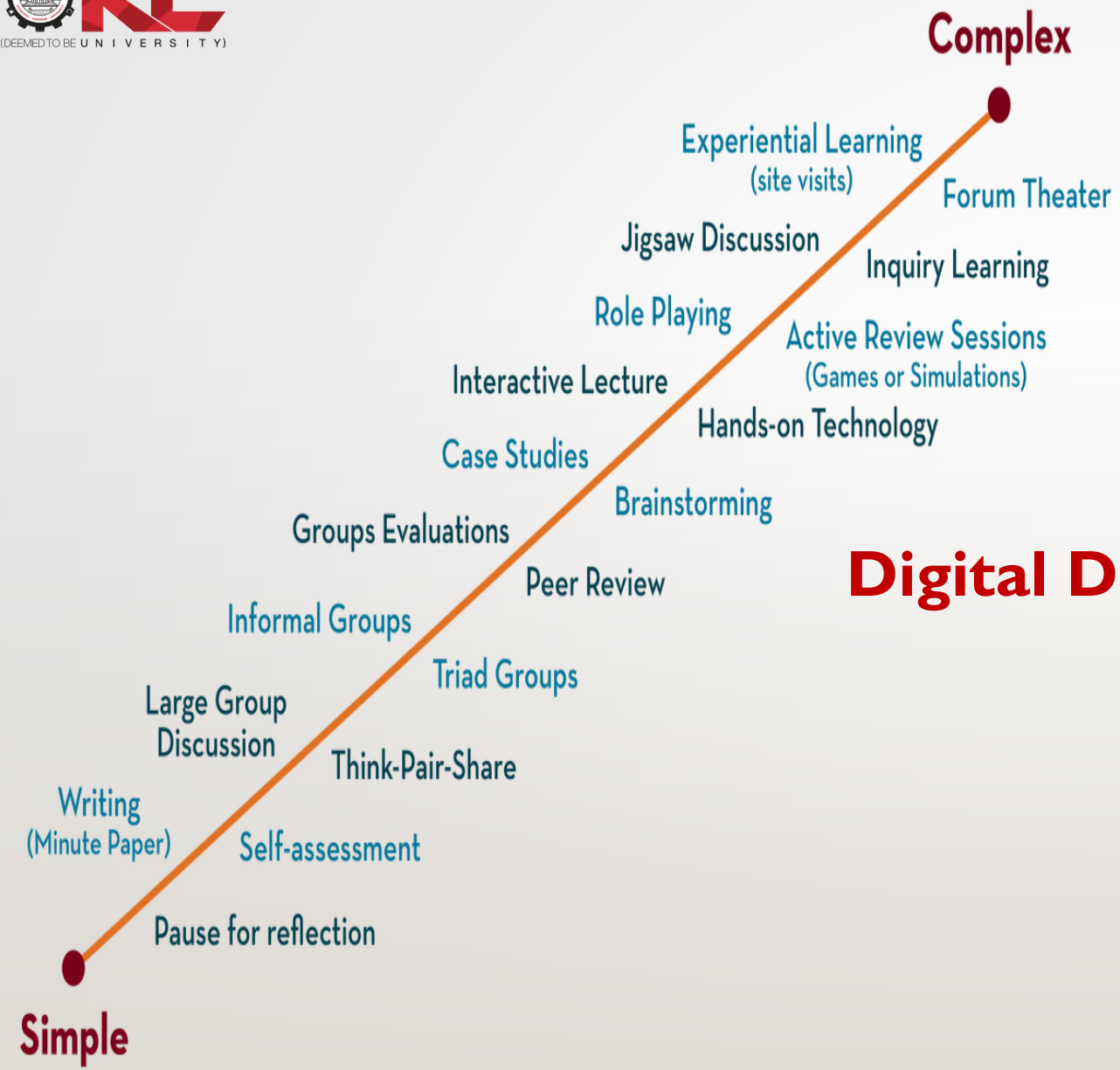


Department of BES-II

Digital Design and Computer Architecture

23EC1202

Topic:

PLD'S, PROM

Session No: 07

AIM OF THE SESSION

To familiarize students with the basic concept of PLD's and PROM.

