CST 307 Microprocessors and Microcontrollers

Module 1,II and III -

- Bhurchandi and Ray, Advanced Microprocessors and Peripherals, Third Edition McGraw Hill.
- Ramesh Gaonkar, Microprocessor Architecture, Programming, and Applications with the 8085, Penram International Publishing Pvt. Ltd.

Module IV –

- A. NagoorKani, Microprocessor 8086, programming and interfaces
- Douglas V. Hall, SSSP Rao, Microprocessors and Interfacing, Third Edition, McGrawHill Education.

Module V-

- Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and System Design,Pearson Education.
- A. NagoorKani, Microprocessors and Microcontrollers, Second Edition, Tata McGraw Hill.

CO#	Course Outcomes
CO1	Illustrate the **architecture**, modes of operation and addressing modes of microprocessors **(Cognitive knowledge: Understand)**
CO2	Develop 8086 **assembly** language programs. **(Cognitive Knowledge Level: Apply)**
CO3	Demonstrate interrupts, its **handling** and programming in 8086. **(Cognitive Knowledge Level: Apply))**
CO4	Illustrate how different **peripherals** (8255,8254,8257) and memory are interfaced with microprocessors. **(Cognitive Knowledge Level: Understand)**
CO5	Outline features of **microcontrollers** and develop low level programs. **(Cognitive Knowledge Level: Understand)**

Module1

CONTENTS

- Evolution of microprocessors
- 8085 Microprocessor

MICROPROCESSOR

- "The integrated circuit which contain all the function of the CPU (Central Processing Unit) of a computer is known as Microprocessor."

- Microprocessor is a multipurpose, clock driven, register based, programmable electronic device that accepts digital data or binary data as input, process it according to instructions stored in its memory and provides results as output

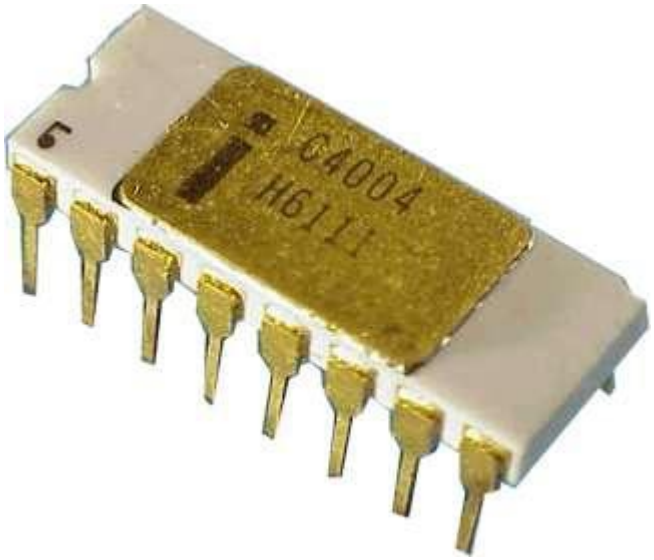
Manufacturers/Designers

- Intel.
- AMD.
- Qualcomm.
- NVIDIA.
- IBM.
- Samsung.
- Motorola.
- Hewlett-Packard (hp)

Evolution of microprocessors

- 4-Bit Microprocessors
- 8-Bit Microprocessors
- 16-Bit Microprocessors
- 32-Bit Microprocessors
- 64-Bit Microprocessors

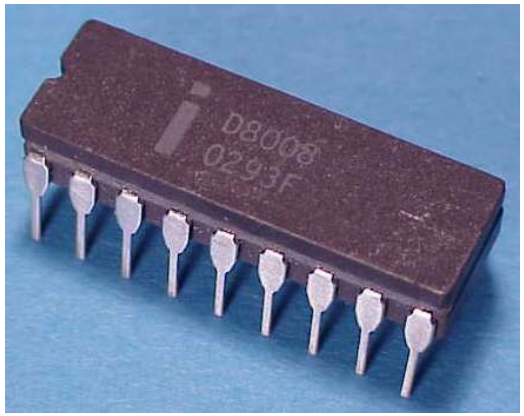
4-BIT MICROPROCESSOR



INTEL 4004

- Introduced in 1971.
- It was the first microprocessor by Intel.
- It was a 4-bit µP.
- Its clock speed was 740KHz.
- It had 2,300 transistors.
- It could execute around 60,000 instructions per second.
- Another eg: INTEL 4040

8-BIT MICROPROCESSOR



INTEL 8008

- Introduced in 1972,first 8-bit µP, clock speed was 500 KHz, could execute 50000 instructions per second.

