UNIT I & 2-THE 8085 MICROPROCESSOR

1. What is Microprocessor?

It is a program controlled semiconductor device (IC), which fetches, decodes and executes instructions.

2. What are the basic units of a microprocessor?

The basic units or blocks of a microprocessor are ALU, an array of registers and control unit.

3. What is Software and Hardware?

The Software is a set of instructions or commands needed for performing a specific task by a programmable device or a computing machine.

The Hardware refers to the components or devices used to form computing machine in which the software can be run and tested. Without software the Hardware is an idle machine.

4. What is assembly language?

The language in which the mnemonics (short -hand form of instructions) are used to write a program is called assembly language. The manufacturers of microprocessor give the mnemonics.

5. What are machine language and assembly language programs?

The software developed using 1's and 0's are called machine language, programs. The software developed using mnemonics are called assembly language programs.

6. What is the drawback in machine language and assembly language, programs?

The machine language and assembly language programs are machine dependent. The programs developed using these languages for a particular machine cannot be directly run on another machine.

7. Define bit, byte and word.

A digit of the binary number or code is called bit. Also, the bit is the fundamental storage unit of computer memory. The 8-bit (8-digit) binary number or code is called byte and 16-bit binary number or code is called word. (Some microprocessor manufactures refer the basic data size operated by the processor as word).

8. What is a bus?

Bus is a group of conducting lines that carries data, address and control signals.

9. Why data bus is bi-directional?

The microprocessor has to fetch (read) the data from memory or input device for processing and after processing, it has to store (write) the data to memory or output device. Hence the data bus is bi-directional.

10. Why address bus is unidirectional?

The address is an identification number used by the microprocessor to identify or access a memory location or I / O device. It is an output signal from the processor. Hence the address bus is unidirectional.

11. What is the function of microprocessor in a system?

The microprocessor is the master in the system, which controls all the activity of the system. It issues address and control signals and fetches the instruction and data from memory. Then it executes the instruction to take appropriate action.

12. How many machine cycles constitute one instruction cycle in 8085?

Each instruction of the 8085 processor consists of one to five machine cycles.

13. Define opcode and operand.

Opcode (Operation code) is the part of an instruction / directive that identifies a specific operation.

Operand is a part of an instruction / directive that represents a value on which the instruction acts.

14. What is opcode fetch cycle?

The opcode fetch cycle is a machine cycle executed to fetch the opcode of an instruction stored in memory. Every instruction starts with opcode fetch machine cycle.

15. What operation is performed during first T -state of every machine cycle in 8085 ?

In 8085, during the first T -state of every machine cycle the low byte address is latched into an external latch using ALE signal.

16. Why status signals are provided in microprocessor?

The status signals can be used by the system designer to track the internal operations of the processor. Also, it can be used for memory expansion (by providing separate memory banks for program & data and selecting the bank using status signals).

17. How the 8085 processor differentiates a memory access (read/write) and 1/0 access (read/write)?

The memory access and 1/0 access is differentiated using 10 I M signal. The 8085 processor asserts 10 I M low for memory read/write operation and 10 I M is asserted high for 1/0 read/write operation.

18. When the 8085 processor checks for an interrupt?

In the second T -state of the last machine cycle of every instruction, the 8085 processor checks whether an interrupt request is made or not.

19. What is interrupt acknowledge cycle?

The interrupt acknowledge cycle is a machine cycle executed by 8085 processor to get the address of the interrupt service routine in-order to service the interrupt device.

20. How the interrupts are affected by system reset?

Whenever the processor or system is reseted , all the interrupts except TRAP are disabled. in order to enable the interrupts, El instruction has to be executed after a reset.

21. What is Software interrupts?

The Software interrupts are program instructions. These instructions are inserted at desired locations in a program. While running a program, if software interrupt instruction is encountered then the processor executes an interrupt service routine.

22. What is Hardware interrupt?

If an interrupt is initiated in a processor by an appropriate signal at the interrupt pin, then the interrupt is called Hardware interrupt.

23. What is the difference between Hardware and Software interrupt?

The Software interrupt is initiated by the main program, but the Hardware interrupt is initiated by an external device.

In 8085, the Software interrupt cannot be disabled or masked but the Hardware interrupt except TRAP can be disabled or masked.

