

QUESTION BANK

CRH301 DIGITAL LOGIC DESIGN

Unit: I

PART – A

Section I – Multiple Choice Questions

1. A digital system processes information in the form of

- A) Analog signals
- B) Continuous signals
- C) Binary signals
- D) Mechanical signals

Answer: C

2. The binary number system has a base of

- A) 8
- B) 10
- C) 2
- D) 16

Answer: C

3. Which number system uses digits 0–7?

- A) Decimal
- B) Binary
- C) Octal
- D) Hexadecimal

Answer: C

4. The hexadecimal number system has a base of

- A) 2
- B) 8
- C) 10
- D) 16

Answer: D

5. The decimal equivalent of $(1010)_2$ is

- A) 8
- B) 10

- C) 12
- D) 14

Answer: B

6. Which code is commonly used for character representation?

- A) Gray Code
- B) Excess-3 Code
- C) ASCII
- D) Hamming Code

Answer: C

7. BCD stands for

- A) Binary Coded Data
- B) Binary Code Decimal
- C) Binary Coded Decimal
- D) Binary Character Data

Answer: C

8. Which gate is known as the inverter?

- A) OR
- B) NAND
- C) NOT
- D) XOR

Answer: C

9. The output of an AND gate is HIGH only when

- A) All inputs are HIGH
- B) Any one input is HIGH
- C) All inputs are LOW
- D) Inputs are different

Answer: A

10. The output of an OR gate is LOW when

- A) Both inputs are HIGH
- B) At least one input is HIGH
- C) Both inputs are LOW
- D) Inputs are different

Answer: C

11. NAND gate is a combination of

- A) AND + NOT
- B) OR + NOT
- C) XOR + NOT
- D) NOR + NOT

Answer: A

12. NOR gate is a combination of

- A) AND + NOT
- B) OR + NOT
- C) XOR + NOT
- D) AND + OR

Answer: B

13. Which gate is called the Universal Gate?

- A) AND
- B) OR
- C) NAND
- D) Both NAND and NOR

Answer: D

14. The output of XOR gate is HIGH when

- A) Inputs are same
- B) Inputs are different
- C) Both inputs are LOW
- D) Both inputs are HIGH

Answer: B

15. Binary addition of $1 + 1$ gives

- A) 0
- B) 1
- C) 10
- D) 11

Answer: C

16. Which digit is not valid in hexadecimal?

- A) A
- B) E
- C) G

- D) F

Answer: C

17. Which number system is used internally by computers?

- A) Decimal
- B) Binary
- C) Octal
- D) Hexadecimal

Answer: B

18. ASCII is represented using

- A) 7 bits
- B) 4 bits
- C) 8 bits only
- D) 16 bits

Answer: A

19. Which gate produces the complement of the OR operation?

- A) NAND
- B) XOR
- C) NOR
- D) NOT

Answer: C

20. Which gate produces the complement of the AND operation?

- A) XOR
- B) NOR
- C) NAND
- D) OR

Answer: C

21. The output of a NOT gate for input '1' is

- A) 1
- B) 0
- C) X
- D) Z

Answer: B

Section II – Analytical MCQs

22. What is the decimal equivalent of $(11011)_2$?

- A) 25
- B) 27
- C) 29
- D) 31

Answer: B

23. Convert $(57)_8$ to decimal.

- A) 45
- B) 47
- C) 49
- D) 55

Answer: B

24. Convert $(2F)_{16}$ to decimal.

- A) 45
- B) 47
- C) 49
- D) 50

Answer: B

25. Find the result of binary addition: $1010 + 0011$

- A) 1100
- B) 1101
- C) 1110
- D) 1111

Answer: B

26. If $A = 1$ and $B = 0$, the output of $A \text{ AND } B$ is

- A) 0
- B) 1
- C) 10
- D) Undefined

Answer: A

27. If $A = 1$ and $B = 0$, the output of $A \text{ XOR } B$ is

- A) 0

- B) 1
- C) 10
- D) Undefined

Answer: B

28. Which gate can be used alone to implement all Boolean functions?

- A) OR
- B) AND
- C) NAND
- D) XOR

Answer: C

29. ASCII code is mainly used for

- A) Arithmetic operations
- B) Character representation
- C) Memory addressing
- D) Error detection

Answer: B

30. Which code stores each decimal digit separately in binary?

- A) Gray Code
- B) ASCII
- C) BCD
- D) Excess-3

Answer: C

PART –B

Section I – Descriptive Questions

31. Explain the importance and applications of digital systems.

A digital system is an electronic system that represents and processes information using binary digits (0 and 1). It is built using digital circuits and logic gates.

Importance of Digital Systems

- High accuracy and precision.
- Less affected by electrical noise.
- High-speed operation.
- Reliable and consistent performance.
- Easy storage and retrieval of information.

- Programmable and flexible.
- Low maintenance and cost.

Applications of Digital Systems

- Computers and laptops
- Mobile phones
- Digital communication systems
- Industrial automation
- Medical equipment
- Banking and financial systems
- Consumer electronics such as televisions and digital cameras

32. Explain the ASCII and BCD binary code standards.

Binary codes are standardized methods used to represent numbers, letters, and special characters in digital systems.