INSTRUCTIONAL OBJECTIVES

This Session is designed to:

1. Gain the insights into the classification of PLD's and its importance in digital design.
2. Understand the concept of PROM as a type of memory that can be programmed once and read many times.

LEARNING OUTCOMES

At the end of this session, you should be able to:

1. Design and implement flexible digital logic circuits using PLDs, allowing for customizable solutions to various digital design challenges.
2. Understand how to utilize PROM for storing fixed data and configuration information in digital systems.

Session Introduction: Purpose of PLD's

Problems by Using Basic Gates

- Many components on PCB: As no. of components rise, nodes interconnection complexity grow exponentially.
- Growth in interconnection will cause increase in interference, PCB size, PCB design cost, and manufacturing time.

Purpose of PLD's:

- The purpose of a PLD device is to permit elaborate digital logic designs to be implemented by the user in a single device.
- Can be erased electrically and reprogrammed with a new design, making them very well suited for academic and prototyping.

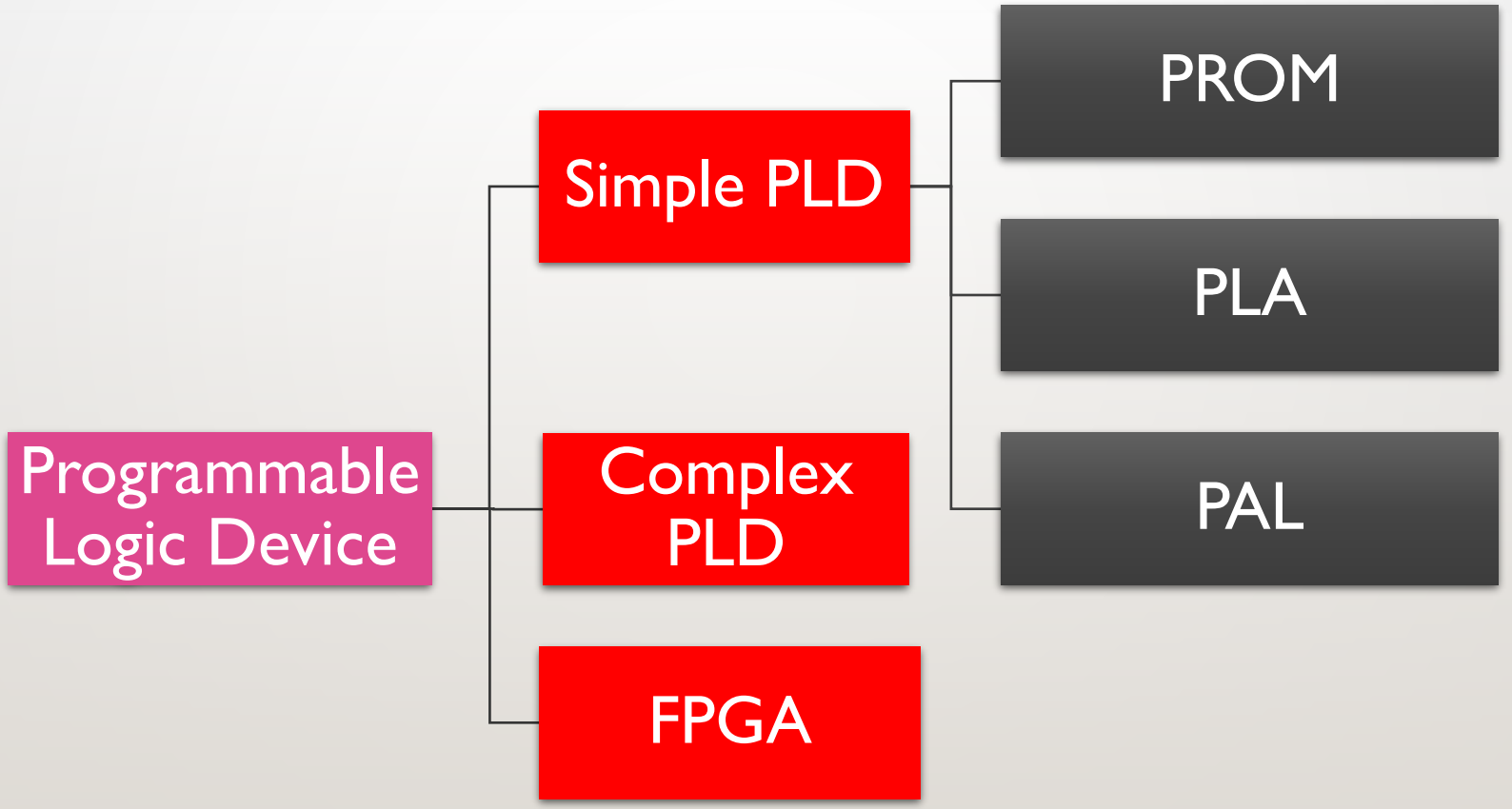
PROGRAMMABLE LOGIC DEVICES (PLD)

