I

Name _____

Roll No. _____ Year 20____20____

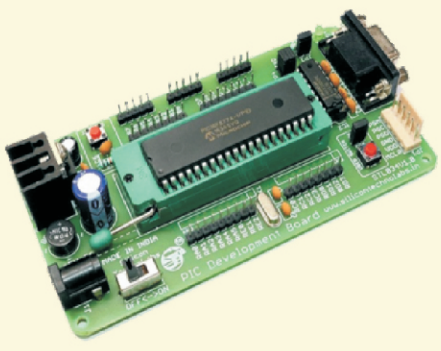
Exam Seat No. _____

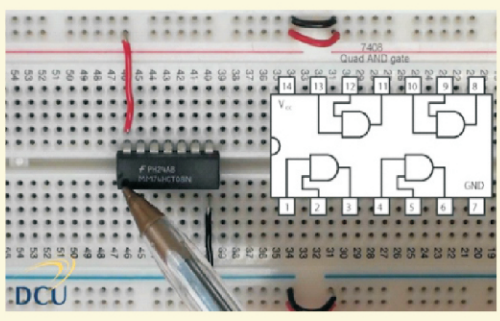
ELECTRICAL GROUP | SEMESTER - IV | DIPLOMA IN ENGINEERING AND TECHNOLOGY

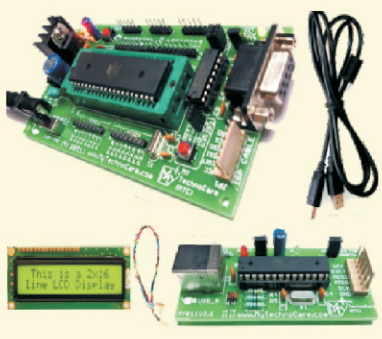
A LABORATORY MANUAL

FOR

DIGITAL ELECTRONICS AND MICROCONTROLLER APPLICATIONS (22421)







MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual
For

Digital Electronics and Microcontroller Applications

(22421)

Semester– (IV)

(EE, EP, EU)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO 9001 : 2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on November 2018)

Maharashtra State
Board of Technical Education

Certificate

This is to certify that Mr. / Ms……. Roll No…….of Fourth Semester of Diploma in …… of Institute …….. (Code……..) has completed the term work satisfactorily in course **Digital Electronics and Microcontroller Applications (22421)** for the Academic Year 20…….to 20…..... as prescribed in the curriculum.

Place ……. Enrollment No……
Date:…..... Exam Seat No. ……..

Course Teacher **Head of the Department** **Principal**

Seal of the Institute

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practical to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practical to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

The electrical diploma holder has to work in industry as technical person in middle level management. He has to work as production, maintenance, testing engineer in various industries like power generation, transmission, distribution, traction etc. and has to deal with different electrical measurement. He/she also has to deal with advanced, automated and sophisticated equipment that are used in modern techniques. While performing above task he has to measure different electrical and electronic parameters with testing, therefore he/she must require the skills for these measurements and broad idea of different meters and equipment. Equipment may contain digital and microcontroller based embedded systems, for which the basic knowledge of this subjects is required.

Although all care has been taken to check for mistakes in this laboratory manual, yet it is impossible to claim perfection especially as this is the first edition. Any such errors and suggestions for improvement can be brought to our notice and are highly welcome.

Programme Outcomes (POs) to be achieved through Practical of this Course:-

Following POs and PSO are expected to be achieved through the practical of this course

PO 1. Basic knowledge: Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.

PO 2. Discipline knowledge: Apply Electrical engineering knowledge to solve broad-based electrical engineering related problems.

PO 3. Experiments and practice: Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.

PO 4. Engineering tools: Apply relevant Electrical technologies and tools with an understanding of the limitations.

PO 5. The engineer and society: Assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to practice in the field of Electrical engineering.

PO 6. Environment and sustainability: Apply Electrical engineering solutions also for sustainable development practices in societal and environmental contexts.

PO 7. Ethics: Apply ethical principles for commitment to professional ethics, responsibilities and norms of the practice also in the field of Electrical engineering.

PO 8. Individual and team work: Function effectively as a leader and team member in diverse/ multidisciplinary teams.

PO 9. Communication: Communicate effectively in oral and written form.

PO 10. Life-long learning: Engage in independent and life-long learning activities in the context of technological changes also in the Electrical engineering and allied industry.

Program Specific Outcomes (PSOs) :-

PSO 1. Electrical Equipment: Maintain various types of rotating and static electrical equipment.

PSO 2. Electric Power Systems: Maintain different types of electrical power systems.

List of Industry Relevant Skills

The following industry relevant skills of the competency '**Use digital electronics and microcontroller based systems'** are expected to be developed in the students by undertaking the laboratory work in this practical manual.

a. Realize logic circuits using Boolean expressions.
b. Build simple combinational and sequential circuits.
c. Analyze the architecture of microcontroller ICs.
d. Write programs in assembly language for microcontrollers.
e. Interface the memory and I/O devices to microcontrollers.

Practical- Course Outcome matrix

Course Outcomes (COs):-

a. Use Boolean expressions to realize logic circuits.
b. Build simple combinational and sequential circuits.
c. Analyze the architecture of microcontroller ICs.
d. Write programs in assembly language for micro controllers.
e. Interface the memory and I/O devices to microcontrollers.

S. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.
1	Construct AND, OR, NOT gates using universal gates.	√	√	-	-	-
2	Build the logic circuit on breadboard to check the De Morgan's theorems.	√	√	-	-	-
3	Design Half adder and Half subtractor using Boolean expressions.	√	√	-	-	–
4	Design Full adder and full subtractor.	√	√	-	-	-
5	Build / test function of RS flip flop using NAND Gate.	√	√	-	-	-
6	Build / test function of MS JK flip flop using 7476.	√	√	-	-	-
7	Use IC 7476 to construct and test the functionality of D and T flip flop.	√	√	-	-	-
8	Implement 4 bit ripple counter using 7476.	√	√	-	-	-
9	Implement 4 bit universal shift register.	√	√	-	-	-
10	Identify various blocks of 8051 microcontroller.	-	-	√	√	√
11	Write an assembly language program (ALP) to perform following arithmetic operations on 8-bit data:-addition, subtraction, multiplication and division.	-	-	√	√	-
12	Write an ALP to transfer data from source to destination location of internal data memory.	-	-	√	√	-
13	Write an ALP to transfer data from source to destination location of external data memory.	-	-	√	√	-
14	Write an ALP to exchange data from source to destination memory location.	-	-	√	√	-
15	Interface LED with 8051 to turn on the LED.	-	-	√	√	√
16	Interface 7-segment display to display decimal number from 0 to 9.	-	-	√	√	√
17	Interface the given keyboard with 8051and display the key pressed.	-	-	√	√	√
18	Interface LCD with 8051 microcontroller to display the alphabets and decimal numbers.	-	-	√	√	√
19	Interface stepper motor and write ALP to rotate stepper motor in clockwise and anti-clockwise direction at given angles.	-	-	√	√	√

Guidelines to Teachers

1. Teacher need to ensure that a dated log book for the whole semester, apart from the laboratory manual is maintained by every student which s/he has to submit for assessment to the teacher in the next practical session.
2. There will be two sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practical.
3. For difficult practical if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
4. Teachers should give opportunity to students for hands-on after the demonstration.
5. Assess the skill achievement of the students and COs of each unit.
6. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question banks for each course.
7. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
8. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
9. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
10. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines

Instructions for Students

1. For incidental writing on the day of each practical session every student should maintain a dated log book for the whole semester, apart from this laboratory manual which s/he has to submit for assessment to the teacher in the next practical session.
2. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
3. Student ought to refer the data books, safety norms, technical manuals, etc.
4. Student should not hesitate to ask any difficulties they face during the conduct of practical.
5. Select the proper ICs, power supply as per the specifications/ratings given.

Content Page

List of Practical and Progressive Assessment Sheet

Sr. No	Practical Outcome	Page No.	Date of performance	Date of submission	Assessment marks(25)	Dated sign. of teacher	Remarks (if any)
16 *	Interface 7-segment display to display decimal number from 0 to 9.	118					
17	Interface the given keyboard with 8051and display the key pressed.	127					
18	Interface LCD with 8051 microcontroller to display the alphabets and decimal numbers.	138					
19 *	Interface stepper motor and write ALP to rotate stepper motor in clockwise and anti-clockwise direction at given angles.	151					
Total							

Note:

- ***The practicals marked as '*' are compulsory.***
- ***Column 6th to be transferred to pro-forma of CIAAN-2017***

Practical No.1: Construct AND, OR, NOT gates using universal gates.

I. Practical Significance

There are few basic operations performed a number of times in digital systems like computers or control systems. The basic operations which are performed are AND, OR and NOT. NAND and NOR gates are universal gates as any Boolean expression can implemented using these gates. This a great advantage to digital circuit designer.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'Use digital electronics and microcontroller based systems'.**

1. Identify gates and respective IC number and configuration.
2. Design and implement Boolean expression using NAND and NOR gates.

IV. Relevant Course Outcome(s)

Use Boolean expressions to realize logic circuits.

V. Practical Outcome

Construct AND, OR, NOT gates using universal gates.

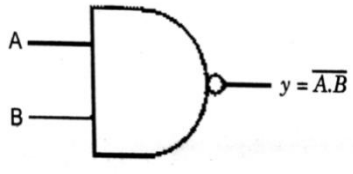
VI. Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

NAND and NOR gates are universal gates because any Boolean expression can be realized using these gates. The symbol and truth table is as shown below.

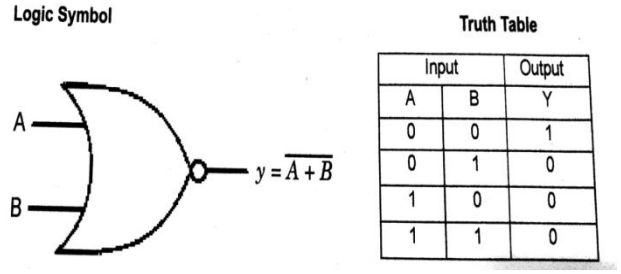
Logic Symbol



Truth Table

Input		Output
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Figure1. a) Symbol of NAND gate b) Truth table



Truth Table

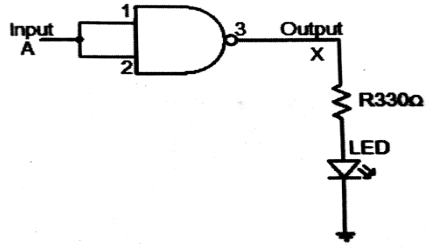
Input		Output
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Figure2. a) Symbol of NOR gate b) Truth table

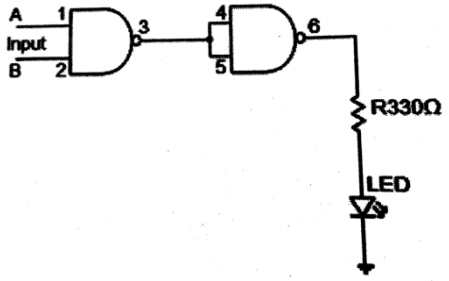
VIII. Practical set-up/ Circuit diagram /Work Situation

A. Basic gates using NAND

a. NOT gate



b. AND gate



c. OR gate

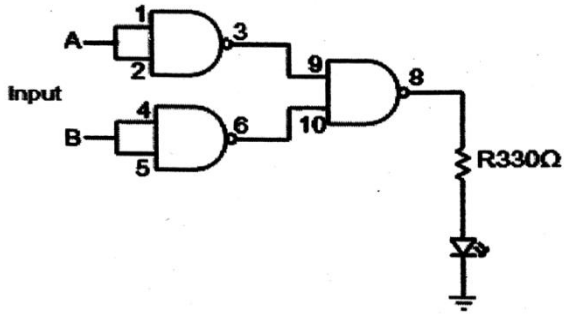
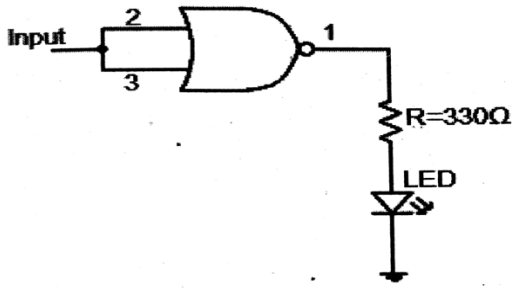


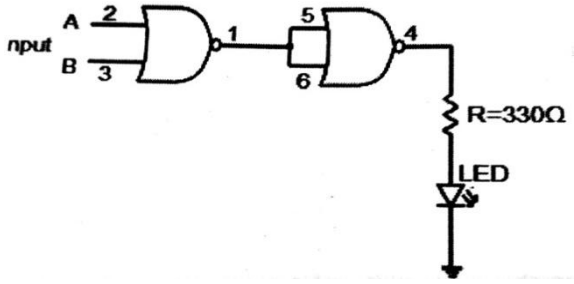
Figure 3. Circuit diagram for Basic gates using NAND gate (IC 7400)

Basic gates using NOR

a. NOT gate



b. OR gate



c. AND gate

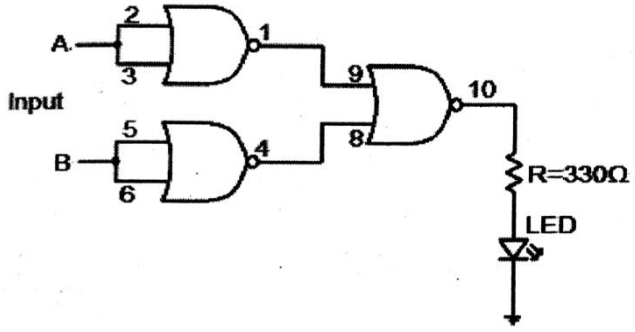


Figure 4.Circuit diagram for Basic gates using NOR gate (IC 7402)

IX. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital IC tester	Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	01
2	Bread Board Development System OR Trainer kits for digital ICs	Bread Board system with DC power output 5V, +/-12V and 0-5V variable, digital voltmeter, LED indicators 8 no, logic input switches 8 no, Manual pulser, Breadboard with about 1,600 points.	01
		Trainer kit shall consist of digital ICs for logic gates along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	01
3	Regulated power supply	Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A	01

X. Precautions to be followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in ‘off’ condition initially.
3. Ensure proper settings of trainer kit before use.

XI. Procedure

1. Check the ICs on the IC tester.
2. Mount the ICs on the breadboard or the trainer kit.
3. Connect pin 14 to Vcc = +5V and pin 7 to ground = 0V of all ICs used.
4. Make the connections as per the logic diagram given in Figure3 and similarly for Figure 4.
5. Apply logic inputs and verify the truth table for each gate.
6. Write the reading in each observation table.

XII. Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII. Actual Procedure Followed

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XIV. Precautions Followed

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XV. Observations (use blank sheet provided if space not sufficient)

Observation table for basic gates using IC 7400 and IC 7402

a. NOT gate

Input	Output (using NAND gates)	Output (using NOR gates)
A	$Y = \overline{A}$	$Y = \overline{A}$
0		
1		

b. AND gate

Input		Output (using NAND gates)	Output (using NOR gates)
A	**B**	**Y =A.B**	**Y =A.B**
0	**0**		
0	**1**		
1	**0**		
1	**1**		

c. OR gate

Input		Output (using NAND gates)	Output (using NOR gates)
A	**B**	**Y =A + B**	**Y =A + B**
0	**0**		
0	**1**		
1	**0**		
1	**1**		

XVI. Results

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XVII. Interpretation of Results (Give meaning of the above obtained results)

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XVIII. Conclusions

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XIX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more Such questions so as to ensure the achievement of identified CO.

1. How many gates are available in IC 7400?
2. How much supply voltage should be given to logic gate ICs for its proper working?
3. Write IC numbers for AND, OR and NOT gate.

[Space for Answer]

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XX. References / Suggestions for Further Reading

S.No.	Title of Book	Author	Publication
1	Principles of Digital Techniques	Jain, R.P.	Tata McGraw-Hill Education
2	Digital Principles	Malvino, A.P; Leach, D.P;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……
2. ……....
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 2: Build the logic circuit on breadboard to check the De Morgan's theorems.

I. Practical Significance

A mathematician named De-Morgan developed a pair of important rules regarding group complementation in Boolean algebra. He developed many concepts that make Boolean logic work with electronics. He stated two laws.

1. AND gate with inverted output behaves as same as OR gate with inverted input.
2. OR gate with inverted output behaves as same as AND gate with inverted input.

De-Morgan's Laws are very powerful tools for grouping and ungrouping logical statements. It is used to simplify logical expression.

II. Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Realize basic gates and universal gates operation.
2. Built logic circuits using different basic and universal gates.

IV. Relevant Course Outcomes

Use Boolean expressions to realize logic circuits.

V. Practical Learning Outcome

Verification of De Morgan's theorem using logic circuits.

VI. Affective domain outcomes

a. Follow safety practices.
b. Demonstrate working as a leader/a team member.
c. Maintain tools and equipment.
d. Follow ethical practices.

VII. Minimum Theoretical Background

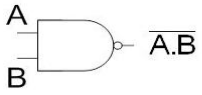
De Morgan's Theorem is used to simplify Boolean expressions and digital circuits.

De Morgan's First Theorem:

It states that the complement of the product of variables is equal to the sum of complements of individual variables.

$$\overline{A.B} = \bar{A} + \bar{B}$$

$$\text{NAND gate} = \text{Bubbled OR gate}$$



a)NAND gate

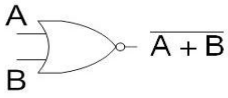
b)Bubbled OR gate

De Morgan's Second Theorem:

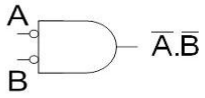
It states that the complement of the sum of variables is equal to the product of complements of individual variables.

$$\overline{A+B}=\overline{A}.\overline{B}$$

NOR gate = Bubbled AND gate

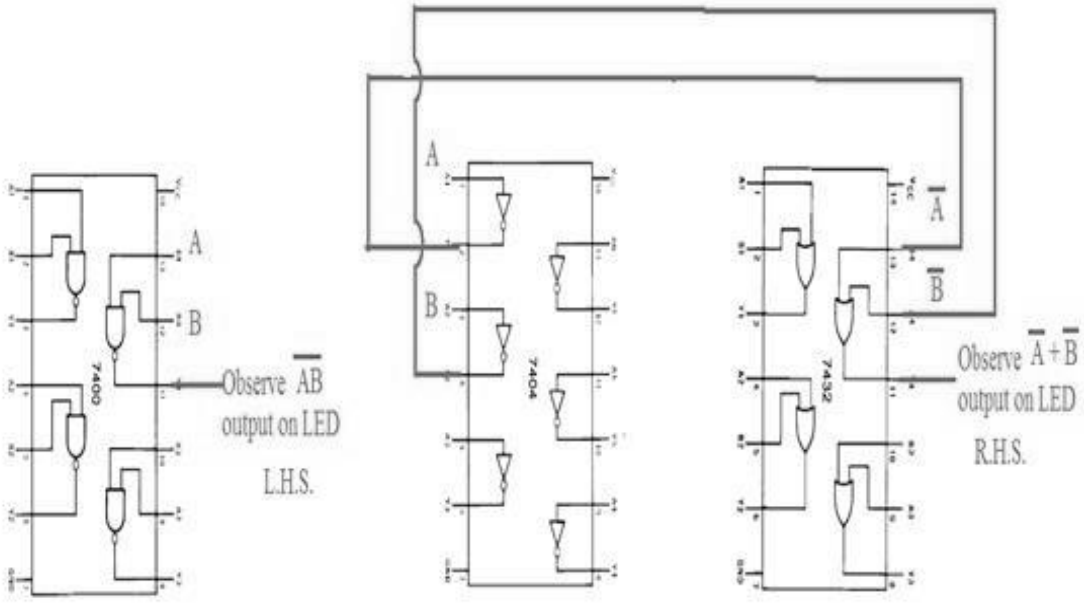


a)NOR gate



b)Bubbled AND gate

VIII. Circuit diagram :



Note: Give +5 V Vcc to pin 14 of each IC & connect GND to pin 7 of each IC.