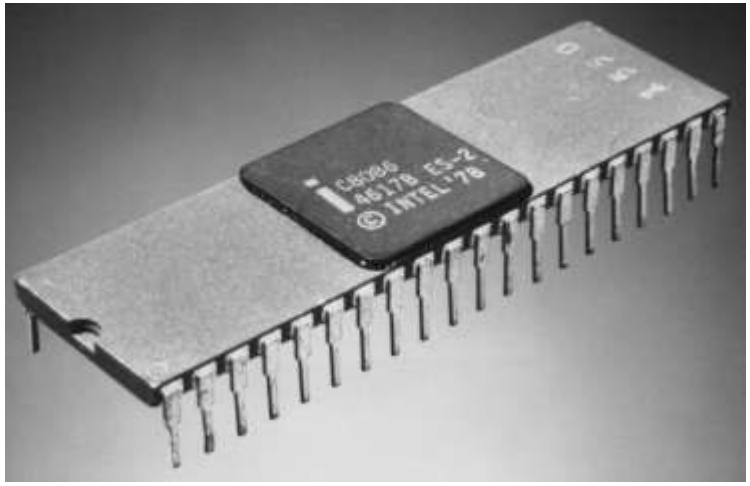
INTEL 8080

- Introduced in 1974,clock speed was 2MHz, 6,000 transistors,10 times faster than 8008. Could execute 5,00,000instructions per second.

INTEL 8085

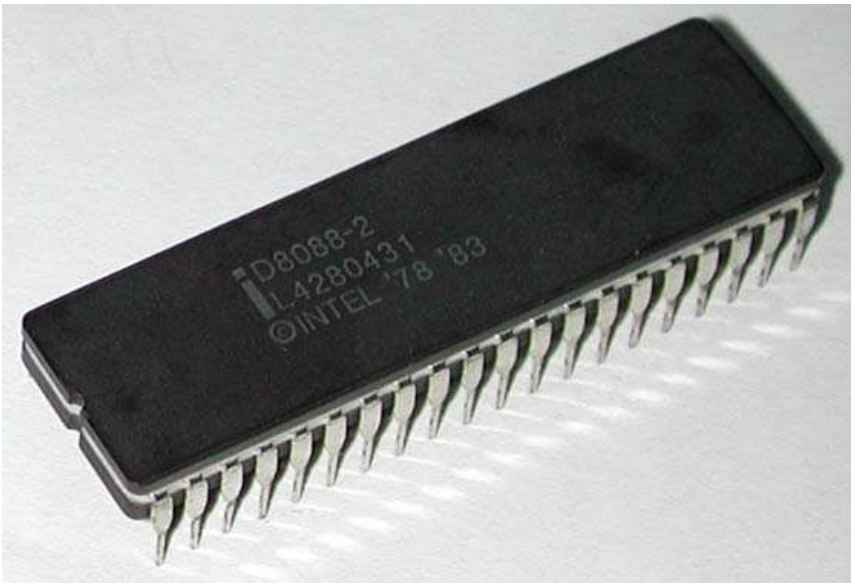
- Introduced in 1976, clock speed was 3 MHz. Its data bus is 8-bit and address bus is 16-bit.
- 6,500 transistors, execute 7,69,230 instructions per second.
- It could access 64 KB of memory.

16-BIT MICROPROCESSORS



INTEL 8086

- Introduced in 1978, clock speed is 4.77 MHz, 8 MHz and 10 MHz, depending on the version.
- Its data bus is 16-bit and address bus is 20-bit.
- It had 29,000 transistors, execute 2.5 million instructions per second.
- It could access 1 MB of memory.



