
System Bus
    |
-----------------------
|       |           |
Data   Address    Control
Bus      Bus       Bus
```

Types of Bus Based on Architecture

---

1. Internal Bus

CPU ke andar use hoti hai.

Example

Registers aur ALU ke beech communication.

2. External Bus

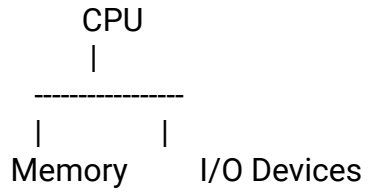
CPU aur external devices ke beech communication.

Example

CPU RAM

CPU I/O Devices

Bus Organization in Computer



Sabhi units bus ke through connected rehte hain.

Advantages of Bus Structure

1. Simple Design

Hardware design simple hoti hai.

---

2. Cost Effective

Wiring cost reduce hoti hai.

---

3. Easy Communication

Different components easily communicate karte hain.

---

4. Expandability

New devices easily add kiye ja sakte hain.

---

5. Efficient Data Transfer

Fast communication possible hoti hai.

Disadvantages of Bus Structure

1. Bus Congestion

Ek hi bus use hone par traffic badh sakta hai.

---

2. Speed Limitation

Bus speed system performance ko limit kar sakti hai.

---

3. Failure Problem

Bus fail hone par communication stop ho sakta hai.

---

4. Security Issues

Shared communication channel hone ke karan security concerns ho sakte hain.

Data Bus vs Address Bus vs Control Bus

Feature	Data Bus	Address Bus	Control Bus
Purpose	Data Transfer	Address Transfer	Control Signals
Direction	Bidirectional	Unidirectional	Both
Carries	Data	Memory Address	Commands
Example	25, 100	Address 500	Read/ Write

Applications of Bus Structure

Desktop Computers

CPU and RAM communication.

Laptops

Data transfer.

Smartphones

Processor and memory connection.

Embedded Systems

Microcontroller communication.

Servers

High-speed data transfer.

Viva Questions

Q1. What is a Bus?

A bus is a communication pathway used to transfer data, addresses and control signals.

Q2. What are the types of buses?

Data Bus, Address Bus and Control Bus.

Q3. Which bus is bidirectional?

Data Bus.

Q4. Which bus is usually unidirectional?

Address Bus.

Q5. What is System Bus?

Combination of Data Bus, Address Bus and Control Bus.

Frequently Asked RGPV Questions

2 Marks

1. Define Bus.
2. What is Data Bus?
3. What is Address Bus?
4. What is Control Bus?

---

5 Marks

1. Explain Bus Structure.
2. Explain Data Bus and Address Bus.
3. Explain System Bus.

---

7 Marks

1. Explain Bus Organization with diagram.
2. Differentiate Data Bus, Address Bus and Control Bus.

3. Explain working of Bus Structure.

---

14 Marks

1. Explain Bus Structure with neat diagram.
2. Discuss types of buses and their functions.
3. Explain System Bus and its components.

One-Minute Revision

 Bus = Communication Path

 Types:

- Data Bus
- Address Bus
- Control Bus

 Data Bus = Data Transfer

 Address Bus = Address Transfer

 Control Bus = Control Signals

 System Bus = Data + Address + Control Bus

Conclusion

Bus Structure computer system ka communication backbone hai jo CPU, Memory aur I/O devices ke beech data, address aur control signals transfer karta hai. Data Bus, Address Bus aur Control Bus milkar System Bus banate hain jo efficient communication aur processing ke liye essential hai. Bus Structure Computer Organization ka ek fundamental aur frequently asked topic hai.

CS404 – Computer Organization & Architecture

Register Transfer Language (RTL)

Most Important Topic

RTL (Register Transfer Language) RGPV me sabse jyada puche jane wale Unit-1 topics me se ek hai.

Is topic se 7 marks aur 14 marks dono questions frequently aate hain.

*Ye answer **3–4 pages** aasani se cover karega.*

Register Transfer Language (RTL)

Introduction

Computer ke andar data ek register se dusre register me continuously transfer hota

rehta hai.

CPU ke internal operations ko represent karne ke liye ek symbolic language use ki jati hai jise **Register Transfer Language (RTL)** kehte hain.

RTL ki help se hum register operations aur data movement ko easily describe kar sakte hain.

Definition

"Register Transfer Language (RTL) is a symbolic notation used to describe the transfer of data between registers and the micro-operations performed on data stored in registers."

Why RTL is Needed?

RTL ka use CPU ke internal operations ko represent karne ke liye kiya jata hai.

Purposes

- Data transfer representation
- Micro-operations description
- CPU operation analysis
- Hardware design simplification
- Computer architecture understanding

Basic Concept of RTL

RTL mainly do cheezon ko describe karta hai:

1. Register Transfer

Ek register se dusre register me data transfer.

2. Micro Operations

Registers par perform hone wale operations.

RTL Notation

RTL me transfer ko arrow symbol se represent karte hain.

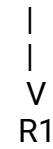
`R1  R2`

Meaning:

R2 ka data R1 me transfer hoga.

RTL Diagram

R2



Data transfer from R2 to R1.

Register Transfer Operation

Definition

Ek register se dusre register me binary information transfer karna.

