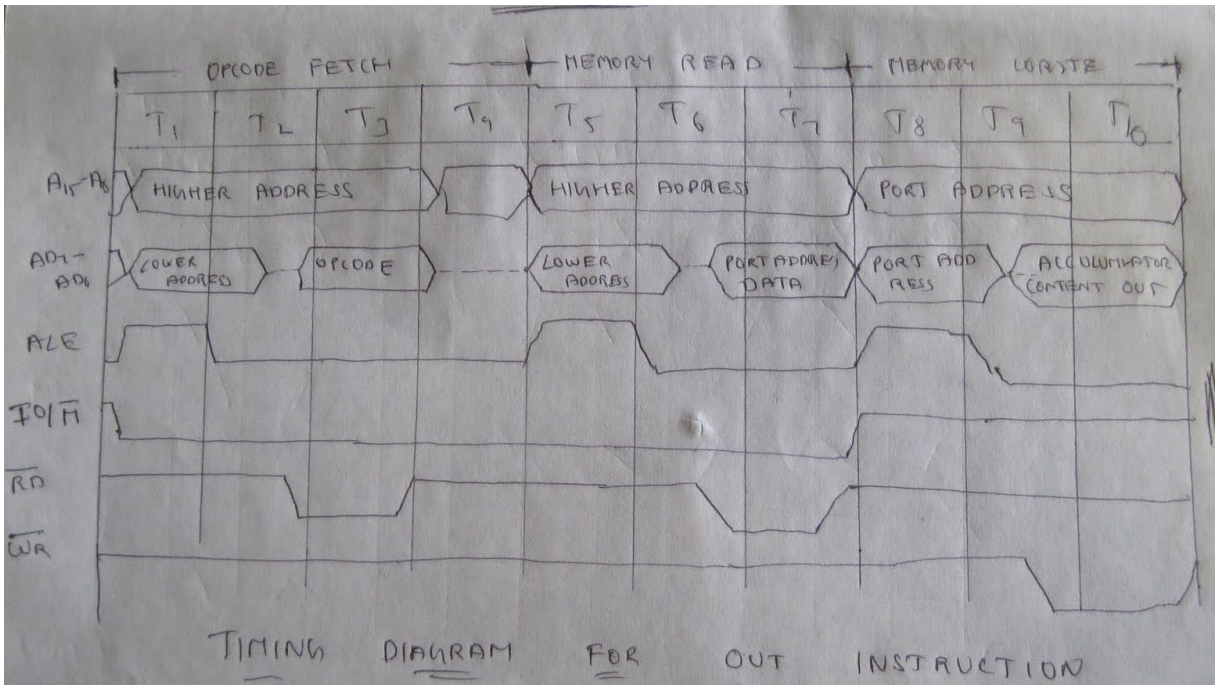
Unit –IV

Lecture notes on :- Microprocessor 8085 timing diagram



INSTRUCTION EXECUTION AND TIMING DIAGRAM:

Each instruction in 8085 microprocessor consists of two part- operation code (opcode) and operand. The opcode is a command such as ADD and the operand is an object to be operated on, such as a byte or the content of a register.

Instruction Cycle: The time taken by the processor to complete the execution of an instruction. An instruction cycle consists of one to six machine cycles.

Machine Cycle: The time required to complete one operation; accessing either the memory or I/O device. A machine cycle consists of three to six T-states.

T-State: Time corresponding to one clock period. It is the basic unit to calculate execution of instructions or programs in a processor.

To execute a program, 8085 performs various operations as:

- Opcode fetch
- Operand fetch
- Memory read/write
- I/O read/write

External communication functions are:

- Memory read/write
- I/O read/write
- Interrupt request acknowledge

Opcode Fetch Machine Cycle:

It is the first step in the execution of any instruction. The timing diagram of this cycle is given in Fig. 7.

The following points explain the various operations that take place and the signals that are changed during the execution of opcode fetch machine cycle:

T1 clock cycle.

i. The content of PC is placed in the address bus; AD0 - AD7 lines contains lower bit address and A8 – A15 contains higher bit address.
ii. IO/M signal is low indicating that a memory location is being accessed. S1 and S0 also changed to the levels as indicated in Table 1.
iii. ALE is high, indicates that multiplexed AD0 – AD7 act as lower order bus.