A Programmable Logic Device (PLD) is a type of digital integrated circuit that can be programmed or configured by the user to implement various digital logic functions.

Key characteristics of PLDs include:

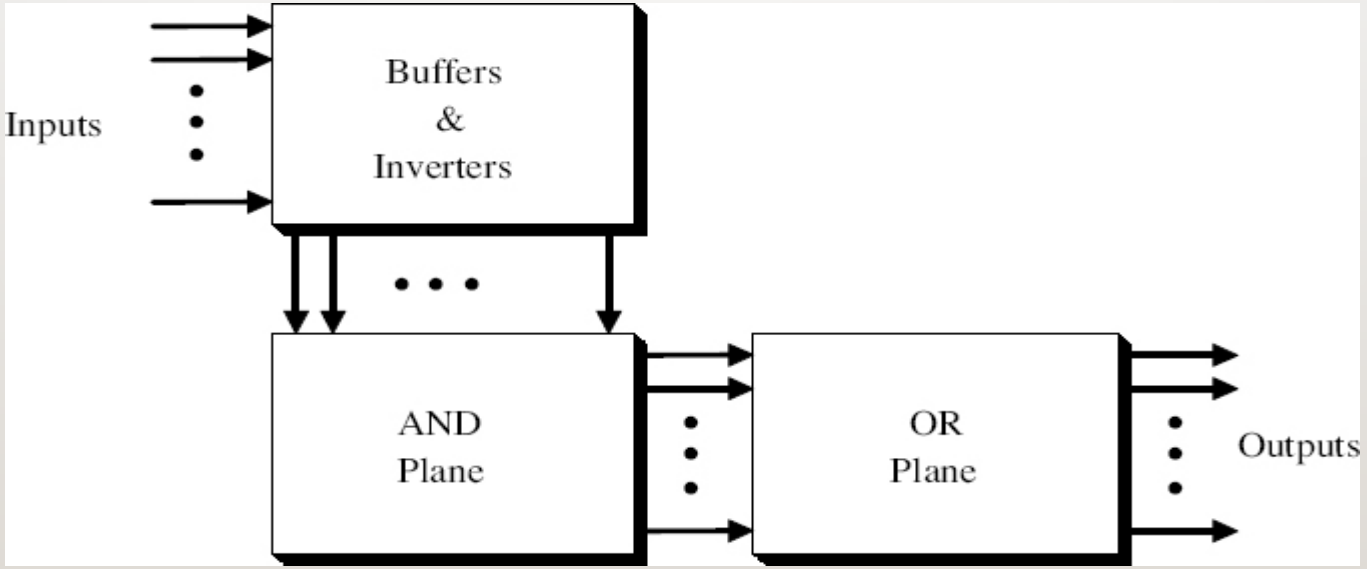
- Programmability
- Reprogrammability
- Configurable Logic Blocks (CLBs)
- Interconnectivity