Example

Suppose:

`R2 = 1010`

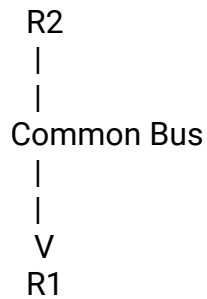
Operation:

`R1 ← R2`

Result:

`R1 = 1010`

Hardware Representation of Register Transfer



Control Function in RTL

Kabhi-kabhi transfer sirf condition true hone par hota hai.

RTL notation:

`P : R1 ← R2`

Meaning:

Agar control signal P = 1 hai to transfer perform hoga.

Example

`P = 1`

Then:

R1 □ R2

Bus Transfer Using RTL

Bus ke through multiple registers ke beech transfer hota hai.

Diagram

```
 R1
 R2
 R3
  |
  V
Common Bus
  |
  V
 R4
```

RTL Representation

R4 □ R2

Data R2 se Bus ke through R4 me jayega.

Memory Transfer Using RTL

Memory aur CPU ke beech data transfer ko bhi RTL me represent karte hain.

Memory Read Operation

RTL Statement

DR □ M[AR]

Meaning

Memory location AR ka data DR me transfer hoga.

Diagram

```
Memory
  |
  |
  V
 Data Register
```

Memory Write Operation

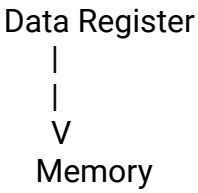
RTL Statement

M[AR] ← DR

Meaning

DR ka data Memory location AR me store hoga.

Diagram



Types of Micro Operations in RTL

RTL sirf transfer nahi balki micro operations bhi represent karta hai.

---

1. Register Transfer Micro Operation

Example:

R1 ← R2

---

2. Arithmetic Micro Operation

Addition, subtraction etc.

Example:

R3 ← R1 + R2

Meaning:

R1 aur R2 add karke result R3 me store hoga.

---

3. Logic Micro Operation

Logical operations.

Example:

R1 ← R1 AND R2

---

4. Shift Micro Operation

Bit shifting.

Example:

R1 ← Shift Left R1

Arithmetic RTL Examples

Addition

R3 ← R1 + R2

Suppose:
R1 = 10

R2 = 20
Result:

R3 = 30

Subtraction

R3 ← R1 - R2

Logic RTL Examples

AND Operation

R1 ← R1 AND R2

OR Operation

R1 ← R1 OR R2

NOT Operation

R1 ← NOT R1

Shift RTL Examples

Shift Left

R1 ← SHL R1

Shift Right

R1 ← SHR R1

Advantages of RTL

1. Easy Representation

Hardware operations ko easily represent karta hai.

---

2. Better Understanding

CPU operations samajhne me help karta hai.

---

3. Hardware Design

Digital system design ko simplify karta hai.

---

4. Standard Notation

Universal symbolic representation.

---

5. Useful for Microprogramming

Control unit design me use hota hai.

Disadvantages of RTL

1. Complex for Large Systems

Large architectures me difficult ho sakta hai.

---

2. Limited Abstraction

High-level programming ko represent nahi karta.

---

3. Hardware Dependent

Hardware architecture ke according change hota hai.

Applications of RTL

CPU Design

Processor architecture.

Microprocessor Design

Instruction implementation.

Control Unit Design

Microprogramming.

Digital System Design

Hardware development.

Computer Architecture

Register operations representation.

Difference Between RTL and High-Level Language

RTL	High-Level Language
Hardware Oriented	Software Oriented
Register Based	User Based
Low Level	High Level
Used in Architecture	Used in Programming
Example: R1 ← R2	Example: A = B

Viva Questions

Q1. What is RTL?

RTL is a symbolic language used to describe register transfers and micro operations.

Q2. What is Register Transfer?

Movement of data from one register to another.

Q3. What does R1 ← R2 mean?

Contents of R2 are transferred to R1.

Q4. What is Memory Read Operation?

DR ← M[AR]

Q5. What is Memory Write Operation?

M[AR] ← DR

Frequently Asked RGPV Questions

2 Marks

1. Define RTL.
2. What is Register Transfer?
3. Explain Memory Read Operation.
4. Explain Memory Write Operation.

---

5 Marks

1. Explain RTL notation.
2. Explain Register Transfer operation.
3. Explain Bus Transfer using RTL.

---

7 Marks

1. Explain RTL with examples.
2. Explain Memory Transfer using RTL.
3. Explain Micro Operations in RTL.

---

14 Marks

1. Explain Register Transfer Language with neat diagram and examples.
2. Discuss Register Transfer, Bus Transfer and Memory Transfer using RTL.
3. Explain various micro operations represented using RTL.

One-Minute Revision

• RTL = Register Transfer Language

• Register Transfer:

R1 ← R2

• Memory Read:

DR ← M[AR]

 Memory Write:

M[AR] DR

 Types of Micro Operations:

- Register Transfer
- Arithmetic
- Logic
- Shift

Conclusion

Register Transfer Language (RTL) computer architecture me data transfer aur micro-operations ko represent karne ke liye use ki jane wali symbolic language hai. RTL hardware operations ko simple aur understandable banata hai. CPU, Control Unit aur Digital Systems ke design me iska bahut important role hai aur ye RGPV exams ka frequently asked topic hai.

