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Assignment-3

(1) What is microprocessor, processor, microcomputer and microcontroller?

Ans. A microprocessor is a multipurpose programmable, clock driven, register based electronic device that reads binary instructions from a storage device called memory, accepts binary data as input, processes data according to those instructions and provides results as output. A microprocessor contains ALU, CU and registers on a single chip.

Processor.

A processor is an integrated electronic circuit that performs the calculations that run a computer. It contains ALU, CU and register separately which performs arithmetical and logical operations.

Microcomputer.

~~Microp~~ Microcomputers are those computers that have microprocessors as CPU.

Microcontroller.

Microcontroller is a single chip consisting of microprocessor unit, memory, I/O and interfacing circuits

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(2) Write in short about the development history of microprocessor.

Ans. Marcian E Hubb is the father of microprocessor. The first commericial microprocessor came in 1971, which was Intel 4004 having 2300 transistors. It was a 4-bit microprocessor. It was basically designed for calculators at that time.
The next microprocessor was Intel 8008 having 3500 transistors. After this, Intel 8080 having 4000 transistors and ZILOG Z80 having 6000 transistors came for commercial purpose.
The evolution of transistors continued and first 8-bit microprocessor was developed which was Intel 8085
Next to this was Intel 8086 having 16-bit.
This evolution of microprocessor continued upto Intel ~~Pentium~~ Pentium M/Centrino for Mobile versions.
Then the final microprocessor Intel Core 2 x86.
After this, the amount of transistors were too large to be fitted in a single chip. So, after this, processors were developed again.

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(3) What are the different components of a microprocessor? Explain it.

Ans The different components of a microprocessor are:-
(i) ALU (Arithmetic and Logic Unit)
(ii) CU (control unit).
(iii) Register Array.

(i) ALU (Arithmetic and Logic Unit)

This is the area of the microprocessor where various computing functions are performed on data. The ALU unit performs such arithmetic operations as addition and subtraction, and logic operations such as AND, OR and exclusive OR.

(ii) Control Unit (CU).

The control unit provides the necessary timing and control signals to all the operations in the microcomputer. It controls the flow of data between the micro-processor and memory and peripherals.

(iii) Register Array.

This area of the microprocessor consists of various registers indentified by letters such as B, C, D, E, H and L. These registers are primarily used to store data temporarily during the execution of a program and are

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accessible to the user through instructions.

(4) What is system bus? Explain about different buses present in microprocessor.

Ans. A system bus is a single computer bus that connects the major components of a computer system, combining the functions of a data bus to carry information, an address bus to determine where it should be sent and a control bus to determine its operations.

There are three types of buses. They are:-

(i) Address Bus
(ii) Data Bus
(iii) Control Bus

(i) Address Bus.

It is a group of conducting wires which carries address only. Address bus is unidirectional because data flow in one direction, from microprocessor to memory or from microprocessor to Input/Output device. The length of the address bus determines the amount of memory a system can address. Such as a system with a 32-bit address bus can 2^{32} memory locations. If each memory holds one byte, the addressable memory space is 4 GB. However the actual amount of memory that can be

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accessed is usually much less than this theoretical limit due to chipset and motherboard limitations.

(ii) Data Bus.

It is a group of conducting wires which carries data only. Data bus is bidirectional because data flow in both directions, from microprocessor to memory or Input/Output devices and from memory or Input/Output devices to microprocessor.
When it is write operation, the processor will put the data on the data bus, when it is read operation, the memory controller will get the data from fro specific memory block and put it into data bus.
The width of the data bus is directly related to the largest number that the bus can carry, such as an 8-bit bus can represent 2^8 unique values, this equals to the number 0 to 255. A 16 bit bus can carry 0 to 65535.

(iii) Control Bus.

It is a group of conducting wires which is used to generate timing and control signals to ~~call~~ control ~~call~~ all the associated peripherals. Microprocessor uses control bus to process data, that is what to do with selected memory location. Some control signals are, Memory Read/Write, I/O read/write and opcode fetch.

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If one line of control may be read/write line, if the wire is low then the memory is read and if the wire is high then the memory is written.

(5) Draw and explain the functional block diagram of 8085 microprocessor.

Ans.

