Degree Engineering

A Laboratory Manual for

Microprocessor and Interfacing (3160712)

[B.E. (Computer Engineering) : Semester - 6]

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CERTIFICATE

This is to certify that Mr. Mandeep Jadeja Enrollment No. _230213107008_ of B.E. Semester _6th__ from ***Computer Engineering Department*** *of this Institute (GTU Code:* ***021****) has satisfactorily completed the Practical / Tutorial work for the subject* ***Microprocessor and Interfacing (3160712)*** *for the academic year*

Place: _____

Date: _____

Signature of Course Faculty **Head of the Department**

Preface

Main motto of any laboratory/practical/field work is for enhancing required skills as well as creating ability amongst students to solve real time problem by developing relevant competencies in psychomotor domain. By keeping in view, GTU has designed competency focused outcome-based curriculum for engineering degree programs where sufficient weightage is given to practical work. It shows importance of enhancement of skills amongst the students and it pays attention to utilize every second of time allotted for practical amongst students, instructors and faculty members to achieve relevant outcomes by performing the experiments rather than having merely study type experiments. It is must for effective implementation of competency focused outcome-based curriculum that every practical is keenly designed to serve as a tool to develop and enhance relevant competency required by the various industry among every student. These psychomotor skills are very difficult to develop through traditional chalk and board content delivery method in the classroom. Accordingly, this lab manual is designed to focus on the industry defined relevant outcomes, rather than old practice of conducting practical to prove concept and theory.

By using this lab manual students can go through the relevant theory and procedure in advance before the actual performance which creates an interest and students can have basic idea prior to performance. This in turn enhances pre-determined outcomes amongst students. Each experiment in this manual begins with competency, industry relevant skills, course outcomes as well as practical outcomes (objectives). The students will also achieve safety and necessary precautions to be taken while performing practical.

This manual also provides guidelines to faculty members to facilitate student centric lab activities through each experiment by arranging and managing necessary resources in order that the students follow the procedures with required safety and necessary precautions to achieve the outcomes. It also gives an idea that how students will be assessed by providing rubrics.

The modern digital systems including computer systems are designed with microprocessor as central device connected to memory and I/O devices. The subject introduces the students with basics of microprocessor, microprocessor architecture and assembly language programming, interfacing microprocessor with memory and various I/O (Input/Output) devices.

Utmost care has been taken while preparing this lab manual however always there is chances of improvement. Therefore, we welcome constructive suggestions for improvement and removal of errors if any.

DTE's Vision

- To provide globally competitive technical education
- Remove geographical imbalances and inconsistencies
- Develop student friendly resources with a special focus on girls' education and support to weaker sections
- Develop programs relevant to industry and create a vibrant pool of technical professionals

Institute's Vision

- To create an ecosystem for proliferation of socially responsible and technically sound engineers, innovators and entrepreneurs.

Institute's Mission

- To develop state-of-the-art laboratories and well-equipped academic infrastructure.
- To motivate faculty and staff for qualification up-gradation, and enhancement of subject knowledge.
- To promote research, innovation and real-life problem-solving skills.
- To strengthen linkages with industries, academic and research organizations.
- To reinforce concern for sustainability, natural resource conservation and social responsibility.

Department's Vision

- To create an environment for providing value-based education in Computer Engineering through innovation, team work and ethical practices.

Department's Mission

- To produce computer engineering graduates according to the needs of industry, government, society and scientific community.
- To develop state of the art computing facilities and academic infrastructure.
- To develop partnership with industries, government agencies and R & D organizations for knowledge sharing and overall development of faculties and students.
- To solve industrial, governance and societal issues by applying computing techniques.
- To create environment for research and entrepreneurship.

Programme Outcomes (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

- Sound knowledge of fundamentals of computer science and engineering including software and hardware.
- Develop the software using sound software engineering principles having web based/mobile based interface.
- Use various tools and technology supporting modern software frameworks for solving problems having large volume of data in the domain of data science and machine learning.