T2 clock cycle

i. Multiplexed address bus is now changed to data bus.
ii. The $\overline{RD}$ signal is made low by the processor. This signal makes the memory device load the data bus with the contents of the location addressed by the processorT3 clock cycle

T3 clock cycle

i. The opcode available on the data bus is read by the processor and moved to the instruction register.
ii. The $\overline{RD}$ signal is deactivated by making it logi 1.

T4 clock cycle

i. The processor decode the instruction in the instruction register and generate the necessary control signals to execute the instruction. Based on the instruction further operations such as fetching, writing into memory etc takes place.

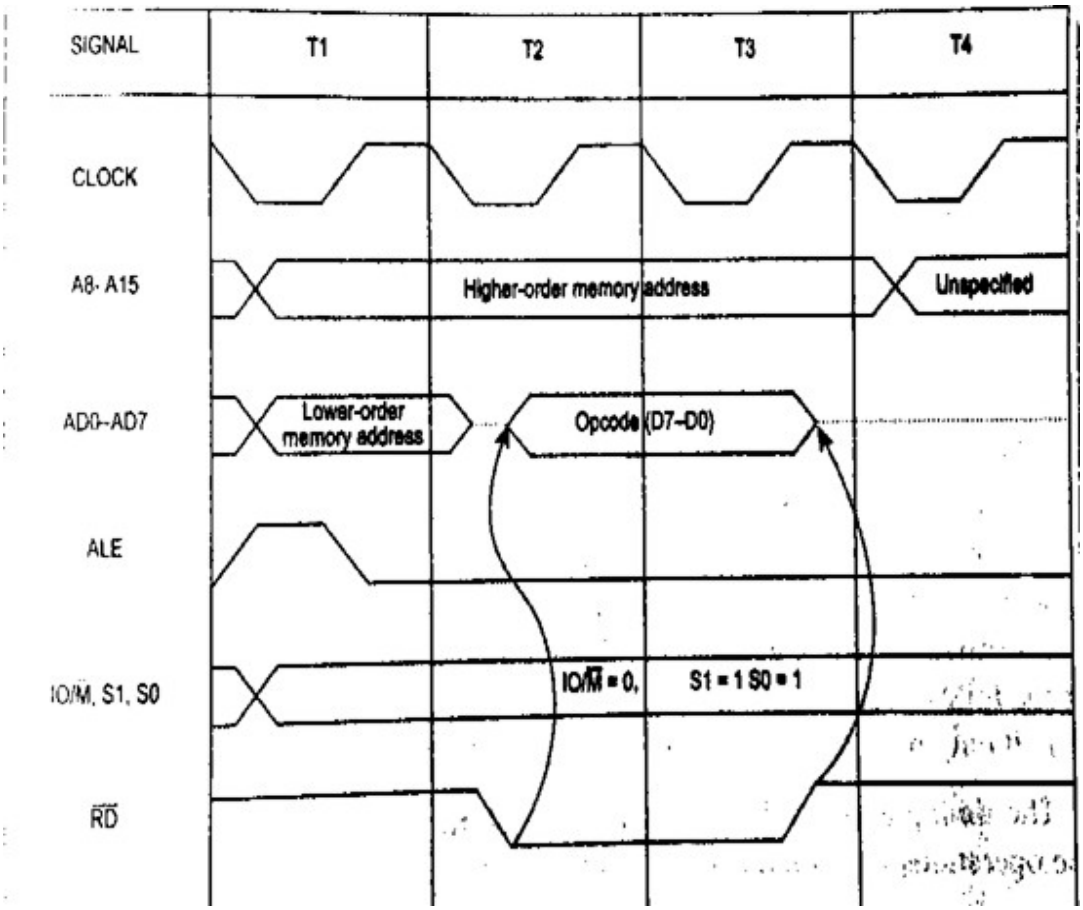


Fig. 7 Timing diagram for opcode fetch cycle

Memory Read Machine Cycle:

The memory read cycle is executed by the processor to read a data byte from memory. The machine cycle is exactly same to opcode fetch except:

a) It has three T-states
b) The S0 signal is set to 0.

The timing diagram of this cycle is given in Fig. 8.