24. What is vectored and Non- Vectored interrupt?

When an interrupt is accepted, if the processor control branches to a specific address defined by the manufacturer then the interrupt is called vectored interrupt.

In Non-vectored interrupt there is no specific address for storing the interrupt service routine. Hence the interrupted device should give the address of the interrupt service routine.

25. List the Software and Hardware interrupts of 8085?

Software interrupts: RST 0, RSTl, RST 2,RST 3, RST 4, RST 5,RST 6 and RST 7.

Hardware interrupts: TRAP, RST 7.5, RST 6.5,RST 5.5 and INTR.

26. What is TRAP?

The TRAP is non-maskable interrupt of 8085. It is not disabled by processor reset or after reorganization of interrupt.

27. Whether HOLD has higher priority than TRAP or not?

The interrupts including map are recognized only if the HOLD is not valid, hence TRAP has lower priority than HOLD.

28. What is masking and why it is required?

Masking is preventing the interrupt from disturbing the current program execution. When the processor is performing an important job (process) and if the process should not be interrupted then all the interrupts should be masked or disabled.

In processor with multiple 'interrupts, the lower priority interrupt can be masked so as to prevent it from interrupting, the execution of interrupt service routine of higher priority interrupt.

29. When the 8085 processor accept hardware interrupt?

The processor keeps on checking the interrupt pins at the second T -state of last Machine cycle of every instruction. If the processor finds a valid interrupt signal and if the interrupt is unmasked and enabled then the processor accepts the interrupt. The acceptance of the interrupt is acknowledged by sending an OOA signal to the interrupted device.

30. When the 8085 processor will disable the interrupt system?

The interrupts of 8085 except TRAP are disabled after anyone of the following operations

1. Executing El instruction.
2. System or processor reset.
3. After reorganization (acceptance) of an interrupt.

31. What is the function performed by Dl instruction?

The function of Dl instruction is to enable the disabled interrupt system.

32. What is the function performed by El instruction?

The El instruction can be used to enable the interrupts after disabling.

33. How the vector address is generated for the INTR interrupt of 8085?

For the interrupt INTR, the interrupting device has to place either RST opcode or CALL opcode followed by l6-bit address. I~RST opcode is placed then the corresponding vector address is generated by the processor. In case of CALL opcode the given l6-bit address will be

the vector address.

34. How clock signals are generated in 8085 and what is the frequency of the internal clock?

The 8085 has the clock generation circuit on the chip but an external quartz crystal or L C circuit or RC circuit should be connected at the pins XI and X2. The maximum internal clock frequency of 8085A is 3.03 MHz

35. What happens to the 8085 processor when it is resetted?

When the 8085 processor is resetted it executes the first instruction at the OOOOH location. The 8085 resets (clears) instruction register, interrupt mask bits and other registers.

36. What are the operations performed by ALU of 8085?

The operations performed by ALU of 8085 are Addition, Subtraction, Logical AND, OR, Exclusive OR, Compare Complement, Increment, Decrement and Left I Right shift

37. What is a flag?

Flag is a flip flop used to store the information about the status of the processor and the status of the instruction executed most recently.

38. List the flags of 8085

There are five flags in 8085. They are sign flag, zero flag, Auxiliary carry flag, and parity flag and carry flag.

39. What is the Hardware interrupts of 8085?

The hardware interrupts in 8085 are TRAP, RST 7.5, RST 6.5 and RST 5,5.

40. Which interrupt has highest priority in 8085? What is the priority of other interrupts?

The TRAP has the highest priority, followed by RST 7.5, RST 6.5, RST 5.5 and INTR.

41. What is ALE?

The ALE (Address Latch Enable) is a signal used to demultiplex the address and data lines, using an external latch. It is used to enable the external latch.

42. Explain the function of IO/M in 8085.

The IO/M is used to differentiate memory access and I/O access. For IN and OUT instruction it is high. For memory reference instructions it is low.

43. Where is the READY signal used?

READY is an input signal to the processor, used by the memory or I/O devices to get extra time for data transfer or to introduce wait states in the bus cycles.