Program Educational Objectives (PEOs)

- Possess technical competence in solving real life problems related to Computing.
- Acquire good analysis, design, development, implementation and testing skills to formulate simple computing solutions to the business and societal needs.
- Provide requisite skills to pursue entrepreneurship, higher studies, research, and development and imbibe high degree of professionalism in the fields of computing.
- Embrace life-long learning and remain continuously employable.
- Work and excel in a highly competence supportive, multicultural and professional environment which abiding to the legal and ethical responsibilities.

Practical – Course Outcome matrix

Course Outcomes (COs)	
CO_3160712.1	Demonstrate the various features of microprocessor, memory and I/O devices including concepts of system bus.
CO_3160712.2	Identify the hardware elements of 8085 microprocessor including architecture and pin functions and programming model including registers, instruction set and addressing modes.
CO_3160712.3	Select appropriate 8085 instructions based on size and functions to write a given assembly language program.
CO_3160712.4	Design a given interfacing system using concepts of memory and I/O interfacing.
CO_3160712.5	Demonstrate the features of advance microprocessors

Sr. No.	Practical Outcome/Title of experiment	CO 1	CO 2	CO 3	CO 4	CO 5
1.	Study about 8085 microprocessor architecture, Pin diagram and bus organization.	√				
2.	Study about following 8085 microprocessor instruction sets. (a) Data transfer instructions (b) Arithmetic instructions (c) Logical instructions (d) Branching instructions (e) Stack, I/O and machine control instructions		√			
3.	(a) Write an assembly language program to add two 16-bit numbers stored in memory with carry in 8085 simulator. Store result in the memory (b) Write an assembly language program to subtract two 8-bit numbers stored in memory location 2050 H and 2051 H with borrow using 8085 simulator. Store your result on memory location 2052			√		
4.	(a) Write an assembly language program to multiply two 8-bit numbers stored in memory by bit rotation method using 8085 simulator. Store result in the memory (b) Write an assembly language program to find the minimum of two 8-bit numbers stored in the memory location 2050H and 2051H using 8085 simulator. Store the result in 2052H			√		
5.	(a) Write an assembly language program using 8085 simulator to find square-root of a given number. Display result on output port number 01H			√		

	(b) Write an assembly language program to find a factorial of a given number using 8085 simulator. Display result on output port number 0AH					
6.	a) Write an assembly language program to move a block of the memory starts at the location 2051H to 4051H using 8085 simulator. The length of the block is given on the memory location 2050H b) Write an assembly language program to arrange numbers in ascending order using 8085 simulator. The length of the block is given on memory location 2050H and block starts from 2051H.			√		
7.	a) Write an assembly language program to covert a given hexadecimal number to its equivalent ASCII number using 8085 simulator b) Write a subroutine to find minimum of two numbers and use it to find minimum from block of data. The length of the block is given on memory location 2050H and block starts from 2051H			√		
8.	a) Write an assembly language program to reverse the block of 8-bit data using stack in 8085 simulator. b) Write an assembly language program for decade counter with 1 ms delay between two successive counts using 8085 simulator			√		
9.	Study about 8255A Programmable Peripheral Interface Architecture, ports and their modes.				√	
10.	Study about 8086 microprocessor architecture and its register organization.					√

Industry Relevant Skills

The following industry relevant competencies are expected to be developed in the student by undertaking the practical work of this laboratory.

1. Will be able to demonstrate various features of microprocessor, memory and I/O devices through microprocessor kit.
2. Will be able to design assembly language programs using appropriate 8085 instructions based on size and functions for conditional statements, branching, looping, stack, subroutine and time delay.
3. Will be able to design a given interfacing system using concepts of memory and I/O interfacing

Guidelines for Faculty members

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain basic concepts/theory related to the experiment to the students before starting of each practical
3. Involve all the students in performance of each experiment.
4. Teacher is expected to share the skills and competencies to be developed in the students and ensure that the respective skills and competencies are developed in the students after the completion of the experimentation.
5. Teachers should give opportunity to students for hands-on experience after the demonstration.
6. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected from the students by concerned industry.
7. Give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions or not.
8. Teacher is expected to refer complete curriculum of the course and follow the guidelines for implementation.

