

COA UNIT III — QUESTION BANK**Register Transfer Language, Micro-Operations & Basic Computer Organization**

SECTION A: Multiple Choice Questions (MCQs)**(15 Questions — 1 Mark Each)**

Q1. RTL (Register Transfer Language) is used to describe:

- (a) High-level programming logic
 - (b) Movement of data between registers and operations on them
 - (c) Memory management in operating systems
 - (d) Input/output device interfacing
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Q2. In RTL notation, the symbol " $\leftarrow$ " represents:

- (a) Comparison between two registers
 - (b) Data transfer (assignment) from source to destination
 - (c) Logical AND operation
 - (d) Memory read operation
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Q3. A bus is used in a computer system primarily to:

- (a) Increase the clock speed
 - (b) Reduce the number of connections between registers
 - (c) Store permanent data
 - (d) Execute arithmetic operations
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Q4. In a multiplexer-based bus, the register that drives the bus is determined by the:

- (a) ALU
 - (b) Program Counter
 - (c) Select (control) signals
 - (d) Interrupt register
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Q5. The RTL statement for a memory read operation is:

- (a) $M[MAR] \leftarrow DR$

- (b) $DR \leftarrow M[MAR]$
 - (c) $AR \leftarrow DR$
 - (d) $PC \leftarrow M[IR]$
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Q6. Which micro-operation is used for selective clearing of bits?

- (a) OR micro-operation
 - (b) XOR micro-operation
 - (c) AND micro-operation
 - (d) Shift micro-operation
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Q7. In an arithmetic left shift, the bit shifted into the LSB is:

- (a) 1
 - (b) The sign bit
 - (c) 0
 - (d) The MSB
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Q8. The Accumulator (AC) register in a basic computer is:

- (a) 12 bits wide
 - (b) 8 bits wide
 - (c) 16 bits wide
 - (d) 32 bits wide
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Q9. The instruction format of a basic computer is 16 bits wide. The opcode field is:

- (a) 12 bits
 - (b) 4 bits
 - (c) 3 bits
 - (d) 1 bit
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Q10. In indirect addressing mode ($I = 1$), the Effective Address (EA) is:

- (a) The address field of the instruction
- (b) The content of the PC
- (c) The memory location pointed to by the address field
- (d) The content of the AC register

Q11. During the Fetch cycle, which register holds the current instruction fetched from memory?

- (a) AR (Address Register)
 - (b) DR (Data Register)
 - (c) PC (Program Counter)
 - (d) IR (Instruction Register)
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Q12. The BUN (Branch Unconditionally) instruction causes:

- (a) AC to be cleared
 - (b) PC to be loaded with the operand address X
 - (c) The next instruction to be skipped
 - (d) An interrupt to be triggered
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Q13. The ISZ instruction skips the next instruction when:

- (a) $AC = 0$
 - (b) AC is negative
 - (c) $M[X]$ after increment = 0
 - (d) The carry flag is set
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Q14. The flag FGI (Flag Input) is set to 1 when:

- (a) Output device is ready
 - (b) Keyboard has new data ready
 - (c) An interrupt occurs
 - (d) $AC = 0$
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Q15. Hardwired control is preferred in RISC processors because:

- (a) It is easy to modify
 - (b) It uses ROM to store control signals
 - (c) It is faster due to AND-OR gate logic
 - (d) It supports microprogramming
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Answer Key — Section A (MCQs)

Q.No	Answer	Explanation
1	(b)	RTL describes data movements between registers and operations performed on them.
2	(b)	" $\leftarrow$ " means transfer/assignment — data moves from right to left.
3	(b)	A bus reduces wiring; n registers need only n connections instead of n^2 dedicated lines.
4	(c)	The MUX select signals determine which register drives the bus at any time.
5	(b)	$DR \leftarrow M[MAR]$ reads data from memory address in MAR into the Data Register.
6	(c)	AND micro-operation: bits ANDed with 0 are cleared; bits ANDed with 1 are unchanged.
7	(c)	In arithmetic left shift, a 0 is shifted into the LSB position.
8	(c)	AC (Accumulator) in the basic computer is a 16-bit register.
9	(c)	The basic computer instruction has 1-bit I + 3-bit opcode + 12-bit address = 16 bits.
10	(c)	Indirect: $EA = M[\text{address field}]$ — the address field points to a memory location holding the actual address.
11	(d)	During fetch, the instruction is loaded into the IR (Instruction Register).
12	(b)	BUN loads PC with address X, causing an unconditional jump.
13	(c)	ISZ increments $M[X]$; if result = 0, the next instruction is skipped (used as loop counter).
14	(b)	$FGI = 1$ signals that the keyboard input register (INPR) has new data ready.
15	(c)	Hardwired control uses AND-OR logic gates, making it faster; used in RISC architectures.