44. What are HOLD and HLDA and how it is used?

Hold and hold acknowledge signals are used for the Direct Memory Access (DMA) type of data transfer. The DMA controller place a high on HOLD pins in order to take control of the system bus. The HOLD request is acknowledged by the 8085 by driving all its tristated pins to

high impedance state and asserting HLDA signal high.

45. Difference between microprocessor and microcontroller.

Microprocessor:

* It is single VLSI chip holding CPU unit.

* It is dedicated to the specific instruction

* It is based on **Princeton or Von-Neumann Architecture** i.e. program as well as data stored in same memorylocation.

Microcontroller:

*It includes microprocessor and memory, peripheral devices on a single unit.

*It is dedicated to implement the specific instruction.

*It is based on **Harvard architecture** i.e. program and data will be stored in different memory location.

46. What is bus contention?

If two devices drive the data bus simultaneously then it is called Bus Contention. It may lead to following undesirable events.

*Damaging one or both the IC chip

*The high current may cause a voltage spike in the supply system leading to data loss.

47. What is an assembler?

An assembler is a program that translates the mnemonics into their machine code. It is generally not available on a single-board microcomputer.

A program can be entered in mnemonics in a microcomputer equipped with an ASCII keyboard. The assembler will translate mnemonics into the 8085 machine code and assign memory locations to each machine code, thus avoiding the manual assembly and the errors associated with it. Additional instructions can be inserted anywhere in the program, and the assembler will assign all the new memory locations and jump instructions.

48. How does the microprocessor differentiate between data and instruction?

When the first machine code of an instruction is fetched and decoded in the instruction register, the microprocessor recognizes the number of bytes required to fetch the entire instruction. For example, in the case of the instruction MVI A, data (3E data), the second byte is always considered data. If that data byte is omitted by mistake, whatever is in that memory location will be considered data. The byte after "Data" will be treated as the next instruction.

49. How does the microprocessor differentiate among positive number, a negative number and a bit pattern?

It does not know the difference. The microprocessor views any data byte as eight binary digits. The programmer is responsible for providing the interpretation.

For example, after an arithmetic or logic operation, if the bits in the accumulator are

1 1 1 1 0 0 1 0 = F2 H

The sign flag is set because D7=1. This does not mean it is a negative number, even if the sign flag is set. The sign flag indicates only that D7=1. the eight bits in the accumulator could be a bit pattern, or a positive number larger that 127_{10}, or the 2's complement of a number.

50. List the components of microprocessor (single board microcomputer) based system.

The microprocessor based system consist of microprocessor as CPU, semiconductor memories like EPROM and RAM, input device, output device and interfacing devices

51. Define machine cycle.

Machine cycle is defined as the time required to complete one operation of accessing memory, input / output or acknowledging an external request. This cycle may consist of 3 to 6 T-states.

52. Define T-state.

T-state is defined as one subdivision of the operation performed in 1 clock period. These subdivisions are internal states synchronized with the system clock, and each T-state is precisely to 1 clock period.

53. What is instruction cycle?

The sequence of operations that a processor has to carry out while executing the instruction is called instruction cycle. Each instruction cycle of a processor consists of a number of machine cycles.

54. What does memory-mapping mean?

The memory mapping is the process of interfacing memories to microprocessor and allocating addresses to each memory locations.

55. What is the need for timing diagram?

The timing diagram provides information regarding the status of various signals, when a machine cycle is executed. The knowledge of timing diagram is essential for system designer to select matched peripheral devices like memories, latches, ports etc, to form a microprocessor system.

56. What are the prime functions performed by microprocessor?

The microprocessor unit performs primarily four operations:

i) **Memory Read:** Reads data (or instructions) from memory
ii) **Memory Write:** Writes data (or instructions) into memory
iii) **I/O read:** Accepts data from input devices
iv) **I/O Write:** Sends data to output devices