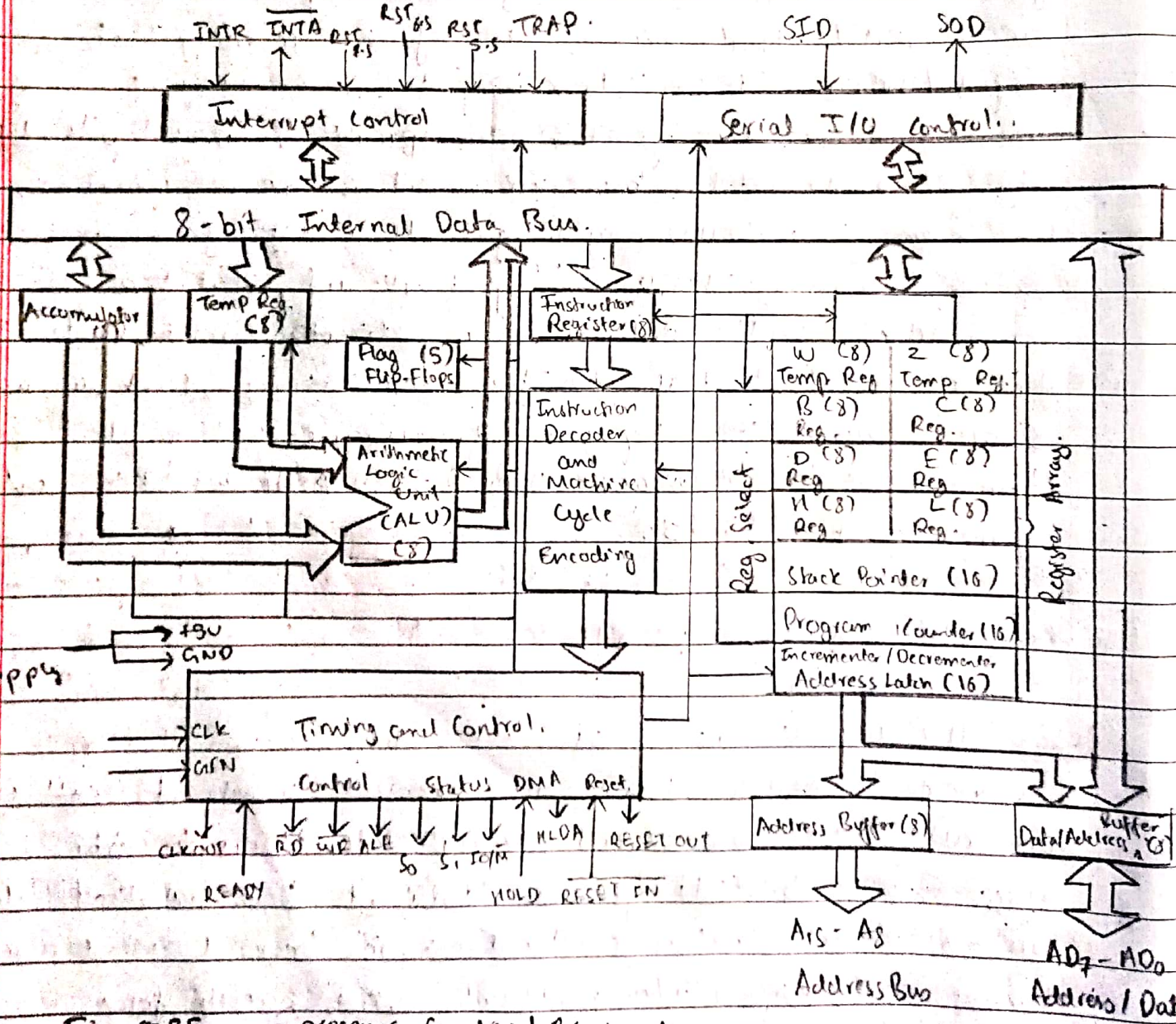

Fig: 8085 microprocessor functional Block diagram.

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(1) ALU :

The arithmetic logic unit performs the computing functions, it includes the accumulator, the temperary register, the arithmetic and logic circuits and five flags. The temporary register is used to hold data during an arithmetic / logic operation. The result is stored in the accumulator; the flags (flip-flops) are set or reset according to the result of the operation.