Figure. 1 Implementation of De-Morgan's first law

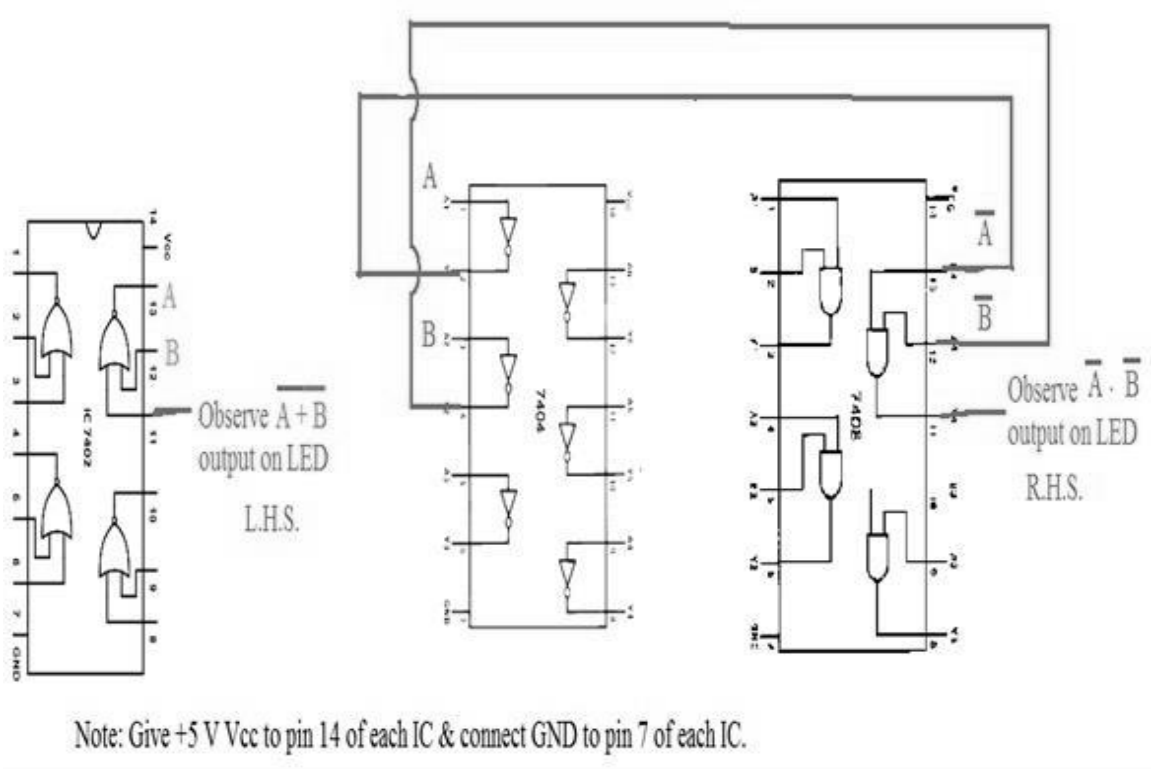


Figure. 2 Implementation of De-Morgan's Second law

IX. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1.	Regulated D.C Power supply	Range- 0 to 12V Range-500 mA	01	
2.	Bread Board	Breadboard with about 1,600 points.	01	
3.	LEDs	-	04	
4.	Resistors	Range- 330Ω	03	
5.	ICs	7404,7408,7400,7432	01 each	

X. Precautions to be followed

1. Ensure the polarities and the pin configurations of components and ICs before connections.
2. Check the suitability of the power supply before connection.
3. The supply voltage to the IC should not exceed +5V.

XI. Procedure

1. Test the ICs using IC tester.
2. Mount the ICs on the bread board.
3. Make the connections as per the logic circuit diagram shown in Fig.1 for first law and Fig 2 for second law and follow the step no. 4 to 7 for both.
4. Apply V_{cc} (+5V) to pin 14 and ground to pin 7.
5. Apply different inputs and observe the output on LED.
6. Note down the outputs in observation table.
7. Switch off the D.C. power supply.

XII. Resources used (with major specifications)

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					
4					
5					

XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observations:

A) Table for De Morgan's first theorem-

Sr.No.	A	B	$\overline{A.B}$	$\bar{A}+\bar{B}$
1.				
2.				
3.				
4.				

B) Table for De Morgan's second theorem -

Sr.No.	A	B	$\overline{A+B}$	$\bar{A}.\bar{B}$
1.				
2.				
3.				
4.				

XVI. Results:

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XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Write application of De Morgan's Theorem
2. List the IC numbers used in De Morgan's first theorem**.**
3. List IC numbers used in De Morgan's second theorem**.**

[Space for Answer]

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XX. References / Suggestions for Further Reading

S.No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No.3: Design Half adder and Half subtractor using Boolean expressions.

I Practical Significance

Adder and subtractor are the combinational logic circuits used to perform basic arithmetic operations like addition and subtraction. They are used in ALUs of computers and other kind of processors. They are also used in other parts of processor to calculate addresses, table indices, and increment and decrement operations. Half adder and subtractor can be used only for two bit addition and subtraction respectively.

II Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '**Use digital electronics and microcontroller based systems.**'

1. Identify gates used for half adder and subtractor.
2. Design and implementation of two bit addition and subtraction.

IV Relevant Course Outcome(s)

Build simple combinational circuits.

V Practical Outcome

Design half adder and half subtractor using Boolean expressions.

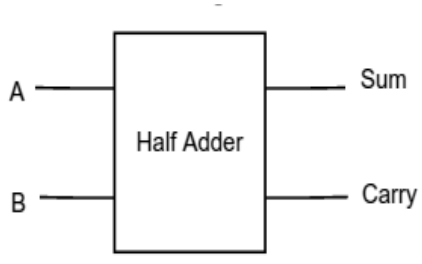
VI Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII Minimum Theoretical Background

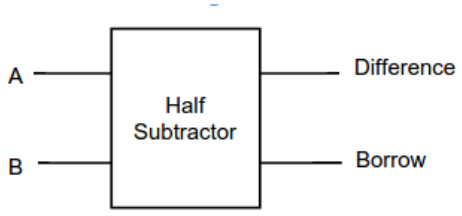
A half adder is a combinational circuit that adds two bits. It has two inputs (A, B) and two outputs.(SUM ,CARRY).

Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1



A half subtractor is a combinational circuit that subtracts two bits.It has two inputs (A,B) and two outputs (DIFFERENCE,BORROW).

Inputs		Output	
A	B	Difference	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0



VIII Practical set-up/ Circuit diagram /Work Situation

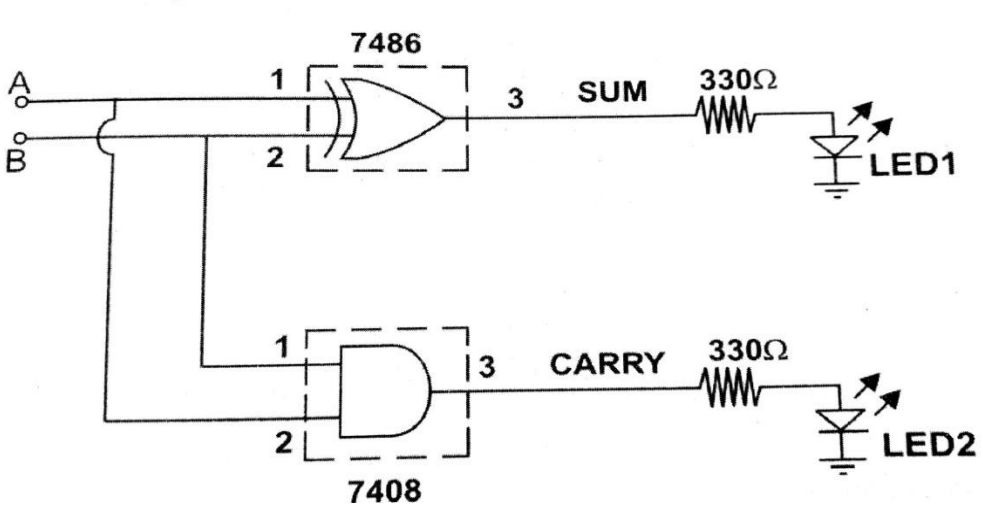


Figure 1. Half Adder

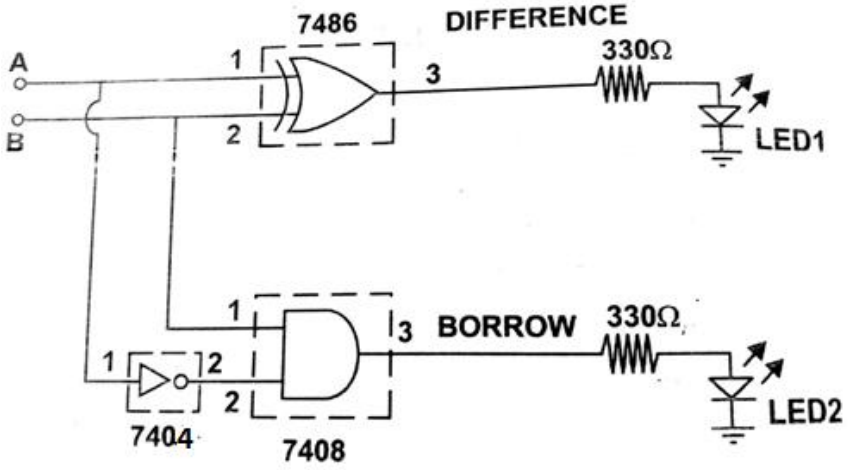


Figure 2. Half Subtractor

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital IC tester	Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	01
2	Bread Board Development System OR Trainer kits for digital ICs	Bread Board system with DC power output 5V, +/-12V and 0-5V variable, digital voltmeter, LED indicators 8 no, logic input switches 8 no, Manual pulser, Breadboard with about 1,600 points.	01
		Trainer kit shall consist of digital ICs for logic gates along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	01
3	Regulated power supply	Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A	01

X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure proper settings of trainer kit before use.

XI Procedure

1. Check the ICs on the IC tester.
2. Mount the ICs on the breadboard or the trainer kit.
3. Connect pin 14 to V_{cc}= +5V and pin 7 to ground = 0V of all the ICs used.
4. Make the connections as per the logic diagram given in Figure 1. for adder and Figure 2.for subtractor respectively.
5. Apply logic inputs and verify the truth table for half adder as well as half subtractor.
6. Write the reading in each observation table.

XII Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations

Truth table for half adder			
A	B	SUM(S)	CARRY(C)
0	0		
0	1		
1	0		
1	1		

Truth table for half subtractor			
A	B	DIFFERENCE(D)	BORROW(B)
0	0		
0	1		
1	0		
1	1		

XVI Results

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XVII Interpretation of Results (Give meaning of the above obtained results)

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XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Which gate is added to half adder circuit to make it behave as a half subtractor?
2. Give any two applications of half adder and half subtractor.

[Space for Answer]

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XX References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No. 4: Design Full adder and full subtractor.

I. Practical Significance

Adder and subtractor are the combinational logic circuits used to perform basic arithmetic operations like addition and subtraction. They used in ALUs of many computers and other kind of processors. They are also used in other parts of processor to calculate addresses, table indices, and increment and decrement operators.

II. Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based systems'.**

1. Identify the gates used for full adder and full subtractor.
2. Design and realize the circuit for 3 bit addition and subtraction.

IV. Relevant Course Outcomes

1. Use Boolean expressions to realize logic circuits.
2. Build simple combinational and sequential circuits.

V. Practical Learning Outcome

Design Full adder and full subtractor; verify the output using different input combinations.

VI. Minimum Theoretical Background

A full adder is a combinational electronic circuit that performs addition of 3 bits. It hasthree inputs (A, B, C_{IN}) and two outputs (Sum S and Carry i.e. C_{OUT})

Figure. 1 Block Diagram of Full Adder

A full subtractor is a combinational electronic circuit that performs subtraction of 3 bits. It has three inputs (A, B, B_{IN}) and two outputs (Difference D and Borrow i.e. B_O)It has to take care of repeated borrow by the next higher bit.

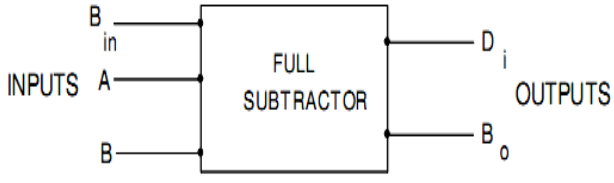

Figure. 2 Block Diagram of Full Subtractor

VII. Circuit diagram :

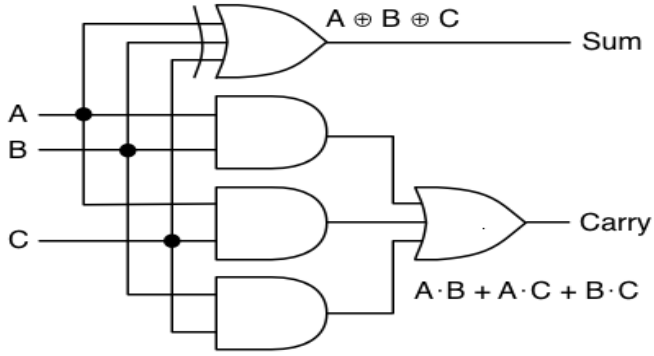

Figure. 3 Full adder circuit

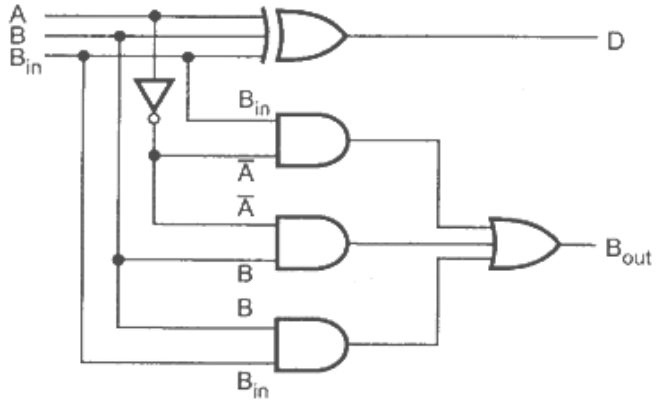

Figure. 4 Full subtractor circuit

VIII. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1.	D.C Power supply	Range- 0 to 12V Range-500 mA	01	
	Bread Board	Breadboard with about 1,600 points.	01	
6.	LEDs	-	04	
7.	Resistors	Range- 330Ω	03	
8.	ICs	7404,7408,7400,7432,7486	01 each	

IX. Precautions to be followed

1. Ensure the polarities and the pin configurations of components and ICs before connections.
2. Check the suitability of the power supply before connection.
3. The supply voltage to the IC should not exceed +5V.

X. Procedure

1. Test the ICs using IC tester.
2. Mount the ICs on the bread board.
3. Make the connections as per the logic circuit diagram shown in Fig. 3 for full adder and Fig. 4 for full subtractor and follow the step no. 4 to 7 for both.
4. Apply V_{cc} (+5V) to pin 14 and ground to pin 7.
5. Apply different inputs and observe the output on LED.
6. Note down the outputs in observation table.
7. Switch off the D.C. power supply.

XI. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XII. Actual procedure followed

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XIII. Precautions followed

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XIV. Observations:

A. Table for Full Adder-

Sr. No.	A	B	C	Sum	Carry
1.	**0**	**0**	**0**		
2.	**0**	**0**	**1**		
3.	**0**	**1**	**0**		
4.	**0**	**1**	**1**		

5.	**1**	**0**	**0**		
6.	**1**	**0**	**1**		
7.	**1**	**1**	**0**		
8.	**1**	**1**	**1**		

B. Table for Full subtractor -

Sr. No.	A	B	C	Difference	Borrow
1.	**0**	**0**	**0**		
2.	**0**	**0**	**1**		
3.	**0**	**1**	**0**		
4.	**0**	**1**	**1**		
5.	**1**	**0**	**0**		
6.	**1**	**0**	**1**		
7.	**1**	**1**	**0**		
8.	**1**	**1**	**1**		

XV. Results:

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XVI. Interpretation of results (Give meaning of the above obtained results**)**

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XVII. Conclusion

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XVIII. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1) Differentiate between half and full adder.
2) Draw the block diagram to implement full adder using half adder circuit.
3) Write the IC number for 4 bit binary adder.

[Space for Answer]

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XIX. References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XX. Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No.5: Build / test function of RS flip flop using NAND Gate.

I Practical Significance

The flip flops are used as registers in microcontrollers or processors. It is also used in binary counters, delay elements and elimination of keyboard debounce.

II Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency **'*Use digital electronics and microcontroller based systems.*'**:

1. Ability to make the pin connections within the single IC.
2. Implement RS flip flop using NAND gates.

IV Relevant Course Outcome(s)

Build simple sequential circuits.

V Practical Outcome

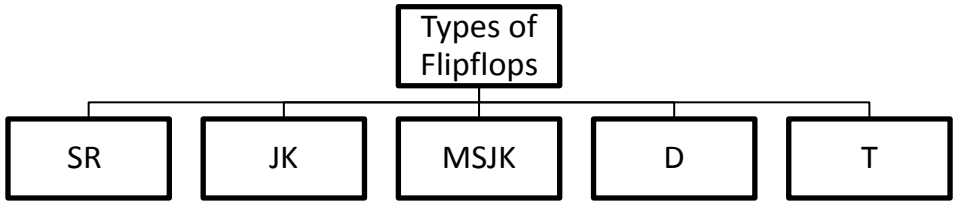
Build /Test RS Flip-flop using NAND Gate

VI Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

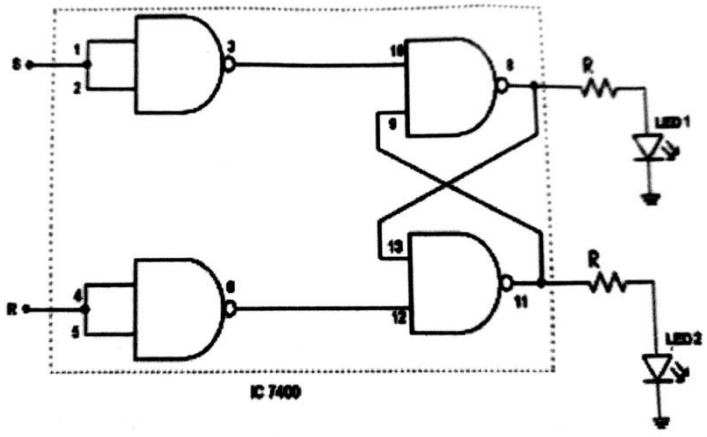
VII Minimum Theoretical Background

A flip-flop is a bi-stable circuit i.e. it has two stable states. It stores one bit of information and it is the basic building block of semiconductor memory. It is a sequential logic circuit whose output depends on present state of input as well as past output. They are broadly classified as SR-FF,JK-FF,MSJK-FF,D-FF and T-FF.



All of them have different applications in digital systems. They can be realized by using NAND gates

VIII Practical set-up/ Circuit diagram /Work Situation



(a)

Input		Output	
R	**S**	**Q**	$\bar{\mathbf{Q}}$
0	0	Last value	
0	1	0	1
1	0	1	0
1	1	Forbidden	

(b)

Figure 1 a) RS Flip flop using NAND gate b) Truth table

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital IC tester	Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	01
2	Bread Board Development System OR Trainer kits for digital ICs	Bread Board system with DC power output 5V, +/-12V and 0-5V variable, digital voltmeter, LED indicators 8 no, logic input switches 8 no, Manual pulser, Breadboard with about 1,600 points.	01
		Trainer kit shall consist of digital ICs for logic gates along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	01
3	Regulated power supply	Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A	01

X Precautions to be followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure proper settings of trainer kit before use.

XI Procedure

1. Check the IC7400 on the IC tester.
2. Mount the IC on the breadboard or the trainer kit.
3. Connect pin 14 to V_{cc}= +5V and pin 7 to ground = 0V.
4. Make the connections as per the logic diagram given in figure 1(a).
5. Apply logic inputs to RS flip-flop according to the truth table given in figure 1(b).
6. Write the reading in observation table by checking the status of LED as ON or OFF.

XII Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII Actual Procedure Followed

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XIV Precautions Followed

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XV Observations:

Inputs		Output (Theoretical)		Output(Practical)	
S	**R**	Q	$\bar{Q}$	$LED1(Q)$	$LED2(\bar{Q})$
0	**0**	**Last value(NC)**			
0	**1**				
1	**0**				
1	**1**	**Forbidden**			

XVI Results

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XVII Interpretation of Results (Give meaning of the above obtained results)

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XVIII Conclusions (Actions/decisions to be taken based on the interpretation of results).

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Which type of multivibrator is called as Flip-flop?
2. Give any four applications of Flip-flop?

[Space for Answer]

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XX References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 6 Build / test function of MS JK flip flop using 7476.

I. Practical Significance

A flip flop is a bi-stable circuit that is it has two stable states it stores one bit of information and it is a basic building block of semiconductor memory. It is a sequential logic circuit whose output depends on present state of input as well as past output. The flip flops are used as registers in processors and microcontrollers. It is also used in binary counters, delay elements and elimination of keyboard debounce.

II. Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Realize MS JK flip flop operation.
2. Built sequential logic circuits using different ICs.

IV. Relevant Course Outcomes

1. Use Boolean expressions to realize logic circuits.
2. Build simple combinational and sequential circuits.

V. Practical Learning Outcome

Build / test function of MS JK flip flop using 7476.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

A MS JK flip flop is a combinational circuit of clocked JK FF with feedback from output of second FF to the input of first flip flop.(Fig. 1)

The J and K data is processed by the flip-flop after complete clock pulse. On the positive transition of the clock, the data from the J and K inputs is transferred to the master. On the negative transition of the clock, the data from the master is transferred to the slave.