Instructions for Students

1. Students are expected to carefully listen to all the theory classes delivered by the faculty members and understand the COs, content of the course, teaching and examination scheme, skill set to be developed etc.
2. Students will have to perform experiments on 8085 microprocessor kit as well as on 8085 simulator.
3. Students should develop assembly language programs and execute all the programs on 8085 simulator. Students have to show output of each program in their practical file.
4. Students are instructed to submit practical list as per given sample list shown on next page.
5. Student should develop a habit of submitting the experimentation work as per the schedule and s/he should be well prepared for the same.

Common Safety Instructions

Students are expected to

1) switch on the PC carefully (not to use wet hands)
2) shutdown the PC properly at the end of your Lab
3) carefully handle 8085 microprocessor kit
4) carefully handle the peripherals (Mouse, Keyboard, Network cable etc)
5) use Laptop in lab after getting permission from Teacher

Index
(Progressive Assessment Sheet)

Sr. No.	Objective(s) of Experiment	Page No.	Date of performance	Date of submission	Assessment Marks	Sign. of Teacher with date	Remarks
1	Study about 8085 microprocessor architecture, Pin diagram and bus organization.						
2	Study about following 8085 microprocessor instruction sets. (a) Data transfer instructions (b) Arithmetic instructions (c) Logical instructions (d) Branching instructions (e) Stack, I/O and machine control instructions						
3	(a) Write an assembly language program to add two 16-bit numbers stored in memory with carry in 8085 simulator. Store result in the memory (b) Write an assembly language program to subtract two 8-bit numbers stored in memory location 2050 H and 2051 H with borrow using 8085 simulator. Store your result on memory location 2052						
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9	Study about 8255A Programmable Peripheral Interface Architecture, ports and their modes.						
10	Study about 8086 microprocessor architecture and its register organization.						
	Total						

Experiment No - 1

Aim: Study about 8085 microprocessor architecture, pin diagram and bus organization.

8085 microprocessor is one of the most prominent entry level processor used to teach students for understanding of the working of microprocessor at hardware level. So this experiment is important with respective learning objective to understand the working of microprocessor at low level.

Date:

Competency and Practical Skills: Understanding and Analyzing

Relevant CO: CO1

Objectives: (a) To understand the architecture of 8085 microprocessor
(b) To understand the control signals of 8085 microprocessor chip.
(c) To understand the Bus organization of 8085 microprocessor
.

Equipment/Instruments: 8085 microprocessor board.

Theory:

8085 Microprocessor Architecture

8085 microprocessor is 8 bit general purpose microprocessor. It is single chip NMOS device with 40 pins. It works on 5V DC power supply. The architecture of 8085 is given in figure -1. It is a modified version of 8080 microprocessor and it requires +5V more than 8080. So it is called 8085. It is used in mobile phones, microwave ovens, etc.

8085 microprocessor consists of the following functional units:

1. Arithmetic and Logic Unit
2. Registers
3. Data and Address Bus
4. Timing and Control Unit

I. Arithmetic and Logic Unit:

- Used to perform arithmetic and logical functions like: addition, subtraction, logical AND, logical OR, etc.
- It is the most important part of microprocessor.
- It executes all the instructions.