(2) Accumulator (register A).

It is a 8-bit register that is the part of ALU. This register is used to store the 8-bit ~~us~~ data and to perform arithmetic and logic operations and 8085 is called accumulator based microprocessor. When data is read from input port, it is first moved to accumulator and when data is sent to output port, it must be first placed in accumulator.

(3) Temporary registers (w & z):

They are 8-bit registers not accessible to the programmer. During program execution, 8085 A places the data into it for a brief period.

(4) Instruction register (IR)

It is a 8-bit register not accessible to the programmer. It receives the operation codes of instruction from internal data bus and passes the instruction

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decoder which decodes so that microprocessor knows which type of operation is to be performed.

(5) Register Array: (Scratch pad registers B, C, D, E):
It is a 8-bit register accessible to the programmers. Data can be stored upon it during program execution. These can be used individually as 8-bit registers or in ~~pair~~ pair BC, DE as 16-bit registers. The data can be directly added to or transferred from one to another. Their contents may be incremented or decremented and combined logically with the content of the accumulator

* Register H & L: They are 8-bit registers that can be used in some manner as scratch pad registers.

* Stack Pointer (SP):
It is a 16-bit register used as a memory pointer. It points to a memory location in R/W memory, called the stack. The beginning of the stack is defined by loading a 16-bit address in the stack pointer.

* Program Counter (PC):
Microprocessor uses the PC register to sequence the execution of the instructions. The function of PC is to point to the memory address from which the next byte is to be fetched. When a byte is being fetched, the PC is incremented by one to point

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to the next memory location.

(6) Flag register.

Register consists of five flip-flops, each holding the status of different states separately known as flag register. and each flip flop are called flags. 8085 A can set or reset one or more of the flags and are sign (S), Zero (Z), Auxiliary Carry (AC) and Parity (P) and Carry (CY). The state of flags indicates the result of arithmetic and logical operations, which in turn can be used for decision making processes. The different flags are described as:

- Carry (CY): If the last operation generates a carry its status will be 1 otherwise 0. It can handle the carry or borrow from one word to another.
- Zero (Z): If the result of last operation is zero, its status will be 1 otherwise 0. It is often used in loop control and in searching for particular data value.
- Sign (S): If the most significant bit (MSB) of the result of the last operation is 1 (negative), then its status will be 1 otherwise 0.
- Parity (P): If the result of the last operation has even number of 1's (even parity), its status will be 1 otherwise 0.
- Auxiliary carry (AC): If the last operation generates a carry from the lower half word, its status will be 1 otherwise 0. It is used for performing BCD arithmetic.

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(7) Timing and control unit.

This unit synchronizes all the microprocessor operations with the clock and generates the control signals necessary for communication between the microprocessor and peripherals. The control signals are similar to the sync pulse in an oscilloscope. The RD and WR signals are syn pulses indicating the availability of data on the data bus.

(8) Interrupt controls:

The various interrupt control signals are used to ~~interd~~ interrupt a microprocessor.

(9) Serial I/O controls:

Two serial I/O control signals are used to implement the serial data transmission.

(6) Discuss the bus system in 8085 microprocessor.

Ans Bus is a group of conducting wires which carries information. All the peripherals are connected to microprocessor through bus.