ASCII (American Standard Code for Information Interchange)

- ASCII is a standard binary code used to represent letters, numbers, punctuation marks, and control characters.
- It uses 7 bits to represent 128 characters.
- Extended ASCII uses 8 bits to represent 256 characters.
- ASCII enables communication between computers and electronic devices.

Applications

- Text processing
- Computer programming
- Data communication
- File storage

BCD (Binary Coded Decimal)

- BCD is a coding system in which each decimal digit is represented separately using 4 bits.
- Each decimal digit from 0 to 9 has a unique 4-bit binary code.
- It simplifies the display of decimal numbers in digital devices.

Applications

- Digital clocks
- Calculators
- Digital meters
- Seven-segment displays

Difference between ASCII and BCD

ASCII	BCD
Represents characters	Represents decimal digits
Uses 7 or 8 bits	Uses 4 bits per decimal digit
Used in computers and communication	Used in digital displays and calculators

33. Explain the operations of logic gates with suitable examples.

Logic gates are the basic building blocks of digital circuits. They perform logical operations on one or more binary inputs to produce a binary output.

AND Gate

- Produces HIGH output only when all inputs are HIGH.
- Used in control circuits and decision-making circuits.

OR Gate

- Produces HIGH output if at least one input is HIGH.
- Used in alarm systems and switching circuits.

NOT Gate

- Produces the complement of the input.
- Also called an inverter.
- Used wherever signal inversion is required.

NAND Gate

- Produces the complement of the AND operation.
- It is a universal gate capable of implementing any logic function.

NOR Gate

- Produces the complement of the OR operation.
- It is also a universal gate.

XOR (Exclusive-OR) Gate

- Produces HIGH output only when the inputs are different.
- Used in arithmetic circuits, parity generators, and error detection.

Applications of Logic Gates

- Digital computers
- Arithmetic Logic Units (ALUs)
- Memory circuits

- Communication systems
- Embedded systems

34. Explain universal gates and their advantages.

A universal gate is a logic gate that can be used to implement all other basic logic gates and any Boolean function.

The two universal gates are:

- NAND Gate
- NOR Gate

Characteristics

- Can realize AND, OR, and NOT gates.
- Can implement any combinational or sequential logic circuit.
- Reduce the need for multiple gate types.

Advantages

- Simplifies circuit design.
- Reduces manufacturing cost.
- Easy to fabricate using integrated circuits.
- Improves reliability.
- Widely used in digital electronics.

Applications

- Logic circuit design
- Microprocessors
- Digital control systems
- Embedded systems
- VLSI design

Section II – Analytical Descriptive Question

35. Analyze the role of universal gates in digital circuit design. Explain how NAND and NOR gates can be used to realize the basic logic gates (AND, OR, and NOT). Discuss the advantages of using universal gates in the design of digital systems.

Universal gates are logic gates that can be used to implement any Boolean function and construct any digital circuit. The two universal gates are NAND and NOR. Since all other logic gates can be realized using only NAND gates or only NOR gates, they play a significant role in digital system design.

Realization of Basic Gates Using NAND Gates

1. NOT Gate

A NAND gate acts as a NOT gate when both its inputs are connected together.

Expression:

$$Y=(A \cdot A)'=A' \quad Y=(A \cdot A)'=A' \quad Y=(A \cdot A)'=A'$$

2. AND Gate

An AND gate is obtained by connecting the output of a NAND gate to another NAND gate configured as a NOT gate.

Expression:

$$Y=((A \cdot B)')'=AB \quad Y=((A \cdot B)')'=A \cdot B \quad Y=((A \cdot B)')'=A \cdot B$$

3. OR Gate

Using De Morgan's theorem, an OR gate is realized with NAND gates.

Expression:

$$A+B=(A' \cdot B')' \quad A+B=(A' \cdot B')' \quad A+B=(A' \cdot B')'$$

Realization of Basic Gates Using NOR Gates

1. NOT Gate

A NOR gate acts as a NOT gate when both its inputs are connected together.

Expression:

$$Y=(A+A)'=A' \quad Y=(A+A)'=A' \quad Y=(A+A)'=A'$$

2. OR Gate

An OR gate is obtained by connecting the output of a NOR gate to another NOR gate configured as a NOT gate.

Expression:

$$Y=((A+B)')'=A+B \quad Y=((A+B)')'=A+B \quad Y=((A+B)')'=A+B$$

3. AND Gate

Using De Morgan's theorem, an AND gate is realized with NOR gates.

Expression:

$$A \cdot B=(A'+B')' \quad A \cdot B=(A'+B')' \quad A \cdot B=(A'+B')'$$

Advantages of Universal Gates

- A single type of gate can implement any digital circuit.
- Simplifies the design and fabrication of integrated circuits.
- Reduces manufacturing and maintenance costs.
- Improves circuit reliability.
- Reduces inventory by using only one type of logic gate.
- Widely used in VLSI and digital system design.

