

## Assignment :- 6.

(1) What is the full form of PLD? Explain different types of PLD's in detail.

→ PLD stands for Programmable Logic device.

→ It is an electronic component used to build reconfigurable digital circuits.

→ Unlike fixed-function logic gates, a PLD can be programmed to perform various logic functions based on the user's needs, making it flexible and adaptable.

→ Types of PLDs:-

(i) Simple programmable logic devices (SPLDs) :-

→ SPLDs are the simplest form of PLDs, designed for basic logic functions. They usually contain a small number of gates and flip-flops.

→ Example: PROM (Programmable Read-only memory), PAL (Programmable Array Logic), GAL (Generic Array Logic).

→ PROM (Programmable Read-Only Memory) :-

Programmable memory used mainly for storing data.

→ It has a fixed AND plane and a programmable OR plane, used more for memory-related applications than logic functions.



→ PAL (Programmable Array Logic):  
Has a fixed OR plane and a programmable AND plane.

→ Mainly used for combinational logic designs and less for sequential logic.

→ GAL (Generic Array Logic):

- An improved version of PAL that can be erased and reprogrammed multiple times.

→ Offers more flexibility and reusability compared to standard PAL.

## 2 (2) Complex Programmable Logic Devices (CPLDs)

→ CPLDs are more advanced than SPLDs, containing multiple blocks of logic, each block having programmable AND and OR gates.

→ They can handle more complex logic functions and are used for more sophisticated applications than SPLDs.

→ CPLDs are non-volatile, meaning they retain their configuration even when the power is turned off.



### (3) Field Programmable Gate Arrays (FPGAs).

- FPGAs are the most advanced types of PLDs. They consist of an array of programmable logic blocks and interconnects, allowing complex circuit designs.
- Each block in a FPGA can be configured to perform a specific function, and the blocks can be connected in various ways, allowing highly customizable designs.

### (2) Write a short note on ROM (Read only memory)

- Read - Only Memory (ROM) is a type of non-volatile memory used in computers and other electronic devices to store data that does not change and needs to be preserved even when the device is powered off.
- Unlike Random Access Memory (RAM), which is volatile and used for temporary storage, ROM retains its contents permanently.
- Non-volatile : Data is retained even when power is turned off.
- Pre-programmed: ROM is often programmed during manufacturing, storing firmware or software that doesn't need frequent updates.
- Read-only : Data stored in ROM cannot be modified easily ; it is "read-only", meaning



the system can only read the data, not write or alter it under normal operations.

- Types of ROM:-

- (1) PROM (Programmable ROM): Can be programmed once after manufacturing, but not re-written.
- (2) EPROM (Erasable Programmable ROM): Can be erased (usually with UV light) and reprogrammed.
- (3) EEPROM (Electrically Erasable Programmable ROM): Can be electrically erased and reprogrammed multiple times.

- Application :-

→ ROM is commonly used for storing firmware, embedded systems, and other permanent instructions critical for the basic functioning of a device.

- (3) What is the full form of PLA and explain PLA in detail.

→ The full form of PLA is programmable Logic array.

→ A programmable Logic Array (PLA) is a type of programmable Logic device used to implement combinational logic circuits.

→ It consists of two programmable planes:



- Programmable AND plane : Allows for the customiz<sup>n</sup> of AND gates.
- Programmable OR Plane : Allows for the customiz<sup>n</sup> of OR gates.
- PLAs are more flexible than fixed-function logic circuits because they can be programmed to perform different logic operations depending on the user's needs.
- This makes PLAs useful for custom digital circuits where specific logic functions are required.
- A PLA takes multiple inputs and produces outputs based on the combination of the inputs and the programmed logic.
- You can program the connections in both the AND and OR planes to create a specific truth table, defining the output for any set of input combinations.
- PLAs can be programmed to implement any combinational logic function.
- Since both the AND and OR planes are programmable, it allows for a high degree of customization compared to fixed-function logic devices.



- It reduces the need for multiple fixed gates, allowing for more compact designs.
- As the number of inputs and outputs increases, the size of the PLA grows, which can lead to slower operation.
- PLAs are more flexible than PALs but are also more complex and expensive to implement.
- PLAs are used in digital systems for custom logic applications, such as designing state machines, implementing control units, or performing specific data manipulations in embedded systems.

#### (4) Explain the Programmable Array Logic (PAL)

- Programmable Array Logic (PAL) is a type of programmable logic device (PLD) used to implement digital logic circuits.
- PALs are designed to simplify and reduce the complexity of digital circuits by allowing the user to customize certain portions of the device to perform specific logic functions.
- In a PAL, the OR plane is fixed, meaning the connections between the AND gates



and the OR gates are predefined and cannot be altered.

- The AND gate plane is programmable, allowing customization of the inputs to the AND gates.
- The AND gate plane receives input signals and creates various logic combinations (minterms).
- The inputs go through the programmable AND plane, where different combinations of input variables are generated by configuring the AND gates.
- This allows the creation of specific logic conditions.
- These combinations of AND gate outputs are then passed through a predefined OR plane, where the final logic functions are generated.
- Because only the AND plane is programmable and the OR plane is fixed, PAL devices are less flexible than Programmable Logic Arrays (PLAs), but they offer the advantage of being faster and less expensive due to simpler internal structures.
- Allows for a customizable logic circuit design by enabling programming of the AND gates.
- The OR gates are predefined and cannot be changed by the user.



- Since the OR plane is fixed, PAL devices are generally faster than PLAs.
- PAL devices are used in digital circuits where specific logic functions need to be implemented quickly and efficiently, such as in control units, address decoding, and simple combinational logic applications.

(5) Give comparisons between PLA and PAL.

PLA (Programmable Logic Array)

PAL (Programmable Array Logic)

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| → Both AND and OR planes are programmable                            | → Only the AND plane is programmable, OR plane is fixed. |
| → High flexibility due to fully programmable logic planes            | → Less flexibility since the OR plane is fixed.          |
| → Generally slower due to complex programmability.                   | → Faster due to simpler, fixed OR plane.                 |
| → More complex to design and program due to dual programmable planes | → Simpler design and easier to program.                  |



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|--|---|
| <p>→ Can implemented more complex logic functions.</p>                       | <p>→ Limited to simpler logic functions.</p>                                      |
| <p>→ More complex to design and program due to dual programmable planes.</p> | <p>→ Simpler design and easier to program.</p>                                    |
| <p>→ Can implemented more complex logic functions.</p>                       | <p>→ Limited to simpler Logic functions.</p>                                      |
| <p>→ More expensive due to complexity and higher flexibility.</p>            | <p>→ Less expensive because of reduced programmability.</p>                       |
| <p>→ Used in more complex and customizable digital circuits.</p>             | <p>→ Used in simpler applications where speed is important.</p>                   |
| <p>→ May consume more Power due to increased complexity</p>                  | <p>→ Consumes less power because of the fixed OR plane.</p>                       |
| <p>→ Less commonly used in simpler designs due to complexity.</p>            | <p>→ More commonly used in commercial applications for basic logic functions.</p> |
| <p>→ Larger circuit size due to full programmability</p>                     | <p>→ smaller circuit size due to fixed OR plane.</p>                              |