Lecture 39

Memory:

- Memory element used in sequential circuits are relatively small and store few binary bits of information.
- Large memory capable of storing very large amount of information.
- Memories store data in units that have one, four, eight or higher number of bits.
- Smallest unit of binary data is a bit.
- Data is also handle is a 4-bit unit called a **Nibble.**
- The combination of two 4-bit units called **Nibbles.**
- Each storage element of a memory can either store a logic 0 or

a logic 1 is called a cell.

Memory organization:

The memory array can be organized in several ways depending on the unit of data.

The 64-cell array organized as 8x8 cell array is considered as an 8 byte memory, that is, it has eight locations and each location store a single byte.

64-bit memory:

The 16x4 memory is used as a 16 nibble memory and the 64x1 is known as a 64 bit memory.

Memory capacity and density:

The capacity and the density of a memory are determined by the total number of cells implemented in a unit area.

Memory density on the other hand

specifies the number of bits store per unit area.

Basic operation on memory:

Two basic operation are performed on memory, that is,

- Reading of information from the memory
- Writing of data to the memory.

Address signals:

Address of signals are required to specify the location in the memory from which information is accessed (read & write). A set of parallel address lines known as address bus carry the addsess information.

Memory select or enable signal:

In a computer system there are more than one memory chips to store program information.

All memory chips have a chip

enable or chip select signal which has to be activated befor the memory can be accessed.

Memory types:

Two major categories of memory chips are
RAM (random access memory)
ROM (read only memory)

RAM:

- Ram allow a read or write operation to be carried out at any addres.
- RAM don't store formed data.
- All locations are accessible at equal time.
- RAM memory are also known as volatile memory.

Types of RAM:

Two types of RAM are given:
Static RAM
Dynamic RAM.

Static RAM:

Static RAM which uses

flip flops as storage element.

- In static Ram, each cell which is capable of storing a binary 0 or 1 is made up of flip flop which retain information.
- Static memory are faster.

Dynamic memory:

- Dynamic memory uses a capacitor to store a single bit of data.
- To store binary 1, capacitor is charged, to store 0, capacitor is uncharged.
- Dynamic memory is slower than static memory.

RoM:

- Rom chip retain data permanently.
- ROM chip are also know as non-volatile memory.
- ROM chips are read only, user can't write information.

ROM chip are programmed by the manufacturer.

3X8 decoder:

A 3X8 decoder decodes a 3-bit address to slect any one of eight location comprising of a group of 4-cells.

- For example, when the address is 000, the first output line of the 3X8 decoder is activated which is connected to the SEL input of 4 latches in the first row.

~~Subdivision of RAM:~~

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Subdivision of RAM:

RAM chips are subdivided into part are given:-

- Asynchronous SRAM
- Synchronous SRAM.

Asynchronous SRAM:

The static memory described is an asynchronous SRAM, the operation of which doesn't depend upon the clock signal. The read and write operations are carried out asynchronously.

Synchronous SRAM:

Synchronous SRAM uses a clock signal which is used by microprocessor to synchronize its activities to synchronize the read and write operations for faster operation.

Drawback of DRAM:

The drawback of DRAM is the discharging of the capacitor over a period of time unless the capacitor is periodically recharged all the information stored in the form of binary bits in a capacitor based memory any

is lost.
The extra circuitry required to refresh the capacitor complicates the operation of the DRAM.

Address Multiplexing:

DRAM chips use address multiplexing to reduce the number of address lines by half.
The address required by to select a memory location is split into row and column address.
To access a DRAM location for reading or writing of information the row address is first applied at the address line.

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Fast mode page access:

In fast Mode page access all the column in the same row are either read or written.
A single row is considered to be

'Page' of memory storing data values in successive memory locations.

- The Fast Mode page access allows faster memory read and access times.

~~Distrub~~

Distributed mode:

In distributed mode, the refresh cycle is interspersed between normal read and write cycle.

Types of DRAMs:

Types of DRAM are given below:-

- Fast page mode DRAM
- Extended Data output (EDO) DRAM.
- Synchronous DRAM

Types of ROM:

ROMs are of different type are given:

- Mask ROM
- PROM

- EPROM
- UV EPROM
- EEPROM

Mask ROM:

Data is permantly stored duing the manufactuing process.

PROM:

Programmable rom allows storge of data by the user using a PROM programmer.

The PROM once programmed stood the data peremantly.

EPROM:

Erasable PROM allows erasing and of stood data and reprogramming.

UV EPROM:

In a programble ROM, Data is erase by exposing the PROM to ultra voilet light.