Applications

- Digital computers
- Arithmetic Logic Units (ALUs)
- Memory circuits
- Microprocessors
- Embedded systems
- Communication systems

Unit: II

PART – A

Section I – Multiple Choice Questions

1. Boolean algebra was developed by

- A) Charles Babbage
- B) George Boole
- C) John Von Neumann
- D) Claude Shannon

Answer: B

2. Boolean algebra deals with

- A) Decimal numbers
- B) Binary variables
- C) Complex numbers
- D) Real numbers

Answer: B

3. In Boolean algebra, the complement of 1 is

- A) 1
- B) 2
- C) 0
- D) Undefined

Answer: C

4. According to the Identity Law,

- A) $A+0=A$
- B) $A+1=A$
- C) $A \cdot 0=A$
- D) $A+A'=0$

Answer: A

5. Which law states $A+A=A$?

- A) Complement Law
- B) Idempotent Law
- C) Identity Law
- D) Associative Law

Answer: B

6. According to the Complement Law,

- A) $A+A'=1$
- B) $A+A=A$
- C) $A \cdot 1=1$
- D) $A \cdot 0=1$

Answer: A

7. De Morgan's first theorem is

- A) $(A+B)'=A'+B'$
- B) $(AB)'=A'+B'$
- C) $(AB)'=A'B'$
- D) $(A+B)'=AB$

Answer: B

8. K-map is mainly used for

- A) Coding
- B) Simplifying Boolean expressions
- C) Data storage
- D) Programming

Answer: B

9. A 3-variable K-map contains

- A) 4 cells
- B) 6 cells

- C) 8 cells
- D) 16 cells

Answer: C

10. Which logic circuit performs binary addition?

- A) Comparator
- B) Multiplexer
- C) Adder
- D) Decoder

Answer: C

11. Half adder has

- A) One input
- B) Two inputs
- C) Three inputs
- D) Four inputs

Answer: B

12. A Full Adder has

- A) Two inputs
- B) Three inputs
- C) Four inputs
- D) One input

Answer: B

13. Which circuit compares two binary numbers?

- A) Multiplexer
- B) Comparator
- C) Decoder
- D) Encoder

Answer: B

14. A Multiplexer is also called

- A) Decoder
- B) Data Selector
- C) Encoder
- D) Comparator

Answer: B

15. A Demultiplexer is also called

- A) Data Distributor
- B) Data Selector
- C) Encoder
- D) Comparator

Answer: A

16. A Decoder converts

- A) Binary to decimal
- B) Decimal to binary
- C) Analog to digital
- D) Digital to analog

Answer: A

17. Priority encoder gives priority to

- A) Lowest input
- B) Highest priority input
- C) Output
- D) Clock

Answer: B

18. Which law states $A \cdot 1 = A$?

- A) Identity Law
- B) Complement Law
- C) Associative Law
- D) Absorption Law

Answer: A

19. The output of XOR is HIGH when

- A) Inputs are equal
- B) Inputs are different
- C) Both inputs are LOW
- D) Both inputs are HIGH

Answer: B

20. SOP stands for

- A) Sum of Products
- B) Series of Products

- C) Sum of Process
- D) Standard Output Product

Answer: A

21. POS stands for

- A) Product of Sums
- B) Process of Sums
- C) Product Output System
- D) Parallel Output Sum

Answer: A

Section II – Analytical MCQs

22. If $A=1$ and $B=0$, then $A+B$ equals

- A)0
- B)1
- C)2
- D)Undefined

Answer: B

23. If $A=1$ and $B=1$, then $(AB)'$ equals

- A)0
- B)1
- C)2
- D)Undefined

Answer: A

24. Which Boolean expression is simplified?

- A) $A+A$
- B) $A+A'$
- C) $A+A=A$
- D) $A+A'$

Answer: C

25. A half adder produces

- A) Sum only
- B) Carry only
- C) Sum and Carry
- D) Difference only

Answer: C

26. A Full Adder differs from Half Adder by having

- A) Extra output
- B) Carry input
- C) Less inputs
- D) Decoder

Answer: B

27. A 4:1 Multiplexer has

- A) Two select lines
- B) One select line
- C) Four select lines
- D) Three select lines

Answer: A

28. A 1:4 Demultiplexer has

- A) Four inputs
- B) One input and four outputs
- C) Two inputs
- D) Four outputs only

Answer: B

29. Which circuit converts binary information into one of many outputs?

- A) Encoder
- B) Decoder
- C) Comparator
- D) Adder

Answer: B

30. K-map grouping is done in powers of

- A)3
- B)5
- C)2
- D)10

Answer: C

PART – B

Descriptive Questions

31. Explain the basic concepts of Boolean algebra, including its laws and theorems.

- Definition of Boolean algebra
- Basic operations (AND, OR, NOT)
- Identity Law
- Null Law
- Idempotent Law
- Complement Law
- Commutative Law
- Associative Law
- Distributive Law
- Absorption Law
- Importance in digital circuit design

32. Explain De Morgan's Theorems and standard representations of Boolean functions (SOP and POS).

First De Morgan's theorem:

- $(AB)' = A' + B'$ $(A + B)' = A'B'$

Second De Morgan's theorem:

- $(A + B)' = A'B'$ $(AB)' = A' + B'$
- Explanation of SOP (Sum of Products)
- Explanation of POS (Product of Sums)
- Applications in logic circuit simplification