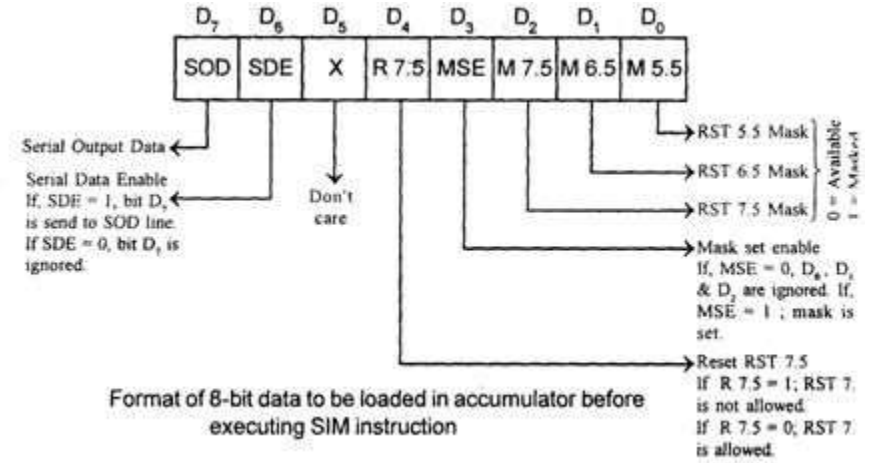
57. What are the three steps that a microprocessor follows to execute an instruction–

1. Fetch – The instructions are in storage from where the processor fetches them.
2. Decode – It then decodes the instruction to assign the task further. During this, the arithmetic and logic unit also performs to register the data temporarily.
3. Execute – The assigned tasks undergo execution and reach the output port in binary form.

58. Explain SIM and RIM for interrupts:

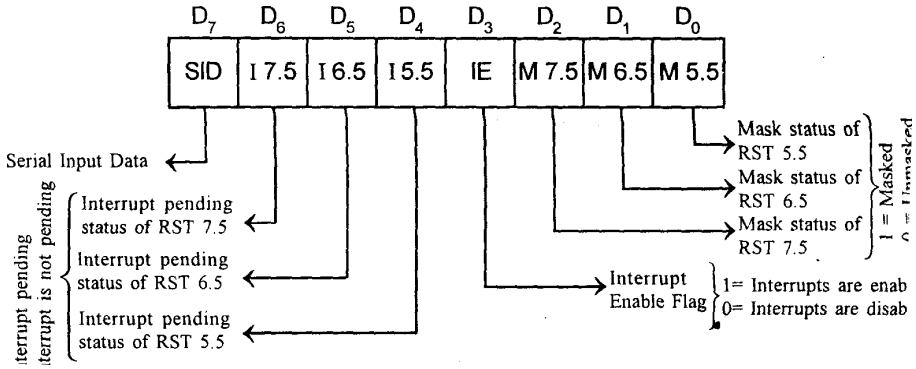
- The 8085 provide additional masking facility for RST 7.5, RST 6.5 and RST 5.5 using SIM instruction.

- The status of these interrupts can be read by executing RIM instruction.
- The masking or unmasking of RST 7.5, RST 6.5 and RST 5.5 interrupts can be performed by moving an 8-bit data to accumulator and then executing SIM instruction.
- The format of the 8-bit data is shown below.



Format of 8-bit data to be loaded in accumulator before executing SIM instruction

- The status of pending interrupts can be read from accumulator after executing RIM instruction.
- When RIM instruction is executed an 8-bit data is loaded in accumulator, which can be interpreted as shown in fig.



59. Write note on SOFTWARE INTERRUPTS.

The software interrupts are program instructions. Theseinstructions are inserted at desired locations in a program.

The 8085 has eight software interrupts from RST 0 to 7. If the external device places an Opcode for any one of the RST instruction (RST 0 to RST 7), then 8085 pushes the contents of

PC onto the stack. It then branches the program control to the vector address of the corresponding RST instruction. The vector address for these interrupts can be calculated as follows:

Interrupt number x 8 = vector address

Instruction	Vector Address
RST 0	0000H
RST 1	0008H
RST 2	0010H
RST 3	0018H
RST 4	0020H
RST 5	0028H
RST 6	0030H
RST 7	0038H

60. Explain the machine control instructions with 8085 with example.

These instructions are related to interrupts and are used to halt program execution.

1. DI : Disable interrupts

Description: The Interrupt enable flip – flop is reset and all the interrupts except the TRAP (8085) are disabled.

One byte instruction.

One machine cycle: OPcode fetch – 4 T

No flags are affected.