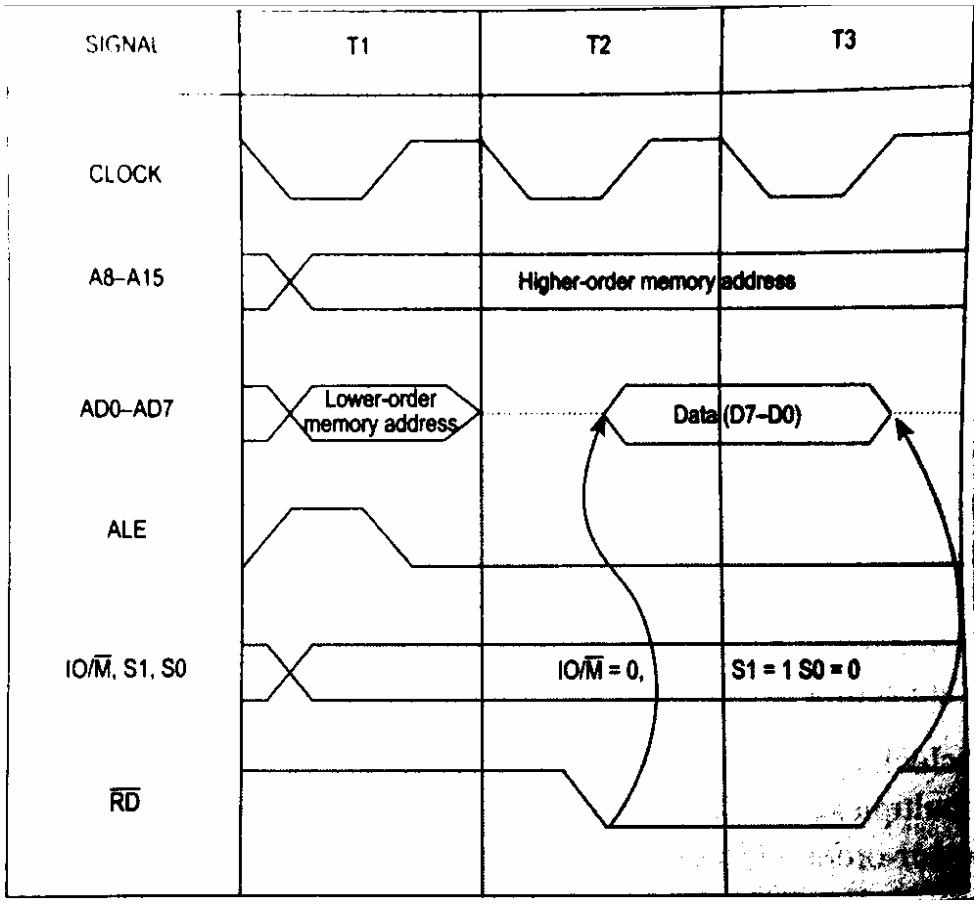


Fig. 8 Timing diagram for memory read machine cycle

Memory Write Machine Cycle:

The memory write cycle is executed by the processor to write a data byte in a memory location. The processor takes three T-states and $\overline{WR}$ signal is made low. The timing diagram of this cycle is given in Fig. 9.

I/O Read Cycle:

The I/O read cycle is executed by the processor to read a data byte from I/O port or from peripheral, which is I/O mapped in the system. The 8-bit port address is placed both in the lower and higher order address bus. The processor takes three T-states to execute this machine cycle. The timing diagram of this cycle is given in Fig. 10.