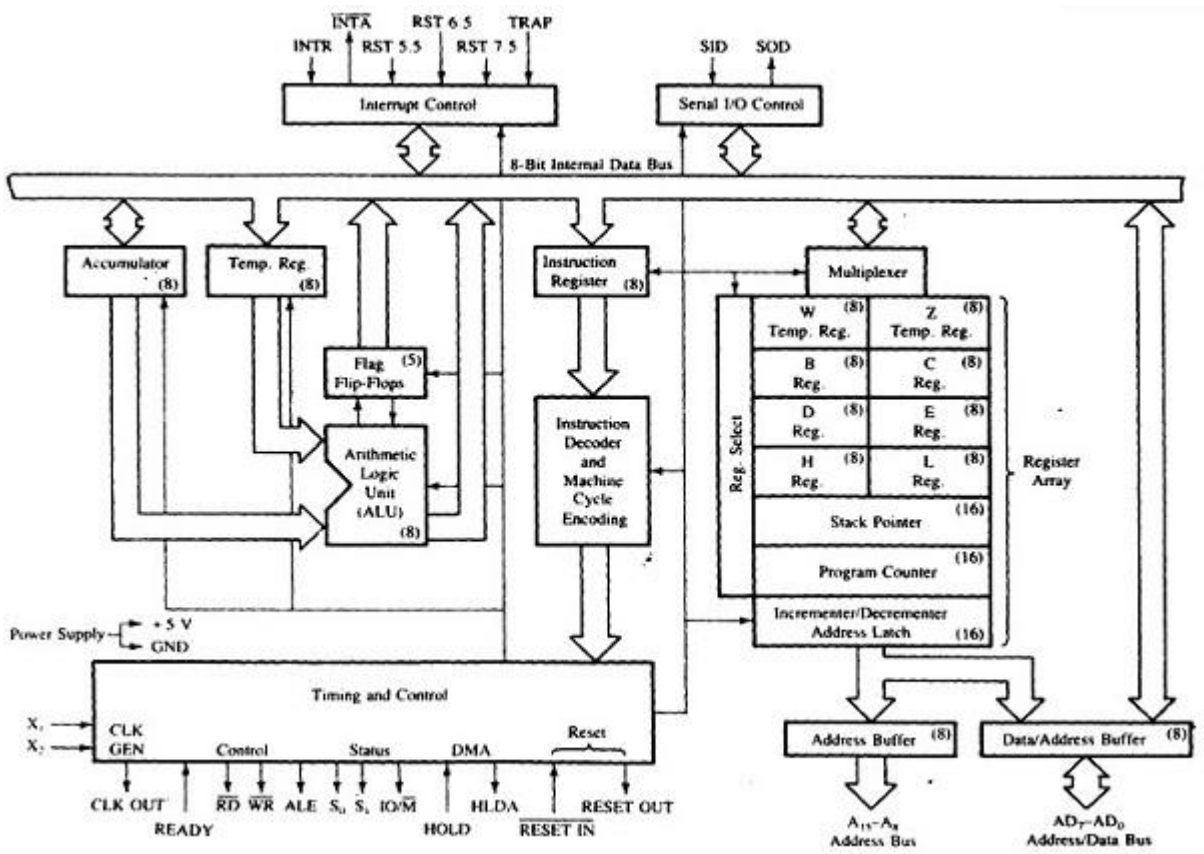

Figure – 1: Architecture of 8085 Microprocessor

II. Registers:

- There are multiple different types of registers in microprocessor.

i. Accumulator:

- It is an 8 bit register identified as A.
- It is used to store 8-bit data to perform arithmetic and logical instructions.
- The result of operations is stored in accumulator.

ii. General purpose register:

- There are in total 6 general purpose registers.
- They all store 8-bit data.
- They are as: B, C, D, E, H & L.

iii. Program counter:

- It is known as PC.
- Microprocessor uses PC register to sequence the execution of instructions.
- Its function is to point to memory address from which next byte is to be fetched.
- When a byte is being fetched, PC is incremented by 1 to point the next location in memory.

iv. Stack pointer:

- This register is used as memory pointer.
- It points to the memory location in R/W memory called Stack.
- Beginning of the stack is defined by loading 16-bit address in the stack pointer.

v. Temporary register:

- It is an 8-bit register, which holds the temporary data of arithmetic and logical operations.
- It is used by the microprocessor.
- It is not accessible to programmer.

vi. Flag register:

- It is an 8-bit register having five 1-bit flip-flops, which holds either 0 or 1 depending upon the result stored in the accumulator.

vii. Instruction register:

- The instruction register holds the op-code of the instruction which is being decoded and executed.

III. Timing and Control Unit:

- It provides timing and control signals to the microprocessor to perform various operations.
- It has 3 control signals which control all external and internal circuits.
- These signals are synchronized with the clock signals to have synchronized data transfers.

IV. Address Bus and Data Bus:

- Group of 16 unidirectional lines generally identified as A0 to A15 i.e. bits flow from microprocessors to peripheral devices.
- These 16 address lines are capable of addressing 65536 memory locations.
- So, 8085 has 64K memory locations.