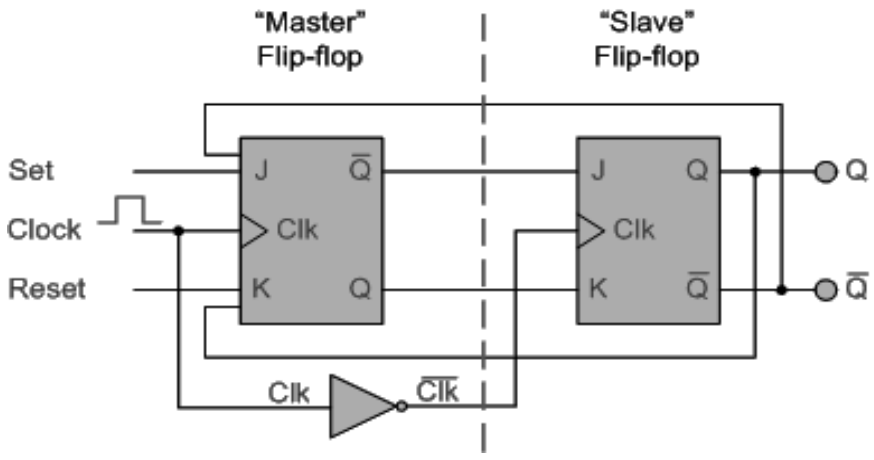

Figure. 1 J K Master Slave Flip flop

VIII. Circuit diagram

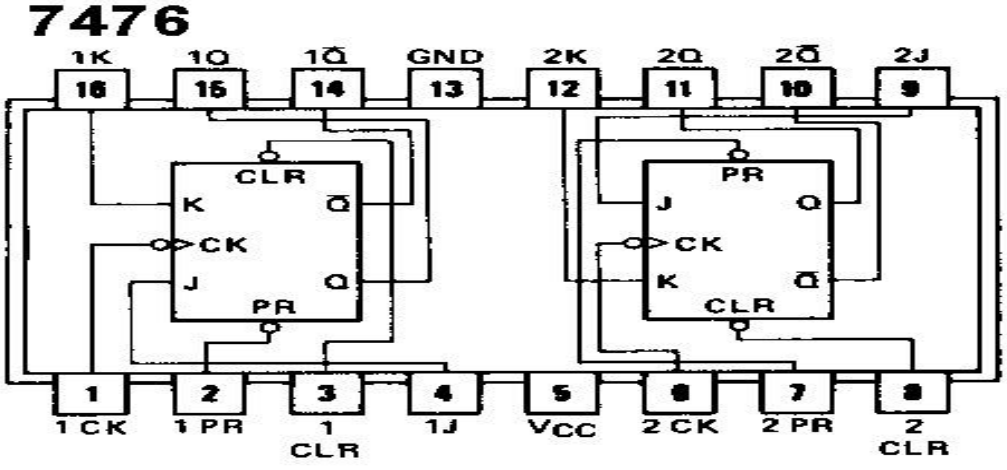

Figure. 2 Pin configuration of IC 7476

IX. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1	Regulated D.C Power supply	Range- 0 to 12V Range-500 mA	01	
2	Bread Board/Trainer Kit	1,600 points	01	
3	LEDs	-	04	
4	Resistors	Range- 330Ω	03	
5	ICs	7476	01	

X. Precautions to be followed

1. Ensure the polarities of components and the pin configurations of ICs before connections.
2. Check the suitability of the power supply before connection.
3. The supply voltage to the IC should not exceed +5V.

XI. Procedure

1. Test the IC 7476 using IC tester.
2. Mount the ICs on the breadboard.
3. Make the connections as per the logic diagram shown in Figure. 1
4. Apply V_{cc} (+5V) to pin no. 5 and ground (0V) to pin no. 13.
5. Apply different inputs and observe the output on LED (LED ON = Logic 1 and LED OFF = 0) Note down the outputs in observation table.
6. Switch off the D.C. power supply.

XII. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
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XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observations:

Sr.No.	$\overline{PR}$	$\overline{CR}$	J_n	K_n	Clk	Q_n	$\overline{Q_n}$	Q_{n+1}	$\overline{Q_{n+1}}$
						Theoretical		Practical	
1.	0	1	X	x	X	1	0		
2.	1	0	X	x	X	0	1		
3.	1	1	0	0	X	Last Value			
4.	1	1	X	x	0	Last Value			
5.	1	1	1	0	⎍	1	0		
6.	1	1	0	1	⎍	0	1		
7.	1	1	1	1	⎍	Toggle			

XVI. Results:

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XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1) How many MS JK flip flop are there in IC7476?
2) State when race around condition occurs.
3) State applications of MS JK flip flop.

[Space for Answer]

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XX. References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.; Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No.7 : Use IC 7476 to construct and test the functionality of D and T flip flop.

I. Practical Significance

IC 7476 is a dual JK flip-flop negative edge triggered 16 pin IC. It can be used as D or T type flip-flops. D flip-flops are the basic building blocks of registers. T flip-flops are used in counters.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '***Use digital electronics and microcontroller based systems.***'

1. Conversion of JK flip-flop into D and T flip flop.
2. Identify the pins and make proper connections for the required connections.

IV. Relevant Course Outcome(s)

Build simple sequential circuits.

V. Practical Outcome

Use IC7476 to construct and check the functionality of D and T Flip-flop

VI. Relevant affective Domain related Outcomes

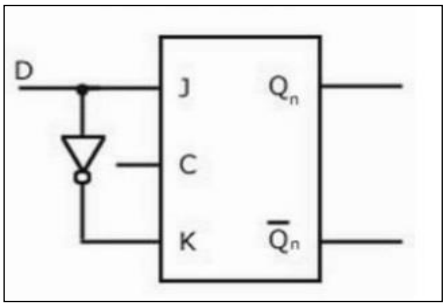
1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

JK flip flop is basically a gated SR flip flop with the addition of a clock input circuitry that prevents the invalid output condition that can occur when both inputs S and R are equal to logic level 1.IC 7476 has two such JK flip-flops in it.The truth table of JK flip flop is as given below.

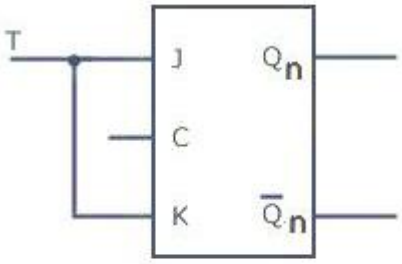
J	K	Q_{n+1}	Action
0	0	Q_n	**No Change**
0	1	0	RESET
1	0	1	SET
1	1	$\overline{Q_n}$	**TOGGLE**

Truth table of JK flip-flop



Input (D)	Output (Qn)
0	0
1	1

Figure 1.a) J-K Flip Flop converted into D Flip flop **b) Truth table of D Flip flop**



Input (T)	Output (Q_n)
0	Q_n
1	$\overline{Q_n}$

Figure 2.a) J-K Flip Flop converted into T Flip flop **b) Truth table of T Flip flop**

VIII. Practical set-up/ Circuit diagram /Work Situation

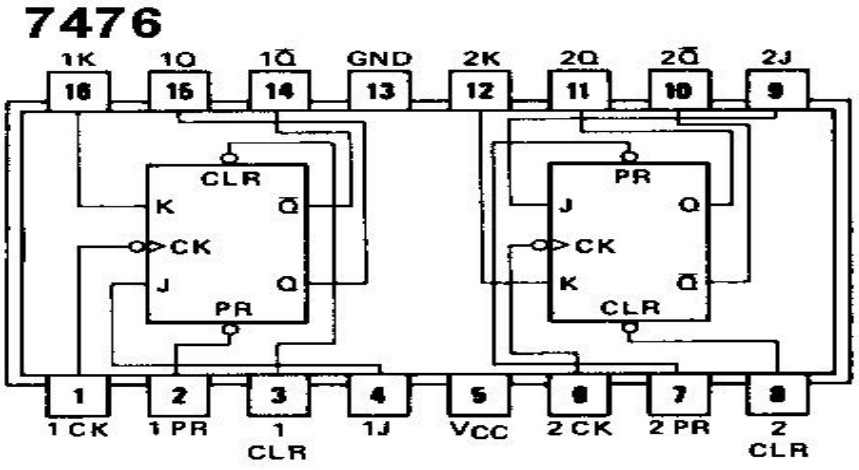


Figure 3.IC 7476

IX. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital IC tester	Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	01
2	Bread Board Development System OR Trainer kits for digital ICs	Bread Board system with DC power output 5V, +/-12V and 0-5V variable , digital voltmeter , LED indicators 8 no, logic input switches 8 no, Manual pulser, Breadboard with about 1,600 points.	01
		Trainer kit shall consists of digital ICs for logic gates, FlipFlop IC(7476) along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	01
3	Regulated power supply	Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A	01

X. Precautions to be followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure proper settings of trainer kit before use.

XI. Procedure

1. Check the IC7476 on the IC tester.
2. Mount the IC on the breadboard or the trainer kit.
3. Make the connections as per the logic diagram given for D FF(Figure 1)
4. Apply logic inputs to IC 7476 (Figure 3), to convert it into D FF according to the observation table.
5. Write the reading in observation table by checking the status of LED as ON or OFF after applying input..
6. Repeat the steps 3 to 5 for T FF(Figure 2).

XII. Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII. Actual Procedure Followed

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XIV. Precautions Followed

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XV. Observations (use blank sheet provided if space not sufficient)

Observation table for D flip-flop using 7476 gate IC

Input (D)	Theoretical Output (Q_n)	Practical Output (LED)
0		
1		

Observation table for T flip-flop using 7476 gate IC

Input (T)	Theoretical Output (Q_n)	Practical Output (LED)
0		
1		

XVI. Results

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XVII. Interpretation of Results (Give meaning of the above obtained results)

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XVIII. Conclusions

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XIX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. How JK FF can be converted into D FF and T FF.
2. Give any two applications of D and T Flip-flop.

[Space for Answer]

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XX. References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 8: Implement 4 bit ripple counter using 7476

I. Practical Significance

In digital logic and computing, a counter is a device which stores the number of times a particular event or process has occurred in relationship to a clock signal. Each pulse applied to the clock input increments or decrements the number in the counter. It is usually constructed of a number of flip flops connected in cascade. It is very widely used component in digital circuits.

II. Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Built sequential logic circuits using ICs.

IV. Relevant Course Outcomes

1. Use Boolean expressions to realize logic circuits.
2. Build simple combinational and sequential circuits.

V. Practical Learning Outcome

Build / test function of 4 bit ripple counter using 7476.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

Counter is a sequential circuit used for counting the number of clock pulses. It has a natural count of 2^n where n is number of flip-flop in counter. Counters are broadly classified as asynchronous and synchronous counter.

A **ripple counter** is an **asynchronous counter** where only the first flip-flop is clocked by an external clock. All subsequent flip-flops are clocked by the output of the preceding flip-flop. **Asynchronous** counters are also called **ripple**-counters because of the way the clock pulse **ripples** it way through the flip-flops.

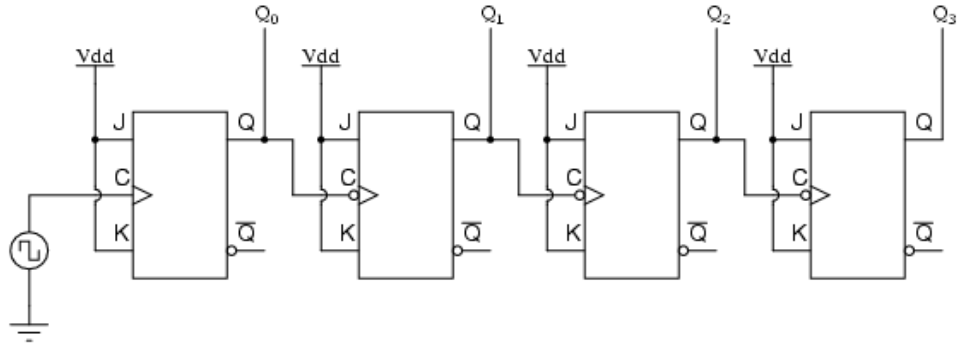

Figure. 1 Ripple counter

VIII. Circuit diagram:

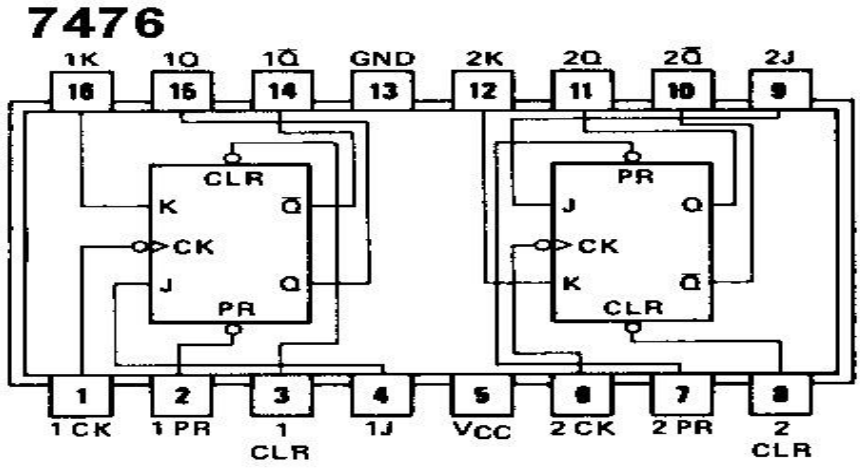

Figure. 2 Pin diagram of 7476

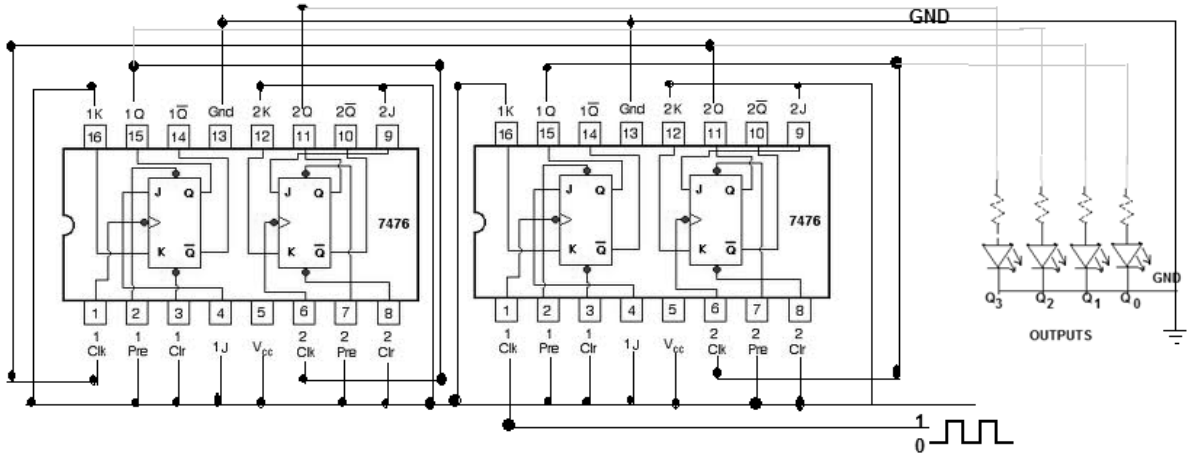

Figure. 3 Ripple counters using IC 7476

IX. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1.	Regulated D.C Power supply	Range- 0 to 12V Range-500 mA	01	
2.	Bread Board	Breadboard with about 1,600 points.	01	
3.	LEDs	-	04	
4.	Resistors	Range- 330Ω	03	
5.	ICs	7404,7408,7400,7432	01 each	

X. Precautions to be followed

1. Ensure the polarities of components and the pin configurations of ICs before connections.
2. Check the suitability of the power supply before connection.
3. The supply voltage to the IC should not exceed +5V.

XI. Procedure

1. Test the IC 7476 using IC tester.
2. Mount the ICs on the breadboard.
3. Make the connections as per the circuit diagram shown in Fig. 3
4. Apply V_{cc} (+5V) to pin no. 5 and ground (0V) to pin no. 13.
5. Apply the clock pulse at the input and observe the output on LED (LED ON = Logic 1 and LED OFF = 0) Note down the outputs in observation table.
6. Switch off the D.C. power supply.

XII. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					
4					

XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observations :

Sr. No.	Input	Output				
	No of Clock pulses	Q_3	Q_2	Q_1	Q_0	Decimal equivalent
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						

XVI. Results:

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XVII. Interpretation of results (Give meaning of the above obtained results**)**

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XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1) State the nos. of ICs used in this experiment.
2) How many pulses a 4-bit ripple counter can count?
3) How many flip flops are required to count 8 pulses & why?

[Space for Answer]

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XX. References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXII. Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No.9: Implement 4 bit universal shift register

I Practical Significance

An array of flip flop is referred to as a register. Registers find application in variety of digital systems including microprocessor and microcontrollers.

II Relevant Program Outcomes (POs)

1. **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
2. **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
3. **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '***Use digital electronics and microcontroller based systems.***':

1. Identify the flip flop which can be used in a shift register.
2. Implement universal shift register.

IV Relevant Course Outcome(s)

Build simple sequential circuits.

V Practical Outcome

To implement 4 bit universal shift register.

VI Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII Minimum Theoretical Background

The way in which data is entered or/and taken out in a Register defines the mode of operation. There are four possible modes of operation.

1. Serial in , serial out (SISO)
2. Serial in , parallel out (SIPO)
3. Parallel in, serial out (PISO)
4. Parallel in, parallel out (PIPO)

A register is referred to as a Universal register if it can be operated in the above mentioned modes and also as a bi-directional register IC 7495,74178,74179 and 74194 are universal register.

VIII Practical set-up/ Circuit diagram /Work Situation

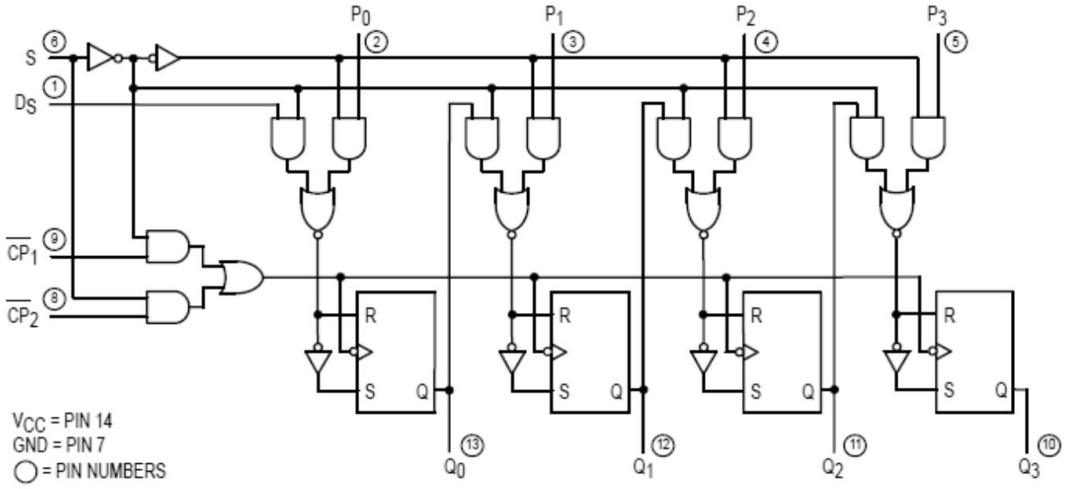

Figure 1- 4 bit universal shift register using IC7495A /B

IX Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital IC tester	Tests a wide range of Analog and Digital IC's such as 74 Series, 40/45 Series of CMOS IC's.	01
2	Bread Board Development System OR Trainer kits for digital ICs	Bread Board system with DC power output 5V, +/-12V and 0-5V variable , digital voltmeter , LED indicators 8 no, logic input switches 8 no, Manual pulser, Breadboard with about 1,600 points.	01
		Trainer kit shall consists of digital ICs for logic gates, universal shift register(IC7495A) along with toggle switches for inputs and bi-colour LED at outputs, built in power supply.	01
3	Regulated power supply	Floating DC Supply Voltages Dual DC : 2 x 0 -30V; 0-2 A	01

X Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure proper settings of trainer kit before use.

XI Procedure

1. Check the IC used on the IC tester.
2. Mount the IC on the breadboard or the trainer kit.
3. Make the connections as per the logic diagram given in figure1.

4. Select the mode in which shifting is to be done and accordingly apply input and observe the output.
5. Write the output in the observation table and draw the timing diagram for the same.

XII Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
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XIII Actual Procedure Followed (use blank sheet provided if space not sufficient)

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XIV Precautions Followed

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XV Observations (use blank sheet provided if space not sufficient)

Note: Out of four modes, operate the register in any two modes and write the observations in tabular format in below given space.

Observation table for Universal shift register

XVI Results

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XVII Interpretation of Results (Give meaning of the above obtained results)

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XVIII Conclusions

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XIX Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. How a bidirectional shift register is converted in universal shit register.
2. Draw the configuration of IC used in the practical of universal shift register.

[Space for Answer]

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XX References / Suggestions for Further Reading

S. No.	Title of Book	Author	Publication
1	Modern Digital Electronics	Jain, R.P.	McGraw-Hill Publishing, New Delhi, 2009; ISBN: 9780070669116
2	Digital Principles	Malvino, A.P.; Leach, D.P.;Saha G.	McGraw Hill Education, New Delhi, 2014, ISBN : 9789339203405

XXI Assessment Scheme

Performance Indicators		Weightage %
Process Related (20)		**80%**
1	Selection of ICs and power supply	20 %
2	Testing of ICs	20 %
3	Proper connections	20 %
4	Observations and verification	20 %
Product Related (05)		**20%**
5	Answer to given questions	10 %
6	Timely submission	10 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……..
2. ……..
3. ……..
4. ……..

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 10: Identify various Blocks of 8051 microcontroller

I. Practical Significance

A **microcontroller** (**MCU-** *microcontroller unit*) is a small computer on a single integrated circuit. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Microcontrollers are designed for embedded applications. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Identify different blocks of microcontroller 8051.
2. Ability to do the connections of development board with computer.
3. Learn to use simulation software for microcontroller programming.

IV. Relevant Course Outcomes

1. Analyze the architecture of microcontroller ICs .
2. Write programs in assembly language for microcontrollers.

V. Practical Learning Outcome

Identify various blocks of 8051 microcontroller.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

Important features of 8051 microcontroller

1. 8-bit CPU.
2. Processor with support Boolean operations on bits.
3. Program Memory 4K × 8
4. Internal RAM of 128 byte
5. Two 16-bit timers (counter / timers).
6. A channel for full duplex asynchronous serial RS-232 communications.