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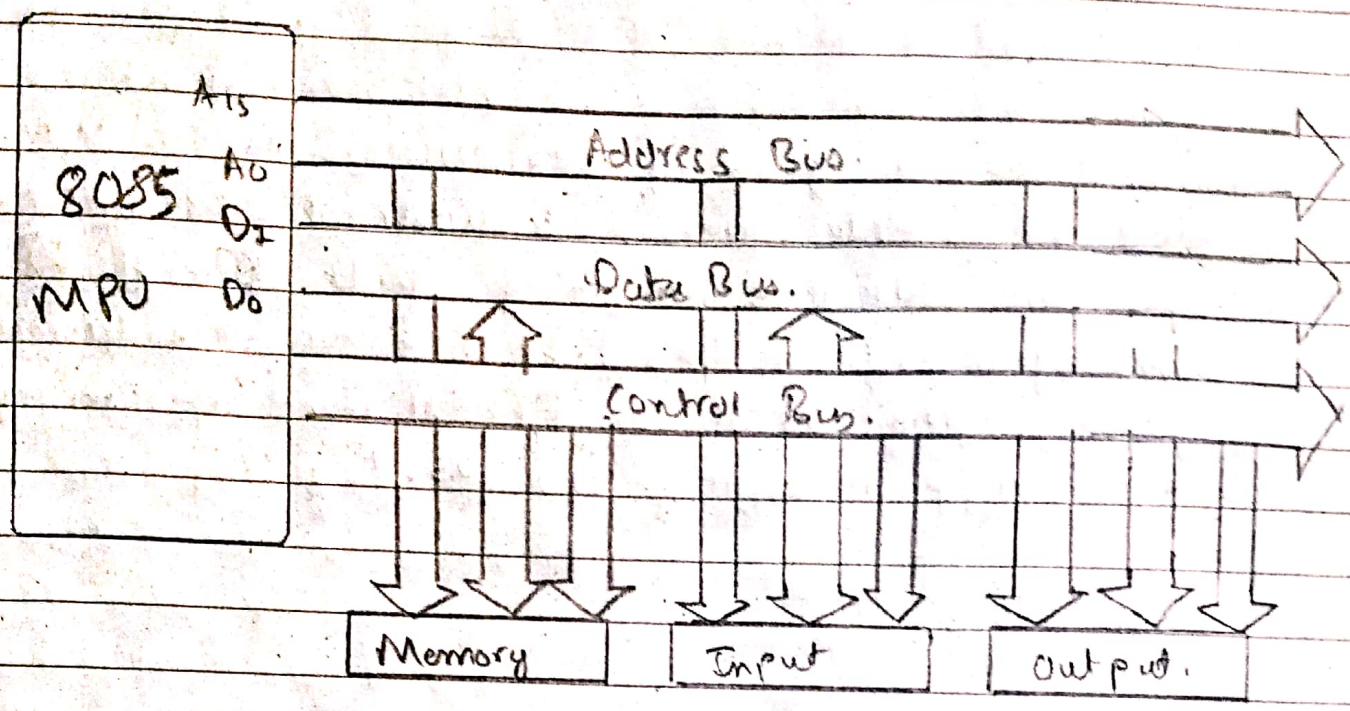

Fig: Bus organization of 8085 microprocessor.

There are three types of buses. They are:

(i) Address Bus.
(ii) Data Bus.
(iii) Control Bus.

(i) Address Bus.

It is a group of conducting wires which carries address only. Address bus is unidirectional because data flows in one direction. length of Address Bus of 8085 microprocessor is 16 Bit, ranging from 0000H to FFFFH (H denotes hexadecimal). The microprocessor 8085 can transfer maximum 16 bit address which means it can address 65536 different memory locations.

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(ii) Data Bus.

It is a group of conducting wires which carries data only. Data bus is bidirectional because data flow in both directions. Length of Data Bus of 8085 microprocessor is 8 Bit (i.e. two hexadecimal digits) ranging from 00 H to FF H. So, it can represent 256 different digits (i.e 0 to 255).

(iii) Control Bus.

It is a group of conducting wires which is used to generate timing and control signals to controll all the associated peripherals. It is unidirectional. Microprocessors uses ~~control~~ control bus to process data, that is what to do with selected memory location.

(7) What are the different types of registers that are available in the 8085 microprocessor. Explain function of each of them.

Ans. The different types of register that are available in the 8085 microprocessor are :-

(a) General Purpose registers
(b) Special purpose registers
(c) Memory registers.

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(a)(i) General purpose registers:

The 8085 has six-general purpose registers to store 8-bit data; these are identified as B, C, D, E, H and L. These can be combined as register pairs, BC, DE, and HL to perform some 16-bit operation. These registers are used to store or copy temporary data, by using instructions, during the execution of the program.

(b)
(ii)(b) Special purpose registers

They include the following.

- Accumulator.

Accumulator is an 8-bit register that is part of the arithmetic and logical unit. After performing arithmetical or logical operations, the result is stored in accumulator. Accumulator is also defined as register A.

- Flag registers.

D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z	-	AC	-	P	-	CY

Bit position of flag registers of 8085.

