WB Board Class 12 Modern Computer Applications Question Paper with Solutions(Memory Based)

Time Allowed :3 Hour	Maximum Marks :60	Total Questions :24

General Instructions

Read the following instructions very carefully and strictly follow them:

- Answers to this Paper must be written on the paper provided separately.
- You will not be allowed to write during the first 15 minutes
- This time is to be spent in reading the question paper.
- The time given at the head of this Paper is the time allowed for writing the answers,
- The paper has four Sections.
- Section A is compulsory - All questions in Section A must be answered.
- You must attempt one question from each of the Sections B, C and D and one other question from any Section of your choice.

1. Realize the basic gates (AND, OR, NOT) using only NAND or NOR universal gates.

Correct Answer: Basic gates can be implemented using only NAND or only NOR gates because they are universal gates.

Solution: Concept: NAND and NOR are called **universal gates** because:

- Any Boolean function can be implemented using only NAND gates.
- Any Boolean function can also be implemented using only NOR gates.

Part A: Using NAND Gates Only
Step 1: NOT gate using NAND.
Tie both inputs together:

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

Thus, a NAND gate acts as a NOT gate.
Step 2: AND gate using NAND.
First NAND gives:

$$(A \cdot B)'$$

Then pass through another NAND (as NOT):

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

Step 3: OR gate using NAND.
Using De Morgan's law:

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

Implementation:

- Use two NAND gates as NOT gates to get A' and B'.
- Feed them into a NAND gate to get OR output.

Part B: Using NOR Gates Only
Step 4: NOT gate using NOR.
Tie inputs together:

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

Step 5: OR gate using NOR.
First NOR gives:

$$(A + B)'$$

Apply NOR again as inverter:

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

Step 6: AND gate using NOR.
Using De Morgan's law:

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

Implementation:

- Use two NOR gates as NOT gates to get A' and B'.
- Feed into another NOR gate to obtain AND output.

Conclusion:
Both NAND and NOR gates can independently realize NOT, AND, and OR gates, proving they are universal gates.

Quick Tip

Remember: NAND → AND with double inversion, NOR → OR with double inversion. Both use De Morgan's laws.

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2. Explain the working of a 4×1 Multiplexer (MUX) with its function table and logic circuit.

Correct Answer: A 4×1 MUX selects one of four inputs and forwards it to a single output based on two select lines.

Solution: Concept: A Multiplexer (MUX) is a **data selector** circuit that:

- Selects one input from multiple inputs.

- Sends the selected input to a single output line.

A 4×1 MUX has:

- 4 data inputs: I_0, I_1, I_2, I_3
- 2 select lines: S_1, S_0
- 1 output: Y

Step 1: Working principle.
The select lines determine which input is connected to the output:

- Binary combination of select lines acts as an address.
- Output equals the selected input.

Step 2: Function table.

S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

Step 3: Logic expression.
Using sum of products:

$$Y = \overline{S_1}\,\overline{S_0}\,I_0 + \overline{S_1}S_0I_1 + S_1\overline{S_0}I_2 + S_1S_0I_3.$$

Step 4: Logic circuit description.

- Use NOT gates to generate $\overline{S_1}$ and $\overline{S_0}$.
- Use four AND gates:
  - AND1: $\overline{S_1S_0}I_0$
  - AND2: $\overline{S_1}S_0I_1$
  - AND3: $S_1\overline{S_0}I_2$
  - AND4: $S_1S_0I_3$
- Combine outputs using one OR gate to get Y.

Step 5: Applications.

- Data routing in digital systems
- Communication switching
- CPU data selection
- Parallel-to-serial data conversion

Conclusion:
A 4×1 MUX uses two select lines to choose one of four inputs and route it to a single output using logic gates based on a sum-of-products expression.

Quick Tip

Number of select lines = $\log_2$(number of inputs). For 4 inputs $\rightarrow \log_2 4 = 2$ select lines.

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3. Prove the De Morgan's Theorems using a truth table.

Correct Answer: De Morgan's theorems are verified by showing equivalence using truth tables:

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

Solution: Concept: De Morgan's Theorems are fundamental Boolean algebra laws:

- Complement of AND = OR of complements
- Complement of OR = AND of complements

We prove both using truth tables.

Theorem 1: $(A \cdot B)' = A' + B'$
Step 1: Construct the truth table.

A	B	$A \cdot B$	$(A \cdot B)'$	$A' + B'$
0	0	0	1	1
0	1	0	1	1
1	0	0	1	1
1	1	1	0	0

Observation: Columns $(A \cdot B)'$ and $A' + B'$ are identical. Hence proved.

Theorem 2: $(A + B)' = A' \cdot B'$
Step 2: Construct the truth table.