7. Modes in low power consumption (Idle mode Power-down mode).
8. Compatible with TTL and CMOS digital technologies.
9. Clock frequencies including body work 3.5 to 33MHz.
10. Internal oscillator.
11. 5 interrupt sources with different levels of priority.
12. 2 external interrupts.
13. 2 counters / timers.
14. Memory addressing capability 64k ROM and 64k RAM.
15. 1 interrupts for serial port.

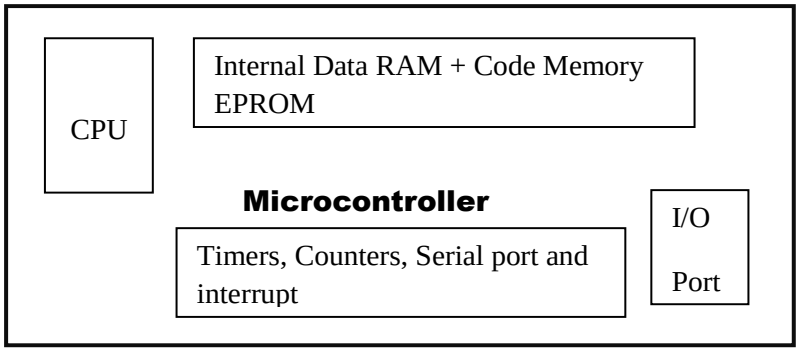

Figure. 1 Conceptual block diagram of microcontroller 8051

VIII. Circuit diagram/ Internal Block Diagram:

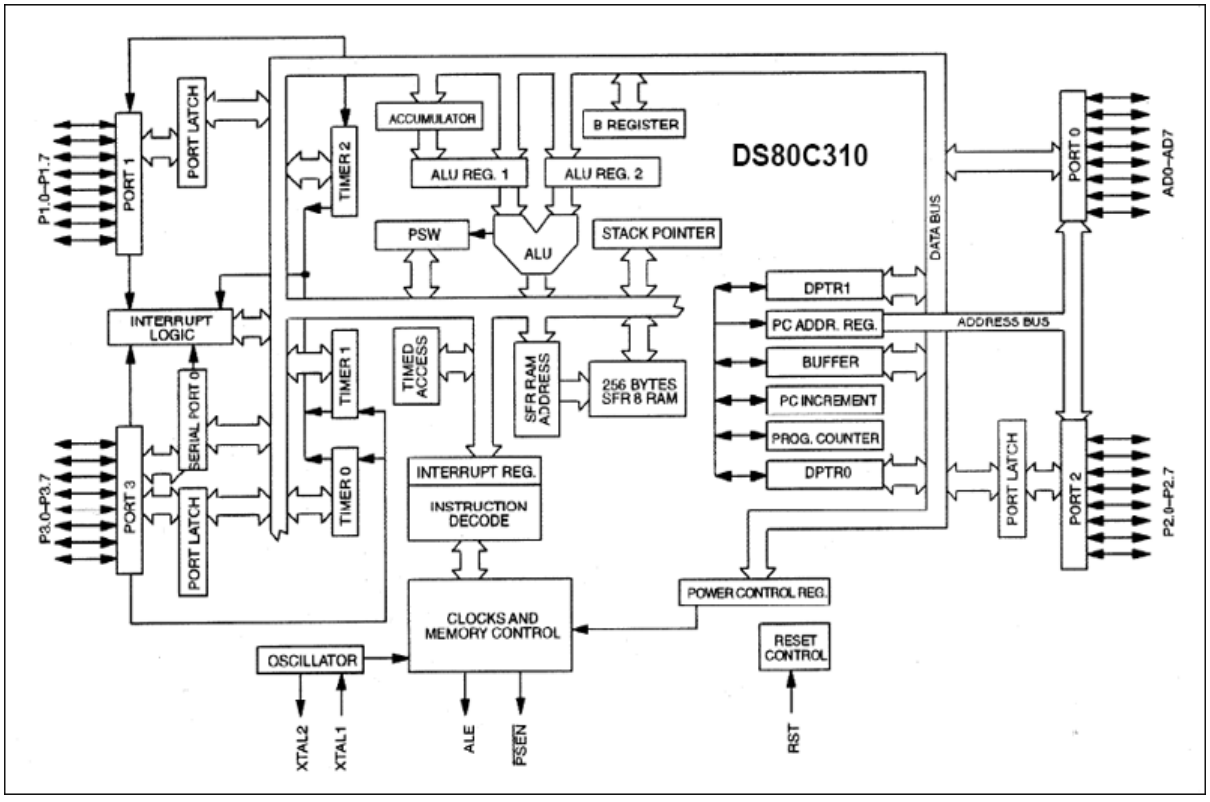

Figure.2 Architecture of 8051

IX. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1	Desktop PC with microcontroller simulation software	---	10	
2	8051 Development Board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross,c-compiler,RS-232,USB, interfacing facility with built in power supply.	5	
3	Keil or similar IDE	---	For all PCs	

X. Precautions to be followed

1. Software to be installed properly.
2. Appropriate microcontroller IC selection from the predefined list.
3. Program should be saved with correct extension after creating a new project
4. Ensure the polarities of components and the pin configurations of ICs before connections.
5. Check the suitability of the power supply before connection.
6. The supply voltage to the IC should not exceed +5V.

XI. Procedure

Creating new project:

1. Start Keil by double clicking on Keil icon.(Keil automatically opens the last project which was opened previously, when Keil was closed).
2. To create new project, Click and select new project. Fig.3
3. Select appropriate location for new project and type project name, click on save button. Fig.4
4. “Select device for Target Target-1” window will open. It displays a list of manufacturers of microcontrollers. Fig.5
5. Double click on ATMEL or INTEL, list of supported microcontrollers gets displayed. Select 80C51AH from INTEL or AT 89C51 (or as per the target board) for ATMEL then click ok. Fig. 6
6. New project is created Fig. 7

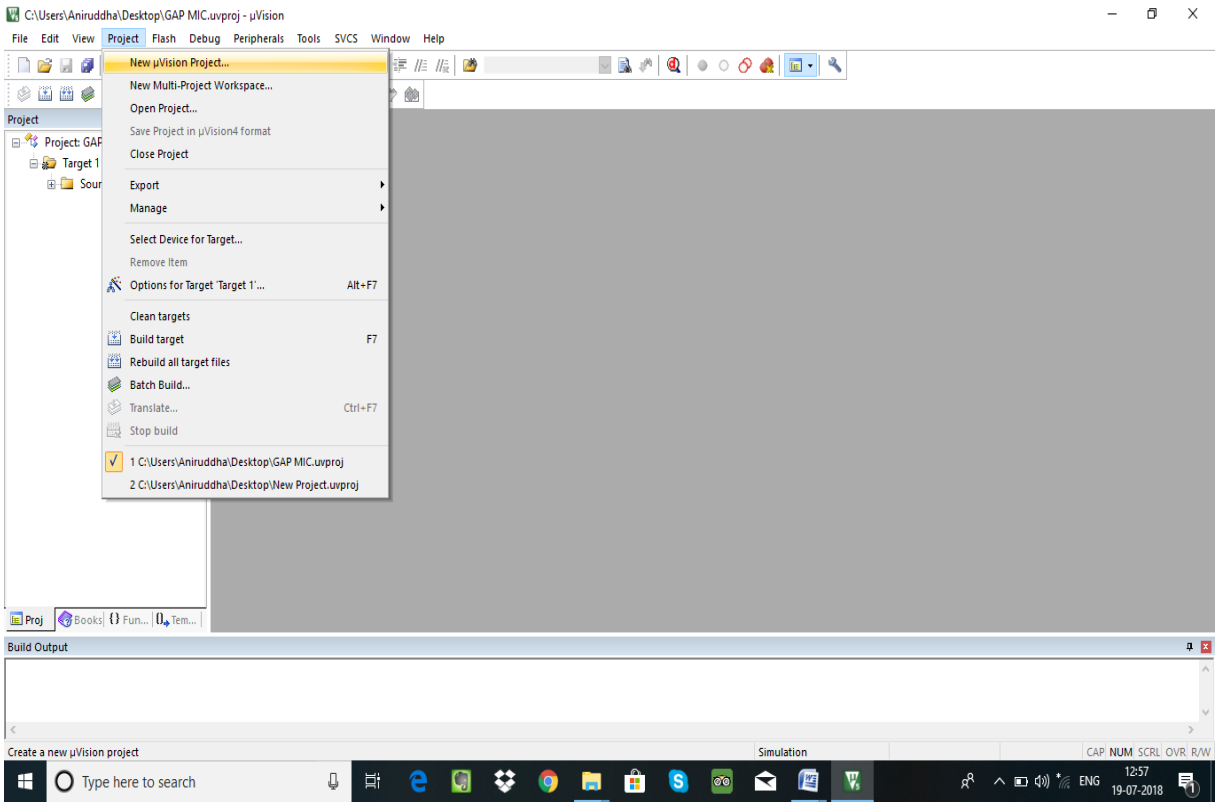

Figure. 3

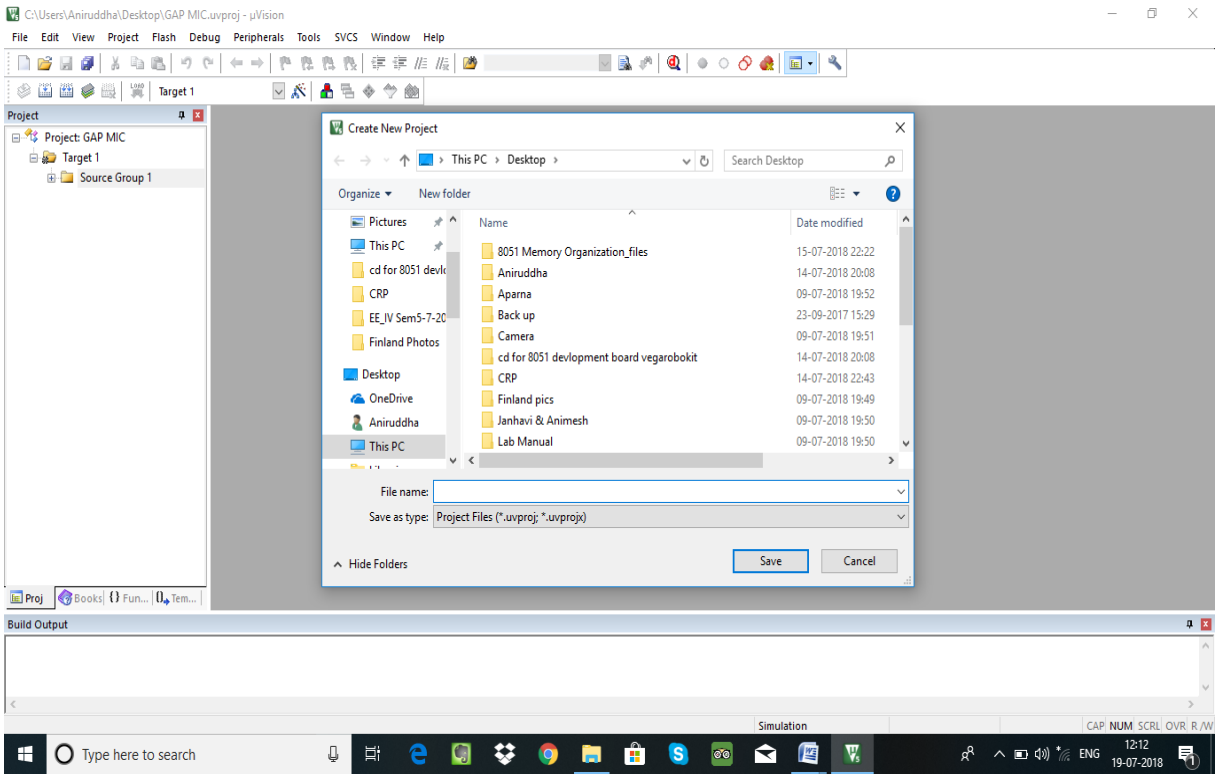

Figure. 4

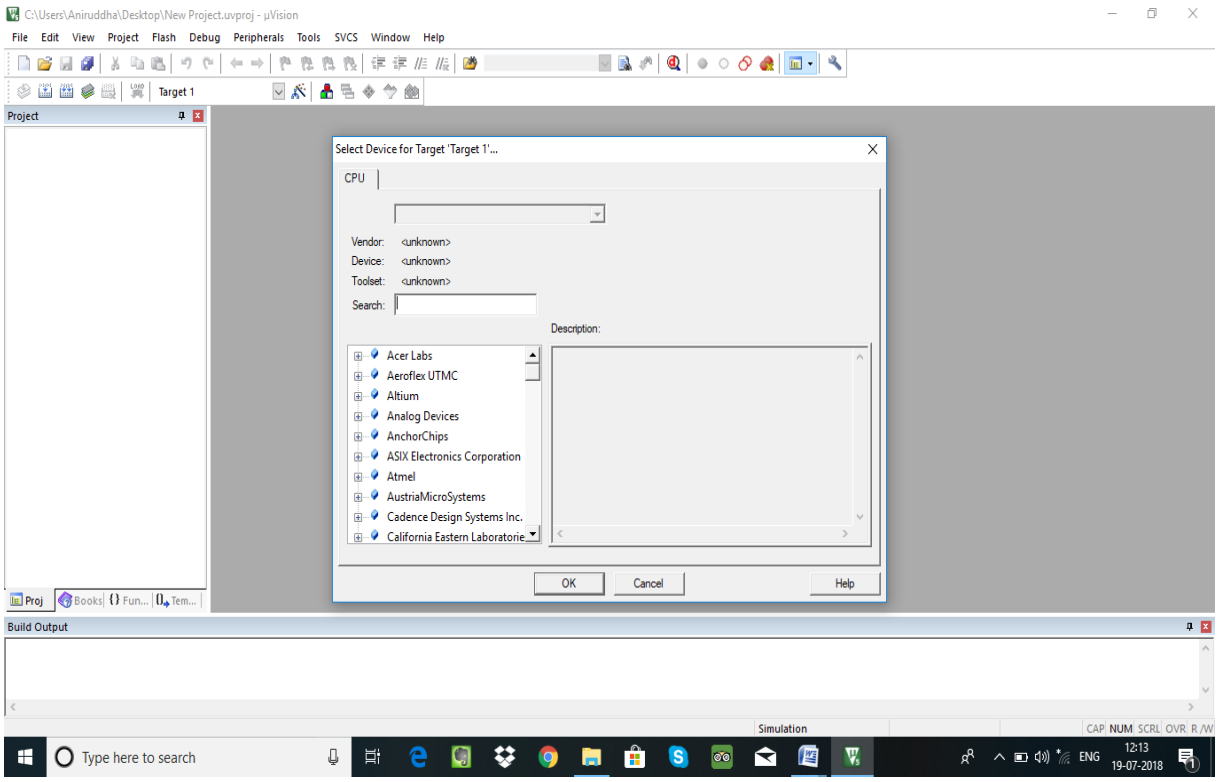

Figure.5

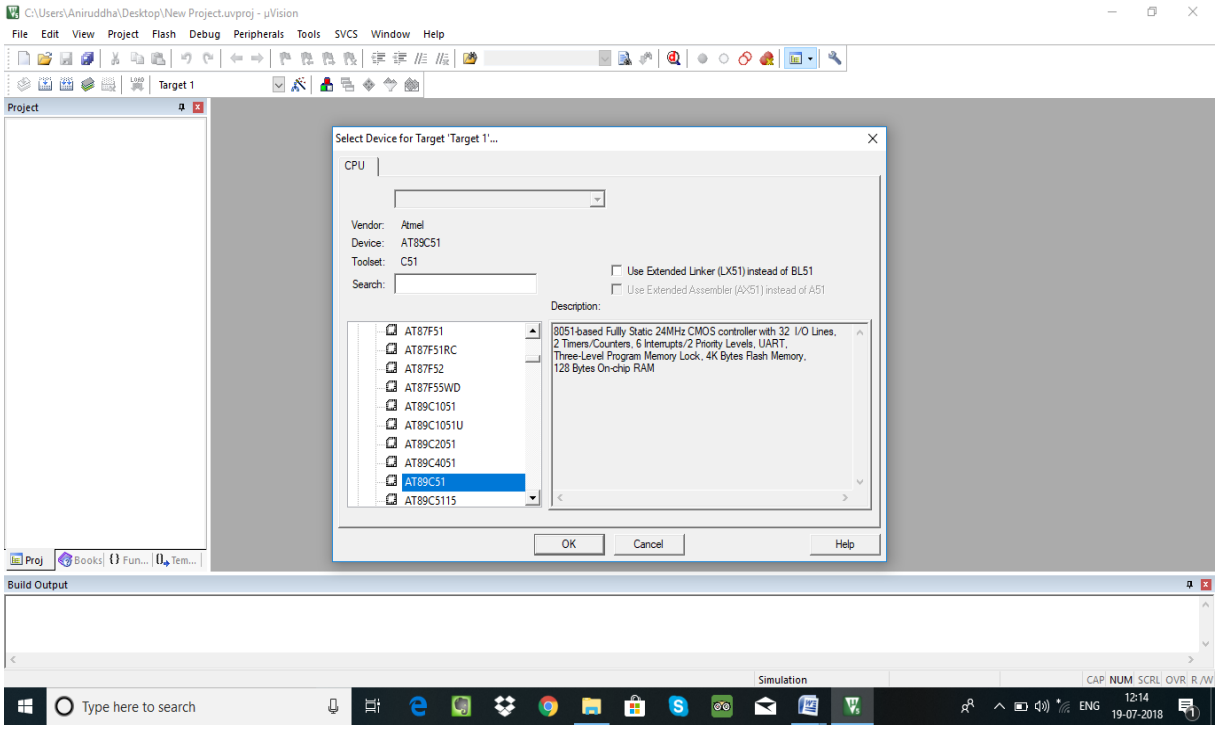

Figure. 6

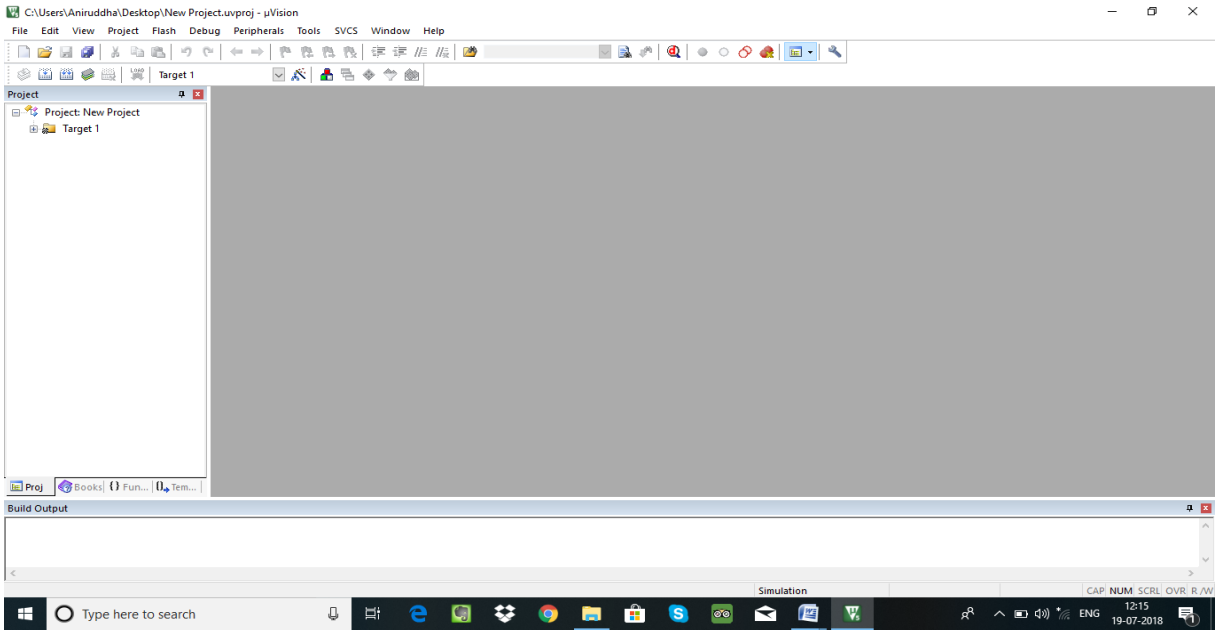

Figure. 7

Creating new file:

1. Click file pull down menu, Select new, A text editor window will open. Save this file in a same folder where project was stored. Give extension as .ASM or .A51.Fig. 8, 9 and 10.
2. On left hand project work space window will display Target 1 and source group 1 Right click on source group; Select Add files to source group 1. Fig. 11
3. Select file type as .asm source file. Now all .asm file names will be displayed, select appropriate file, click ADD and close. Fig. 12
4. Project work space window will display ‘Target 1’ and source group 1’ with added file name. Fig 13