Flag register is a special purpose register and it is completely different from other registers in microprocessor.

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It consists of 8 bits and only 5 of them are useful. The other three are left vacant. The 5 flags are set or reset after an operation according to data condition of the result in the accumulator and other registers.

The 5 flag registers are:

(i) Sign Flag (S):

It occupies the seventh bit of flag register. It helps the programmer to know whether the number stored in accumulator is positive or negative. If the sign flag is set, it means that number stored in the accumulator is negative and if reset, then the number is positive.

(ii) Zero Flag (Z):

It occupies the sixth bit of the flag register. It is 1, when operation performed in the ALU results in zero (all 8 bits are zero), otherwise is 0.

It helps in determing if two numbers are equal or not.

(iii) Auxiliary Carry Flag (AC):

It occupies fourth bit of flag register. In an arithmetic operation, when a carry flag is generated by the third bit and passed on to the fourth bit, the AC flag is set. If not flag is reset. It is used internally for BCD operations.

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(iv) Parity flag (P)

It occupies the second bit of the flag register. This flag tests for number of 1's in accumulator. If accumulator holds even number of 1's then flag is set otherwise it is reset. If it is set, it is called even parity otherwise it is called odd parity.

(v) Carry Flag (C)

It occupies zeroth bit of the flag register. If the arithmetic operation results in a carry, the C flag is set, otherwise it is reset.

(c) Memory Registers.

There are two 16-bit registers used to hold memory addresses. The size of these registers is 16-bit because the memory address are 16 bits. They are:

- Program counter

This register is used to sequence the execution of the instructions. The function of the program counter is to point to the memory address from which the next byte is to be fetched. When a byte is being fetched, the program counter is incremented by one to point to the next memory location.

- Stack Pointer:

It is used as a memory pointer. It points to a

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memory location in read/write memory, called the stack. It is always incremented/decremented by 2 during push and pop operation.

(8) Explain the data flow between memory and microprocessor.

Ans First of all, the 16-bit address is placed on the address bus from the PC. Suppose, the address is 1020H where the data is placed. The higher order address i.e. 10H is placed on the address bus $A_8 - A_{15}$ while the lower order address i.e. 20H is placed on the multiplexed address and data bus $AD_0 - AD_7$. The lower order address continues to remain on this address bus as long as ALE remains high. Once ALE goes low, it carries data. The control unit sends the signal to indicate what type of the operations is to be performed. Since, the data is to be read from the memory therefore it is sends to enable the memory chip. The byte, from the memory location is then placed in the data bus, is placed on the data bus and sent to the instruction decoder. The instruction is decoded and accordingly the task is performed by the ALU.

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(9) Why addressing modes are required in microprocessor? Discuss different types of addressing modes with suitable examples

Ans Instructions are command to perform a certain task in microprocessor. The instruction consists of op-code and data called operand. The operand may be the source only, destination only or both of them. In these instructions, the source can be a register, a memory or an input port. Similarly, destination can be a register, a memory location, or an output port. The various formal(way) of ~~op~~ specifying the operands are called addressing mode. So, addressing modes are required in order to specify ~~the~~ where the operands are located.

There are 5 different addressing modes. They are

(i) Direct addressing mode:

The instruction using this mode specifies the effective address as part of instruction. The instruction size is either 2 bytes or 3-bytes with first byte op-code followed by 1 or 2 bytes of address of d.

Eg: LDA 9500 H A ← [9500]

IN 80 H A ← [80]

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(ii) Register Direct addressing mode:

This mode specifies the register or register pair that contains the data.

Eg: MOV A, B.

Here, register B contains data rather than address of the data. Other examples are : ADD, XCHG etc.

(iii) Register Indirect addressing mode:

In this mode the address part of the instruction specifies the memory whose contents are the address of the operand. So, in this type of addressing mode, it is the address of the address rather than address itself. (one operand is register.

eg: STAX, LDAX etc.

STAX B, [B = 95, C = 00]

[9500] ← A.

(iv) Immediate addressing mode:

In this mode, the operand position is the immediate data. For 8-bit data, instruction size is 2 bytes. and for 16 bit data, instruction size is 3 bytes.

Eg: MVI A, 69 H. , A ← [69]

LXI B, 4567 H.