33. Explain Karnaugh Map (K-map) representation and simplification of Boolean expressions up to three variables.

- Definition of K-map
- Structure of 2-variable and 3-variable K-maps
- Grouping of 1s
- Groups of 1, 2, 4, and 8 cells
- Rules for overlapping and wrapping
- Advantages of K-map
- Applications in digital circuit design

34. Explain the working principle and applications of Adders, Subtractors, Digital Comparators.

- Half Adder
- Full Adder
- Half Subtractor

- Full Subtractor
- Digital Comparator
- Applications of each circuit

Analytical Descriptive Question

35. Compare the operation of combinational logic circuits such as Multiplexers, Demultiplexers, Decoders, and Priority Encoders. Analyze their functions, advantages, applications, and explain how Boolean algebra and K-map simplification help in designing efficient combinational circuits.

The answer should include:

- Definition of combinational logic circuits.
- Working principles of:
 - Multiplexer (Data Selector)
 - Demultiplexer (Data Distributor)
 - Decoder
 - Priority Encoder
- Comparison of their functions.
- Advantages of simplified Boolean expressions.
- Role of Boolean algebra laws and De Morgan's theorems.
- Use of K-map simplification to reduce gate count, cost, power consumption, and propagation delay.
- Practical applications in computers, communication systems, ALUs, memory addressing, digital control systems, and embedded systems.

Unit: III

PART – A

Section I – Multiple Choice Questions

1. A Flip-Flop is a

- A) Combinational circuit
- B) Sequential circuit
- C) Analog circuit
- D) Logic gate

Answer: B

2. A Flip-Flop can store

- A) 2 bits
- B) 4 bits
- C) 1 bit
- D) 8 bits

Answer: C

3. The SR Flip-Flop has

- A) One input
- B) Two inputs
- C) Three inputs
- D) Four inputs

Answer: B

4. JK Flip-Flop is an improvement over

- A) D Flip-Flop
- B) T Flip-Flop
- C) SR Flip-Flop
- D) Master-Slave Flip-Flop

Answer: C

5. The invalid state of SR Flip-Flop occurs when

- A) $S=0, R=0$
- B) $S=0, R=1$
- C) $S=1, R=0$
- D) $S=1, R=1$

Answer: D

6. The D Flip-Flop is also known as

- A) Delay Flip-Flop
- B) Toggle Flip-Flop
- C) Set Flip-Flop
- D) Reset Flip-Flop

Answer: A

7. Edge triggering changes the output during

- A) Entire clock pulse
- B) Rising or falling edge of the clock
- C) Input pulse only
- D) Reset pulse

Answer: B

8. Which Flip-Flop eliminates the invalid state?

- A) SR
- B) JK
- C) RS
- D) T

Answer: B

9. Registers are mainly used for

- A) Amplification
- B) Data storage
- C) Voltage regulation
- D) Frequency generation

Answer: B

10. A Shift Register is formed using

- A) Gates
- B) Flip-Flops
- C) Multiplexers
- D) Decoders

Answer: B

11. A Serial-in Serial-out register is abbreviated as

- A) SISO
- B) SIPO
- C) PISO
- D) PIPO

Answer: A

12. A Serial-to-Parallel converter uses

- A) Shift Register
- B) Decoder
- C) Encoder
- D) Comparator

Answer: A

13. A Parallel-to-Serial converter uses

- A) Shift Register
- B) Comparator

- C) Decoder
- D) Adder

Answer: A

14. Counter is a

- A) Combinational circuit
- B) Sequential circuit
- C) Analog circuit
- D) Memory

Answer: B

15. An asynchronous counter is also called

- A) Ripple Counter
- B) Ring Counter
- C) Johnson Counter
- D) Decade Counter

Answer: A

16. In a synchronous counter

- A) Only first Flip-Flop receives clock
- B) All Flip-Flops receive common clock
- C) No clock is used
- D) Separate clocks are used

Answer: B

17. A Decade Counter counts from

- A) 0 to 7
- B) 0 to 9
- C) 0 to 15
- D) 1 to 10

Answer: B

18. A 4-bit counter has

- A) 4 states
- B) 8 states
- C) 16 states
- D) 32 states

Answer: C

19. Flip-Flops are widely used in

- A) Memory circuits
- B) Amplifiers
- C) Oscillators
- D) Rectifiers

Answer: A

20. Registers are mainly used in

- A) Arithmetic operations
- B) Data transfer
- C) Voltage conversion
- D) Signal amplification

Answer: B

21. The basic building block of a register is

- A) Multiplexer
- B) Flip-Flop
- C) Decoder
- D) Comparator

Answer: B

Section II – Analytical MCQs

22. Which Flip-Flop toggles when $J = K = 1$?

- A) SR
- B) JK
- C) D
- D) RS

Answer: B

23. Which Flip-Flop transfers the input directly to the output on the clock edge?

- A) SR
- B) JK
- C) D
- D) T

Answer: C

24. A 3-bit asynchronous counter has how many states?

- A) 4
- B) 6
- C) 8
- D) 16

Answer: C

25. Which register converts serial data into parallel data?

- A) PISO
- B) PIPO
- C) SIPO
- D) SISO

Answer: C

26. Which register converts parallel data into serial data?

- A) SISO
- B) PISO
- C) SIPO
- D) PIPO

Answer: B

27. Which counter is faster?

- A) Ripple Counter
- B) Asynchronous Counter
- C) Synchronous Counter
- D) Decade Counter