 RGPV 14 Marks Tip

Answer me likho:

 Definition

 RTL Diagram

 Register Transfer

 Control Function

 Bus Transfer

 Memory Transfer

 Micro Operations

 Advantages

 Applications

 Conclusion

Is format me answer **3–4 pages** aasani se cover ho jayega aur full marks ke chances badh jayenge.

CS404 – Computer Organization & Architecture

Bus Transfer and Memory Transfer

 Very Important Topic

*RGPV me **Bus Transfer**, **Memory Transfer**, **RTL Statements**, aur **Memory Read/Write Operations** par direct questions frequently aate hain.*

*Ye answer **3–4 pages** aasani se cover karega.*

Bus Transfer and Memory Transfer

Introduction

Computer system me CPU, Registers aur Memory ke beech continuously data transfer hota rehta hai.

Data transfer ko efficiently perform karne ke liye Bus System aur Memory Transfer techniques ka use kiya jata hai.

Register Transfer Language (RTL) ki help se in operations ko represent kiya jata hai.

Definition of Bus Transfer

"Bus Transfer is the process of transferring binary information from one register to another register through a common communication bus."

Definition of Memory Transfer

"Memory Transfer is the process of transferring data between memory and CPU registers."

Bus Transfer

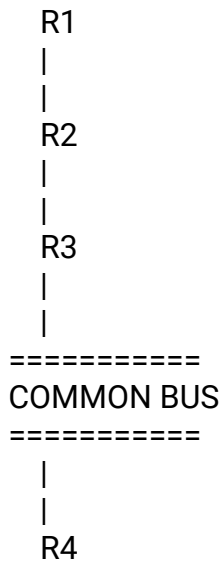
Introduction

CPU ke andar kai registers hote hain.

Agar har register ko directly connect kiya jaye to bahut zyada wires lagengi.

Is problem ko solve karne ke liye Common Bus System use kiya jata hai.

Common Bus Structure



Bus ek common communication path provide karta hai.

Working of Bus Transfer

Suppose:
R1 = 1010

R2 = 1100
Aur hume R1 ka data R4 me transfer karna hai.

RTL Statement:

R4 ← R1

Working

Step 1:

R1 select kiya jayega.

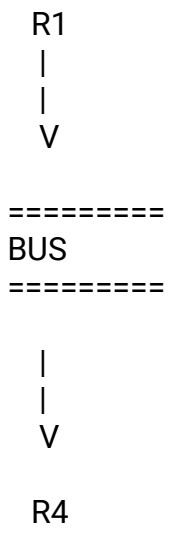
Step 2:

Data Common Bus par aayega.

Step 3:

Data R4 me load ho jayega.

Bus Transfer Diagram



RTL Representation of Bus Transfer

Example 1

R2 ← R1

Meaning:

R1 ka data R2 me transfer hoga.

Example 2

R4 ← R3

Meaning:

R3 ka data R4 me transfer hoga.

Bus Transfer Hardware

Bus Transfer ke liye generally:

- Multiplexer
- Tri-State Buffers
- Common Bus Lines

use kiye jate hain.

Advantages of Bus Transfer

1. Less Hardware

Kam wires lagti hain.

---

2. Low Cost

System economical banta hai.

---

3. Easy Communication

Registers easily communicate karte hain.

---

4. Efficient Design

CPU organization simple ho jata hai.

Memory Transfer

Introduction

Memory aur CPU ke beech data transfer ko Memory Transfer kehte hain.

Memory Transfer do types ka hota hai:

1. Memory Read
2. Memory Write

Memory Read Operation

Definition

Memory se data ko register me transfer karna.

RTL Representation

DR M[AR]

Meaning

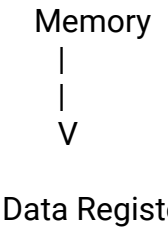
DR = Data Register

AR = Address Register

M[AR] = Memory Location

Memory location AR ka data DR me transfer hoga.

Memory Read Diagram



Example of Memory Read

Suppose:

AR = 500

Memory Location:

Address	Data
500	25

Operation:

DR M[AR]

Result:

DR = 25

Steps of Memory Read

Step 1

Address AR me load hota hai.

AR = 500

Step 2

Read Signal activate hota hai.

Step 3

Memory location access hoti hai.

Step 4

Data DR me transfer hota hai.

Memory Write Operation

Definition

Register se data ko memory me transfer karna.

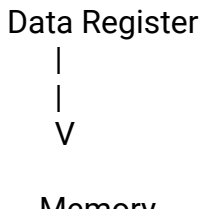
RTL Representation

M[AR] □ DR

Meaning

Data Register ka data Memory location AR me store hoga.

Memory Write Diagram



Example of Memory Write

Suppose:
AR = 700

DR = 50
Operation:

M[AR] □ DR

Result:

Address	Data
700	50

Steps of Memory Write

Step 1

Address AR me load hota hai.

Step 2

Data DR me load hota hai.

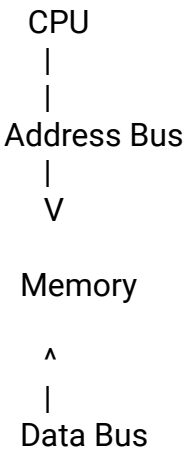
Step 3

Write Signal activate hota hai.

Step 4

Data Memory me store ho jata hai.