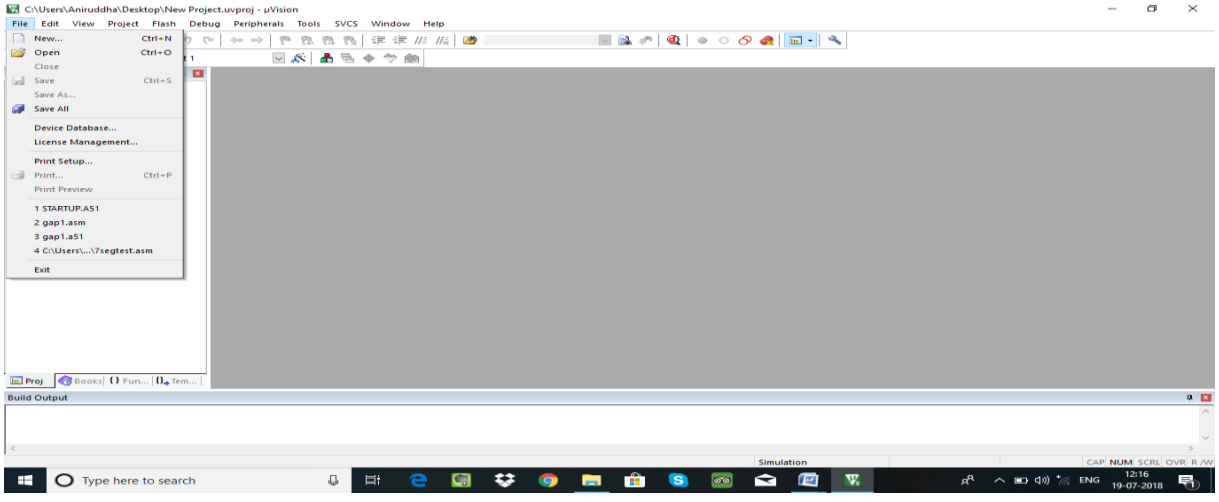

Figure. 8

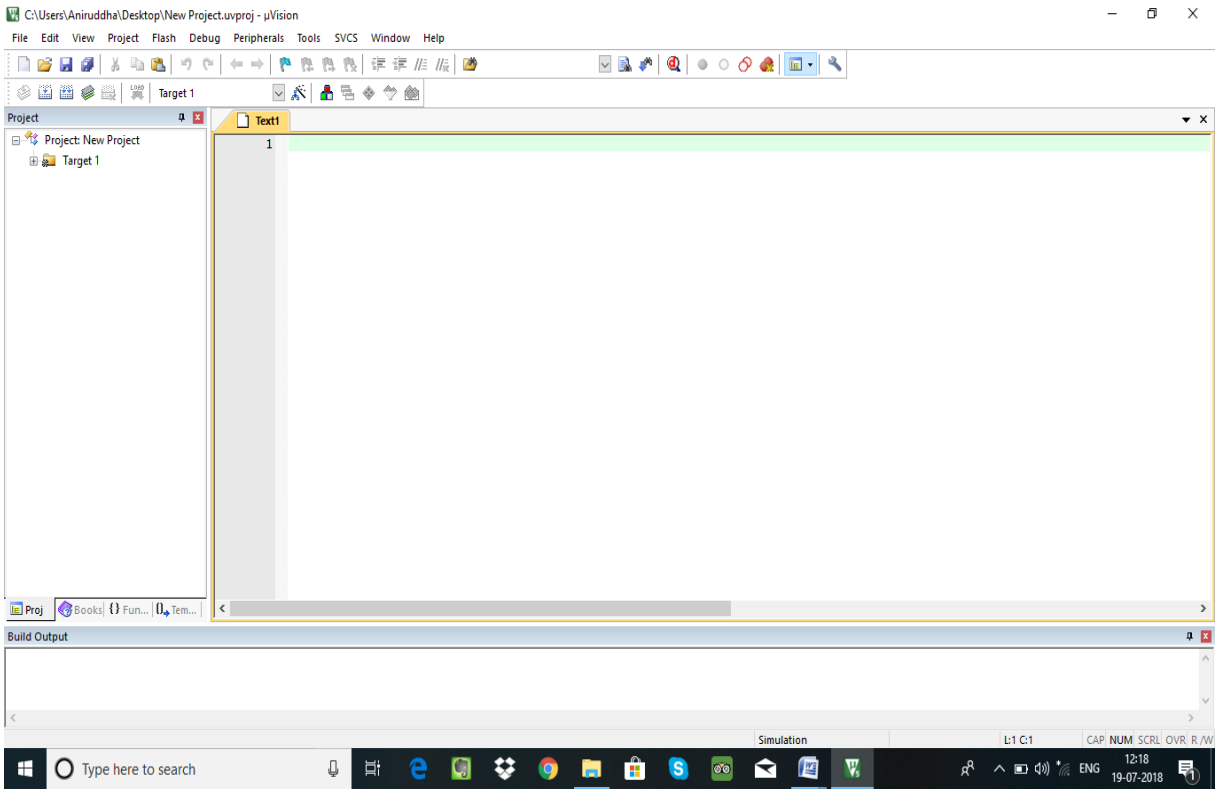

Figure.9

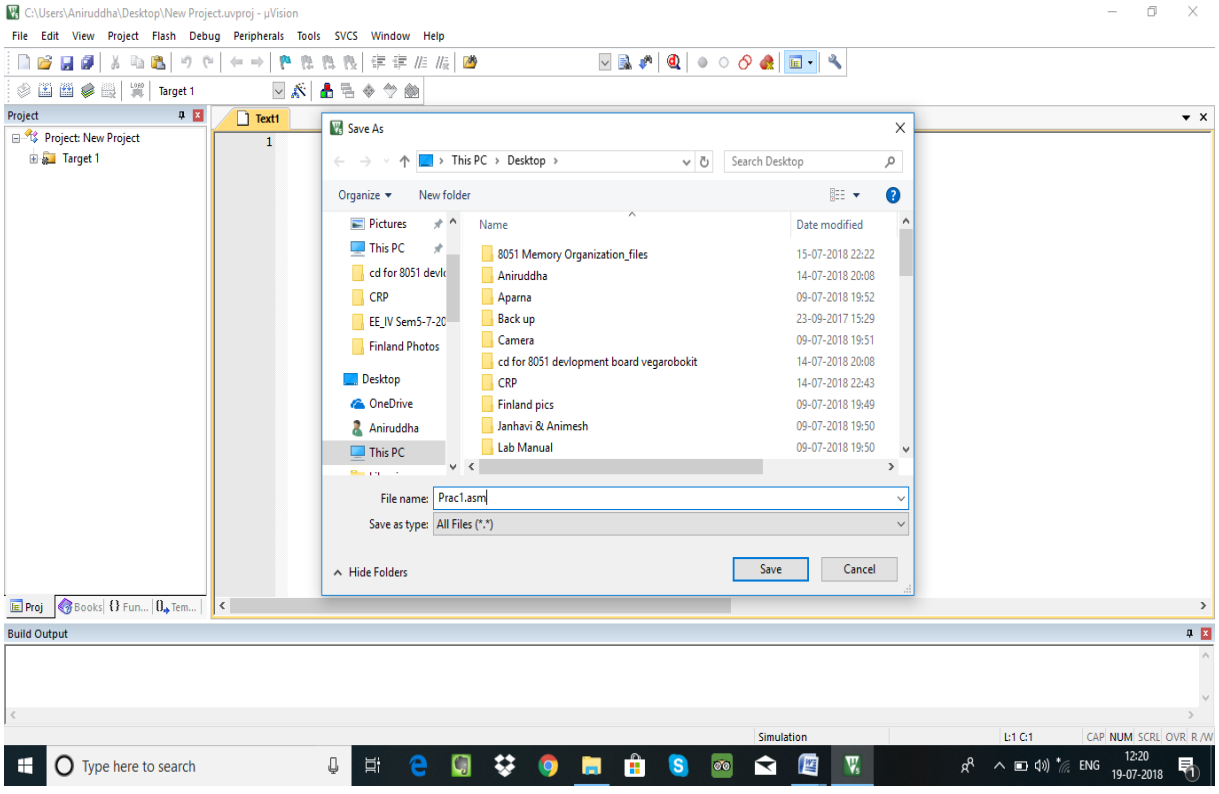

Figure. 10

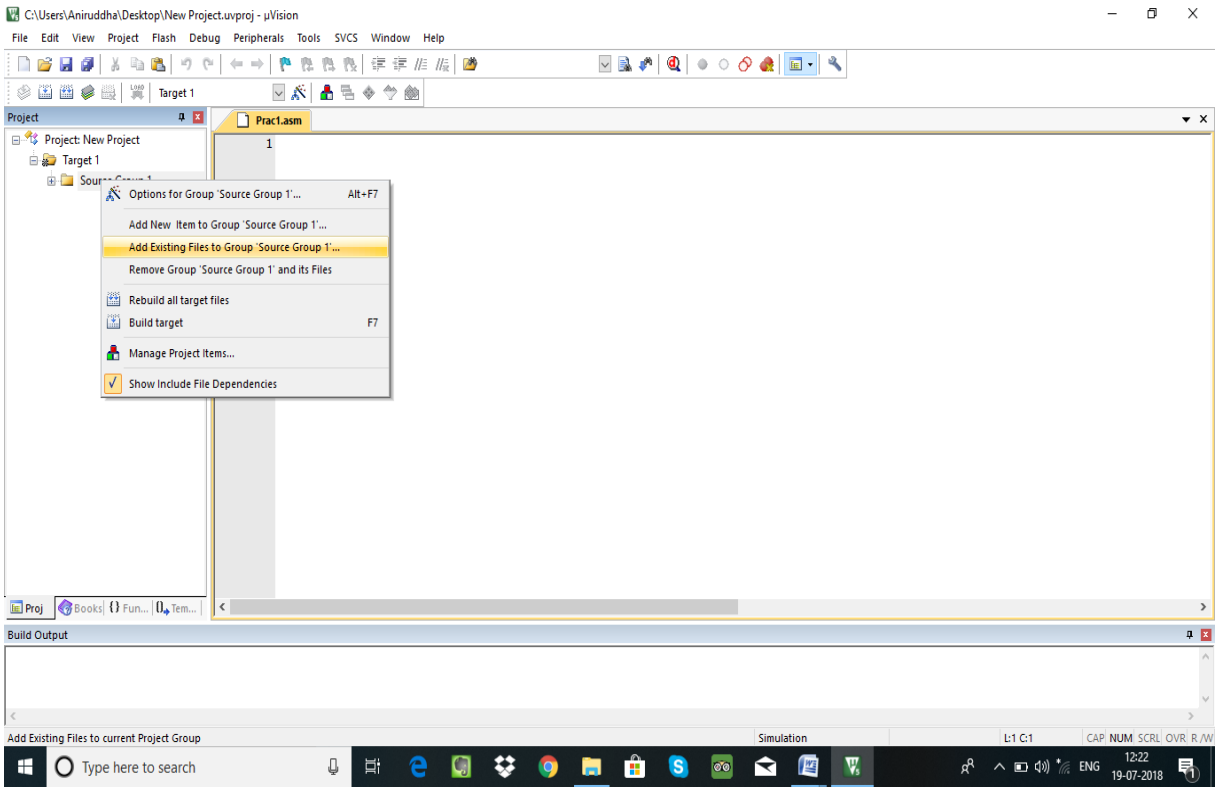

Figure. 11

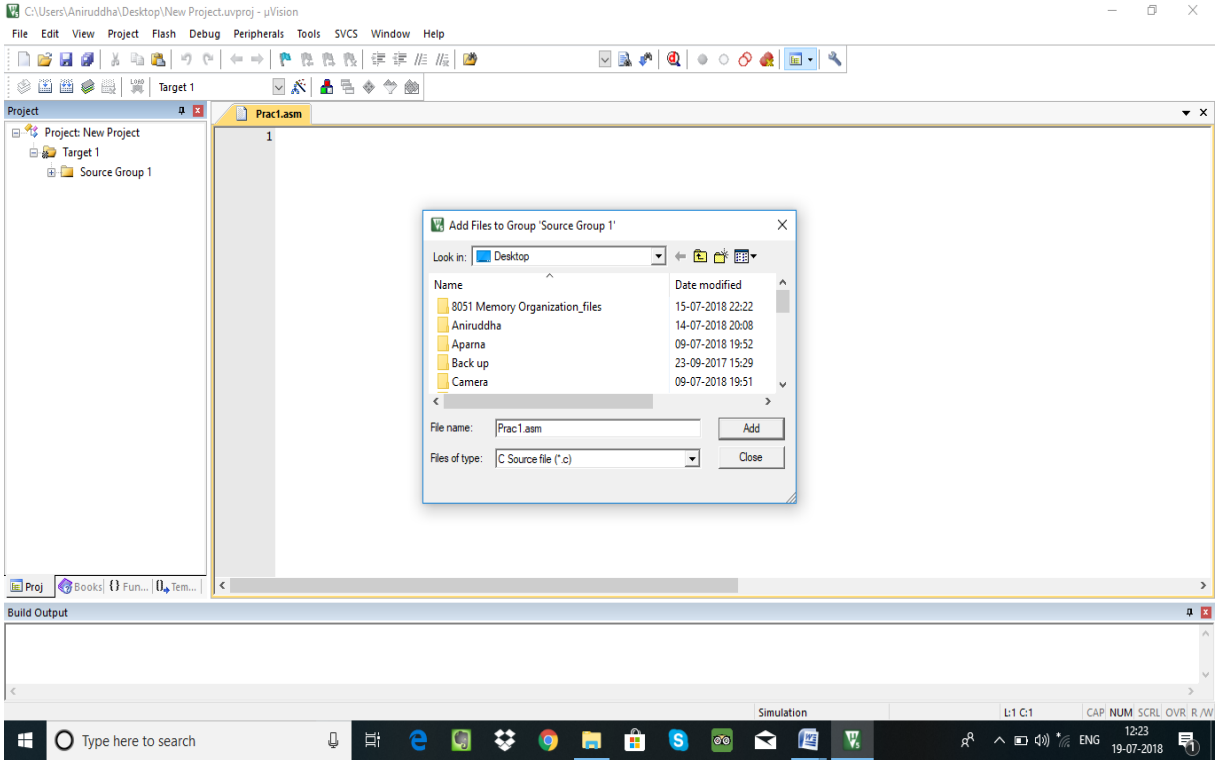

Figure. 12

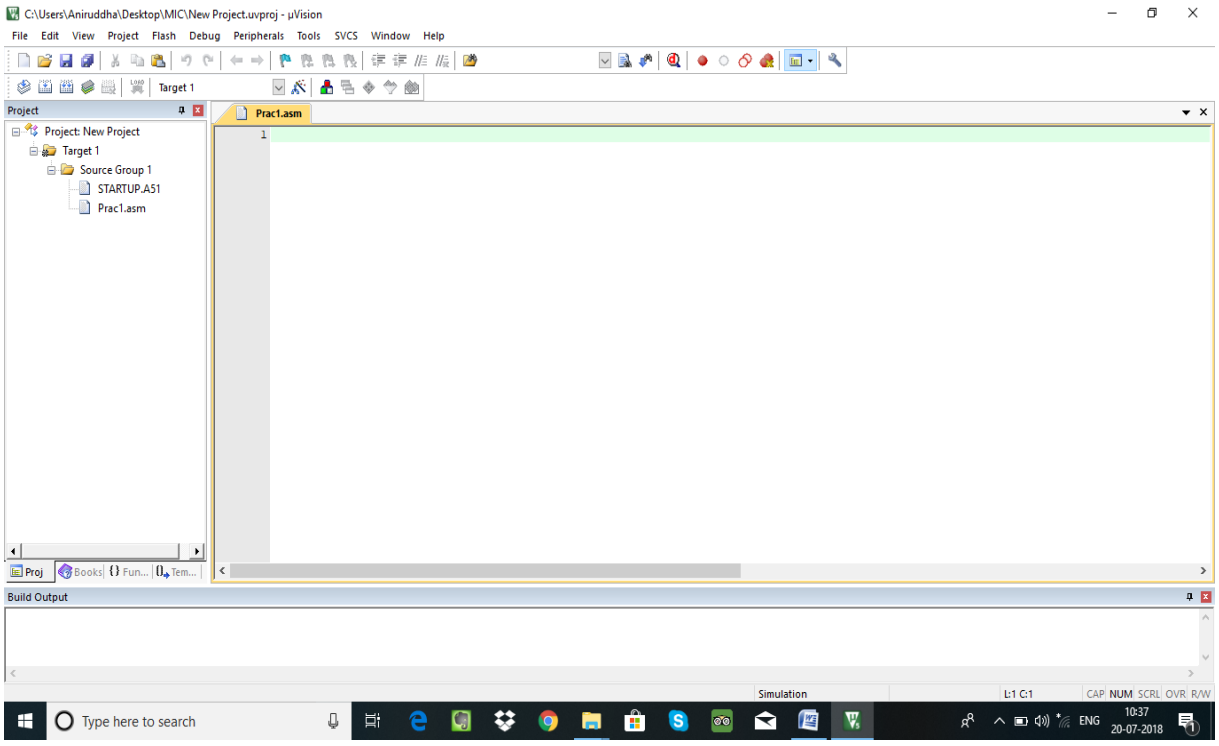

Figure.13

Creation and execution of program:

1. Type assembly language program. End with END directive. Save the file periodically. Fig 14
2. Right click source group 1 and Click on Build target files or Rebuild target or press F7. Fig 15
3. Output window will display the errors if any, if there are some errors then remove the errors and repeat step number 2 until no errors. Fig 15
4. To start the simulation, click on Debug pull down. Then select Start/Stop debug session. Fig 16
5. On start of debug session, project window will display all internal registers of 8051 and their contents. Fig 17
6. To execute the program step by step, go no clicking on “step over “button. Or Run the complete program by clicking Run or F5.
7. Observe the logic levels of port pins, timers; interrupt etc. by clicking ion PERIPHERALS and select appropriate ports.
8. Observe the serial communication by clicking VIEW pull down and select serial window- 1 option.
9. To observe the contents of internal, external and code memory contents-
   Click on memory window button.
   Memory window will get displayed near output window with address bar.
   Type “i: address 8 bit H” for internal memory.”
   Type “x: address 16 bit H” for external memory,
   for code memory type “c: address H”.
10. To modify the contents of memory, right click on contents of any memory location and enter new values to be loaded in that memory location.