INTEL 8088

- Introduced in 1979.
- It was created as a cheaper
- version of Intel's 8086.
- It was a 16-bit processor with an 8-bit external bus.
- Could execute 2.5 million
- instructions per second.
- This chip became the most popular in the computer industry when IBM used it for its first PC.
- Other eg:80186 & 80188,80286

32-BIT MICROPROCESSORS

INTEL 80386

- Introduced in 1986.
- 32-bit µP, data bus is 32-bit and address bus is 32-bit.
- It could address 4 GB of Memory, 2,75,000 transistors.
- Its clock speed varied from 16MHz to 33 MHz depending upon
- the various versions.
- Different versions:
  - 80386 DX
  - 80386 SX
  - 80386 SL

32-BIT MICROPROCESSORS Contd..

- INTEL 80486, INTEL PENTIUM, PENTIUM PRO, PENTIUM II,PENTIUM II XEON, PENTIUM III, PENTIUM IV, DUAL CORE,

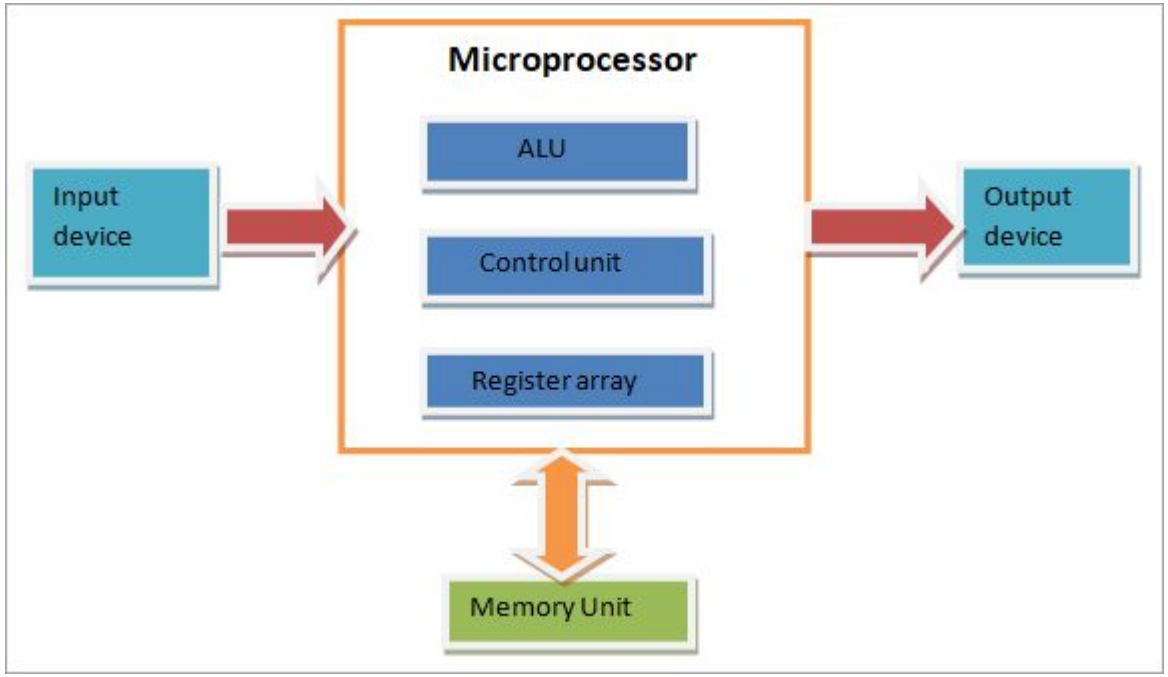
64-BIT MICROPROCESSORS

INTEL CORE 2

- Introduced in 2006.
- clock speed is from 1.2GHz to 3 GHz.
- It has 291 million transistors.
- It has 64 KB of L1 cache per core and 4 MB of L2 cache.
- It is launched in three different versions:
  - Intel Core 2 Duo
  - Intel Core 2 Quad
  - Intel Core 2 Extreme