Classification of PLD's



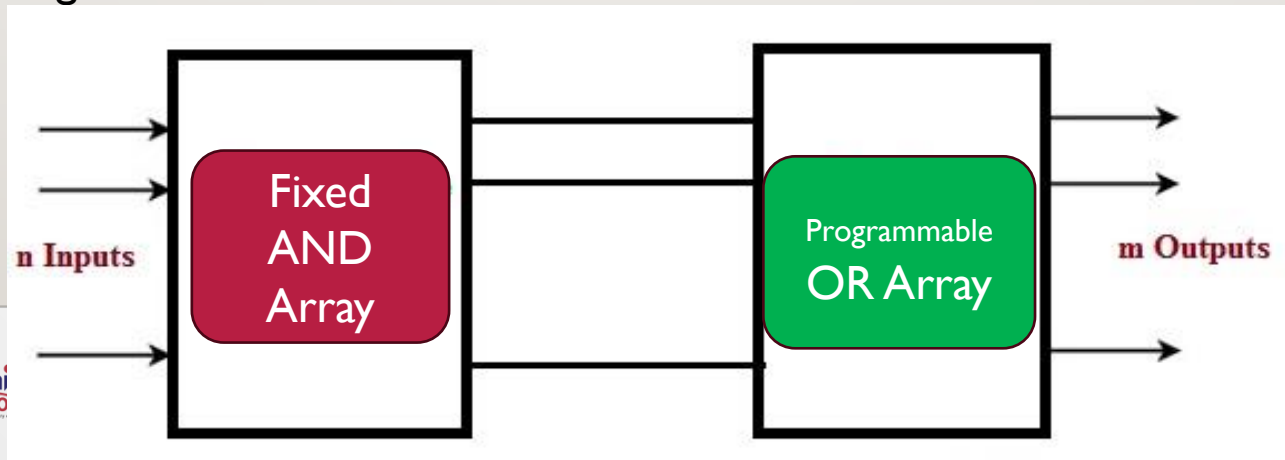
SIMPLE PROGRAMMABLE LOGIC DEVICES (SPLD)

- Simple Programmable Logic Devices (SPLDs) are the integrated circuits which contains an array of AND gates & another array of OR gates.
- Three kinds of SPLD's are PROM, PAL and PLA.