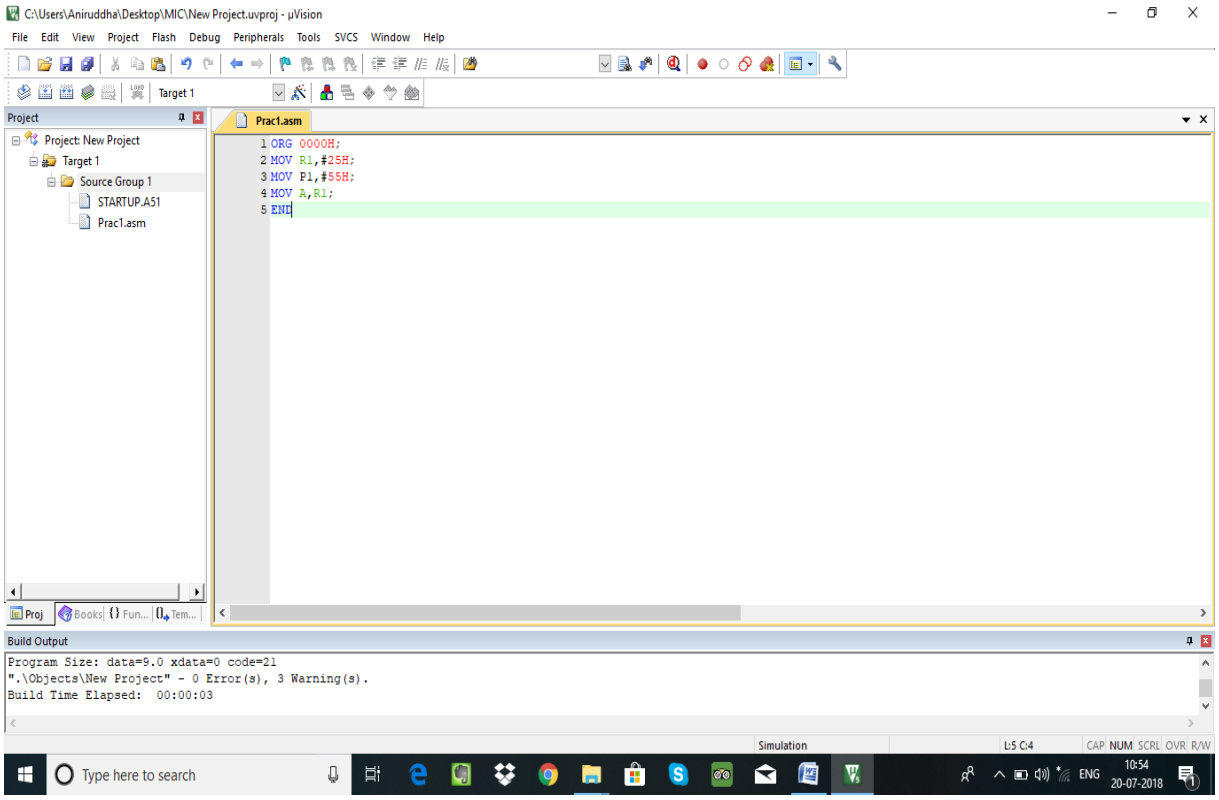

Figure.14

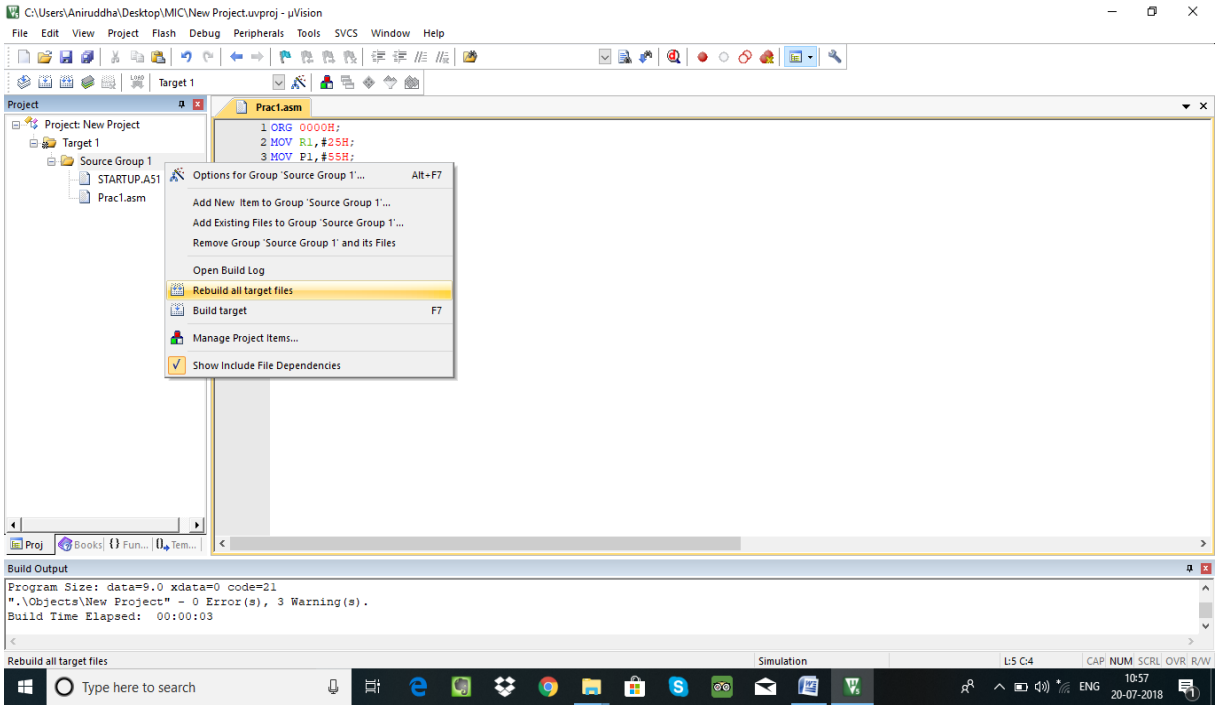

Figure.15

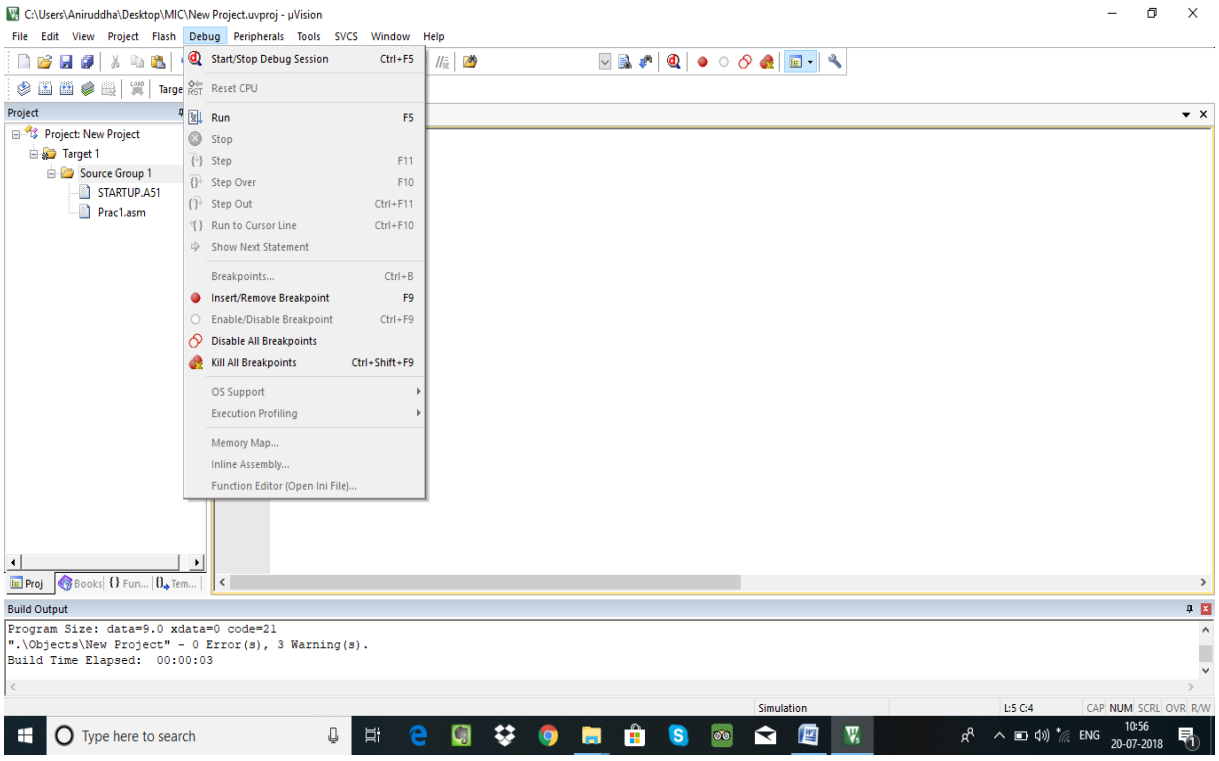

Figure.16

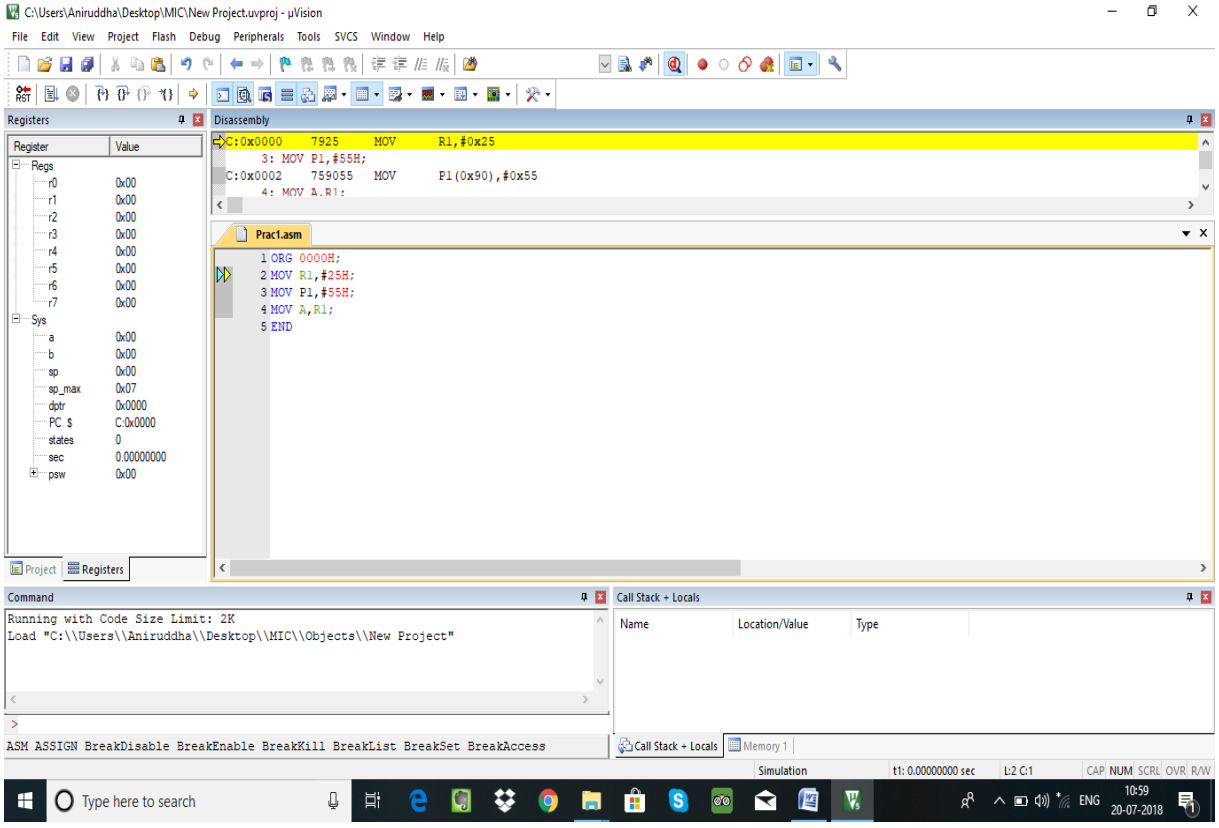

Figure.17

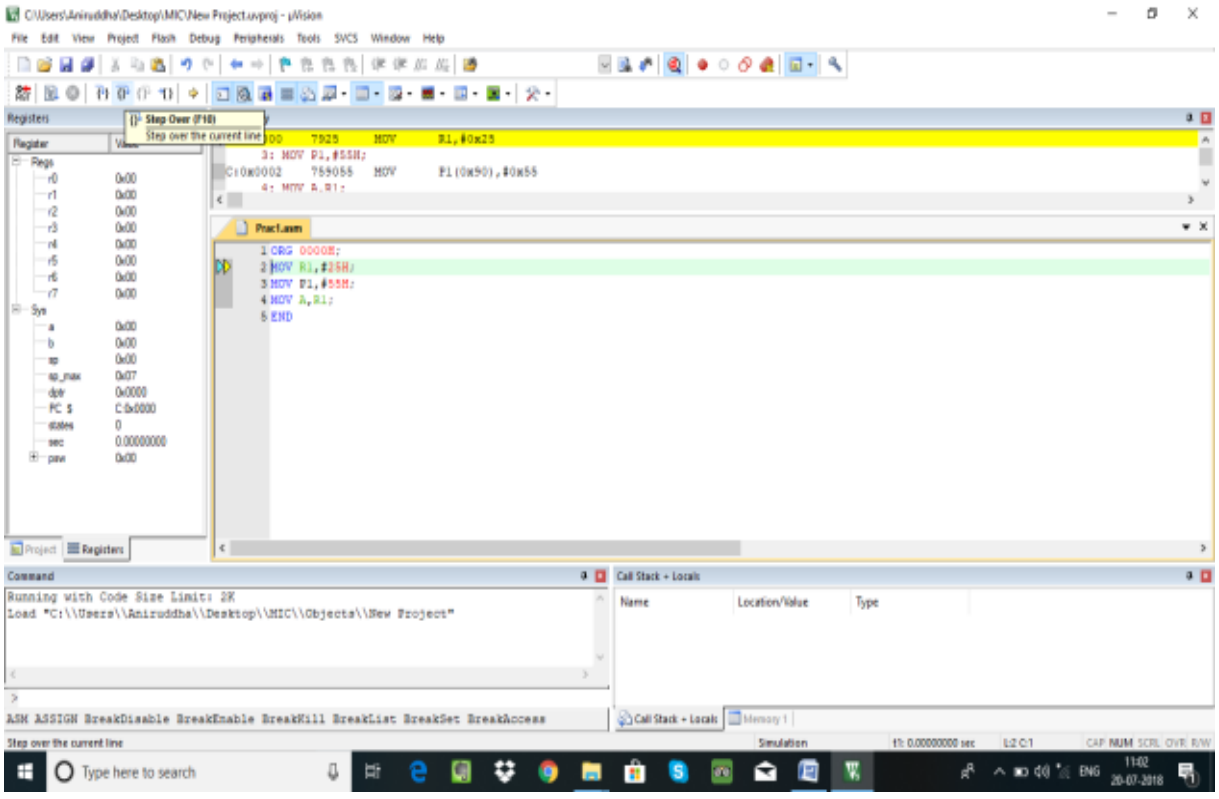

Figure.18

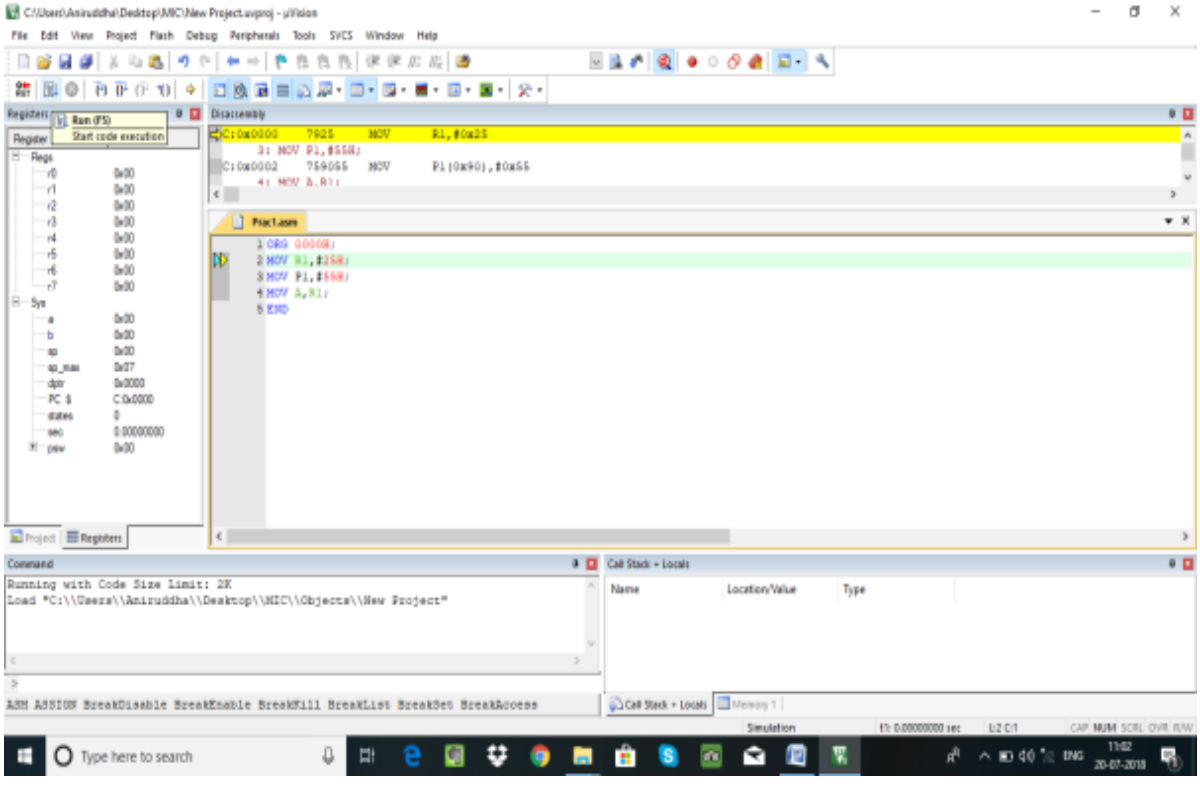

Figure.19

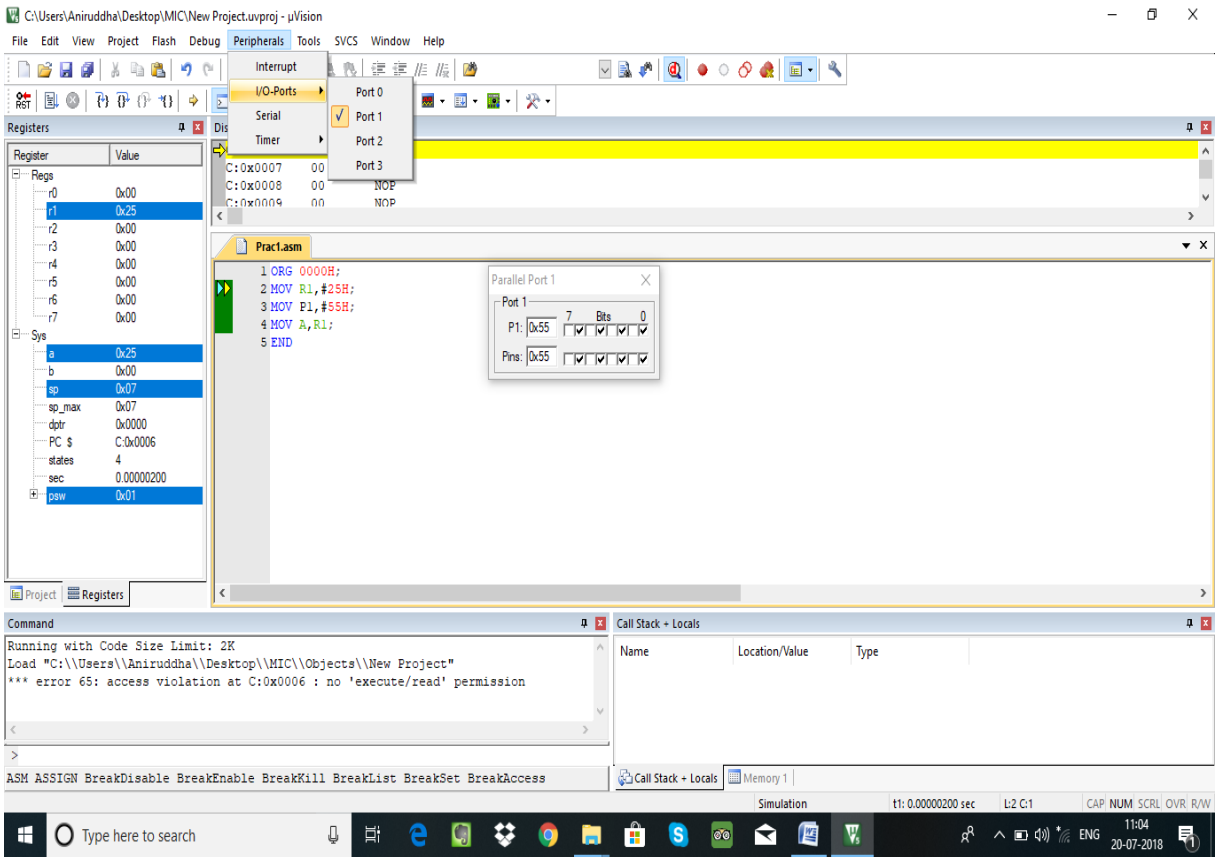

Figure.20

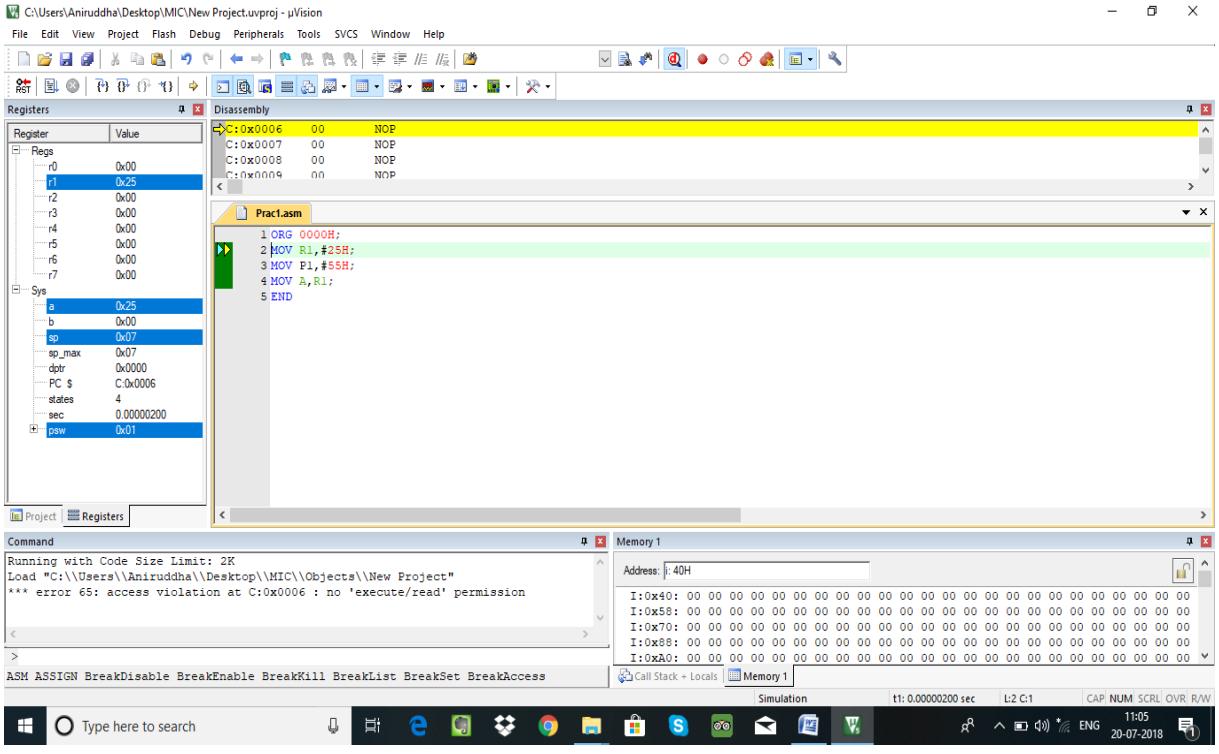

Figure.21

Creation of Hex file:

1. To create a hex file Right click on target in project window. Fig. 21
2. Click on options for target ‘target 1’.Fig 21
3. Click on select folder option and choose required folder to save hex file. Fig.22
4. Click on output tab write correct name of the file and checkmark the option “create hex file “. Fig 23
5. Click ok. Observe output window. Hex file is created. Fig 24