[This instruction is commonly used when the execution of a code sequence cannot be interrupted. For example, in critical time delays, this instruction is used at the beginning of the code and the interrupts are enabled at the end of the code. Te 8085 TRAP connect be disabled.]

2. EI : Enable Interrupts

Description:The interrupts enable flip – flop is set and all interrupts are enabled.

One byte instruction

One machine cycle: Opcode fetch – 4 T

No flags are affected

[After a system reset or the acknowledgment of an interrupt the Interrupt enable flip flop is reset, thus disabling the interrupts. This instruction is necessary to reenable the interrupts (except TRAP)]

HLT : Halt and Enter Wait State:

Description:

The MPU finished executing the current instruction and halfs any further execution. The MPU enters the Halt Acknowledge machine cycle and Wait states re inserted in every clock period. The address and the data bus are placed in the high impedance state. The contents of the registers are unaffected during the HLT state. An interrupt or reset is necessary to exit from the Halt state.

One byte instruction.

Two machine cycle: Opcode fetch – 3 T

Bus idle -2T

No flags are affected. 5 T

4. NOP: No Operation

Description:

No operation is performed. The instruction is fetched and decoded; however, no operation is executed. This is an useful instruction for producing software delay and reserve memory space for future software modifications.

One byte instruction

One machine cycle: Opcode fetch – 4T

5. RIM : Read Interrupt Mask

Description:

This is a multipurpose instruction used to read the status of interrupts 7.5, 6.5, 5.5 and to read serial data input bit. This instruction loads 8 bits in the accumulator with the interpretations as,

* Bits D0, D1, D2 provide the mask status of RST interrupts.
* If the interrupt enable bit (IE) D3 is "O", the 8085's maskable interrupts are disabled. The interrupts are enabled if this bit is 1. interrupt
* If a particular pending bit is 1, s an interrupt is being requested on the identified RST line. When this bit is 'O', no interrupt is waiting to be serviced.

6. SIM: Set Interrupt Mask

Description:

This is a multipurpose instruction and used to implement the 8085 interrupts (RST 7.5, 6.5 and 5.5) and serial data output.