Answer: C

28. A decade counter requires how many states?

- A) 8
- B) 10
- C) 12
- D) 16

Answer: B

29. Which Flip-Flop is most suitable for data storage?

- A) SR
- B) JK

- C) D
- D) T

Answer: C

30. Edge-triggered Flip-Flops improve

- A) Propagation delay
- B) Timing accuracy
- C) Voltage gain
- D) Frequency

Answer: B

PART – B

Descriptive Questions

31. Explain SR, JK, and D Flip-Flops with their characteristic tables and applications.

- Definition of Flip-Flop
- SR Flip-Flop: Inputs, operation, characteristic table, applications
- JK Flip-Flop: Elimination of invalid state, operation, characteristic table, applications
- D Flip-Flop: Working, characteristic table, applications
- Comparison of SR, JK, and D Flip-Flops

32. Explain the concept of edge triggering in Flip-Flops. Discuss the applications of Flip-Flops in digital systems.

- Definition of edge triggering
- Positive edge triggering
- Negative edge triggering
- Advantages of edge-triggered Flip-Flops
- Applications:
 - Registers
 - Counters
 - Memory devices
 - Frequency division
 - Data synchronization

33. Explain shift registers. Describe Serial-to-Parallel and Parallel-to-Serial data conversion using shift registers.

- Definition of registers
- Definition of shift registers
- Types of shift registers (SISO, SIPO, PISO, PIPO)
- Working of Serial-to-Parallel converter

- Working of Parallel-to-Serial converter
- Applications of shift registers

34. Explain Asynchronous Up Counter, Synchronous Down Counter, and Decade Counter with their working and applications.

- Definition of counters
- Asynchronous Up Counter:
 - Working
 - Advantages
 - Applications
- Synchronous Down Counter:
 - Working
 - Advantages
 - Applications
- Decade Counter:
 - Working
 - Counting sequence (0–9)
 - Applications

Analytical Descriptive Question

35. Compare Flip-Flops, Registers, and Counters. Analyze their working principles, advantages, and applications in digital systems. Explain how Flip-Flops are used to construct registers and counters.

Answer

The answer should include:

- Definition of sequential circuits
- Comparison of SR, JK, and D Flip-Flops
- Role of edge triggering
- Construction of registers using Flip-Flops
- Construction of counters using Flip-Flops
- Comparison of asynchronous and synchronous counters
- Working of decade counter
- Advantages of registers and counters
- Applications in computers, processors, memory systems, communication systems, and digital control circuits
- Conclusion highlighting the importance of Flip-Flops as the fundamental building blocks of sequential digital systems.

Unit: IV

PART – A

Section I – Multiple Choice Questions

1. Digital interfacing is used to

- A) Increase voltage
- B) Connect digital circuits with input/output devices
- C) Reduce current
- D) Store data

Answer: B

2. A sensor is a device that

- A) Stores data
- B) Converts physical quantity into an electrical signal
- C) Amplifies signals
- D) Generates power

Answer: B

3. Which of the following is a temperature sensor?

- A) LDR
- B) Thermistor
- C) Relay
- D) LED

Answer: B

4. TTL stands for

- A) Transistor-Transistor Logic
- B) Transistor Timing Logic
- C) Timing Transfer Logic
- D) Total Transistor Logic

Answer: A

5. CMOS stands for

- A) Complementary Metal Oxide Semiconductor
- B) Common Metal Oxide Semiconductor
- C) Complementary Memory Output System
- D) Current Metal Oxide Switch

Answer: A

6. An LED is mainly used for

- A) Data storage
- B) Indication
- C) Amplification
- D) Switching

Answer: B

7. A relay is used for

- A) Voltage conversion
- B) Switching high-power loads
- C) Signal generation
- D) Data storage

Answer: B

8. A solenoid converts electrical energy into

- A) Heat
- B) Light
- C) Mechanical motion
- D) Sound

Answer: C

9. ADC stands for

- A) Analog to Digital Converter
- B) Automatic Digital Circuit
- C) Analog Data Controller
- D) Automatic Data Converter

Answer: A

10. DAC stands for

- A) Digital Analog Controller
- B) Digital to Analog Converter
- C) Data Analog Circuit
- D) Digital Automatic Converter

Answer: B

11. Successive approximation ADC is known for

- A) Low accuracy
- B) High conversion speed
- C) High power consumption
- D) Simple resistor network

Answer: B

12. Dual slope ADC provides

- A) Fast conversion
- B) High accuracy and noise immunity
- C) Low resolution
- D) High output voltage

Answer: B

13. Weighted resistor DAC uses

- A) Equal resistors
- B) Binary weighted resistors
- C) Capacitors
- D) Inductors

Answer: B

14. R-2R ladder DAC uses only

- A) One resistor
- B) Two resistor values
- C) Three resistor values
- D) Capacitors