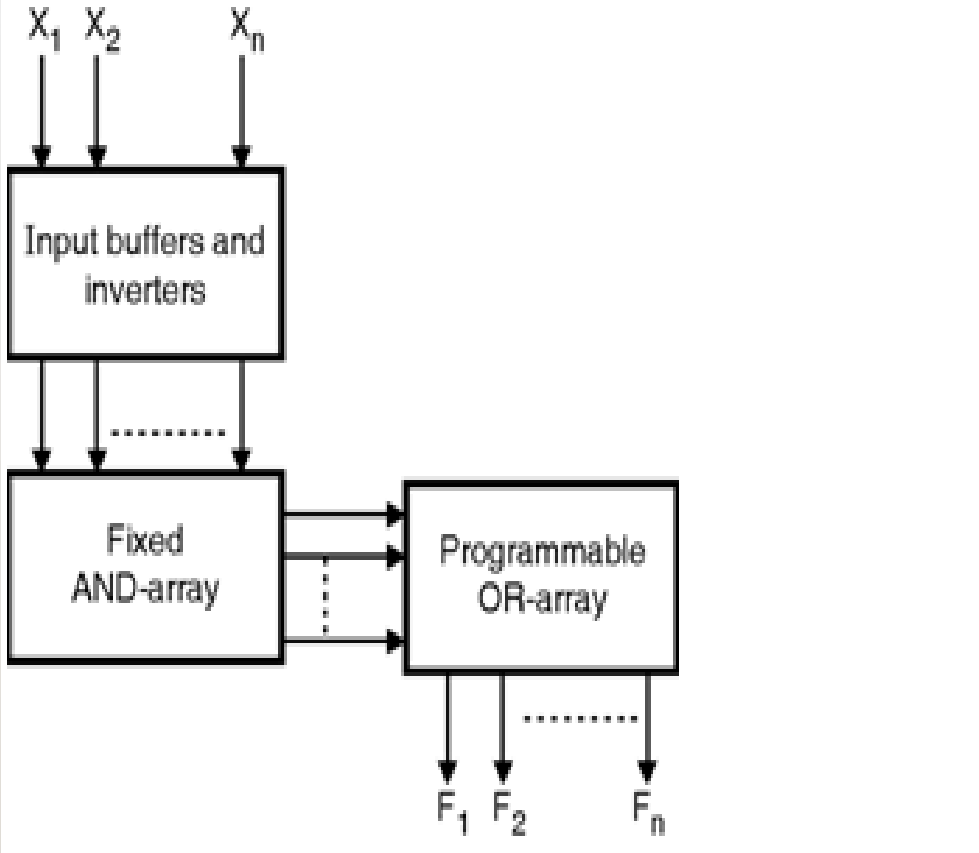


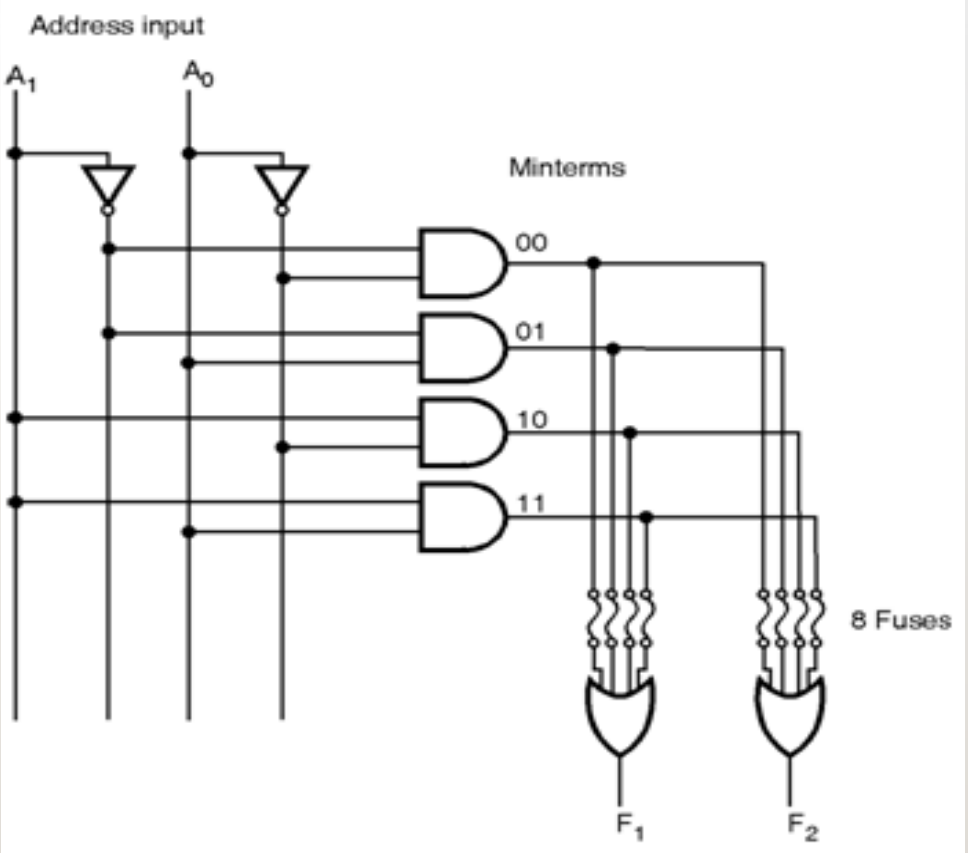
PROGRAMMABLE READ ONLY MEMORY (PROM)

- PROM is a programmable logic device that has fixed AND array & Programmable OR array.
- PROM is a type of non-volatile memory that can be programmed by the user to store fixed data or program code.
- PROM can be programmed once, and the programmed data cannot be changed afterward.
- There are other types of programmable memory like EPROM (Erasable Programmable Read-Only Memory) and EEPROM (Electrically Erasable Programmable Read-Only Memory), which allow for reprogramming under certain conditions.