Memory Transfer Flow Diagram



Memory Read vs Memory Write

Memory Read	Memory Write
Memory → Register	Register → Memory
Data fetched	Data stored
READ Signal	WRITE Signal
DR ← M[AR]	M[AR] ← DR

Bus Transfer vs Memory Transfer

Bus Transfer	Memory Transfer
Register to Register	Register and Memory
Uses Common Bus	Uses Memory Unit
Faster	Comparatively Slower
Internal CPU Operation	CPU-Memory Operation
Example: R1 ← R2	DR ← M[AR]

Applications

Bus Transfer

- Register communication
- ALU operations
- CPU internal data movement

Memory Transfer

- Program execution
- Data storage
- Instruction fetch

Advantages of Memory Transfer

1. Efficient Data Storage

Data memory me store hota hai.

2. Fast Retrieval

Required data quickly fetch hota hai.

3. Supports Program Execution

CPU continuously memory access karta hai.

Disadvantages

1. Memory Access Delay

Memory access register transfer se slow hota hai.

2. Bus Bottleneck

Heavy traffic performance reduce kar sakta hai.

Viva Questions

Q1. What is Bus Transfer?

Transfer of data between registers through a common bus.

Q2. What is Memory Transfer?

Transfer of data between memory and CPU registers.

Q3. Write RTL for Memory Read.

DR □ M[AR]

Q4. Write RTL for Memory Write.

M[AR] □ DR

Q5. Which operation is faster?

Bus Transfer.

Frequently Asked RGPV Questions

2 Marks

1. Define Bus Transfer.
2. Define Memory Transfer.
3. Write RTL for Memory Read.
4. Write RTL for Memory Write.

---

5 Marks

1. Explain Bus Transfer.

2. Explain Memory Read Operation.
3. Explain Memory Write Operation.

---

7 Marks

1. Explain Bus Transfer with diagram.
2. Explain Memory Transfer with examples.
3. Differentiate Memory Read and Memory Write.

---

14 Marks

1. Explain Bus Transfer and Memory Transfer with neat diagrams.
2. Discuss Memory Read and Memory Write operations using RTL.
3. Compare Bus Transfer and Memory Transfer.

One-Minute Revision

 Bus Transfer:

`R2  R1`

(Register Register)

 Memory Read:

`DR  M[AR]`

(Memory Register)

 Memory Write:

`M[AR]  DR`

(Register Memory)

 Bus Transfer = Faster

 Memory Transfer = CPU Memory Communication

Conclusion

Bus Transfer aur Memory Transfer Computer Organization ke fundamental operations hain. Bus Transfer registers ke beech data movement ko enable karta hai, jabki Memory Transfer CPU aur Memory ke beech data exchange ko manage karta hai. RTL notation ki help se in operations ko easily represent aur understand kiya ja sakta hai. Ye topic RGPV exams me bahut frequently pucha jata hai aur 14 marks ke liye highly important hai.

CS404 – Computer Organization & Architecture

Addressing Modes

Most Important Topic

Addressing Modes RGPV me sabse jyada puche jane wale topics me se ek hai.

Har saal 5, 7 ya 14 marks ka question aane ke chances bahut high hote hain.

*Ye answer **3–4 pages** aasani se cover karega.*

Addressing Modes

Introduction

Computer me instruction execute karne ke liye CPU ko operand (data) ki location pata honi chahiye.

Operand memory me ho sakta hai, register me ho sakta hai ya instruction ke andar bhi ho sakta hai.

Operand ko locate karne ki technique ko **Addressing Mode** kehte hain.

Definition

"Addressing Mode is a method used by the CPU to determine the location of an operand required for executing an instruction."

Need of Addressing Modes

Addressing Modes ka use:

1. Operand Location Find Karne Ke Liye

CPU ko data ka address milta hai.

2. Memory Access Reduce Karne Ke Liye

Fast execution hoti hai.

3. Program Flexibility

Different situations me different modes use kiye ja sakte hain.

4. Efficient Programming

Instructions compact aur efficient banti hain.

General Instruction Format

```
-----------------------
| Opcode | Address Field |
-----------------------
```

Opcode

Operation specify karta hai.

Example:

ADD
SUB
MOV

Address Field

Operand ka address specify karta hai.

Types of Addressing Modes

Main Addressing Modes

1. Immediate Addressing Mode
2. Direct Addressing Mode
3. Indirect Addressing Mode
4. Register Addressing Mode
5. Register Indirect Addressing Mode
6. Relative Addressing Mode
7. Indexed Addressing Mode
8. Auto Increment Addressing Mode
9. Auto Decrement Addressing Mode

---

1. Immediate Addressing Mode □ □ □ □ □

Most Important

Definition

Operand directly instruction ke andar diya hota hai.

Format

`MOV R1,#50`

Meaning

Value 50 directly instruction me present hai.

CPU ko memory access nahi karni padti.

Diagram

```
Instruction
    |
    V

MOV R1,#50
      |
```

V

Operand = 50

Advantages

 Fastest Mode

 No Memory Access

Disadvantages

 Limited Data Size

---

2. Direct Addressing Mode

Frequently Asked

Definition

Instruction me memory address directly diya hota hai.

Format

`MOV R1,500`

Meaning

Address 500 par jo data hai woh R1 me load hoga.