Answer: B

15. Which sensor detects light intensity?

- A) Thermistor
- B) LDR
- C) Strain gauge
- D) Pressure sensor

Answer: B

16. Which logic family consumes less power?

- A) TTL
- B) CMOS
- C) RTL
- D) DTL

Answer: B

17. LED stands for

- A) Light Emitting Diode
- B) Light Electronic Device
- C) Low Energy Diode
- D) Logic Emitting Device

Answer: A

18. Which device converts digital data into analog output?

- A) ADC
- B) DAC
- C) Encoder
- D) Decoder

Answer: B

19. Which ADC is commonly used in digital voltmeters?

- A) Flash ADC
- B) Dual Slope ADC
- C) Counter ADC
- D) Pipeline ADC

Answer: B

20. A motor is an example of

- A) Input device
- B) Output actuator
- C) Memory device
- D) Sensor

Answer: B

21. Digital interfacing is widely used in

- A) Embedded systems
- B) Mechanical systems only
- C) Hydraulic systems
- D) Pneumatic systems

Answer: A

Section II – Analytical MCQs

22. Which logic family provides higher noise immunity?

- A) TTL
- B) CMOS
- C) RTL
- D) DTL

Answer: B

23. Which device is suitable for controlling high-voltage appliances from a microcontroller?

- A) LED
- B) Relay
- C) Switch
- D) Sensor

Answer: B

24. Which ADC offers the best accuracy for low-speed measurements?

- A) Flash ADC
- B) Dual Slope ADC
- C) Successive Approximation ADC
- D) Counter ADC

Answer: B

25. The output of a DAC is

- A) Binary signal
- B) Analog voltage or current
- C) Clock pulse
- D) Digital pulse

Answer: B

26. Which DAC is easier to fabricate using integrated circuits?

- A) Weighted Resistor DAC
- B) R-2R Ladder DAC
- C) Counter DAC
- D) Dual Slope DAC

Answer: B

27. A thermistor is mainly used to measure

- A) Pressure
- B) Temperature
- C) Light
- D) Speed

Answer: B

28. TTL circuits generally operate at

- A) 3.3 V
- B) 5 V
- C) 12 V
- D) 24 V

Answer: B

29. Which interface device provides visual indication?

- A) Relay
- B) LED
- C) Motor
- D) Solenoid

Answer: B

30. Which converter changes an analog signal into digital form?

- A) DAC
- B) ADC
- C) Decoder
- D) Encoder

Answer: B

PART – B

Descriptive Questions

31. Explain digital interfacing and describe the different types of sensors used in digital systems.

- Digital interfacing is the process of connecting digital circuits or microprocessors with external input and output devices to exchange information.
- It enables communication between the digital system and the physical environment.

Types of Sensors

- Temperature Sensor (Thermistor): Measures temperature.
- Light Sensor (LDR): Detects light intensity.
- Pressure Sensor: Measures pressure.
- Proximity Sensor: Detects nearby objects without contact.
- Motion Sensor: Detects movement.
- Humidity Sensor: Measures moisture in air.

Applications

- Industrial automation
- Home automation
- Robotics
- Medical equipment
- Smart monitoring systems

32. Explain TTL and CMOS interfacing with switch, LED, relay, motor, and solenoid.

TTL (Transistor-Transistor Logic)

- Operates at 5 V.
- Faster switching speed.
- Higher power consumption.

CMOS (Complementary Metal Oxide Semiconductor)

- Low power consumption.
- High noise immunity.
- Widely used in modern digital circuits.

Interfacing Devices

- Switch: Used as a digital input.
- LED: Used for visual indication of output.
- Relay: Controls high-voltage or high-current loads.
- Motor: Converts electrical energy into mechanical motion.
- Solenoid: Produces linear mechanical movement.

Applications

- Embedded systems
- Industrial control
- Home automation
- Robotics

33. Explain the working principle of Successive Approximation ADC and Dual Slope ADC.

Analog-to-Digital Converter (ADC) converts analog signals into digital data.

Successive Approximation ADC

- Uses a Successive Approximation Register (SAR).
- Compares the input voltage with the DAC output.
- Performs binary search to obtain the digital equivalent.
- Provides high-speed and medium-to-high accuracy.
- Used in microcontrollers and data acquisition systems.

Dual Slope ADC

- Integrates the input voltage for a fixed time.
- Then integrates a reference voltage in the opposite direction.
- The time required is proportional to the input voltage.
- Highly accurate and immune to electrical noise.
- Used in digital voltmeters and precision instruments.

34. Explain the working principle of Weighted Resistor DAC and R-2R Ladder DAC.

Digital-to-Analog Converter (DAC) converts digital signals into analog voltage or current.

Weighted Resistor DAC

- Uses resistors weighted according to binary values.
- Each binary input controls a switch connected to a weighted resistor.
- Simple design but difficult to manufacture accurately for high-resolution systems.

R-2R Ladder DAC

- Uses only two resistor values (R and 2R).
- Easier to fabricate and provides better accuracy.
- Widely used in integrated circuits.