Pin Diagram

8085 microprocessor consists of 40 pins which are divided into 6 different groups as per following details. The pin diagram of 8085 is given in Figure - 2

- Address bus
- Multiplexed address/data bus
- Control and status signals
- Power supply and frequency signals
- Externally initiated signals
- Serial I/O ports

Address Bus:

- 16 single lines are used as address bus.
- But these 16 lines split into 2 segments: A15 – A8 and AD7 – AD0.
- A15 - A8 are unidirectional and used to carry high-order address of 16-bit address.
- AD7 - AD0 are used for dual purpose.

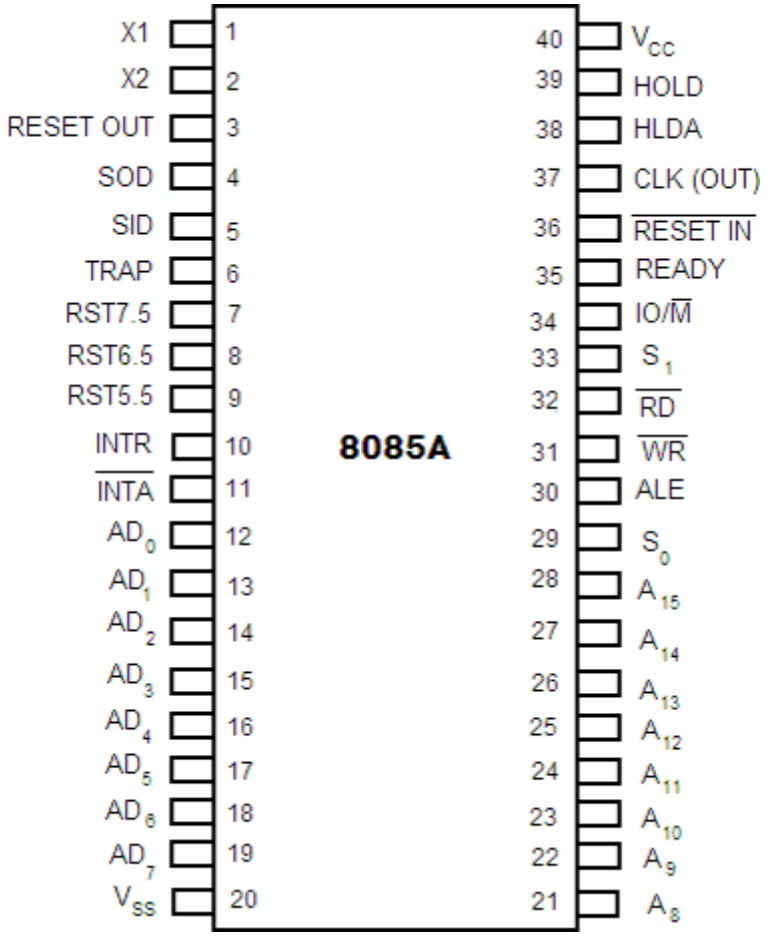

Figure – 2 Pin diagram of 8085 Microprocessor

Multiplexed Address/Data Bus:

- Signal lines AD7 – AD0 are bidirectional and serve dual purpose.
- They are used as low-order address bus as well as data bus.
- The low-order address bus can be separate from these signals by using a latch (ALE).

Control and Status Signals:

- ALE (Output): ALE stands for Address Latch Enable signal. ALE goes high during first clock cycle of a machine cycle and enables the lower 8-bits of the address to be latched either into the memory or external latch.

- IO/M (Output): It is a status signal which distinguishes whether the address is for memory or I/O device.

- S0, S1 (Output): These are status signals sent by the microprocessors to distinguish the various types of operation given in table below:

S0	S1	Operation
0	0	HALT
0	1	WRITE
1	0	READ
1	1	FETCH

- RD (Output): RD is a signal to control READ operation. When it goes low, the selected I/O device or memory is read.
- WR (Output): WR is a signal to control WRITE operation. When it goes low, the data bus's data is written into the selected memory or I/O location.
- READY (Input): It is used by the microprocessor to sense whether a peripheral is ready to transfer a data or not. If READY is high, the peripheral is ready. If it is low the microprocessor waits till it goes high.