Example

Address Data

500 25

Result:

`R1 = 25`

Diagram

Instruction
|
V

Address = 500
|
V

Memory[500]

Advantages

 Simple

Disadvantages

 Extra Memory Access

---

3. Indirect Addressing Mode

Most Repeated

Definition

Instruction address nahi balki address ka address contain karti hai.

Format

```
MOV R1,(500)
```

Example

Address Value

500 700

700 25

Result:

```
R1 = 25
```

Diagram

```
500
 |
 V
700
 |
 V
25
```

Advantages

 Large Address Space

Disadvantages

 Slower due to two memory accesses

---

4. Register Addressing Mode

Definition

Operand register ke andar stored hota hai.

Format

```
ADD R1,R2
```

Example

R1 = 20

R2 = 10

Result:

```
R1 = 30
```

Diagram

```
R1  R1 + R2
```

Advantages

 Very Fast

 No Memory Access

Disadvantages

 Limited Registers

---

5. Register Indirect Addressing Mode

Definition

Register operand ko nahi balki operand ke address ko store karta hai.

Example

R1 = 500

Memory:

500 = 25

Result:

Operand = 25

Diagram

R1
|
500
|
Memory
|
25

Advantages

 Flexible

Disadvantages

 Extra Memory Access

---

6. Relative Addressing Mode

Definition

Effective Address = PC + Address Field

Formula

EA = PC + Offset

Example

PC = 100

Offset = 20

Result:

EA = 120

Use

Branch Instructions

Jump Instructions

---

7. Indexed Addressing Mode □ □ □ □

Definition

Address calculate kiya jata hai:

EA = Index Register + Address

Example

Index Register = 50

Address = 200

Result:

EA = 250

Applications

Arrays

Tables

---

8. Auto Increment Addressing Mode □ □ □

Definition

Operand access ke baad register automatically increment ho jata hai.

Example

(R1)+

Working

R1 = 500

Use Memory[500]

R1 = 501

---

9. Auto Decrement Addressing Mode □ □ □

Definition

Operand access se pehle register decrement hota hai.

Example

`-(R1)`

Working

R1 = 500

R1 = 499

Use Memory[499]

Comparison of Addressing Modes □ □ □ □ □

Addressing Mode	Operand Location	Speed
Immediate	Inside Instruction	Very Fast
Direct	Memory Address	Medium
Indirect	Address of Address	Slow
Register	Register	Very Fast
Register Indirect	Memory via Register	Fast
Relative	PC + Offset	Medium
Indexed	Index + Address	Medium

Advantages of Addressing Modes

1. Efficient Memory Usage

Memory utilization improve hoti hai.

---

2. Faster Execution

Register addressing fast hoti hai.

---

3. Program Flexibility

Different applications ke liye different modes.

---

4. Better CPU Performance

Execution time reduce hota hai.

Disadvantages

1. Hardware Complexity

CPU design complex ho jata hai.

---

2. Increased Instruction Decoding

Different modes ko identify karna padta hai.

---

3. Extra Memory Access

Indirect mode me extra access required hota hai.

Applications

Arrays

Indexed Addressing

Loops

Relative Addressing

Function Calls

Indirect Addressing

Fast Computation

Register Addressing

Viva Questions

Q1. What is Addressing Mode?

Method used to locate operands.

Q2. Which is the fastest addressing mode?

Immediate Addressing Mode.

Q3. Which addressing mode uses PC?

Relative Addressing Mode.

Q4. Which addressing mode is used for arrays?

Indexed Addressing Mode.

Q5. Which mode requires two memory accesses?

Indirect Addressing Mode.

Frequently Asked RGPV Questions

2 Marks

1. Define Addressing Mode.
2. What is Immediate Addressing?
3. What is Direct Addressing?
4. What is Relative Addressing?

---

5 Marks

1. Explain Register Addressing Mode.
2. Explain Direct and Indirect Addressing.
3. Explain Indexed Addressing.

---

7 Marks

1. Explain various Addressing Modes.
2. Compare Direct and Indirect Addressing.
3. Explain Relative and Indexed Addressing.

---

14 Marks

1. Explain Addressing Modes with suitable examples.

2. Discuss different types of Addressing Modes.
3. Compare Immediate, Direct, Indirect and Register Addressing Modes.

One-Minute Revision

 Immediate Operand inside instruction

`MOV R1,#50`

 Direct Address given directly

`MOV R1,500`

 Indirect Address of address

`500  700  25`

 Register Operand in register

`ADD R1,R2`

 Relative PC + Offset

 Indexed Index Register + Address

Conclusion

Addressing Modes CPU ko operand ki location identify karne me help karte hain. Immediate, Direct, Indirect, Register, Relative aur Indexed modes computer architecture ke important addressing techniques hain. Ye execution speed, flexibility aur memory utilization ko improve karte hain. Addressing Modes RGPV exams ka ek highly important aur frequently asked topic hai.

CPU and Memory Organization (14 Marks Answer)

Most Important Topic

CPU and Memory Organization RGPV me frequently asked question hai.

*Is topic se direct **7 marks aur 14 marks** ke questions aate hain.*

*Ye answer **3–4 pages** aasani se cover karega.*

CPU and Memory Organization

Introduction

Computer System me CPU aur Memory do sabse important components hote hain.

CPU instructions ko execute karta hai aur Memory data aur instructions ko store karti hai.