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(v) Implied or Inherent addressing mode.

The instructions of this mode do not have operands.
Eg: HLT : Halt
NOP : No operation etc.

(10) What is interrupts? What are maskable and non-maskable interrupts? What are the various interrupts that are available in 8085 microprocessors?

Ans. Interrupts are the signals generated by the external devices to request the microprocessor to perform a task.

Maskable interrupts are the type of interrupts ~~where~~ which we can disable the interrupt by writing some instructions into the program. Eg: RST 7.5, RST 6.5, RST 5.5

Non-maskable interrupts are those interrupts which are cannot disable by writing some instructions into the program.
Eg: TRAP

The various interrupts that are available in 8085 microprocessors are:-

(i) Vector interrupt: Eg: RST 7.5, RST 6.5, RST 5.5, TRAP.
(ii) Non-vector interrupt: Eg:- INTR.
(iii) Maskable interrupt: Eg: RST 7.5, RST 6.5, RST 5.5
(iv) Non-maskable interrupt: Eg: TRAP.

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(v) Software interrupt: Eg: RST 0, RST 1, RST 2, ..., RST 7.
(vi) Hardware interrupt: Eg: TRAP, RST 7.5, RST 6.5, RST 5.5, INTA.

(11) Explain various types of instructions based on word length and function.

Ans There are three types of instructions based on word length. They are.

(i) One-byte instruction
(ii) Two-byte instruction
(iii) Three-byte instruction

(i) One-byte instruction.

In 1-byte instruction, the opcode and the operand of an op instruction are represented in one byte. A one-byte instruction includes opcode & operand in the same byte. Operands are internal registers and are in the instruction in form of codes. If there is non-numeral present in the instruction, then the instruction will be of one byte.
Eg:- MOV C, ADD B, etc.

(ii) Two-Byte instruction.

Two-byte instruction is the type of instruction in which the first 8-bits indicate the opcode and the next 8-bits indicate the operand. This type

of instructions need two ~~by~~ ~~by~~ bytes to store the binary codes. The mnemonic is always followed by 8-bit data. If a 8-bit numeral is ~~pes~~ present in the instruction then that instruction will be of two byte. Eg:- MVI H, 24H, ~~In~~ IN F1 H etc.

(iii) Three-Byte instruction.

Three-byte instruction is the type of instruction in which the first ~~two~~ 8-bit indicates the opcode and the next two bytes specify the 16-bit address. The lower-order address is represented in second byte and high-order address is represented in the third-byte. ~~This~~ This instruction requires three memory locations to store in the memory. The mnemonic is ~~alto~~ always followed by 16-bit (or address). If a 16-bit numeral is present in the instruction then that instruction will be of three-byte. Eg:- LXI H, 2400H, LDA 2500H.

There are five types of instruction on the basis of function. They are:

(i) Data transfer instruction
(ii) Arithmetic instructions.
(iii) Logic and bit manipulation instructions.
(iv) Branch instructions.
(v) Machine control instructions.

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(i) Data transfer instruction.

These instruction move (or copy) data from source to destination. In this instruction, memory to ~~merory~~ memory transfer is not possible. After the data transfer, the content of the source is not modified and the earlier content of the destination is altered. In this instruction, no flags are affected.
Eg: MOV A, B, LXI H, 2800 H etc.

(ii) Arithmetic Instruction.

Arithmetic operations like addition, subtraction, increment and decrement are ~~perfrm~~ performed by this category of instructions. One of the operand is taken from the accumulator and the other operand may be from registers or memory. The result of the arithmetic operations ~~is~~ is stored in the accumulator. All the flags are affected. Eg: ADD A, SUB B, INR D, DCR C etc.

(iii) Logical instruction.

Logical functions like AND, OR and EX-OR are performed by this instruction. All logic functions are performed in relation with the contents of the accumulator. The logical operations cannot be performed directly with the content of two registers.

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After a logical operation has been performed, the result are placed in the accumulator replacing the original content of the accumulator. All the flags are affected. Eg: ANA B, ORA B, CMP C etc.

(iv) Branch Instruction

Branch instruction changes the sequence of the program execution unconditionally or conditionally. The condition of flags is used to take the decision for conditional branches. These instructions are the key to the flexibility and versatility of computer. No flags are affected. Eg: JMP 4000H, JZ 4001H etc

(v) Machine Control Instruction.

