EC 8392 – DIGITAL ELECTRONICS

UNIT – V : MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS

INTRODUCTION

A memory unit is a device to which binary information is transferred for storage and from which information is retrieved when needed for processing. When data processing takes place, information from memory is transferred to selected registers in the processing unit. Intermediate and final results obtained in the processing unit are transferred back to be stored in memory. Binary information received from an input device is stored in memory and information transferred to an output device is taken from memory. A memory unit is a collection of cells capable of storing a large quantity of binary information.

There are two types of memories that are used in digital systems: random-access memory (RAM) and read-anly memory (ROM). RAM stores new information for later use. The Process of storing new information into memory is referred to as a memory write operation. The process of transferring the stored infomation out of memory is referred to as a memory read operation. RAM can perform both write and read operations. ROM can perfonn only the read operation. This means that suitable binary information is already stored inside memory and can be retrieved or read at any time. However, that information cannot be altered by writing.

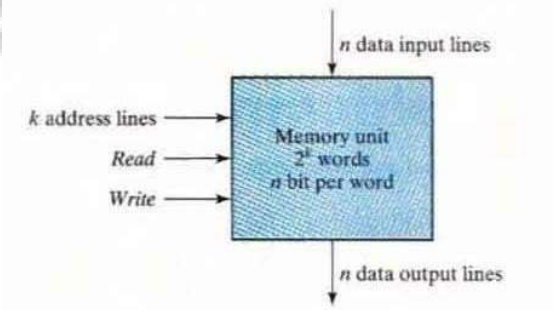
RAM

A memory unit is a collection of storage cells, together with associated circuits needed to transfer information into and out of a device. The architecture of memory is such that information can be selectively retrieved from any of its internal allocations. The time it takes to transfer information to or from any desired random location is always the same- hence the name random access memory, abbreviated RAM. In contrast, the time required to retrieve information that is stored on magnetic tape depends on the location of the data.

A memory unit stores binary information in groups of bits called words. A word in a memory is an entity of bits that move in and out of storage as a unit. A memory word is a group of 1 's and 0's and may represent a number, an instruction , one or more alphanumeric characters or any other binary-coded information. A group of 8 bits is called a byte. Most computer memories use words that are multiples of 8 bits in length. Thus, a

16·bit word contains two bytes, and a 32-bit word is made up of four bytes. The capacity of a memory unit is usually stated as the total number of bytes that the unit can store.

The n data input lines provide the information to be stored in memory, and the n data output lines supply the information coming out of memory. The k address lines specify the particular word chosen among the many available. The two control inputs specify the direction of transfer desired: The Write input causes binary data to be transferred into the memory and the Read input causes binary data to be transferred out of memory.



The memory unit is specified by the number of words it contains and the number of bits in each word. The address lines select one particular word. Each word in memory is assigned an identification number, called an address, starting fro 0 to $2^k - 1$, where k is the number of address lines. The selection of a specific word inside memory is done by applying the k· bit address to the address lines.

Write and Read Operations

The two operations that RAM can perform are the write and read operations. The write signal specifies a transfer-in operation and the read signal specifies a transfer out operation. On accepting one of these control signals, the internal circuits inside the memory provide the desired operation. The steps that must be taken for the purpose of transferring a new word to be stored into memory are as follows:

1. Apply the binary address of the desired word to the address lines.
2. Apply the data bits that must be stored in memory to the data input lines.
3. Activate the write input.

The memory unit will then take the bits from the input data lines and store them in the word specified by the address lines. The steps that must be taken for the purpose of transferring a stored word out of memory are as follows:

1. Apply the binary address of the desired word to the address lines.
2. Activate the read input.

Control Inputs to Memory Chip

Memory Enable	Read/Write	Memory Operation
0	X	None
1	0	Write to selected word
1	1	Read from selected word

Types of Memories

The mode of access of a memory system is determined by the type of components used. In a random-access memory, the word locations may be thought of as being separated in space, each word occupying one particular location. In a sequential-access memory, the information stored in some medium is not immediately accessible, but is available only at certain intervals of time. A magnetic disk or tape unit is of this type. Each memory location passes me read and write heads in turn, but information is read out only when the requested word has been reached. In a random-access memory, the access time is always the same regardless of the particular location of the word. In a sequential -access memory, the time it takes to access a word depends on the position of the word with respect to the position of the read head: therefore, the access time is variable.

Integrated circuits RAM units are available in two cpereting modes: static and dynamic. Static RAM (SRAM) consists essentially of internal latches that store the binary information. The stored information remains valid as long as power is applied to the unit. Dynamic RAM (DRAM) stores the binary information in the form of electric charges on capacitors provided inside the chip by MOS transistors. The stored charge on the capacitors

tends to discharge with time, and the capacitors must be periodically recharged by refreshing the dynamic memory. Refreshing is done by cycling through the words few milliseconds to restore the decaying charge. DRAM offers reduced power consumption and larger storage capacity in a singte memory chip. SRAM is easier to use and has shorter read and write cycles.