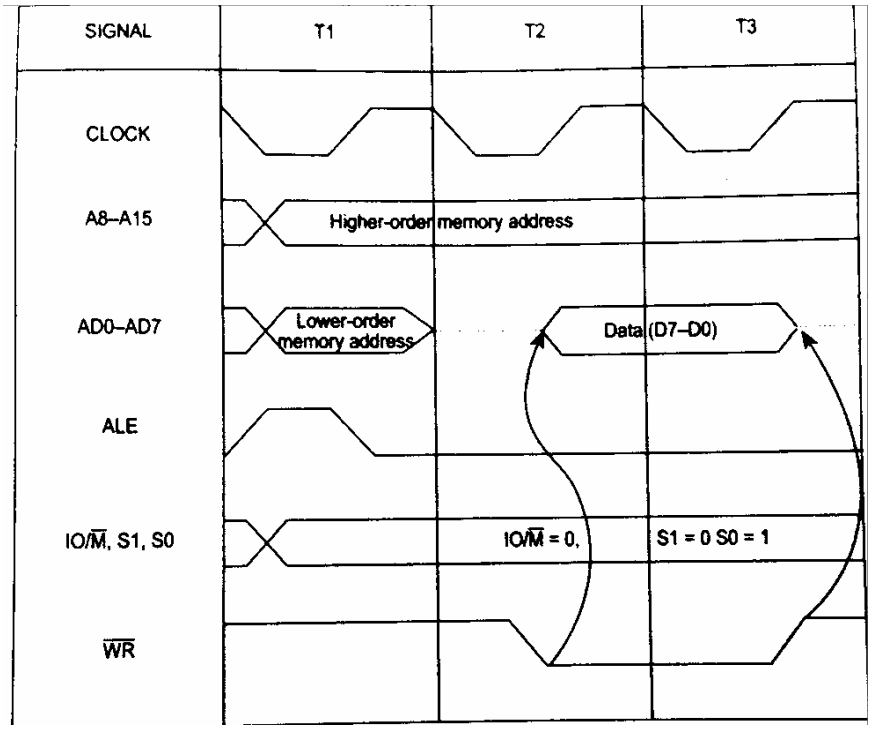


Fig. 9 Timing diagram for memory write machine cycle

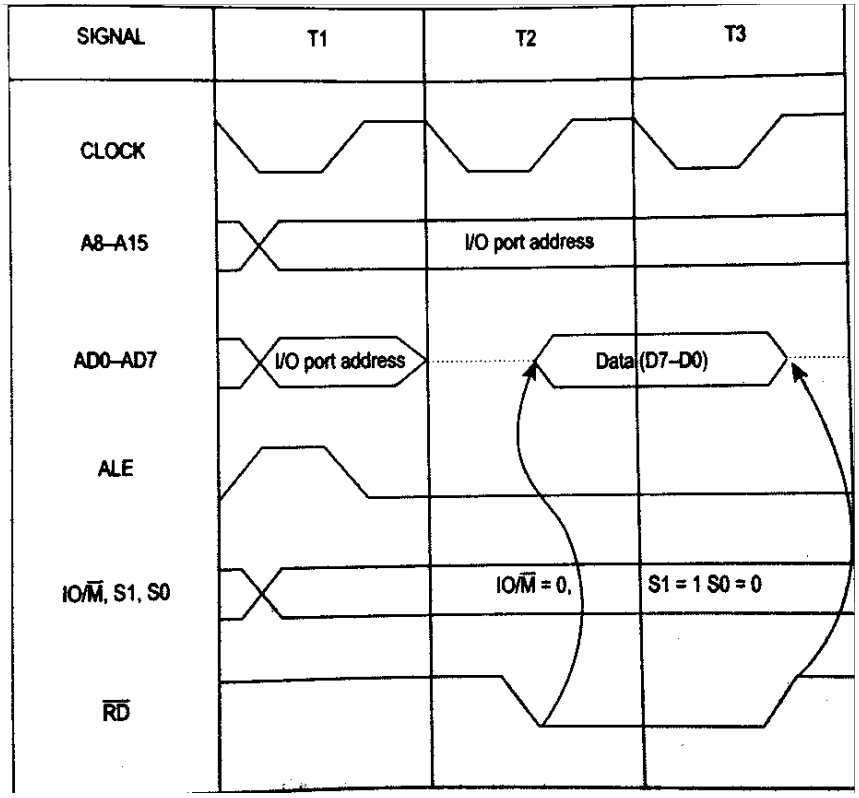


Fig. 10 Timing diagram I/O read machine cycle

I/O Write Cycle:

The I/O write cycle is executed by the processor to write a data byte to I/O port or to a peripheral, which is I/O mapped in the system. The processor takes three T-states to execute this machine cycle. The timing diagram of this cycle is given in Fig. 11.