~~Ma~~ The instructions dealing with interrupt handling and system operations are classified into this category. This type of instruction includes the instructions for input/output, stack and machine control. No flags are affected. Eg: PUSH B, POP B, HLT etc

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(12) What is flag and its application in the microprocessor. Discuss different types of flags with suitable example.

Ans Flag is a flip-flop holding the status of different states separately. It is used in decision making processes and branching.

The different types of flags are:-

(i) Carry flag (CY)
(ii) Zero flag (Z)
(iii) Sign flag (S)
(iv) Parity flag (S)
(v) Auxiliary ~~ft~~ carry flag (AC)

(i) Carry flag (CY)

Carry is generated when performing n bit operations and the result is more than n-bits, then this flag becomes set i.e 1 otherwise it becomes reset i.e 0.

eg: MVI A, 69H [A ← 69H]
MVI B, 69H [B ← 69H]
ADD B (A = A+B)

Here, carry flag is set to 1 as ~~69+69~~ = there results answer with carry.

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(ii) Zero Flag (Z).

If the output becomes '0' after any type of operation, then zero flag is set otherwise it is reset.

Eg: MVI A, 69 H. [A ← 69H]

SUB A [A = A - A].

Here, zero flag is set to 1 since, (69 - 69)H = 00H

(iii) Sign flag (S)

If the value of output is negative, then it is set to 1 otherwise it is reset to 0. Eg:

MVI A, 29 H. (A ← 29H)

MVI B, 32 H. (B ← 32H).

SUB B (A = A - B).

Here, sign flag is set to 1 as 29H - 32H = -3H.. which is negative.

(iv) Parity flag.

If the result after any operation has even no. of 1's then parity flag is set to 1 otherwise it is reset to 0.

eg: MVI A, 03 H. (A ← 03H)

MVI D, 04 H. (D ← 04H).

ADD D (A = A + D).

Here, Parity flag is reset to 0 as (03+04)H = 07H ie (0000 0111 in BCD) which contains odd number of 1's.

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(v) Auxiliary Carry flag (AC).

AC flag is set when there is a carry in the lower order (bit) of numbers when performing any operations. otherwise it is reset.

Eg:- MVI A, 55 H [A ← 55 H]
MVI C, 69 H [C ← 69 H]
ADD C (A = A + C).

Here, the AC flag is set to 1 as 55H + 69H generates a carry in its lower bits i.e $(5+9)^H = DH = (14)_{10}$.

(13) What is multiplexed signal lines and how these multiplexed lines are demultiplexed?

Ans. Multiplexed signal lines are the combination of two or more signal lines to make them a single transferring medium.

Multiplexed lines are demultiplexed by the help of latch. Latch is used to save the value of the multiplexed line before the function of the multiplexed line changes. It is done with the help of ALE signal. In case of Address/Data bus in in 8085 MP, ALE signal is used to save the value of AD7 - AD0 when it is carry address and when ALE is low, the AD7 - AD0 signal carries data and the latch carries address. In this way, multiplexed lines are demultiplexed.

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(14) Assume that the memory location 1024 H holds data byte 2F H and the accumulator holds data by F2 H. Now state the changes in the different flags after adding content of memory location 1024 H with the accumulator.

Ans.

A ← F2 H.

~~1024~~ 1024 H ← 2F H.

Before adding.

CY = 0 (Carry flag)

Z = 0 (Zero flag)

AC = 0 (Auxiliary carry flag)

S = 0 (Sign flag)

P = 0 (Parity flag).

After adding:,

F2 H

2F H.

121 H. → 00100001

CY = 1

Z = 0

AC = 1

S = 0.

P = 1

Here, the output comes 21 H (00100001) after adding. with carry 1 since F2H + 2FH = 121 H. The AC flag is also set as (2+F)F = (11)H. i.e a carry is generated. and since, there are even number of one so, Parity flag is also set.

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(15) What are the different control signal that can be generated in 8085 microprocessor and how they are generated? Elaborate it.