SECTION B: Fill in the Blanks

(15 Questions — 1 Mark Each)

1. RTL stands for _____.
2. The RTL statement P: $R2 \leftarrow R1$ means the transfer occurs only if condition P = _____.
3. A _____ is a shared communication pathway that allows any register to communicate with any other.
4. Memory write operation in RTL is written as _____.
5. The AND micro-operation is used for _____ clearing of selected bits.

6. The OR micro-operation is used for _____ setting of selected bits.
7. In a _____ shift, the sign bit is preserved during right shift.
8. The _____ register holds the address of the next instruction to be executed.
9. The Sequence Counter (SC) generates timing signals _____.
10. In direct addressing ($I = 0$), the Effective Address equals the _____ of the instruction.
11. The three phases of the instruction cycle are Fetch, _____, and Execute.
12. The BSA instruction saves the return address at $M[X]$ and sets PC to _____.
13. The CLA (Clear Accumulator) instruction sets $AC =$ _____.
14. IEN stands for _____ and is used to enable interrupt-driven I/O.
15. In microprogrammed control, control signals are stored in a _____ (ROM).

Answer Key — Section B (Fill in the Blanks)

Q.No	Answer
1	Register Transfer Language
2	1
3	Bus
4	$M[MAR] \leftarrow DR$
5	Selective
6	Selective
7	Arithmetic (right)
8	Program Counter (PC)
9	T0, T1, T2, T3, ... (timing pulses)
10	Address field
11	Decode
12	$X + 1$
13	0
14	Interrupt Enable

Q.No

Answer

SECTION C: Short Questions

15 Control memory
(15 Questions — 1 Mark Each)

Q.No	Question	Answer
1	What is RTL?	A symbolic notation used to describe data movements and operations between registers in a digital computer.
2	What does the RTL statement " $R2 \leftarrow R1$ " mean?	The contents of register R1 are copied into register R2 in one clock cycle.
3	What is a bus in computer organization?	A shared set of wires that allows multiple registers to communicate, reducing the total number of connections needed.
4	What is the purpose of the AND micro-operation?	To selectively clear specific bits of a register (bits ANDed with 0 are cleared).
5	What is the difference between logical shift and arithmetic shift?	Logical shift fills vacated positions with 0; arithmetic shift preserves the sign bit during right shift.
6	What is the function of the Accumulator (AC)?	It is the main 16-bit working register that holds operands and results of ALU operations.
7	What is the role of the Program Counter (PC)?	It holds the address of the next instruction to be fetched from memory.
8	What is an Instruction Register (IR)?	A 16-bit register that holds the current instruction being decoded and executed.
9	What is direct addressing mode?	The address field of the instruction directly gives the Effective Address ($EA = \text{address field}, I = 0$).
10	What is indirect addressing mode?	The address field points to a memory location that contains the actual Effective Address ($EA = M[\text{address field}], I = 1$).
11	What are the three steps of the instruction cycle?	Fetch, Decode, and Execute.
12	What does the STA instruction do?	It stores the content of the Accumulator (AC) into the memory location $M[X]$.
13	What is the function of the ISZ instruction?	It increments $M[X]$ by 1 and skips the next instruction if the result is zero (used for loop control).
14	What is an interrupt in a computer?	A signal that temporarily suspends normal program execution to handle an urgent I/O or event.

End of COA Unit III Question Bank

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What is the difference between hardwired and microprogrammed control?

Hardwired uses logic gates (faster, less flexible); microprogrammed uses ROM-stored microinstructions (slower, easier to modify).