A	B	$A + B$	$(A + B)'$	$A' \cdot B'$
0	0	0	1	1
0	1	1	0	0
1	0	1	0	0
1	1	1	0	0

Observation: Columns $(A + B)'$ and $A' \cdot B'$ are identical. Hence proved.

Conclusion:
Both De Morgan's Theorems are verified using truth tables:

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

Thus, the complement of AND becomes OR of complements, and vice versa.

Quick Tip

Remember: **Break the bar, change the gate**. NOT(AND) → OR with inverted inputs, NOT(OR) → AND with inverted inputs.

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4. Differentiate between Guided (Twisted Pair, Fiber Optic) and Unguided (Radio, Microwave) transmission media.

Correct Answer: Guided media use physical cables for signal transmission, while unguided media transmit signals wirelessly through air or space.

Solution: Concept: Transmission media are classified based on how signals travel from sender to receiver:

- Guided (Wired) Media
- Unguided (Wireless) Media

Step 1: Guided Transmission Media.

- Signals travel through **physical cables**.
- Path is fixed and controlled.

Examples:

- **Twisted Pair Cable:**
  - Two copper wires twisted together.
  - Used in telephones and LANs.
  - Low cost but limited bandwidth.
- **Fiber Optic Cable:**
  - Uses light signals through glass fibers.
  - Very high speed and bandwidth.
  - Immune to electromagnetic interference.

Step 2: Unguided Transmission Media.

- Signals travel through **air or vacuum**.
- No physical connection required.

Examples:

- **Radio Waves:**
  - Used in broadcasting and Wi-Fi.
  - Can travel long distances.

- **Microwaves:**
  - Used in satellite and mobile communication.
  - Requires line-of-sight transmission.

Step 3: Key Differences.

Feature	Guided Media	Unguided Media
$Medium$	$Physical cables$	$Air/space$
$Reliability$	$More stable$	$More interference$
$Speed$	$High (especially fiber)$	$Moderate to high$
$Mobility$	$Limited$	$High (wireless)$

Conclusion:
Guided media provide secure and stable communication through cables, while unguided media enable wireless communication with greater flexibility and mobility.

Quick Tip

Guided = Wired (controlled path), Unguided = Wireless (signals travel freely in air).

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5. Explain the difference between Packet Switching and Circuit Switching.

Correct Answer: Circuit switching establishes a dedicated path for the entire communication, while packet switching breaks data into packets that travel independently across shared networks.

Solution: Concept: Switching techniques define how data is transmitted across a network. Two major methods are:

- Circuit Switching
- Packet Switching

Step 1: Circuit Switching.

- A **dedicated communication path** is established before data transfer.
- The path remains reserved for the entire session.
- Continuous transmission without interruption.
- Example: Traditional telephone networks.

Working:

- Call setup → Dedicated channel created.
- Data flows continuously.
- Channel released after communication ends.

Step 2: Packet Switching.

- Data is divided into **small packets**.
- Each packet travels independently.
- No dedicated path; uses shared network resources.
- Example: Internet communication.

Working:

- Message split into packets.
- Packets routed dynamically.
- Reassembled at destination.

Step 3: Key Differences.

Feature	Circuit Switching	Packet Switching
$Path$	$Dedicated$	$Shared$
$SetupTime$	$Required$	$Minimal$
$Efficiency$	$Low(idlechannelpossible)$	$High(efficientuseofbandwidth)$
$Reliability$	$Stableconnection$	$Packetsmaytakedifferentroutes$
$Example$	$Telephonesystem$	$Internet$

Conclusion:
Circuit switching provides a fixed, reliable communication path, while packet switching offers flexible and efficient data transmission by sending data in packets over shared networks.

Quick Tip

Circuit Switching = Dedicated line (like phone calls), Packet Switching = Data broken into packets (like the Internet).

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6. Create an HTML Table showing "Subject" and "Marks" with a border of 2 pixels.

Correct Answer: Use the `<table>` tag with `border="2"` and include columns for Subject and Marks.

Solution: Concept: To create a table in HTML:

- `<table>` defines the table.
- `border` attribute sets the border thickness.
- `<tr>` defines rows.
- `<th>` defines headings.

- `<td>` defines table data cells.

Step 1: Create the table structure.
Use the `<table>` tag with border value 2.
Step 2: Add table headings.
Use `<th>` for column titles: Subject and Marks.
Step 3: Add data rows.
Insert rows using `<tr>` and data using `<td>`.
Step 4: Complete HTML code.

```
<!DOCTYPE html>
<html>
<head>
    <title>Subject Marks Table</title>
</head>
<body>

<table border="2">
    <tr>
        <th>Subject</th>
        <th>Marks</th>
    </tr>
    <tr>
        <td>Maths</td>
        <td>90</td>
    </tr>
    <tr>
        <td>Science</td>
        <td>85</td>
    </tr>
</table>

</body>
</html>
```

Conclusion:
The table displays Subject and Marks with a 2-pixel border using the `border="2"` attribute.