CPU aur Memory milkar computer ko efficiently operate karte hain.

Definition

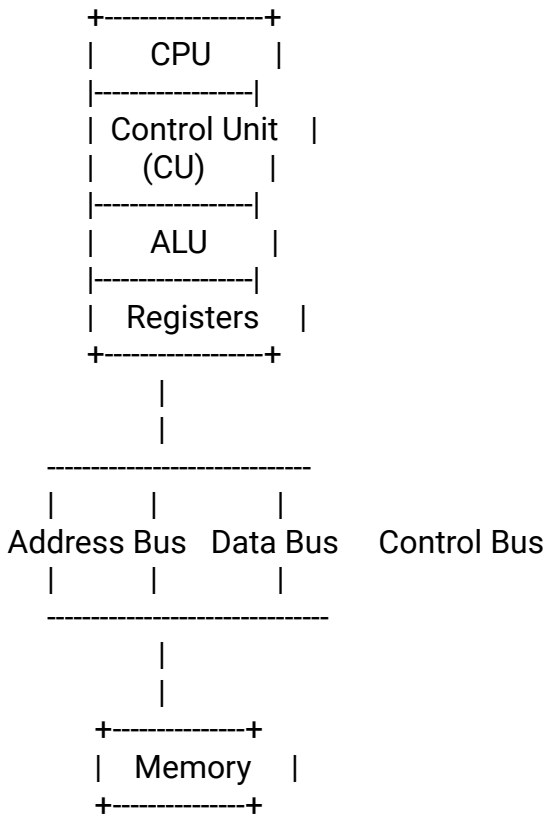
CPU (Central Processing Unit)

CPU computer ka brain hota hai jo instructions ko fetch, decode aur execute karta hai.

Memory

Memory ek storage unit hai jo data aur instructions ko temporarily ya permanently store karti hai.

CPU and Memory Organization



Components of CPU

1. Control Unit (CU)

Control Unit CPU ka controlling part hota hai.

Functions

- Instructions fetch karna
- Instructions decode karna
- Data flow control karna
- Memory aur I/O devices ko coordinate karna

---

2. Arithmetic Logic Unit (ALU)

ALU arithmetic aur logical operations perform karta hai.

Arithmetic Operations

- Addition
- Subtraction
- Multiplication
- Division

Logical Operations

- AND
- OR
- NOT
- XOR

---

3. Registers

Registers CPU ke andar high-speed storage locations hote hain.

Important Registers

Program Counter (PC)

Next instruction ka address store karta hai.

Instruction Register (IR)

Current instruction store karta hai.

Memory Address Register (MAR)

Memory address store karta hai.

Memory Data Register (MDR)

Memory se aane wala data store karta hai.

Memory Organization

Memory data aur instructions ko store karti hai.

Memory ko bahut saare memory locations me divide kiya jata hai.

Memory Structure

Address Data

1000 A
1001 B
1002 C
1003 D

Har memory location ka unique address hota hai.

Types of Memory

1. Primary Memory

Directly CPU se connected hoti hai.

Examples

- RAM
- ROM

---

2. Secondary Memory

Permanent storage provide karti hai.

Examples

- Hard Disk
- SSD
- DVD

CPU and Memory Communication

CPU aur Memory buses ke through communicate karte hain.

---

1. Address Bus

Address transfer karti hai.

Example

CPU Address 500 Memory

---

2. Data Bus

Data transfer karti hai.

Example

Memory Data CPU

---

3. Control Bus

Read aur Write signals transfer karti hai.

Example

READ
WRITE

Memory Read Operation

Definition

Memory se data ko CPU me transfer karna.

RTL Representation

MDR M[MAR]

Steps

Step 1

Address MAR me load hota hai.
MAR = 500

Step 2

Control Unit READ signal bhejti hai.

Step 3

Memory address 500 access hota hai.

Step 4

Data MDR me transfer hota hai.
MDR = 25

Memory Read Diagram

CPU
 |
READ
 |
 V

Memory
|
Data
|
V
CPU

Memory Write Operation

Definition

CPU se Memory me data store karna.

RTL Representation

M[MAR] □ MDR

Steps

Step 1

Address MAR me load hota hai.

Step 2

Data MDR me load hota hai.

Step 3

WRITE signal generate hota hai.

Step 4

Data memory me store ho jata hai.

Memory Write Diagram

CPU
|
Data
|
V
Memory

Instruction Execution Cycle

CPU aur Memory milkar instruction execute karte hain.

Step 1: Fetch

Instruction memory se fetch hoti hai.
IR M[PC]

Step 2: Decode

Instruction decode hoti hai.

Step 3: Execute

ALU operation perform karta hai.

Step 4: Store

Result memory me store hota hai.

CPU-Memory Interaction Example

Suppose:
Instruction:
ADD X
Memory:
Address Data

500 20

Working

Step 1:

CPU Address 500 bhejta hai.

Step 2:

Memory value 20 return karti hai.

Step 3:

ALU operation perform karta hai.

Step 4:

Result store hota hai.

Advantages of CPU and Memory Organization

1. Fast Processing

CPU quickly instructions execute karta hai.

---

2. Efficient Data Storage

Memory large amount of data store karti hai.

---

3. Organized Communication

Buses communication simplify karti hain.

---

4. Better Performance

System efficiency improve hoti hai.