  Other examples: INTEL CORE I3,I5,I7

Basic components of Microprocessor



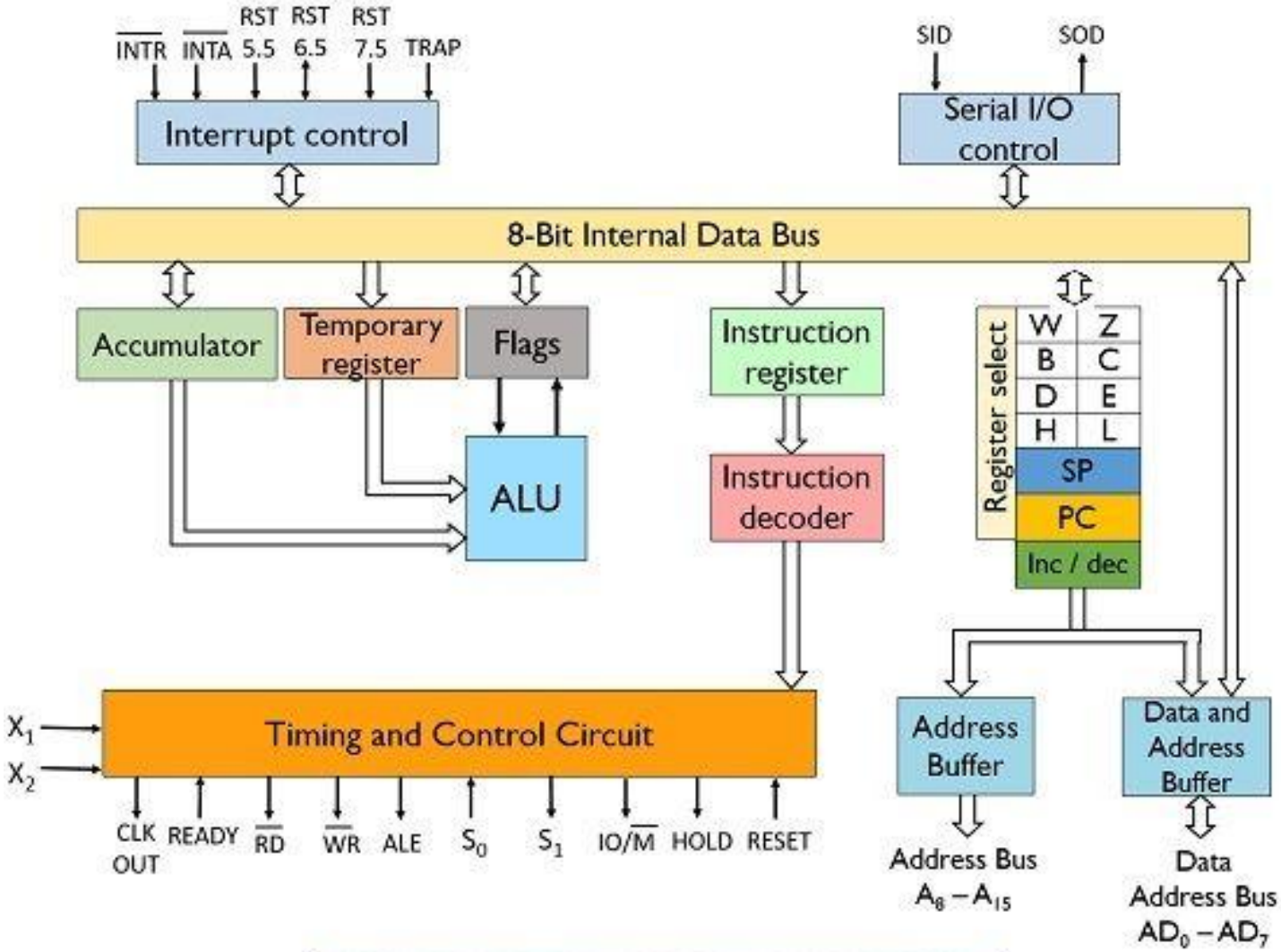
8085 Microprocessor

- It is an 8-bit microprocessor designed by Intel in 1977 using NMOS technology.