Ans The differement control signals that can be generated in 8085 microprocessor are:

(i) ~~IO/M~~. $\overline{MEMR}$ (Memory read)

(ii) $\overline{RD}$ $\overline{MEMW}$ (Memory write)

(iii) ~~$\overline{WR}$~~. $\overline{IOW}$ (I/O read)

(iv) $\overline{IOR}$ (I/O write)

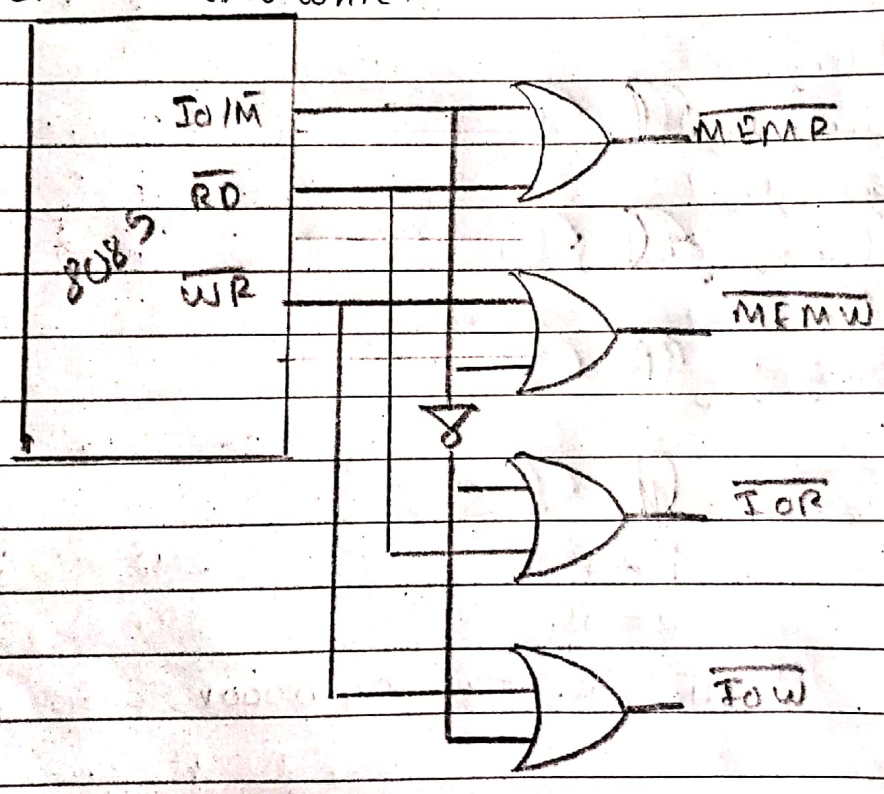

Fig: Control signal in 8085

~~M~~ 8085 has IO/$\overline{M}$, $\overline{RD}$ and WR control signals. These three signals are used to generate 4 control signals i.e. $\overline{MEMR}$, $\overline{MEMW}$, $\overline{IOR}$, $\overline{IOW}$. ~~They can be generated by:~~

(i) ~~$\overline{MEMR}$ — generated by logically ORing IO/$\overline{M}$ and $\overline{RD}$~~

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The $I/O\overline{M}$ signal goes low for memory operation and high for I/O operation. This signal is logically are ORed with $\overline{RD}$ and $\overline{WR}$ signal to get $\overline{MEMR}$, $\overline{MEMW}$, $\overline{IOR}$ and $\overline{IOW}$. For ~~write~~ ~~operat~~ getting $\overline{MEMR}$, the read signal goes low as well and for $\overline{MEMW}$, the write signal goes low.
For $\overline{IOR}$ and $\overline{IOW}$, the $IO\overline{M}$ signal goes high.
For $\overline{IOR}$, the ~~read~~ $\overline{RD}$ signal goes low and
For $\overline{IOW}$, the ~~w~~ R/$\overline{WR}$ signal goes low.

In this way, control signals are generated.

(16) What is meant by memory interfacing? Explain the address decoding process in the 8085 microprocessor.

Ans. Memory interfacing means matching the memory requirements with the microprocessor signals. It is used to access memory quite frequently to read instruction codes and data stored in memory.

There are two types of ~~address decoding in 8085~~ microprocessor.

Confuse vayo sir.

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