Power Supply and Frequency Signals:

- Vcc □ Pin 40, +5V Supply.
- Vss □ Pin 20, Ground Reference
- X1, X2 □ Pin 1 & 2, Crystal Oscillator is connected at these two pins.
- The frequency is internally divided by two;
- Therefore, to operate a system at 3MHz, the crystal should have a frequency of 6MHz.
- CLK (OUT) □ Clock output
- Pin 37: This signal is used as system clock for other I/O devices for synchronization with Microprocessor.

Externally Initiated Signals:

- **INTR (Input)** □ Interrupt Request. It is used for general purpose interrupt.
- **INTA (Output)** □ Interrupt Acknowledge.
- **RST7.5, RST6.5, RST5.5 (Input)** □ Restart Interrupts. These are vector interrupts that transfer the program control to specific memory locations.
- **TRAP (Input)** □ This is a non maskable interrupt & has the highest priority.
- **HOLD (Input)** □ This signal indicates that a peripheral such as DMA Controller is requesting the use of address & data buses.
- **HLDA (Output)** □ Hold Acknowledge. This signal acknowledges the HOLD request.

- **READY (Input)** □ This signal is used to delay the microprocessor read or write cycles until low-responding peripheral is ready to send or accept data.
- **RESET IN (Input)** □ When the signal on this pin goes low, the Program Counter is set to zero, the buses are tri-stated & microprocessor is reset.
- **RESET OUT (Output)** □ This signal indicates that microprocessor is being reset. The signal is also used to reset other devices.

Serial I/O Ports:

- Two pins for serial transmission:
  - **SID** (Serial Input Data)
  - **SOD** (Serial Output Data)
    - In serial transmission, data bits are sent over a single line, one bit at a time.

Bus Organization

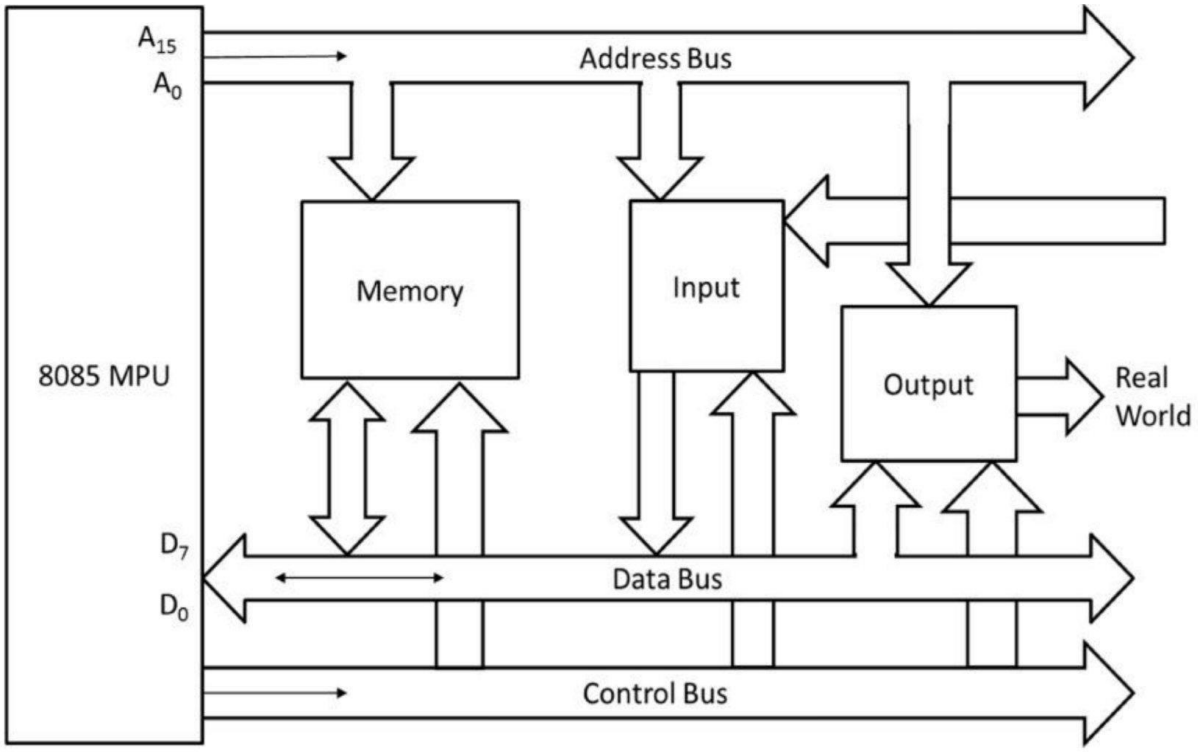

Figure: Bus Organization of 8085.