The instruction interprets the accumulator content as,

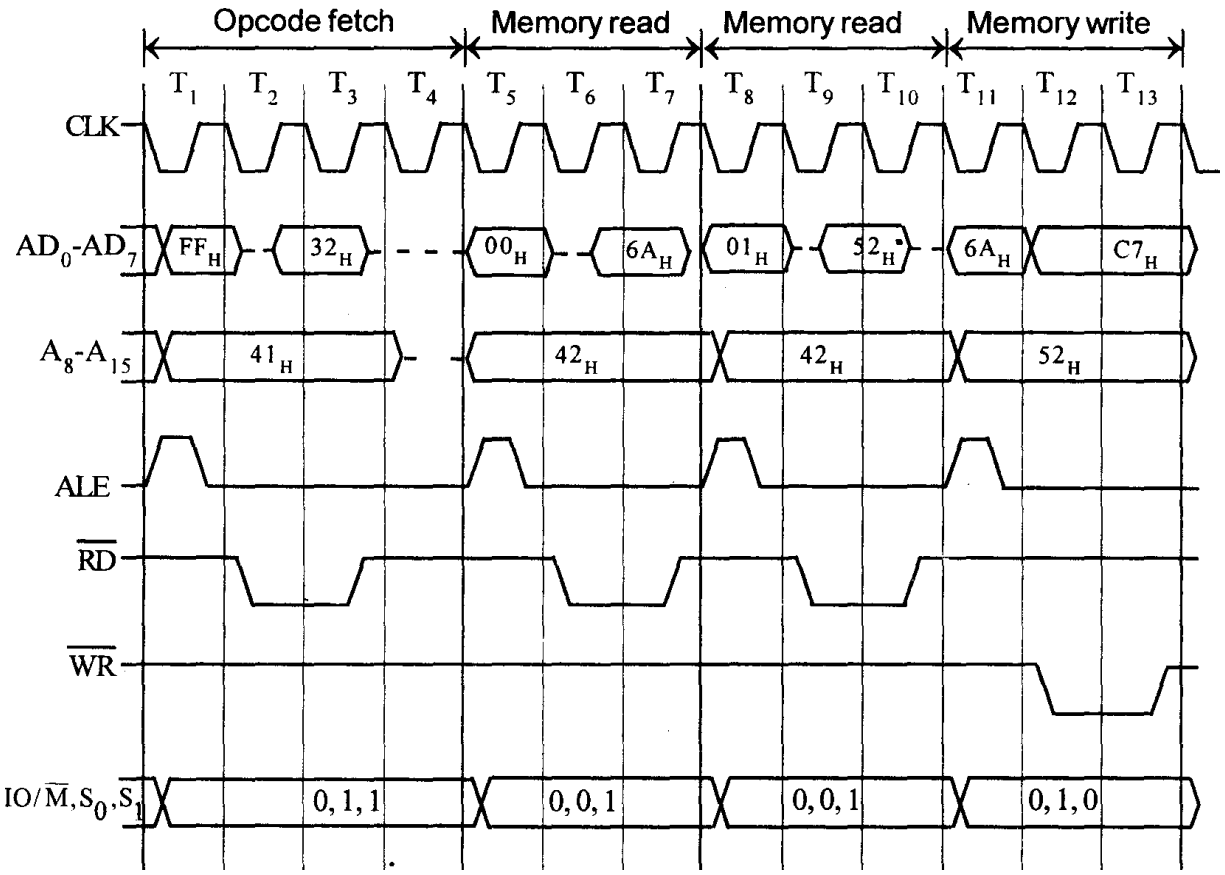
* SOD: Serial Output Data: Bit D_7 of the accumulator is latched into the SOD output line and made available to a serial peripheral if bit $D_6 = 1$
* SDE : Serial Data Enable: If this bit =1, if enables the serial output. To implement serial output. This bit needs to be enabled.
* XXX = Don't care.
* R7.5 = Reset RST 7.5 : If this bit =1, RST 7.5 flip – flop is reset. T is is an additional control to reset RST 7.5.
* MSE: Mast Set Enable: If this it is high it enables the functions of bits D_2, D_1, D_0. This is the master control over all the interrupt masking bit 2. If this bit is low, bits D_2, D_1 and D_0 do not have any effect on the masks.
* M7.5 – D_2 = 0, RST 7.5 is enabled.
  = 1, RST 7.5 is masked or disabled.
* M6.5 – D_1 = 0,RST 6.5 is enabled.
  = 1, RST 6.5 is masked or disabled.
* M5.5 – D_0 = 0, RST 5.5 is enabled
  = 1, RST 5.5 is masked or disabled.

61. Draw the Timing diagram for STA $526A_H$ and IN $C0_H$ INSTRUCTION.

- Fetching the Opcode 32_H from the memory $41FF_H$.
- Read the lower order memory address.

- Read the higher order memory address.
- Write the accumulator content into memory location $526A_H$.
- Assume the memory address for the instruction and let the content of accumulator is $C7_H$.