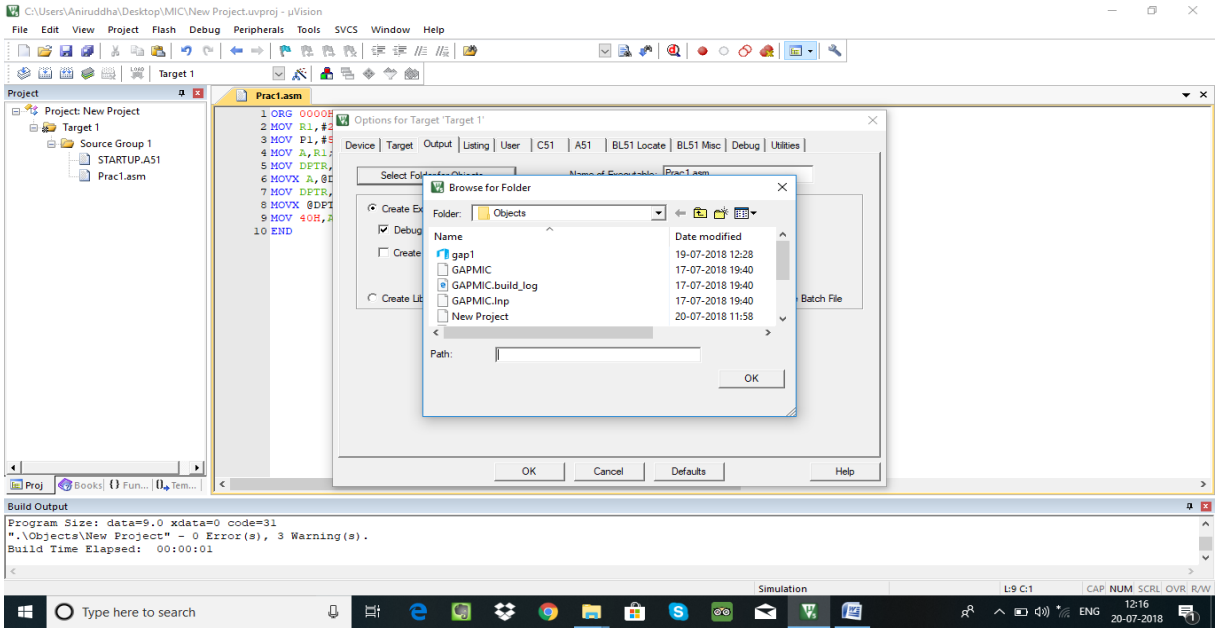

Figure.22

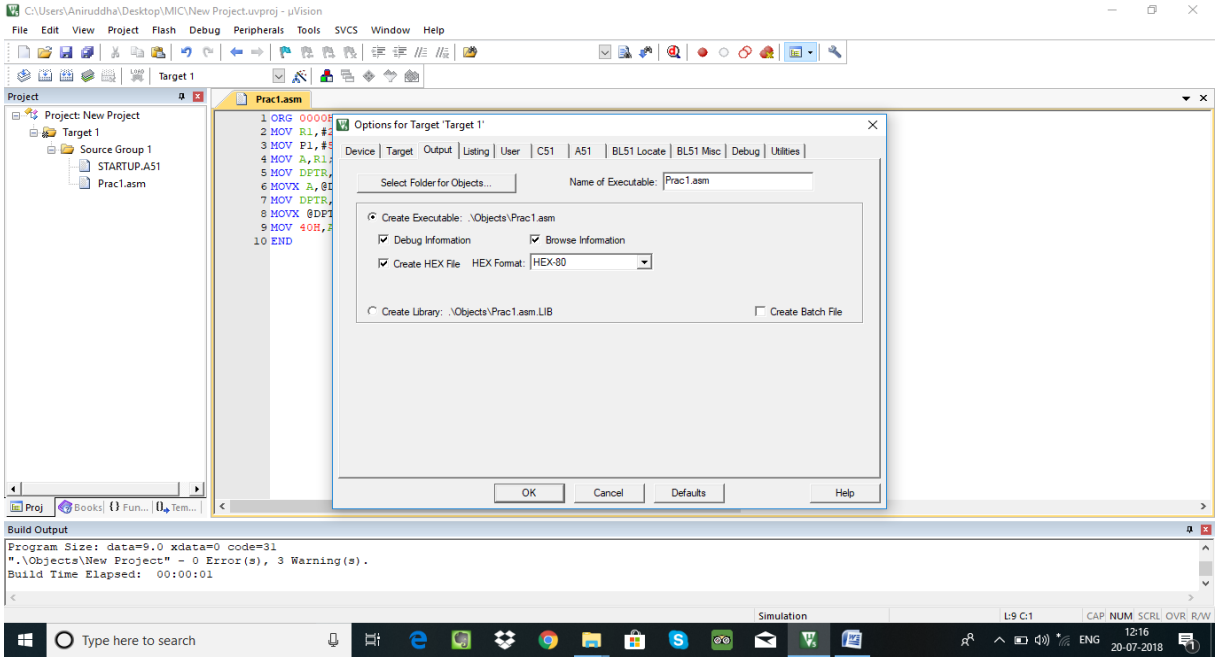

Figure.23

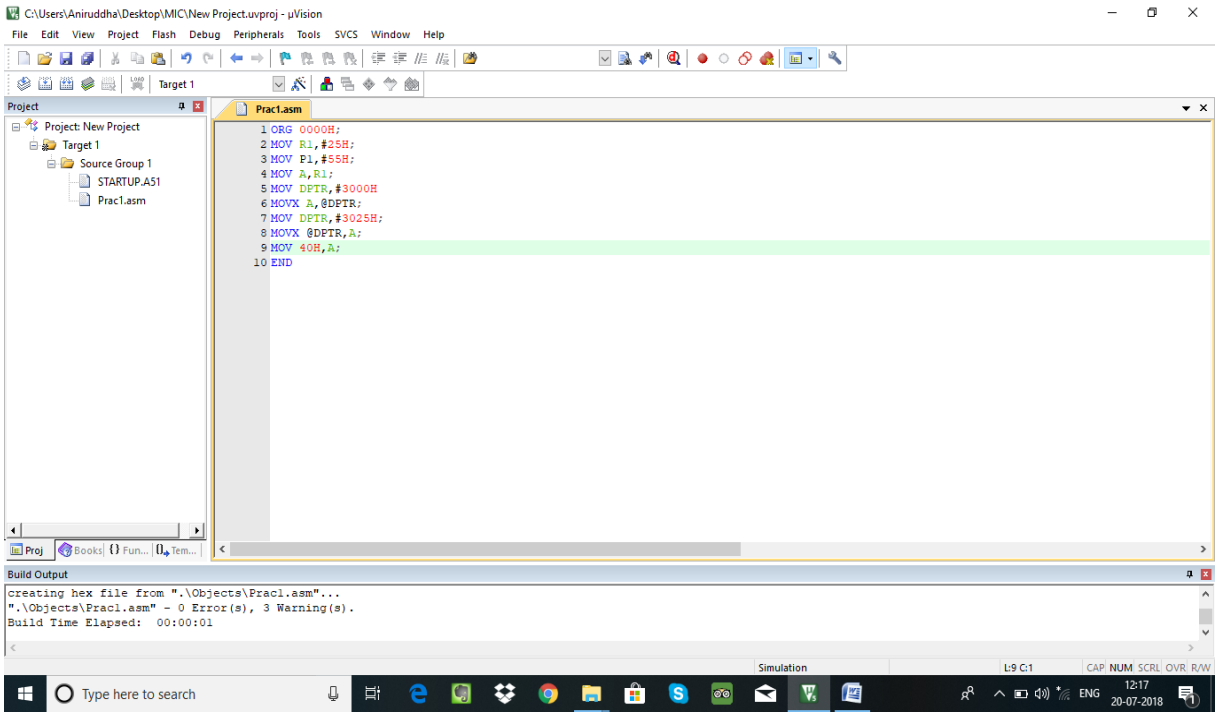

Figure.24

XII. Resources used (with major specifications)

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					

XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observations:

Observe the development board, list various electronics components and sate their functions-

Sr. No	Name of the components/ IC number	Function
1		
2		
3		
4		
5		
6		
7		

XVI. Sample program:

Write an assembly language program to move data 35h, 58h and 74h to register R5, Port1(P1) and register A respectively.	Observations
ORG **MOV R5,#35H;** **MOV P1,#58H;** **MOV A,#74H;** **END**	

Note: Teacher shall allot simple data transfer program to a group of 4 students and supervise.

XVII. Results: (are inclusive in the observations)

XVIII. Interpretation of results:

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XIX. Conclusion

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XX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1) What is the bit size of 8051 microcontroller CPU?
2) How many internal registers available in 8051?
3) How many ports 8051 microcontroller has?
4) How to see the status flag, SP and DPTR registers?

[Space for Answer]

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XXI. References / Suggestions for Further Reading

Sr. No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning, New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 97800705859591

XXII. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No.11: Write an assembly language program to perform following arithmetic operations on 8 bit data: addition, subtraction, multiplication and division.

I. Practical Significance

The computer is often used to compute numerical data to control machinery or some automation. These operations need arithmetic instructions.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '***Use digital electronics and microcontroller based systems.***':

1. Ability to apply the logic and data flow of the program for all arithmetic operations.
2. Ability to type, debug and execute the program by creating project in keil/any other software.
3. Ability to simulate the program for different data

IV. Relevant Course Outcome(s)

Write program for arithmetic operations in assembly language for microcontrollers.

V. Practical Outcome

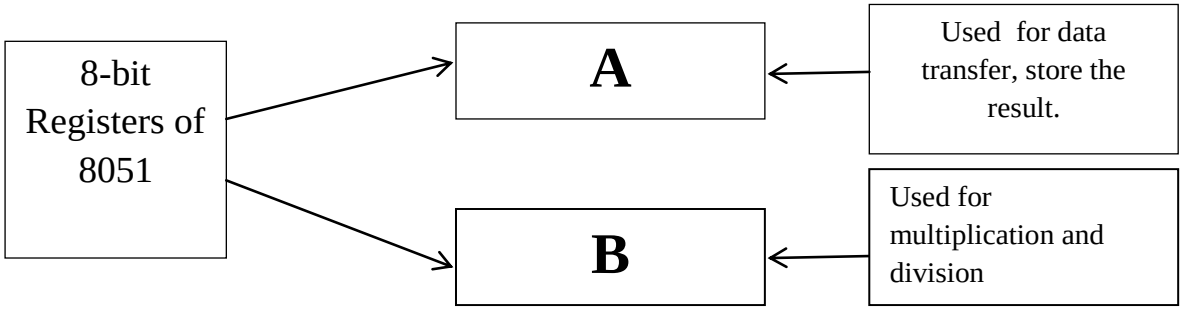
Write an assembly level program to perform the following arithmetic operations on 8 bit data: addition, subtraction, multiplication and division.

VI. Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

To perform arithmetic operations it is necessary that one of the two operands should be in accumulator. Register B is used for multiplication and division only.



8051 have single instructions to perform basic arithmetic operations as follows:

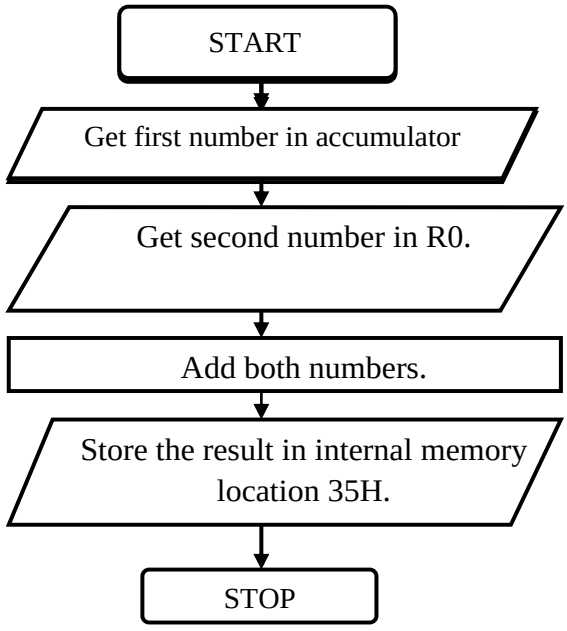
1. Addition : ADD destination, source
2. Subtraction : SUBB destination , source
3. Multiplication : MUL AB
4. Division : DIV AB

VIII. Sample program

Addition:

Problem statement: Addition Write and execute a program to add data 40H and 30H and store result in 35H internal memory	**Student activity :** Write and execute a program to add data 49H and 92H and store result in 30H internal memory
Algorithm: 1. Get first number in accumulator 2. Get second number in R0. 3. Add both numbers. 4. Store the result in internal memory location 35H. 5. Stop	**Algorithm:**

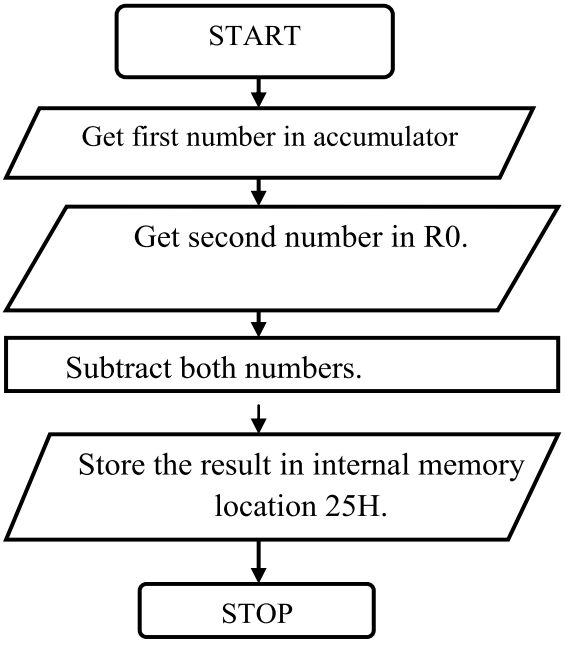
Flow Chart:



Assembly language program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize		
MOV A, #40H	Copy the content of 40h into accumulator		
MOV R0,#30H	Copy the content 30h into accumulator		
ADD A, R0	Add the content A and R0		
MOV 35H, A	Copy result in 35h internal memory		
END	End of program		

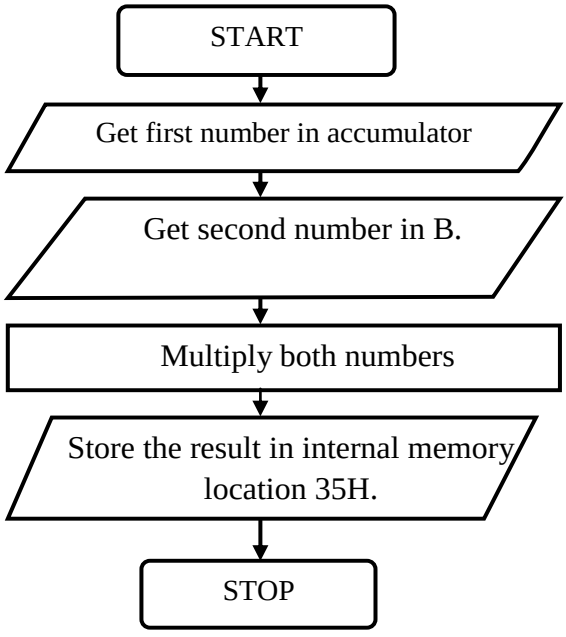
Subtraction:

Problem statement: Subtraction Write and execute a program to subtract data 40H and 30H and store result in 25H internal memory	**Student activity :** Write and execute a program to subtraction data 68H and 43H and store result in 28H internal memory
Algorithm: **1.** Get first number in accumulator **2.** Get second number in R0. **3.** Perform subtraction of two numbers **4.** Store the result in internal memory location 25H. **5.** Stop	**Algorithm:**
Flow Chart:  	

Assembly language program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize		
MOV A, #40H	Copy the content of 40h into accumulator		
MOV R0,#30H	Copy the content 30h into accumulator		
SUBB A, R0	Subtraction of the content A and R0		
MOV 25H, A	Copy result in 25h internal memory		
END	End of program		

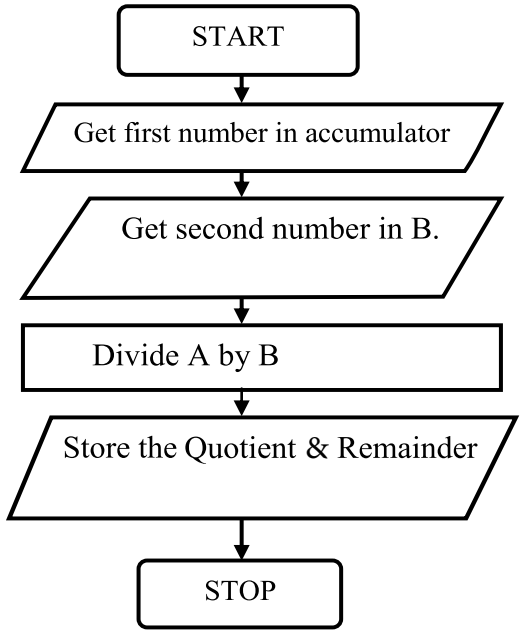
Multiplication:

Problem statement: Multiplication Write and execute a program to multiply data 05H and 06H and store result in 35H internal memory	**Student activity :** Write and execute a program to subtraction multiply data 12H and 02H and store result in 30H internal memory
1. Algorithm: 2. Get first number in accumulator 3. Get second number in B. 4. Multiply both numbers 5. Store the result in internal memory location 35H. 6. Stop	**Algorithm:**
Flow Chart:  	

Assembly language program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize		
MOV A, #05H	Copy the content of 05h into accumulator		
MOV B,# 06H	Copy the content 06h into accumulator		
MUL AB	Multiply the content of A and B		
MOV 35H, A	Copy result in 35h internal memory		
END	End of program		

Division:

Problem statement: Division Write and execute a program to perform division data 40H and 02H	**Student activity :** Write and execute a program to perform division data 44H and 04H
7. Algorithm: 8. Get first number in accumulator 9. Get second number in B. 10. Divide the content of A by content B. 11. Store the result(Quotient and Remainder) in internal memory location 35H and 36H 12. Stop	**Algorithm:**
Flow Chart: 	

Assembly language program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize		
MOV A, #40H	Copy the content of 05h into accumulator		
MOV B,# 02H	Copy the content 06h into accumulator		
DIV AB	Multiply the content of A and B		
MOV 35H, A MOV 36H,B	Copy result in 35h internal memory		
END	End of program		

IX. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1.	Desktop PC with microcontroller simulation software	_____	01
2.	8051 Development board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display,PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in power supply.	01

X. Precautions to be Followed

1. Software to be installed properly.
2. Appropriate microcontroller IC selection from the predefined list.
3. Program should be saved with correct extension after creating a new project

XI. Procedure

Steps to execute the program by Keil software:

Student shall create project and write sample assembly language programs using Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in practical no. 10

XII. Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII. Actual Procedure Followed

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XIV. Precautions Followed

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XV. Observations (use blank sheet provided if space not sufficient)

Note: Students should execute programs for addition, subtraction, multiplication and division

Sr. No	Data stored in register /memory location for the operation	Result of the operation performed	Status of flags affected in PSW
ADDITION			
SUBTRACTION			
MULTIPLICATION			
DIVISION			

XVI. Results (Are inclusive in the observations**)**

XVII. Interpretation of Results

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XVIII. Conclusions (Actions/decisions to be taken based on the interpretation of results**).**

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XIX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. List any four instructions for addition operation and write meaning of each.
2. How subtraction without carry is performed using SUBB instruction.

[Space for Answer]

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XX. References / Suggestions for Further Reading

S, No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 9780070585959
4	Microcontroller Architecture Programming, Interfacing and System Design	Kamal, Raj	Pearson Education India, Delhi,2012, ISBN: 9788131759905

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……**.....**
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 12: Write an ALP to transfer Data from source to destination location of internal data memory

I. Practical Significance

Data transfer is a process of moving or coping information from one location to other location within internal and/or external data memory. To save the results of certain operations, to create lookup tables etc. these data transfer programs are required.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Learn to use simulation software for microcontroller programming.
2. Learn to develop logic and write assembly language program for data transfer.

IV. Relevant Course Outcomes

1. Write programs in assembly language for microcontrollers.

V. Practical Learning Outcome

Write an ALP to transfer data from source to destination location of internal data memory.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

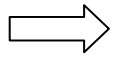
The block transfer is the process of transfer the content of group of memory location from source address to destination address, after block transfer content of destination replace by new contents.

Source memory

Address	Content
40H	75
41H	83
42H	29

Destination memory

Address	Content
50H	32
51H	28
52H	30



Destination memory

Address	Before	After
50H	32	75
51H	28	83
52H	30	29

VIII. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1	Desktop PC with microcontroller simulation software	…	10	
2	8051 Development Board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery backup,16X4,16 X2, LCD display,PC keyboard interfacing facility, Hex keypad facility, single user cross,c-compiler,RS-232,USB, interfacing facility with built in power supply.	5	
3	Keil or similar IDE		For all PCs	

IX. Precautions to be followed

1. Install the correct version of software (IDE) in PC.
2. Appropriate microcontroller IC should be selected from the predefined list.
3. Program should be saved with correct extension after creating a new project.