- Microprocessors consists mainly of 3 units:
  - CPU
  - Memory
  - I/O

- All these 3 part interfaced with each other over common communication path called system bus.
- The network of wires or electronic pathways is known as Bus.
- Bus is a group of conducting wires which carries information, all the peripherals are connected to microprocessor through Bus.
- There are 3 type of bus in System bus.
  - Address Bus
  - Data Bus
  - Control Bus

Address Bus:

- Group of 16 unidirectional lines generally identified as A0 to A15. i.e. bits flow from microprocessor to peripheral devices.
- 16 address lines are capable of addressing 65536 memory locations. So, 8085 has 64K memory locations.

Data Bus:

- Group of 8 lines identified as D0 to D7.
- They are bidirectional i.e. data flow in both directions between microprocessor, memory & peripheral.
- 8 data lines enable microprocessor to manipulate data ranging from 00H to FFH (28 = 256 numbers).
- Largest number appear on data bus is 1111 1111 => (255)10.
- As Data bus is of 8-bit, 8085 is known as 8-bit Microprocessor.

Control Bus:

- It comprises of various single lines that carry synchronization, timing & control signals.
- These signals are used to identify a device type with which MPU intends to communicate.
- Some control signals are **Read**, **Write** and **Op-code fetch** etc.

Observations:

It is observed that, 8085 microprocessor is 40 pin IC having 2- pins used for power supply and remaining 38-pin used as input / output signals. Working of 8085 microprocessor is understood with the block diagram. Working and hardware logic is understood with the help of block diagram of Bus organization of 8085 microprocessor.

Conclusion:

8085 microprocessor architecture, Pin diagram and bus organization understand and recall successfully.

Quiz:

(1) **What is the use of ALE signal?**

The ALE (Address Latch Enable) signal in the 8085 microprocessor is used to separate the lower-order address and data lines (AD0–AD7). It enables an external latch to capture and hold the address information during memory or I/O operations, ensuring proper communication between the processor and external devices.

(2) **What type of address mechanism used in 8085 to address memory and I/O Device?**

The 8085 microprocessor uses two addressing methods: memory-mapped I/O, where I/O devices are treated as memory locations and accessed using 16-bit addresses, and I/O-mapped I/O, where devices are accessed using 8-bit port addresses with specific IN and OUT instructions.

(3) **What is the maximum amount of memory support by the 8085 microprocessors?**

The 8085 microprocessor can support up to 64 KB of memory. This is because it has a 16-bit address bus, which allows it to access 2^{16} (65,536) unique memory locations.

(4) **Why N-MOS Technology is used for 8085 microprocessors?**

N-MOS technology is used in the 8085 microprocessor because it provides a good balance e of speed, power efficiency, and cost. It allows for higher transistor density, making it suitable for designing compact and efficient microprocessors during its time.

Suggested Reference:

8085 – Microprocessor architecture, programming and interfacing by Ramesh S. Goankar, 5th edition, prentice hall publication.

References used by the students:

Rubric wise marks obtained:

Rubrics	Knowledge (2)		Problem Recognition (2)		Logic Building (2)		Completeness and accuracy (2)		Ethics (2)		Total
	Good (2)	Avg. (1)	Good (2)	Avg. (1)	Good (2)	Avg. (1)	Good (2)	Avg. (1)	Good (2)	Avg. (1)	
Marks											

Experiment No - 2

Aim: Study about following 8085 microprocessor instruction sets
(a) Data transfer instructions
(b) Arithmetic instructions
(c) Logical instructions
(d) Branching instructions
(e) Stack, I/O and Machine control instructions

Date:

Competency and Practical Skills: Understanding and Analyzing

Relevant CO: CO1

Objectives: (a) To understand the architecture of 8085 microprocessor
(b) To understand the control signals of 8085 microprocessor chip.
(c) To understand the Bus organization of 8085 microprocessor
.