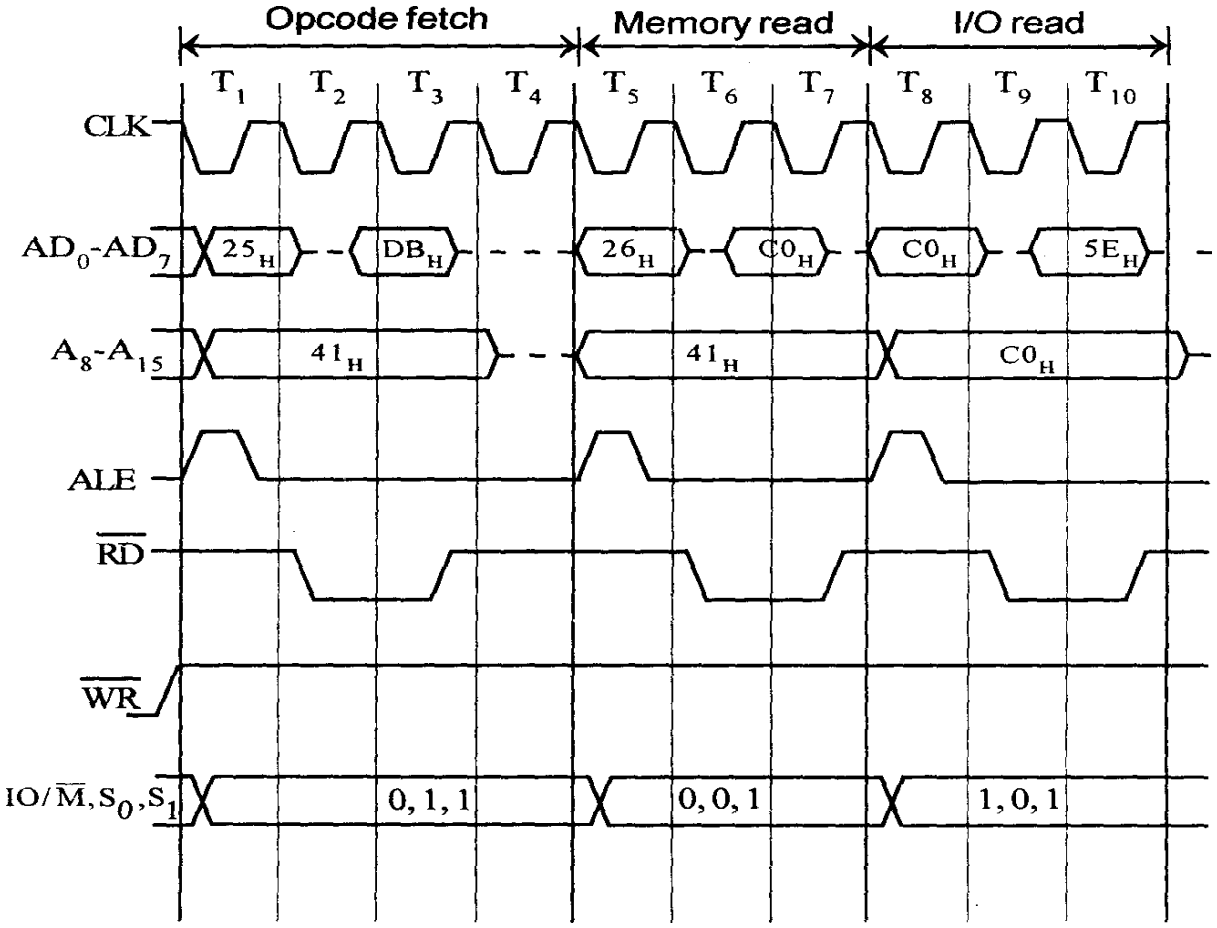
Address	Mnemonics	Opcode
41FF	STA $526A_H$	32_H
4200		$6A_H$
4201		52_H



60. Draw the Timing diagram for IN $C0_H$.

- Fetching the Opcode DB_H from the memory 4125_H.
- Read the port address $C0_H$ from 4126_H.
- Read the content of port $C0_H$ and send it to the accumulator.
- Let the content of port is $5E_H$.