Block diagram of PROM



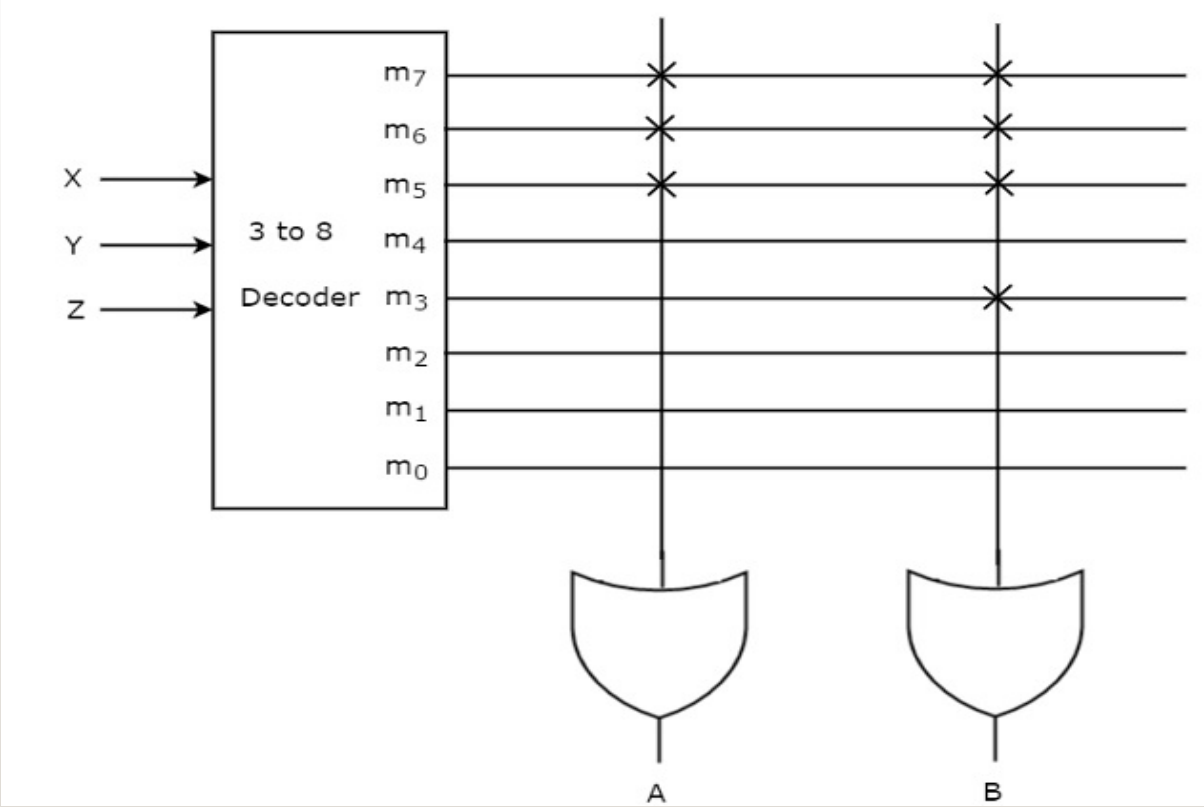


Implementation using PROM

Example: Implement the following Boolean functions using PROM.

$$A\,(X,Y,Z) = \sum m\,(5,6,7) \qquad B\,(X,Y,Z) = \sum m\,(3,5,6,7)$$

We require a 3 to 8 decoder (as we have 3 inputs) and two programmable OR gates for producing A & B functions.