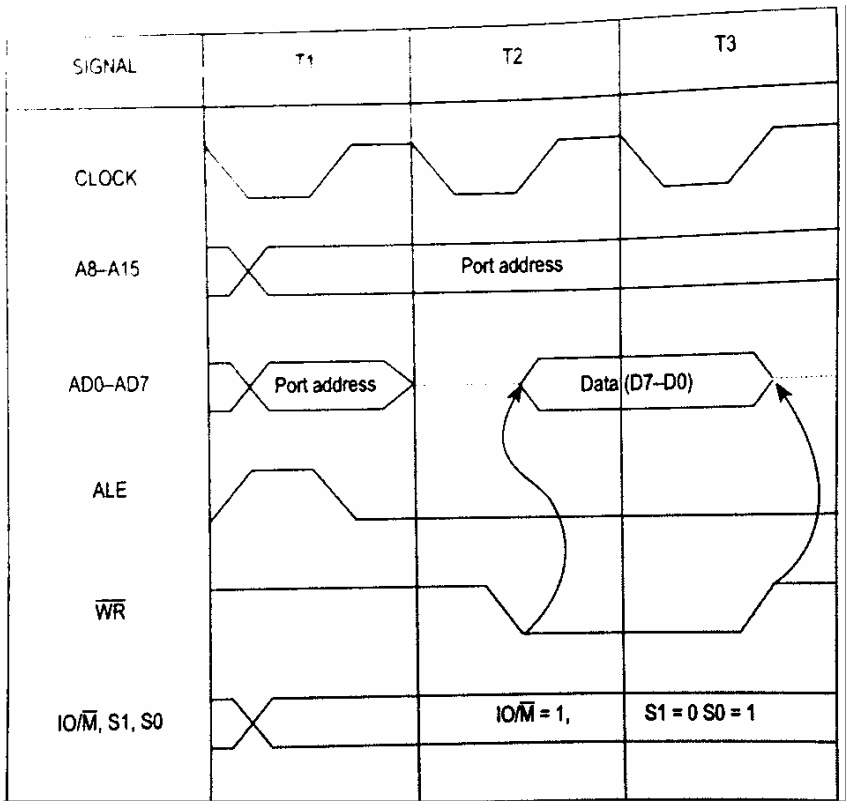


Fig. 11 Timing diagram I/O write machine cycle

Ex: Timing diagram for IN 80H.

The instruction and the corresponding codes and memory locations are given in Table 5.

Table 5 IN instruction

Address	Mnemonics	Opcode
800F	IN 80H	DB
8010		80

i. During the first machine cycle, the opcode DB is fetched from the memory, placed in the instruction register and decoded.

ii. During second machine cycle, the port address 80H is read from the next memory location.

iii. During the third machine cycle, the address 80H is placed in the address bus and the data read from that port address is placed in the accumulator. The timing

diagram is shown in Fig. 12

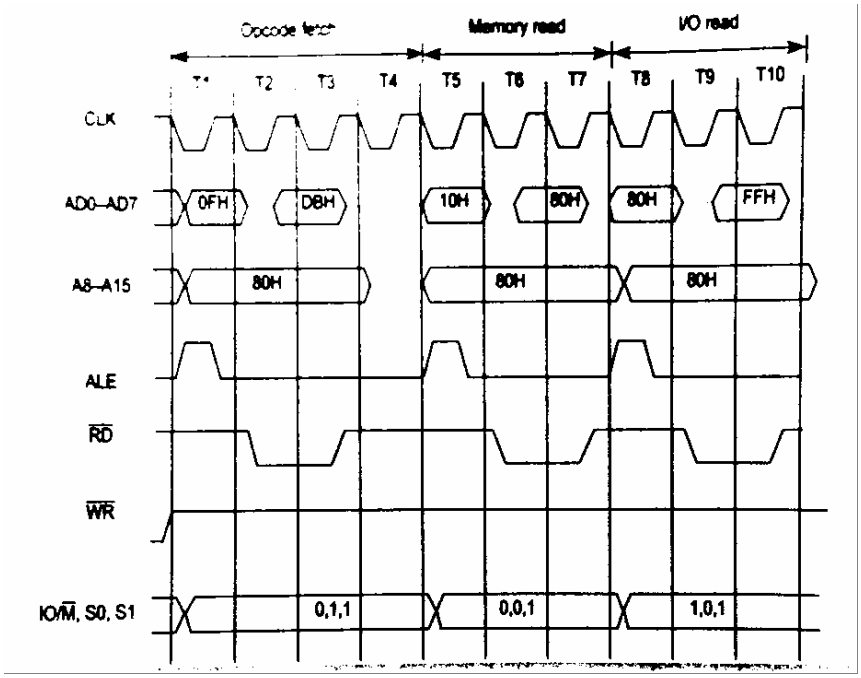


Fig. 12 Timing diagram for the IN instruction