---

5. Reliable Operation

Proper coordination maintain hota hai.

Disadvantages

1. Memory Bottleneck

Slow memory CPU performance reduce kar sakti hai.

---

2. Cost

High-speed memory expensive hoti hai.

---

3. Complex Design

Large systems ka design complex hota hai.

CPU vs Memory

CPU	Memory

Processes Data	Stores Data
Fast	Comparatively Slow
Performs Operations	Provides Storage
Brain of Computer	Storage Unit
Contains ALU, CU	Contains Memory Cells

Applications

Personal Computers

CPU and RAM communication.

Mobile Phones

Processor and memory interaction.

Servers

High-speed data processing.

Embedded Systems

Microcontroller and memory.

Viva Questions

Q1. What is CPU?

CPU is the brain of computer that executes instructions.

Q2. What is Memory?

Memory is a storage unit that stores data and instructions.

Q3. What is MAR?

Memory Address Register stores memory address.

Q4. What is MDR?

Memory Data Register stores data.

Q5. Which bus transfers data?

Data Bus.

Frequently Asked RGPV Questions

2 Marks

1. Define CPU.
2. Define Memory.
3. What is MAR?
4. What is MDR?

---

5 Marks

1. Explain CPU Organization.
2. Explain Memory Organization.
3. Explain Memory Read Operation.

---

7 Marks

1. Explain CPU and Memory Organization.
2. Explain Memory Read and Write operations.
3. Discuss CPU-Memory communication.

---

14 Marks

1. Explain CPU and Memory Organization with neat diagram.
2. Discuss CPU-Memory interaction and instruction execution cycle.
3. Explain Memory Read and Memory Write operations with RTL representation.

One-Minute Revision

 CPU = CU + ALU + Registers

 Memory stores data & instructions

 MAR = Memory Address Register

 MDR = Memory Data Register

 Memory Read:

MDR M[MAR]

 Memory Write:

M[MAR] MDR

 Buses:

- Data Bus
- Address Bus
- Control Bus

Conclusion

CPU and Memory Organization computer system ka fundamental part hai. CPU instructions ko process karta hai aur Memory data aur instructions ko store karti hai. Address Bus, Data Bus aur Control Bus ki help se CPU aur Memory efficiently communicate karte hain. Proper CPU-Memory Organization computer ki speed, efficiency aur performance ko improve karti hai aur Computer Architecture ka ek highly important topic hai.

CS404 COMPUTER ORGANIZATION & ARCHITECTURE SHORT NOTES

UNIT–1 : BASIC STRUCTURE OF COMPUTER

 Exam Target: *Unit-1 se generally 15–20 marks aate hain. CPU Organization, RTL, Addressing Modes aur Bus Structure sabse important topics hain.*

UNIT OVERVIEW

Weightage

 15–20 Marks

Importance

Ye poore Computer Organization ka foundation hai.

Agar Unit-1 samajh li to baaki units kaafi easy lagengi.

 CPU Organization

Study Priority

 High

Score Potential

15+ Marks

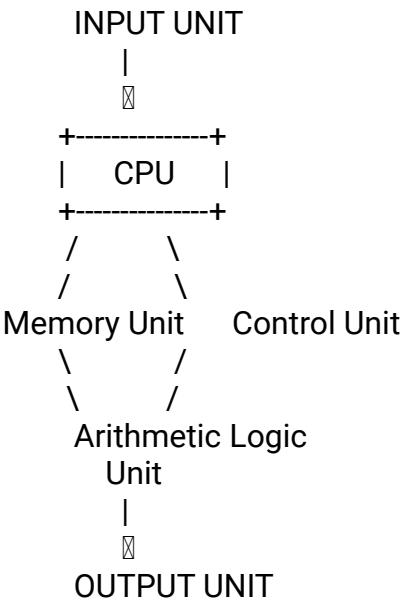
---

1. STRUCTURE OF DESKTOP COMPUTER □ □ □ □ □

Simple Explanation

Computer ek system hai jo Input leta hai, Process karta hai aur Output deta hai.

Block Diagram



Components

Input Unit

Input devices:

- Keyboard
- Mouse
- Scanner

CPU

Brain of computer

Memory Unit

Stores data

Output Unit

Monitor

Printer

Speaker

Exam Definition

"A computer system consists of input unit, CPU, memory unit and output unit."

---

2. CPU ORGANIZATION □ □ □ □ □

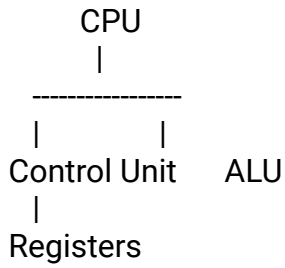
Most Important

What is CPU?

CPU = Central Processing Unit

CPU is the brain of computer.

CPU Structure



Components

ALU

Arithmetic Logic Unit

Performs:

- Addition
- Subtraction
- Multiplication
- Comparison

Control Unit

Controls all operations.

Registers

Small high-speed memory inside CPU.

Advantages

□ Fast Processing

□ Controls system

Viva Question

Q. Why CPU is called brain of computer?

Ans. Because it controls all operations.

---

3. GENERAL REGISTER ORGANIZATION □ □ □ □

Definition

Arrangement of registers inside CPU.

Common Registers

MAR

Memory Address Register

Stores memory address.