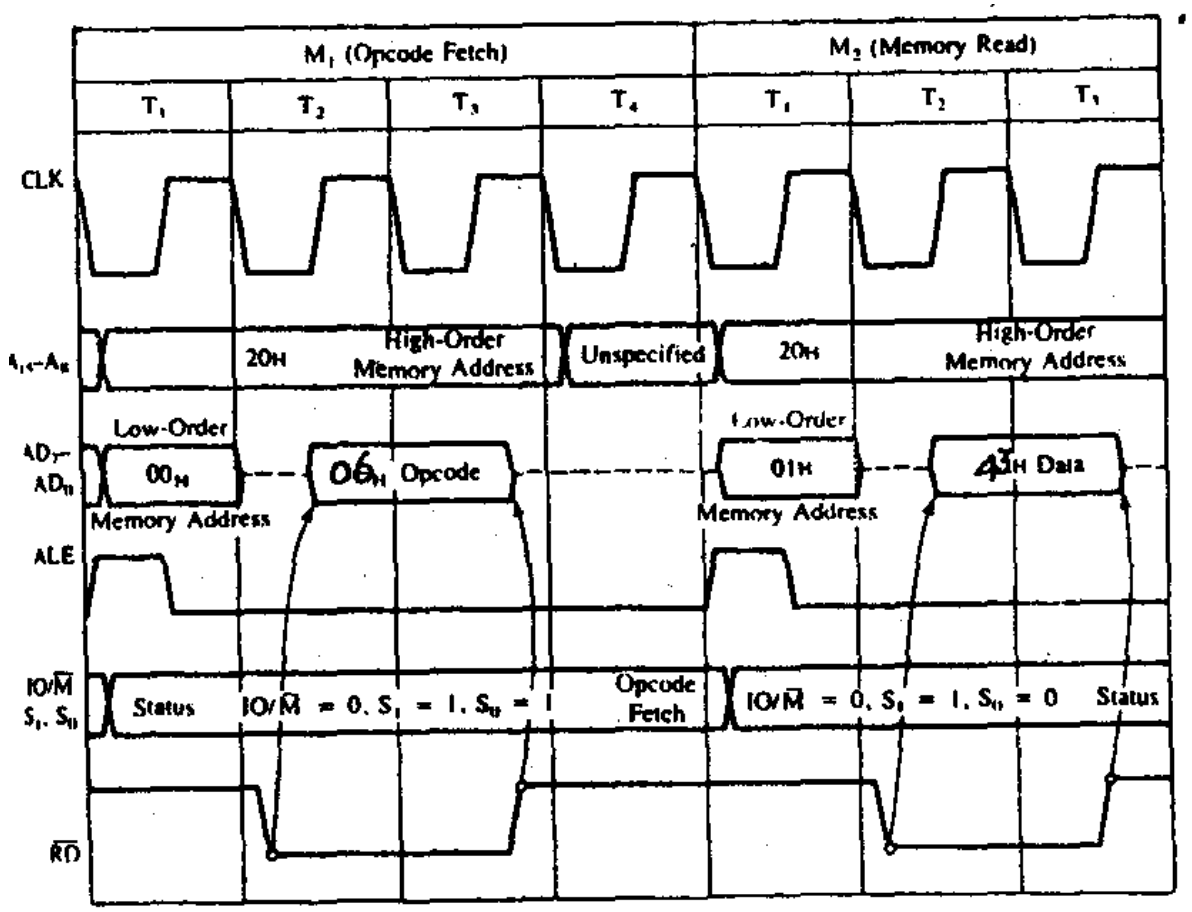
Address	Mnemonics	Opcode
4125	IN $C0_H$	DB_H
4126		$C0_H$



62 Draw the Timing diagram for MVI B, 43 H.

Fetching the Opcode 06_H from the memor2000_H.
Read the data 43H from memory 2001_H.

Address	Mnemonics	Opcode
2000	MVI B, 43_H	06_H
2001		43_H



63. Write general features of advantages, disadvantages and applications of microprocessors.

Features of Microprocessors

- It is low in cost as it uses integrated circuit technology reducing the overall cost of a computer system.
- It generates less heat as semiconductors emit less heat in comparison to vacuum tube devices.
- The microprocessor has a very high speed due to advanced technology, executing

millions of instructions every second.

- It consumes low power because of metal oxide semiconductor technology.
- Its small size and less power consumption make it portable as well.
- It is small in size due to less footprint but has a large-scale integration technology.
- It has a versatile nature as it is usable for several applications.
- The microprocessor has a very low failure rate becoming reliable for the computer system.

Advantages of Microprocessors

- High-speed processing
- Brings intelligence to the system
- Is flexible in nature
- Has a compact size
- Is easy to maintain

Disadvantages of Microprocessors

- Leads to overheating due to continuous use.
- The data size decides the performance
- Larger than microcontrollers
- Doesn't support floating-point operations

Applications of the Microprocessors

- It is present in single-board microcomputers as they use low configuration with software and hardware.
- It is embedded in the PC making it suitable to access and use applications.
- It acts as a controller in many home appliances like toasters, televisions, stereo systems, etc.
- In the science industry, it is useful for measuring speed, temperature, moisture, etc.
- The telecom sector uses it for a digital telephone system, telephone exchange, and modem while the hospitality sector uses it for railway and airline reservation systems.
- Office automation uses it for word processing, spreadsheet operations, storage, etc.
- The publication uses it for automatic photocopies, high-quality printing, and good speed.
- Consumers are using it for toys, amusement devices, and house held devices frequently nowadays.
- It is also present in wireless communication equipment allowing them to interact and connect with devices.