Applications of DAC

- Audio systems
- Signal generators
- Process control
- Communication systems
- Instrumentation

Analytical Descriptive Question

35. Compare Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC). Analyze the working, advantages, limitations, and applications of Successive Approximation ADC, Dual Slope ADC, Weighted Resistor DAC, and R-2R Ladder DAC.

Analog-to-Digital Converter (ADC)

- Converts analog signals into digital data.
- Used where analog sensor outputs must be processed by digital systems.

Types of ADC

- Successive Approximation ADC: Fast conversion, medium-to-high accuracy, suitable for embedded systems.
- Dual Slope ADC: High accuracy, excellent noise immunity, used in precision measuring instruments.

Digital-to-Analog Converter (DAC)

- Converts digital data into analog voltage or current.

Types of DAC

- Weighted Resistor DAC: Simple design but requires precision resistors.
- R-2R Ladder DAC: Uses only two resistor values, easier to implement, more accurate, and widely used in ICs.

Comparison

ADC	DAC
Converts analog to digital	Converts digital to analog
Used with sensors	Used with actuators and analog output devices
Input: Analog	Input: Digital
Output: Digital	Output: Analog

Applications

- Embedded systems
- Data acquisition systems
- Medical instruments
- Audio and video systems
- Industrial automation
- Robotics
- Communication systems

Unit: V

PART – A

Section I – Multiple Choice Questions

1. Memory is used to

- A) Generate signals
- B) Store data and instructions
- C) Amplify signals
- D) Convert analog signals

Answer: B

2. Memory read operation means

- A) Writing data into memory
- B) Retrieving data from memory
- C) Erasing memory
- D) Formatting memory

Answer: B

3. Memory write operation means

- A) Reading data
- B) Storing data into memory
- C) Deleting memory
- D) Compressing memory

Answer: B

4. Access time is

- A) Time taken to erase memory
- B) Time taken to read or write data
- C) Time taken to switch ON a computer
- D) Memory size

Answer: B

5. Memory capacity is measured in

- A) Volts
- B) Amperes
- C) Bits or Bytes
- D) Hertz

Answer: C

6. Address lines are used to

- A) Transfer data
- B) Select memory locations
- C) Generate clock signals
- D) Supply power

Answer: B

7. Word length refers to

- A) Number of memory chips
- B) Number of bits processed at a time
- C) Number of address lines
- D) Memory access time

Answer: B

8. ROM stands for

- A) Random Output Memory
- B) Read Only Memory
- C) Read Operation Memory
- D) Rapid Output Memory

Answer: B

9. RAM stands for

- A) Read Access Memory
- B) Random Access Memory
- C) Rapid Access Memory
- D) Random Analog Memory

Answer: B

10. Which memory is volatile?

- A) ROM
- B) RAM
- C) Flash ROM
- D) EEPROM

Answer: B

11. Which memory retains data after power is OFF?

- A) RAM
- B) SRAM
- C) ROM
- D) Cache

Answer: C

12. Flash memory is mainly used in

- A) Hard disks only
- B) Pen drives and SD cards
- C) Registers
- D) Counters

Answer: B

13. SSD stands for

- A) Solid State Disk
- B) Solid State Drive
- C) Storage System Device
- D) Static Storage Drive

Answer: B

14. Cache memory is

- A) Secondary memory
- B) High-speed memory
- C) Permanent memory
- D) External memory

Answer: B

15. Which memory is fastest?

- A) Hard Disk
- B) RAM
- C) Cache Memory
- D) CD-ROM

Answer: C

16. PLD stands for

- A) Programmable Logic Device
- B) Process Logic Device
- C) Parallel Logic Device
- D) Program Load Device

Answer: A

17. PLA stands for

- A) Programmable Logic Array
- B) Parallel Logic Architecture
- C) Program Logic Adapter
- D) Processor Logic Array

Answer: A

18. Fixed logic circuits are

- A) Reprogrammable
- B) User programmable
- C) Permanently designed
- D) Temporary circuits

Answer: C

19. Programmable logic devices are mainly used for

- A) Audio amplification
- B) Implementing digital logic functions
- C) Voltage regulation
- D) Memory storage

Answer: B

20. Pen drives use

- A) Magnetic storage
- B) Flash memory
- C) Optical storage
- D) Paper tape

Answer: B

21. SD card is mainly used s

- A) Temporary memory
- B) Portable storage device
- C) Cache memory
- D) Register

Answer: B

Section II – Analytical MCQs

22. Which memory loses data when power is switched OFF?

- A) ROM
- B) RAM
- C) Flash ROM
- D) EEPROM

Answer: B

23. A memory with 16 address lines can access

- A) 256 locations
- B) 1024 locations
- C) 65,536 locations
- D) 32 locations

Answer: C

24. Which memory is suitable for BIOS storage?

- A) RAM
- B) ROM
- C) Cache
- D) Register

Answer: B

25. Which storage device has no moving mechanical parts?

- A) Hard Disk Drive
- B) SSD
- C) CD-ROM
- D) DVD

Answer: B

26. Flash ROM differs from RAM because it is

- A) Volatile
- B) Non-volatile
- C) Slower than RAM only
- D) Temporary memory

Answer: B

27. PLA consists of

- A) Fixed AND and Fixed OR arrays
- B) Programmable AND and Programmable OR arrays
- C) Fixed NOT gates only
- D) Memory cells only