MDR

Memory Data Register

Stores data.

IR

Instruction Register

Stores current instruction.

PC

Program Counter

Stores next instruction address.

AC

Accumulator

Stores intermediate results.

Memory Trick

MPAI

M □ MAR

P □ PC

A □ AC

I □ IR

4. MEMORY REGISTER □ □ □

MAR

Stores memory location address.

Example

Address = 1000

MAR = 1000

MDR

Stores actual data.

Example

Data = 25

MDR = 25

---

5. INSTRUCTION REGISTER (IR) □ □ □ □

Definition

Stores current instruction being executed.

Example

Instruction:

ADD R1,R2

Stored in IR

---

6. CONTROL WORD □ □ □

Definition

Binary information that specifies micro-operations.

Purpose

Controls operation of registers.

---

7. STACK ORGANIZATION □ □ □ □ □

Frequently Asked

Definition

Stack is a linear data structure following LIFO.

LIFO = Last In First Out

Diagram

Operations

PUSH

Insert data

POP

Remove data

Example

Books Stack

Last book placed = First removed

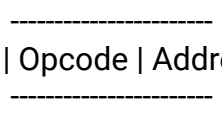
---

8. INSTRUCTION FORMAT

Definition

Structure of instruction.

Format



Opcode

Operation code

Example:

ADD

SUB

MOV

Address Field

Operand location.

---

9. ALU (ARITHMETIC LOGIC UNIT) □ □ □ □ □

Definition

Performs arithmetic and logical operations.

Arithmetic Operations

- Addition
- Subtraction
- Multiplication
- Division

Logical Operations

- AND
- OR
- NOT
- XOR

Example

5 + 10 = 15

Performed by ALU

---

10. I/O SYSTEM □ □ □

Definition

System responsible for communication between computer and external devices.

Examples

Input Devices

Keyboard

Mouse

Scanner

Output Devices

Monitor

Printer

Speaker

---

11. BUS □ □ □ □ □

Most Important

Definition

Bus is a communication pathway used to transfer data.

Types of Bus

Data Bus

Transfers data.

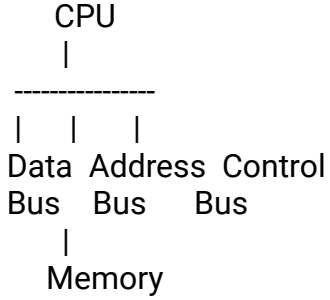
Address Bus

Transfers address.

Control Bus

Transfers control signals.

Bus Structure



Data Bus vs Address Bus

Transfers Data	Transfers Address
Bidirectional	Unidirectional
Carries Data	Carries Location

---

12. CPU AND MEMORY □ □ □ □

Working

CPU
□
Memory Address
□
Memory
□
Data Returned
□
CPU

Purpose

CPU accesses memory using address bus.

---

13. PROGRAM COUNTER (PC) □ □ □ □ □

Frequently Asked

Definition

Stores address of next instruction.

Example

Current Instruction = 100

Next Instruction = 101

PC = 101

Importance

Helps sequential execution.

---

14. REGISTER TRANSFER LANGUAGE (RTL) □ □ □ □ □

Most Important

Definition

Symbolic language used to describe micro-operations.

Example

R1 □ R2

Meaning:

Contents of R2 transferred to R1.

More Examples

R1 □ R2

R3 □ R1 + R2

AC □ AC + DR

RTL Diagram

R2
□
Transfer
□
R1

---

15. BUS TRANSFER □ □ □ □

Definition

Transfer of data through bus.

Example

R1 □ Bus □ R2

Data moves through common bus.

---

16. MEMORY TRANSFER □ □ □ □

Read Operation

Memory
□
CPU

Write Operation

CPU
□
Memory

---

17. ADDRESSING MODES □ □ □ □ □

Most Repeated Topic

Definition

Technique used to specify operand location.

Types

1. Immediate Addressing

```
MOV R1,#10
```

Operand directly given.

---

2. Direct Addressing

```
MOV R1,100
```

Address directly specified.

---

3. Indirect Addressing

Address stored in another location.

---

4. Register Addressing

Operand in register.

```
MOV R1,R2
```

---

5. Register Indirect

Register contains address.

Addressing Modes Comparison

Mode	Operand Location
Immediate	Instruction
Direct	Memory
Indirect	Address Location
Register	Register
Register Indirect	Register Holds Address

REGISTERS vs MEMORY □ □ □ □

Register	Memory
Very Fast	Slower
Small Size	Large Size
Inside CPU	Outside CPU
Expensive	Cheap

LAST NIGHT REVISION SHEET

□ CPU = ALU + CU + Registers

□ MAR = Address

□ MDR = Data

□ IR = Current Instruction

□ PC = Next Instruction Address

 Stack = LIFO

 Bus = Data + Address + Control

 RTL = Register Transfer Language

 Immediate Addressing = Data inside instruction

 Direct Addressing = Address given directly

 Unit-1 Score Target

Agar tum **CPU Organization + RTL + Addressing Modes + Bus Structure** prepare kar lete ho, to Unit-1 se **15+ marks** score karna possible hai. Next most important unit hai **Unit-2: Control Unit Organization**.