Equipment/Instruments: 8085 microprocessor board.

Theory:

A. Data transfer instructions

- MOV Rd, Rs: Copies data from the source register (Rs) to the destination register (Rd).
- MVI Rd, data: Loads an 8-bit value directly into a register or memory.
- LDA 16-bit address: Loads the accumulator with data from a specified memory location.
- STA 16-bit address: Stores the accumulator's contents into a memory location.
- PUSH/POP: Used to save and retrieve data from the stack.

Code :

```
MVI A, 25H
MOV B, A
STA 2050H
LDA 2050H
```

B.Arithmetic instructions

These instructions perform mathematical operations like addition, subtraction, and increment/decrement. Examples:

- ADD R/M: Adds the contents of a register or memory to the accumulator.
- ADI 8-bit data: Adds an 8-bit value directly to the accumulator.
- SUB R/M: Subtracts the contents of a register or memory from the accumulator.
- INR R/M: Increments the value in a register or memory by 1.

Code:

```
MVI A, 10H
MVI B, 05H
ADD B
ADI 02H
```

C. Logical Instructions

These instructions perform logical operations like AND, OR, XOR, and rotate. Examples:

- ANA R/M: Performs a logical AND operation between the accumulator and a register/memory.
- ORI 8-bit data: Performs a logical OR operation with an 8-bit value.
- RLC: Rotates the accumulator’s bits to the left.

Code:

```
MVI A, 0FH
ANI 0FH
RLC
```

D. Branching Instructions

These instructions alter the program flow based on conditions. Examples:

- JMP 16-bit address: Unconditionally jumps to a specified memory location.
- JZ/JNZ: Jumps if the Zero flag is set/not set.
- CALL/RET: Calls a subroutine or returns from it.

Code:

```
MVI A, 00H
JZ LABEL
LABEL: HLT
```

E. Stack, I/O, and Machine Control Instructions

These instructions manage the stack, I/O operations, and CPU control. Examples:

- PUSH/POP: Manages stack operations.
- IN/OUT: Reads from or writes to an I/O port.
- HLT: Stops the CPU execution.

Code:

```
LXI SP, 0FF0H
PUSH B
POP D
HLT
```

Observations:

- The 8085 microprocessor executes instructions efficiently, moving data between registers, memory, and I/O devices.
- Arithmetic and logical operations are performed quickly, with results stored in the accumulator.
- Branching instructions allow the program to make decisions based on flag conditions.
- Stack operations (PUSH/POP) are essential for managing subroutines and temporary data storage.

Conclusion:
This experiment provided a hands-on understanding of the 8085 microprocessor's instruction sets. By writing and executing programs, I learned how data is transferred, arithmetic and logical operations are performed, and program flow is controlled. This knowledge is crucial for designing and programming microprocessor-based systems.

Quiz:

1. **What is the purpose of the PUSH and POP instructions?**

The PUSH instruction saves the contents of a register pair onto the stack, while the POP instruction retrieves data from the stack into a register pair. These instructions are used for temporary data storage and subroutine management.

2. **What is a conditional jump?**

A conditional jump changes the program flow based on specific flag conditions, such as the Zero flag (JZ) or Carry flag (JC). For example, JZ jumps to a specified address if the Zero flag is set.

3. **What is the function of the DAA instruction?**

The DAA (Decimal Adjust Accumulator) instruction corrects the accumulator's value after a BCD addition, ensuring the result is a valid BCD number.

Suggested Reference:

8085 – Microprocessor architecture, programming and interfacing by Ramesh S. Goankar, 5th edition, prentice hall publication.

References used by the students:

Rubric wise marks obtained:

Rubrics	Knowledge (2)		Problem Recognition (2)		Logic Building (2)		Completeness and accuracy (2)		Ethics (2)		Total
	Good (2)	Avg. (1)	Good (2)	Avg. (1)	Good (2)	Avg. (1)	Good (2)	Avg. (1)	Good (2)	Avg. (1)	
Marks											