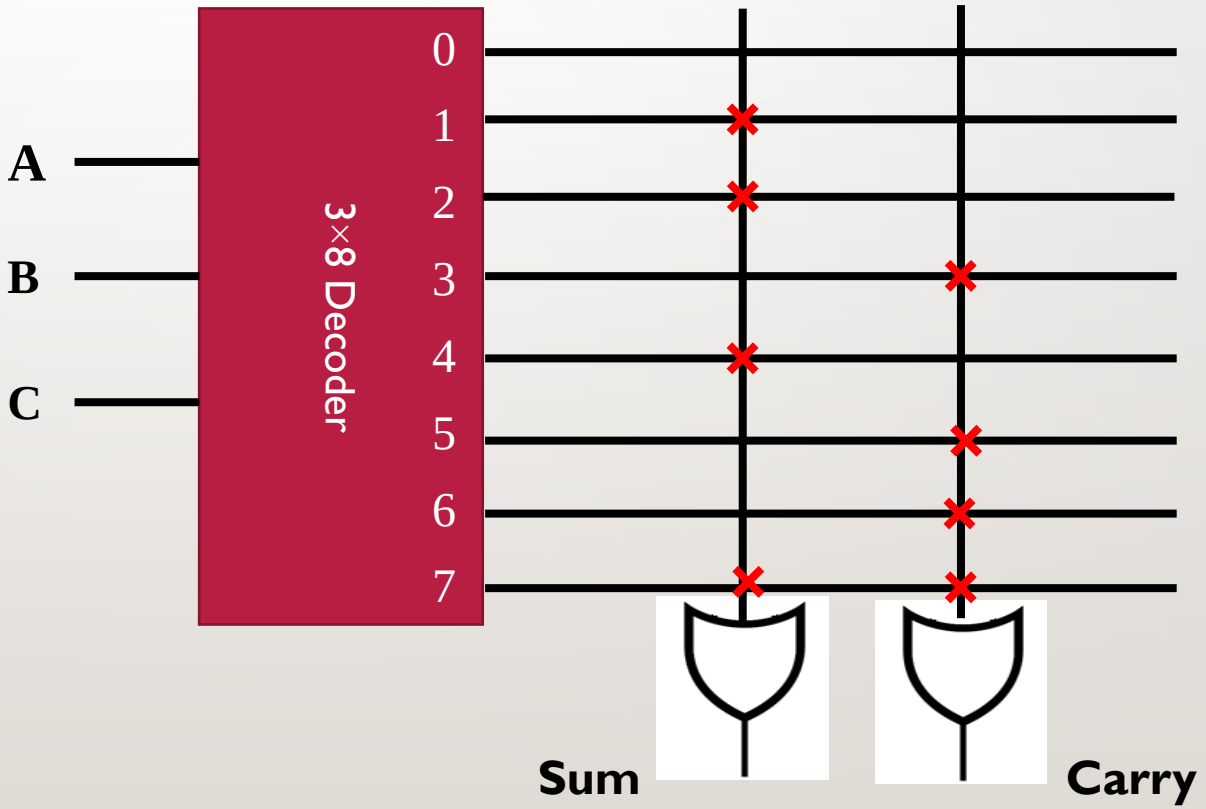


Implementation using PROM

Example: Implement the full adder using PROM.

Full adder output logic function:

Sum = $\sum m\,(1,2,4,7)$
Carry = $\sum m\,(3,5,6,7)$



Applications of PROM

- Look-Up Tables (LUTs)
- Custom Logic Functions
- Multiplexers and Decoders
- Digital Calibration
- Security Key Storage
- Data and Configuration Storage
- Bootloader Programs
- Table-Based Algorithms

SELF-ASSESSMENT QUESTIONS

1. Which of the following is a type of PLD?

(a) CPU
(b) FPGA
(c) RAM
(d) ROM

2. What is the main advantage of using PLDs in digital circuit design?

(a) Lower cost
(b) Faster development time
(c) Higher power efficiency
(d) All of the above

SELF-ASSESSMENT QUESTIONS

3. How is the programming of a PROM different from that of a ROM (Read-Only Memory)?

(a) PROMs are read-only and cannot be programmed.

(b) ROMs are programmable multiple times, while PROMs are programmed only once.

(c) PROMs are programmed once, and the data is permanent.

(d) ROMs require a special programming voltage, unlike PROMs.

4. Which component is typically used for implementing combinational logic functions in a PLD?

(a) Flip-flop

(b) AND gate

(c) OR gate

(d) Inverter

TERMINAL QUESTIONS

Short answer questions:

1. Draw the classification diagram of Programmable Logic Devices (PLDs).

Long answer questions:

1. Design the following Boolean functions using PROM. i) A (X,Y,Z) = ∑m (2,5,6) ii) B (X,Y,Z) = ∑m (0,2,4,7)
2. Design the following Boolean functions using PROM. A (X,Y,Z) = ∑m (5,6,7) B (X,Y,Z) = ∑m (3,5,6,7)
3. How can the outputs of a full adder be designed using a Programmable Read-Only Memory (PROM) along with the appropriate decoder?

REFERENCES FOR FURTHER LEARNING OF THE SESSION

Reference Books:

1. Computer System Architecture by M. Moris Mano

2. Fundamentals of Digital Logic with Verilog HDL by Stephen Brown and ZvonkoVranesic

Sites and Web links:

1. https://www.tutorialspoint.com/digital_circuits/digital_circuits_programmable_logic_devices.htm

2. https://www.geeksforgeeks.org/programming-array-logic/

3. https://www.electrically4u.com/programmable-array-logic/

THANK YOU

(DEEMED TO BE UNIVERSITY)

Team – DIGITAL DESIGN & COMPUTER ARCHITECTURE