It has the following configuration −

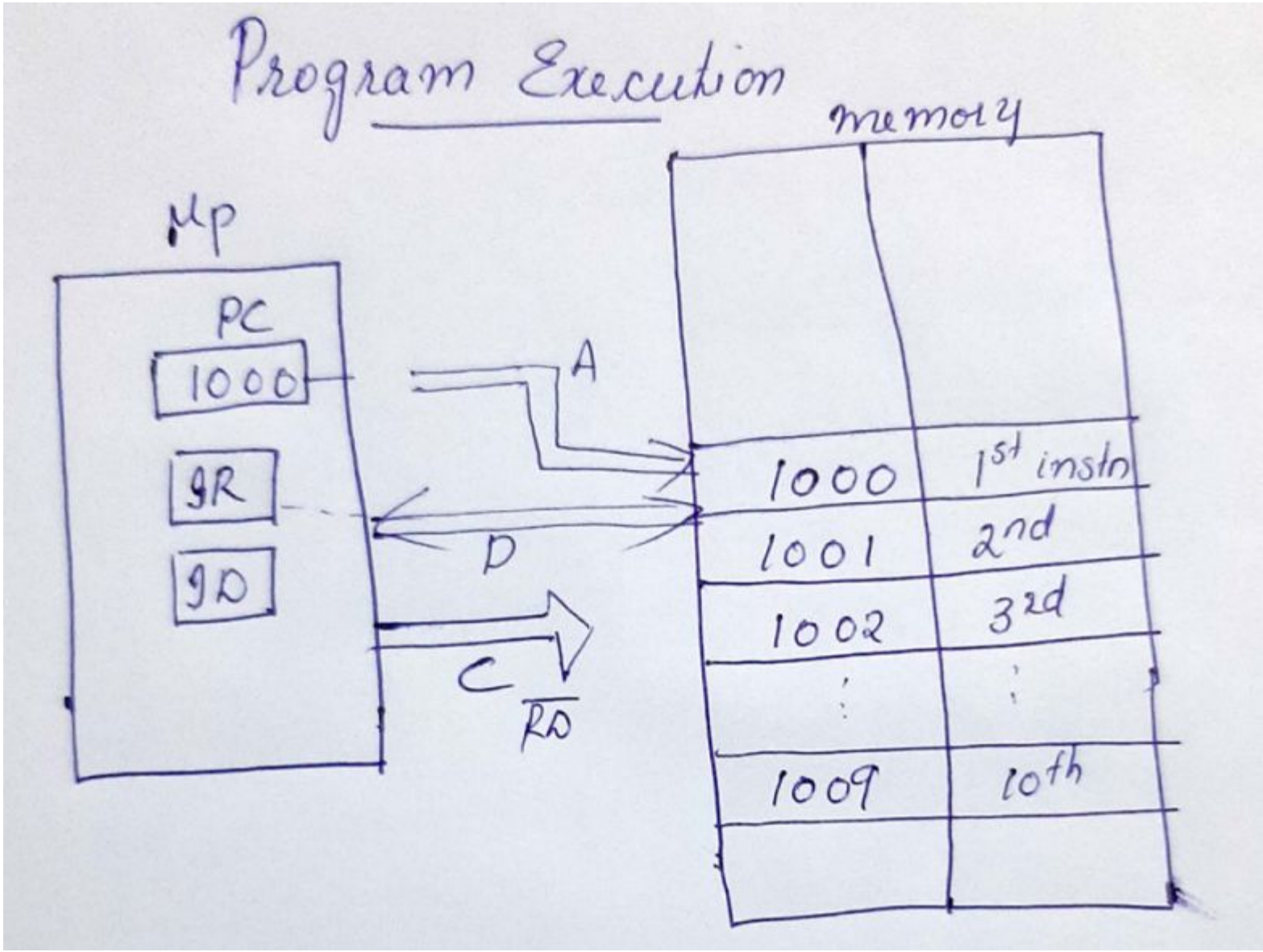
- 8-bit data bus
- 16-bit address bus, which can address upto 64KB
- A 16-bit program counter
- A 16-bit stack pointer
- Six 8-bit registers arranged in pairs: BC, DE, HL
- Requires +5V supply to operate at 3.2 MHZ single phase clock

- It was most commercially successful Processor
- It is used in washing machines, microwave ovens, mobile phones, etc.