Quick Tip

Use `<th>` for headings and set border thickness using `border="value"` inside the `<table>` tag.

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7. What is the difference between a Static and Dynamic webpage?

Correct Answer: Static webpages display fixed content, while dynamic webpages generate content dynamically based on user interaction or server-side processing.

Solution: Concept: Webpages are categorized based on how their content is created and displayed:

- Static Webpages
- Dynamic Webpages

Step 1: Static Webpage.

- Content is **fixed and pre-written**.
- Same information is shown to all users.
- Created using HTML and CSS only.
- No database or server-side scripting required.
- Example: Simple personal websites.

Step 2: Dynamic Webpage.

- Content is **generated dynamically**.
- Changes based on user input, time, or database.
- Uses server-side languages (PHP, Python, Node.js).
- Often connected to databases.
- Example: Social media sites, e-commerce websites.

Step 3: Key Differences.

Feature	**Static Webpage**	**Dynamic Webpage**
$Content$	$Fixed$	$Changing$
$Technology$	$HTML, CSS$	$Server-sidescripting + database$
$Interactivity$	Low	$High$
$Speed$	$Faster(simple)$	$Slightlyslower(processingneeded)$
$Maintenance$	$Easy$	$Morecomplex$

Conclusion:
Static webpages provide fixed content and are simple to build, whereas dynamic webpages offer interactive and personalized content using backend processing.

Quick Tip

Static = Same content for everyone, Dynamic = Content changes based on user or data.

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8. Write the steps to use the VLOOKUP function to find data in a large spreadsheet.

Correct Answer: Use VLOOKUP by specifying the lookup value, table range, column index, and match type to retrieve data from large spreadsheets.

Solution: Concept: VLOOKUP (Vertical Lookup) is used in MS Excel to search for a value in the first column of a table and return corresponding data from another column.
Syntax:

```
=VLOOKUP(lookup_value, table_array, col_index_num, [range_lookup])
```

Step 1: Organize your data.

- Ensure the lookup value is in the **first column** of the table.
- Arrange data in a clear tabular format.

Step 2: Select the cell for the result.
Click the cell where you want the lookup result to appear.
Step 3: Enter the VLOOKUP formula.
Example:

```
=VLOOKUP(A2, B2:D100, 2, FALSE)
```

Where:

- A2 → Lookup value
- B2:D100 → Table range
- 2 → Column number to return value from
- FALSE → Exact match

Step 4: Choose match type.

- FALSE → Exact match (most common)
- TRUE → Approximate match (sorted data required)

Step 5: Press Enter and copy formula.

- Press Enter to get result.
- Drag fill handle to apply to multiple rows.

Step 6: Check for errors.

- #N/A → Value not found
- Use IFERROR for cleaner output:

  ```
  =IFERROR(VLOOKUP(...), "Not Found")
  ```

Conclusion:
VLOOKUP helps efficiently search and retrieve data from large spreadsheets by matching a value in the first column and returning related data.

Quick Tip

Remember order: Lookup value → Table range → Column number → Exact/Approx match.

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9. What is Data Normalization, and why is it necessary for a database?

Correct Answer: Data normalization is the process of organizing database data to reduce redundancy and improve integrity, making databases efficient and consistent.

Solution: Concept: Data Normalization is a database design technique used to:

- Organize data into structured tables.
- Eliminate redundancy (duplicate data).
- Maintain data consistency.

Step 1: Definition of Data Normalization.
Normalization is the process of dividing a database into smaller related tables and defining relationships between them to minimize duplication and dependency.
Step 2: Goals of normalization.

- Reduce data redundancy.
- Improve data integrity.
- Simplify database maintenance.
- Avoid anomalies (insert, update, delete).

Step 3: Why normalization is necessary.

- **Prevents duplication:** Same data is not stored repeatedly.
- **Ensures consistency:** Updates occur in one place.
- **Improves efficiency:** Smaller tables and faster queries.
- **Better data organization:** Logical structure.

Step 4: Example.
Instead of storing student and course data together:

- Create separate tables: Students, Courses, Enrollments.
- Link them using keys.

Step 5: Normal Forms.
Normalization is achieved through stages called normal forms:

- 1NF — Remove repeating groups.
- 2NF — Remove partial dependencies.
- 3NF — Remove transitive dependencies.

Conclusion:
Data normalization is essential for designing efficient and reliable databases by reducing redundancy, improving consistency, and ensuring structured data organization.

Quick Tip

Normalization = Split data into related tables to remove duplication and maintain consistency.