EEPROM:

Electricaly erasable PROM is

is erased electrically.
- EEPROM allows in circuit programming and doesnot need to be removed.

Types of EPROM:

Two types of EPROM are given:
- UV EPROM (ultraviolet EPROM)
- EEPROM (electrically erasable PROM)

Programming EPROM:

Programming the EPROM chip is done by applying a high dc voltage at VPP pin and setting the output enable $\overline{OE}$ to logic high.

Flash memory:

- Flash memory have high density, that is, they store more information per unit area as more storage cells are implemented per unit area.
- These memories have read/write capability and are non-volatile and

can store for indefinite time period.

Flash memory operation:

Flash memory have three operations:

- Programming operation
- Read operation
- Erase operation

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Flash memory array:

The flash memory array is arranged in the form of rows and columns. The row line is connected to the control gate of each MOS transistor which implements a single bit storage cell.

Types of memory:

Two types of memory are given:-

FIFO (first in first out)

LIFO (Last in first out)

FIFO memory:

- FIFO chips store this data in a memory stack with a FIFO style.
- This means that the data that is stored first is removed first.
- FIFO depth is the term given to the amount of memory that can be stored.
- FIFO memory is used for buffering application, when data need to be stored permantly.

LIFO memory:

- LIFO is a stack memory stored data.
- LIFO in short, last in first out.
- LIFO is a method of proccesig data, where the data last recieved is the first to be sent out after processed.

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Address decoders:

All memory chip have the fist location identified by addres zero.

The next location has the addres one and successive memory locations have addresses assigned in an ascending order.

FPGAs:

An FPGAs is a more flexible device then PLDs are instead of a single AND-OR gate array.

An FPGAs device contain multible logic blocks that can be individually programmed to perform different fonctions.

FPGA stand for field programming gate arry.

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Single bit full-Adder:

A single bit Full-Adder can be similarly implemented by using a memory which has three storage locations.

- Each storage location storing two bits.
- A single bit full-Adder has three input variables A, B and C_{in} and two output variables Sum and C_{out}.

Analogue to digital conversion:

Analogue ~~to digital conversion~~ single ~~to~~ are converted into digital singles by analogue to Digital (A/D) converter.

The conversion of analogue into a corresponding digital signal is done by first sampling the analogue signal and holding it stable for the A/D converter to convert the

signal into digital value.

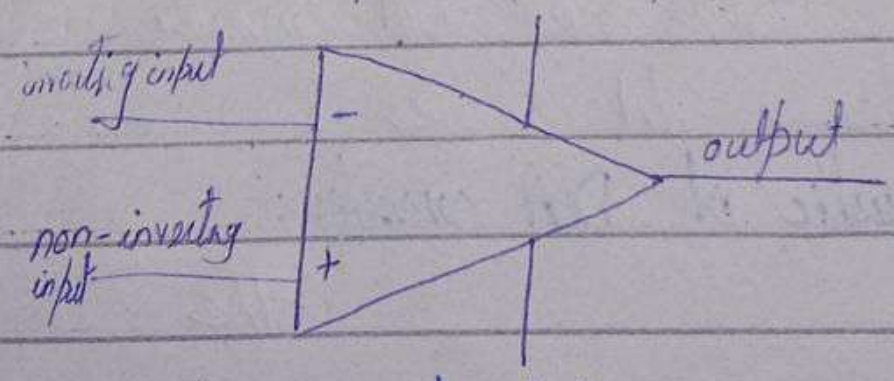
Quantization:

The process of converting the analogue signal into a digital representation is known as quantization.

Operational Amplifier (Op-Amp):

- Operational amplifier is a linear amplifier which has two input (inverting and non-inverting) and one output.
- It has a high voltage gain.
- high input impedance.
- low output impedance.
- Op-Amp is used as an inverting amplifier and as a comparator.

$$V_{out}/V_{in} = R_f/R_i$$



Dual-slope analogue to digital converter:

The Dual-slope A/D converter is used in digital voltmeter and other type of measuring instruments.
A Dual-slop A/D is slower then the flash converter.

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Analogue-to-Digital converter error:

There are three error are given below:

- Missing code
- Incorrect code
- Offset code

types of D/A converter:

There are two types are given:-
Binary-weighted-input D/A converter
R/2R ladder D/A converter

Characteristic of D/A converter:

The

characteristic of D/A converter are given below:

- Resolution
- Accuracy
- Linearity
- Monotonicity
- Settling time

Monotonicity:

In a monotonicity, the analogue output always increases or remains constant as the digital input increases.

End..