Architecture of 8085 Microprocessor

Program Execution



8085 Microprocessor – Functional Units

Accumulator

- It is an 8-bit register used to perform arithmetic, logical, I/O & LOAD/STORE operations. It is connected to internal data bus & ALU.

Arithmetic and logic unit

- As the name suggests, it performs arithmetic and logical operations like Addition, Subtraction, AND, OR, etc. on 8-bit data.

General purpose register

- There are 6 general purpose registers in 8085 processor, i.e. B, C, D, E, H & L. Each register can hold 8-bit data.
- These registers can work in pair to hold 16-bit data and their pairing combination is like B-C, D-E & H-L.

Functional Units (Contd…)

Program counter

- It is a 16-bit register used to store the memory address location of the next instruction to be executed. Microprocessor increments the program whenever an instruction is being executed, so that the program counter points to the memory address of the next instruction that is going to be executed.

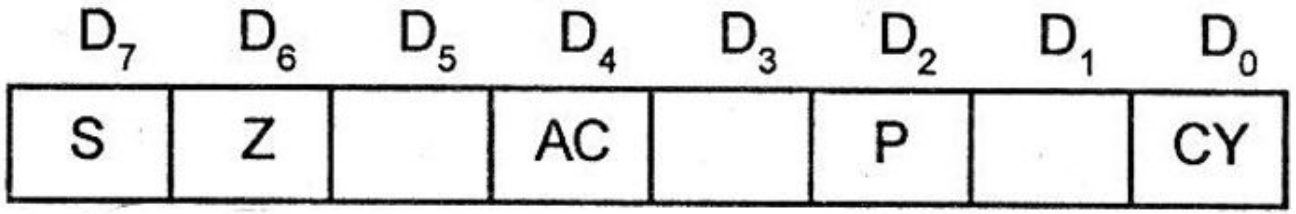
Stack pointer

- It is also a 16-bit register works like stack, which is always incremented/decremented by 2 during push & pop operations.

Temporary register

- It is an 8-bit register, which holds the temporary data of arithmetic and logical operations.

FLAG REGISTER OF 8085



Flag is an 8-bit register containing 5 1-bit flags:

Sign - set if the most significant bit of the result is set.

Zero - set if the result is zero.

Auxiliary carry - set if there was a carry out from bit 3 to bit 4 of the result.

Parity - set if the parity (the number of set bits in the result) is even.

Carry - set if there was a carry during addition, or borrow during subtraction/comparison.

Instruction register and decoder

- It is an 8-bit register. When an instruction is fetched from memory then it is stored in the Instruction register. Instruction decoder decodes the information present in the Instruction register.

Timing and control unit

- It provides timing and control signal to the microprocessor to perform operations. Following are the timing and control signals, which control external and internal circuits −

Control Signals: READY, RD', WR', ALE

Status Signals: S0, S1, IO/M'

DMA Signals: HOLD, HLDA

RESET Signals: RESET IN, RESET OUT

Interrupt control

- When a microprocessor is executing a main program and whenever an interrupt occurs, the microprocessor shifts the control from the main program to process the incoming request. After the request is completed, the control goes back to the main program.
- 5 interrupt signals in 8085 microprocessor: INTR, RST 7.5, RST 6.5, RST 5.5, TRAP.

Serial Input/output control

- It controls the serial data communication by using these two instructions: SID (Serial input data) and SOD (Serial output data).

Address buffer and address-data buffer

- The content stored in the stack pointer and program counter is loaded into the address buffer and address-data buffer to communicate with the CPU. The memory and I/O chips are connected to these buses; the CPU can exchange the desired data with the memory and I/O chips.

Address bus and data bus

- Data bus carries the data to be stored. It is bidirectional, whereas address bus carries the location to where it should be stored and it is unidirectional. It is used to transfer the data & Address I/O devices.

8085-Pin diagram