Answer: B

28. Memory hierarchy improves

- A) Processing speed
- B) Storage cost
- C) Memory organization
- D) All of the above

Answer: D

29. Which device is commonly used for portable digital storage?

- A) Register
- B) Pen Drive
- C) Decoder
- D) Multiplexer

Answer: B

30. The main advantage of programmable logic over fixed logic is

- A) Lower speed
- B) Design flexibility
- C) Higher power consumption
- D) Larger size

Answer: B

PART – B

Descriptive Questions

31. Explain the basic concepts of memory, including memory read, memory write, access time, memory capacity, address lines, and word length.

- Memory: Stores data and program instructions in a computer system.
- Memory Read: Process of retrieving stored data from a memory location.
- Memory Write: Process of storing data into a memory location.
- Access Time: Time required to read or write data from memory.
- Memory Capacity: Total amount of data that can be stored, measured in bits or bytes.
- Address Lines: Used to identify or select a particular memory location. For n address lines, the number of memory locations is 2^n .

- Word Length: Number of bits processed or transferred at one time (e.g., 8-bit, 16-bit, 32-bit, or 64-bit).

Applications: Computers, embedded systems, mobile devices, and digital controllers.

32. Explain the different types of ROM and RAM. Discuss memory hierarchy and memory management.

Types of ROM

- Mask ROM: Programmed during manufacturing.
- PROM: Can be programmed once.
- EPROM: Can be erased using ultraviolet light and reprogrammed.
- EEPROM: Electrically erasable and reprogrammable.
- Flash ROM: A type of EEPROM that can erase and write data in blocks.

Types of RAM

- SRAM (Static RAM):
 - Fast access speed.
 - Does not require refreshing.
 - Used in cache memory.
- DRAM (Dynamic RAM):
 - Requires periodic refreshing.
 - Slower than SRAM.
 - Used as the main memory.

Memory Hierarchy

Registers → Cache → Main Memory (RAM) → Secondary Memory (SSD/HDD)

Memory Management

- Allocation and deallocation of memory.
- Efficient utilization of available memory.
- Protection and sharing of memory among programs.

33. Explain the differences between Flash ROM and NVRAM. Describe the operation of a Pen Drive, SD Card, and Solid-State Hard Disk (SSD).

Difference between Flash ROM and NVRAM

Flash ROM	NVRAM
Non-volatile memory	Non-volatile memory
Erases data in blocks	Data can often be updated directly, depending on the technology
Lower write speed	Generally faster write access
Widely used in storage devices	Used for configuration and system settings
Lower cost	Higher cost

Operation of Pen Drive

- Uses flash memory to store data.
- Connects through a USB interface.
- Data is retained even when power is removed.

Operation of SD Card

- Uses flash memory for portable storage.
- Commonly used in cameras, mobile phones, and tablets.

Operation of SSD

- Uses NAND flash memory chips.
- Has no moving mechanical parts.
- Provides high-speed data access, low power consumption, and improved reliability.

34. Explain fixed logic and programmable logic. Describe the architecture of a Programmable Logic Array (PLA).

Fixed Logic

- Logic functions are permanently defined during manufacturing.
- Cannot be modified after fabrication.
- Used in dedicated hardware circuits.

Programmable Logic

- Logic functions can be programmed by the user.
- Flexible and reusable.
- Reduces hardware complexity and development time.

Difference

Fixed Logic	Programmable Logic
Permanent design	User programmable
Less flexible	Highly flexible
Lower design cost for mass production	Faster development for customized designs

PLA Architecture

- Consists of a programmable AND array followed by a programmable OR array.
- Generates product terms in the AND array.
- Combines them in the OR array to implement Boolean functions.
- Widely used in digital system design for implementing combinational logic.

Analytical Descriptive Question (1 × 10 = 10 Marks)

35. Compare different memory technologies (ROM, RAM, Flash ROM, and NVRAM) with respect to their characteristics and applications. Analyze the importance of memory hierarchy and programmable logic devices (PLDs) in modern digital systems.

Memory Technologies

- ROM: Non-volatile; stores permanent programs such as firmware and BIOS.
- RAM: Volatile; stores temporary data during program execution.
- Flash ROM: Non-volatile; used in pen drives, SD cards, SSDs, and embedded systems.
- NVRAM: Non-volatile; retains data without power and is commonly used for system configuration and critical settings.

Memory Hierarchy

The memory hierarchy consists of:

1. Registers
2. Cache Memory
3. Main Memory (RAM)
4. Secondary Memory (SSD/HDD)

This hierarchy balances speed, storage capacity, and cost, ensuring efficient system performance.

Programmable Logic Devices (PLDs)

PLDs allow users to implement and modify digital logic functions without redesigning hardware.

Advantages

- Flexible and reprogrammable.
- Faster design cycle.
- Reduced hardware complexity.
- Lower development cost for custom logic.

Applications

- Embedded systems
- Industrial automation
- Communication systems
- Consumer electronics
- Computer hardware