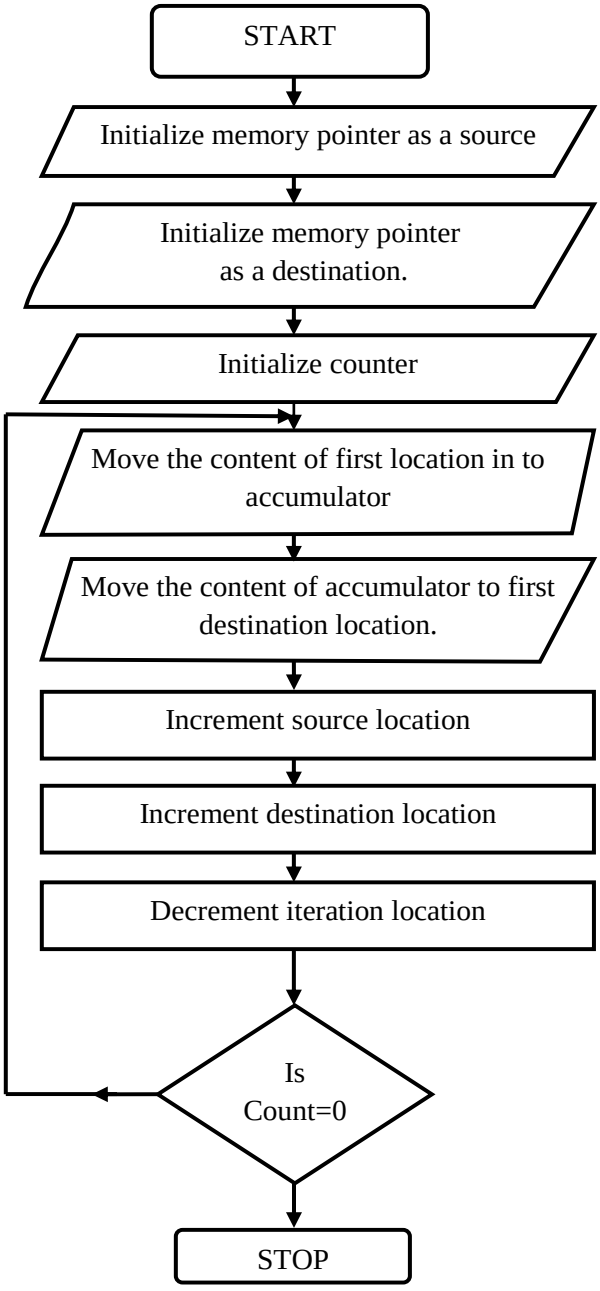
X. Procedure

Student shall create project and write sample assembly language programs using Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in practical no. 10

XI. Sample Program:

Problem statement: Block Transfer Write and execute a program for block transfer Take data of internal memory location 50H and transfer to 65H internal memory location.	**Student activity :** Write and execute a program for block transfer Take data of internal memory location 60H and transfer to 75H internal memory location.
Algorithm: 1. Start 2. Initialize memory pointer as a source. 3. Initialize memory pointer as a destination. 4. Initialize counter. 5. Move the content of first location in to accumulator. 6. Move the content of accumulator to first destination location. 7. Increment source location. 8. Increment destination location. 9. Decrement iteration count and if not zero jump to step 5. 10. Stop	

Flow Chart:


START
Initialize memory pointer as a source
Initialize memory pointer as a destination.
Initialize counter
Move the content of first location in to accumulator
Move the content of accumulator to first destination location.
Increment source location
Increment destination location
Decrement iteration location
Is Count=0
STOP

Assembly language program:

Instructions	Comments	Instructions	comments
ORG 0000H	Initialize		
MOV R0,#50H	Source memory pointer		
MOV R1,#60H	Destination memory pointer		
MOV R7,#05H	Counter		
UP:MOV A,@R0	Get the no. from source into accumulator		
MOV @R1,A	Move it into destination		
INC R0	Point on next memory location		
INC R1			
DJNZ R7,UP	Repeat the transfer till counter ≠ 0		
END	End of Program		

XII. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					
4					

XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observations and Calculations:

Source memory	
Address	**Content**

Destination memory	
Address	**Content**

Destination memory		
Address	**Before**	**After**

XVI. Results: (It is inclusive in the observations)

XVII. Interpretation of results: (Students should write this based on the observations for the different operations)

XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. What are the instructions used for block transfer in this program?
2. What is the significance of DJNZ instruction in this program?
3. What is the capacity of internal memory of 8051 microcontroller?

[Space for Answer]

XX. References / Suggestions for Further Reading

Sr. No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 97800705859591

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No.13 Write an ALP to transfer data from source to destination location of external data memory.

I. Practical Significance

The 8051 has 128 bytes of on chip RAM and 4kB of on chip ROM. But for some applications extra memory is required and hence external memory has to be interfaced with the microcontroller.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '***Use digital electronics and microcontroller based systems***':

1. Ability to apply the logic and data flow of the program for data transfer with external memory.
2. Ability to type, debug and execute the program by creating project in keil/any other software.
3. Ability to simulate the program for different data

IV. Relevant Course Outcome(s)

Write program for data transfer with external memory in assembly language for microcontrollers.

V. Practical Outcome

Write an assembly level program to transfer data from source to destination location of external data memory.

VI. Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

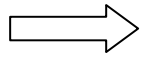
VII. Minimum Theoretical Background

The block transfer is the process of transfer the content of group of memory location from source address to destination address, after block transfer contents of destination are replaced by new contents.

Concept Structure:

Address	Content
4000H	56
4001H	76
4002H	29

Address	Content
5000H	39
5001H	27
5002H	30



Address	Before	After
5000H	39	56
5001H	27	76
5002H	30	29

The designer of an 8051 Microcontroller based system is not limited to the internal RAM and ROM present in the 8051 Microcontroller. There is a provision of connecting both external RAM and ROM i.e. Data Memory and Program. The reason for interfacing external Program Memory or ROM is that complex programs written in high – level languages often tend to be larger and occupy more memory. Another important reason is that chips like 8031 or 8032, which doesn't have any internal ROM, have to be interfaced with external ROM.A maximum of 64B of Program Memory (ROM) and Data Memory (RAM) each can be interface with the 8051 Microcontroller. The following image shows the block diagram of interfacing 64KB of External RAM and 64KB of External ROM with the 8051 Microcontroller.

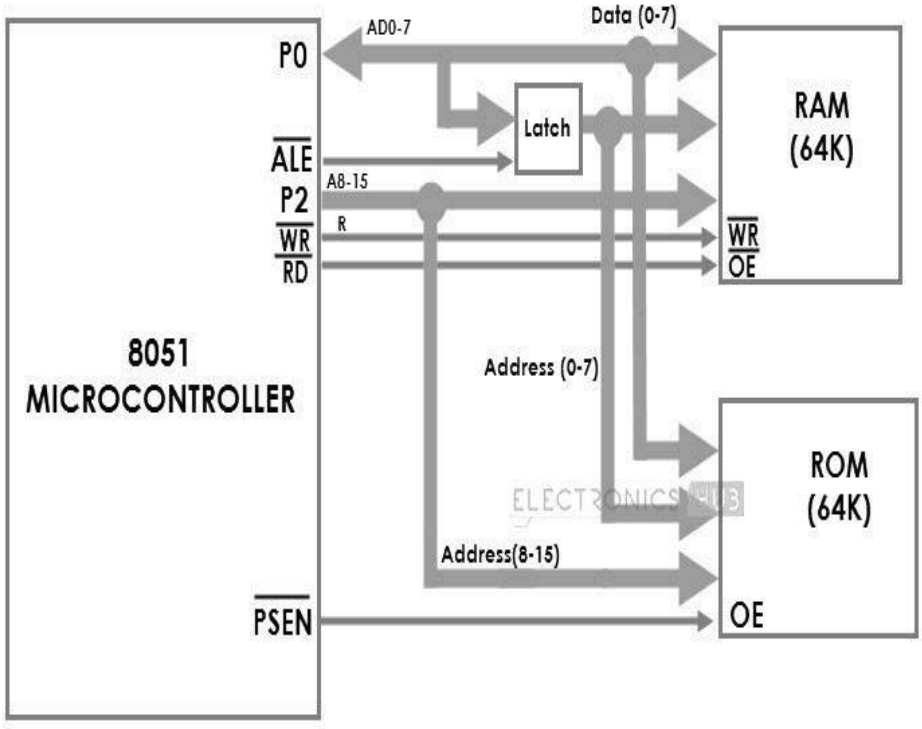


Figure 1. Interfacing of external data and code memory
Courtesy : Electronicshub.org

VIII. Sample program

Problem statement: Block Transfer Write and execute a program for block transfer. Take data of external memory location 4000H and transfer to 5000H external memory location.	**Student activity :** Write and execute a program for block transfer. Take data of external memory location 2000H and transfer to 3000H external memory location
1. Algorithm: 2. Start 3. Initialize counter. 4. Initialize memory pointer as a source by loading 4000H in DPTR 5. Move the content of first location in to accumulator. 6. Initialize memory pointer as a destination 7. by loading 50H in DPH. 8. Move the content of accumulator to first 9. destination location. 10. Increment DPTR. 11. Decrement iteration count and if not zero 12. jump to step 3. 13. Stop	

Assembly language program:

Instructions	**Comments**	**Instructions**	**Comments**
ORG 0000H	Initialize		
MOV R0,#05H	Set the counter		
MOV 82H,#00H	DPL = 00H		
UP:MOV 83,#40H	DPH= 40H		
MOVX A,@DPTR	Get the no. from source into accumulator		
MOV 83,#50H	DPH = 50		
MOVX @DPTR,A	Get the no. from accumulator to destination		
INC DPTR	Increment DPTR		
DJNZ R0,UP	Repeat the transfer till counter = 0		
SJMP $			
END	End of Program		

IX. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Desktop PC with microcontroller simulation software	_____	01
2	8051 Development board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in power supply.	01

X. Precautions to be Followed

1. Software is installed properly.
2. Appropriate microcontroller IC selection from the predefined list.
3. Program should be saved with correct extension after creating a new project

XI. Procedure

Steps for execute the program by Keil software:

Student shall create project and write sample assembly language programs using Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in practical no. 10

XII. Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1					
2					
3					
4					

XIII. Actual Procedure Followed (use blank sheet provided if space not sufficient)

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XIV. Precautions Followed

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XV. Observations (use blank sheet provided if space not sufficient)

Operation performed	Data stored in register /memory location for the operation	Result of the operation performed	Status of flags affected in PSW
Block / data transfer			

XVI. Results (Are inclusive in the observations)

XVII. Interpretation of Results

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XVIII. Conclusions

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XIX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Name instruction used for accessing data from external memory, write syntax and function.
2. Write name of the pins used to access the data from external memory.

[Space for Answer]

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XX. References / Suggestions for Further Reading

S, No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 9780070585959
4	Microcontroller Architecture Programming, Interfacing and System Design	Kamal, Raj	Pearson Education India, Delhi,2012, ISBN: 9788131759905

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 14 : Write an ALP to Exchange Data from source to destination memory location

I. Practical Significance

Data exchange is a process of moving or coping information from one location to other location and vice versa within internal and/or external data memory. To save the results of certain operations, to create lookup tables etc. these data transfer programs are required.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Learn to use simulation software for microcontroller programming.

IV. Relevant Course Outcomes

1. Write programs in assembly language for microcontrollers.

V. Practical Learning Outcome

Write an ALP to exchange data from source to destination memory location.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

Block exchange is process of exchange the content of source memory location with destination memory location. In process of block exchange content of location is exchange.

Before			
Source memory		Destination memory	
Address	**Content**	**Address**	**Content**
40H	37	50H	75
41H	54	51H	83
42H	62	52H	29

After			
Source memory		Destination memory	
Address	**Content**	**Address**	**Content**
40H	75	50H	37
41H	83	51H	54
42H	29	52H	62

VIII. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1.	Desktop PC with microcontroller simulation software	---	10	
2.	8051 Development Board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery backup,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross,c-compiler,RS-232,USB, interfacing facility with built in power supply.	5	
3.	Keil or similar IDE		For all PCs	

IX. Precautions to be followed

1. Install the correct version of software (IDE) in PC.
2. Appropriate microcontroller IC should be selected from the predefined list.
3. Program should be saved with correct extension after creating a new project.

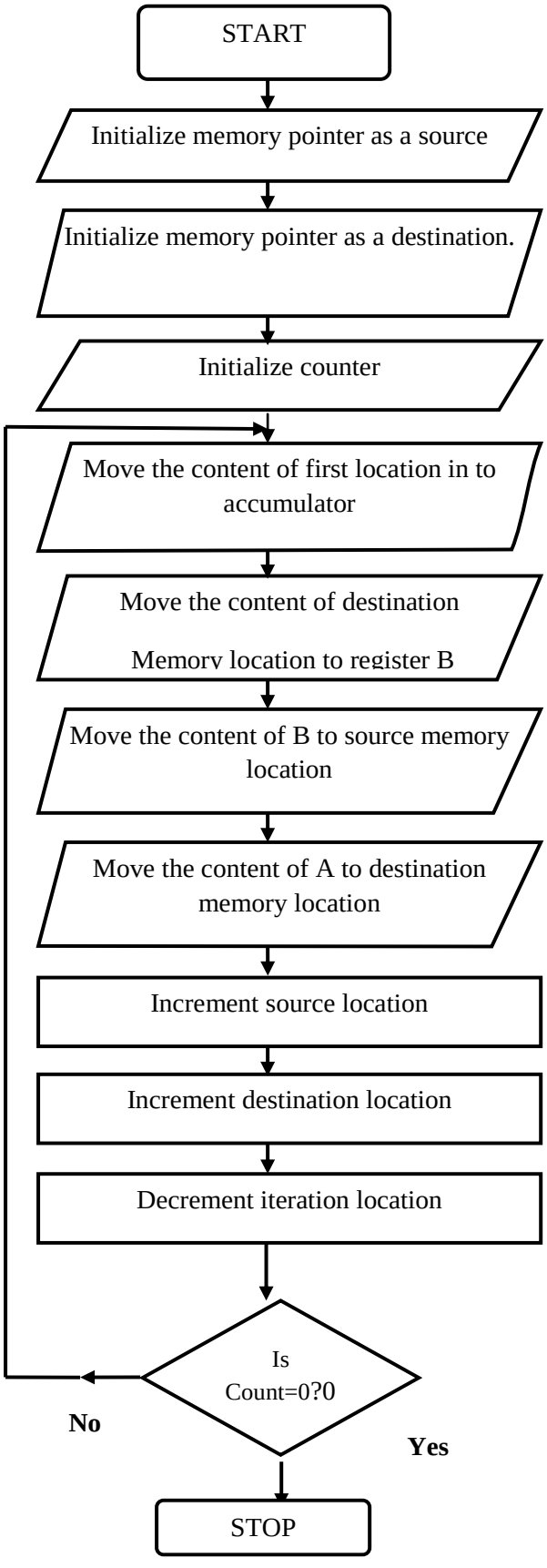
X. Procedure

Student shall create project and write sample assembly language programs using Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in practical no. 10

XI. Sample Program:

Problem statement: Block exchange Write and execute a program for exchange the content of block of starting address 40H internal memory location with 50H internal memory location.	**Student activity :** Write and execute a program for exchange the content of block of starting address 60H internal memory location with 70H internal memory location.
Algorithm: 1. Start 2. Initialize memory pointer as a source. 3. Initialize memory pointer as a destination. 4. Initialize counter. 5. Move the content of source memory location in to accumulator. 6. Move the content of destination memory location to B 7. Move the content register of B to source memory location. 8. Move the content of A to destination memory location. 9. Increment source location. 10. Increment destination location. 11. Decrement iteration count and if not zero jump to step 5. 12. Stop	

Flow chart:


START
Initialize memory pointer as a source
Initialize memory pointer as a destination.
Initialize counter
Move the content of first location in to accumulator
Move the content of destination
Memory location to register B
Move the content of B to source memory location
Move the content of A to destination memory location
Increment source location
Increment destination location
Decrement iteration location
Is Count=0?0
No
Yes
STOP

Assembly language program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize		
MOV R0,#40H	Memory pointer1		
MOV R1,#50H	Memory pointer 2		
MOV R7,#05H	Counter		
UP:MOV A,@R0	Get data from memory pointer 1 into accumulator		
MOV B,@R1	Get data from memory pointer 2 into Register B		
MOV @R0,B	Store data of memory block 1 into memory block 2 and vice versa		
MOV @R1,A			
INC R0	Increment memory pointers		
INC R1			
DJNZ R7,UP	Repeat the exchange till counter = 0		
END	End of Program		

XII. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observations:

Before			
Source memory		Destination memory	
Address	**Content**	**Address**	**Content**

After			
Source memory		Destination memory	
Address	**Content**	**Address**	**Content**

XVI. Results: (are inclusive in the observations)

XVII. Interpretation of results:

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XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. What are the instructions used for block exchange in this program?
2. What are the additional steps to be added in the block transfer program to make it block exchange?
3. Which register is used to access external data memory and how?

[Space for Answer]

XX. References / Suggestions for Further Reading

Sr.No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning, New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 97800705859591

XXI. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical no.15: Interface LED with 8051to turn on the LED.

I. Practical Significance

Display devices are interfaced with the microcontroller to indicate the results of the operation performed. LED, seven segment displays and LCDs can be interfaced to display the output in form of single digit, single character or alphanumeric character.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency '***Use digital electronics and microcontroller based systems.***'

1. Develop the program to interface LED using the port pins.
2. Ability to type, debug and execute the program by creating project in keil software.

IV. Relevant Course Outcome(s)

1. Write programs in assembly language for micro controllers.
2. Interface the memory and I/O devices to microcontrollers.

V. Practical Outcome

Interface LED with 8051 to turn on the LED.

VI. Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

8051 has 4 bidirectional I/O ports which can be used as input or output ports. LED s can be used as output devices to display the result obtained from the operation. Even the LED can be turned on /off by some switch or delay.

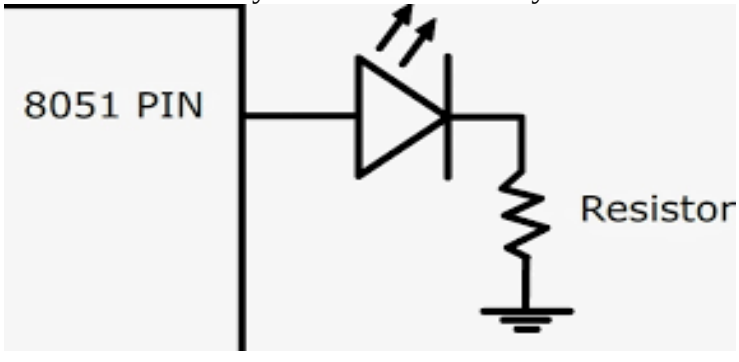

Figure 1. LED connected to the port pin of 8051

VIII. Interfacing diagram

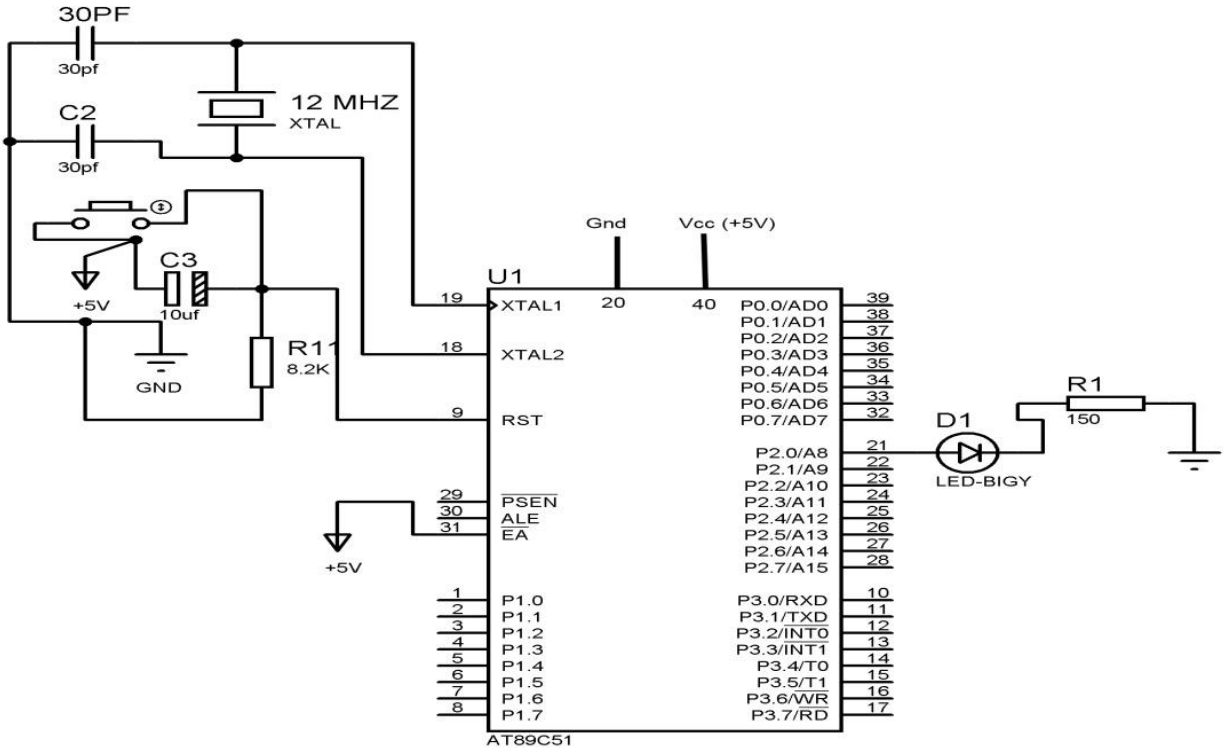

Figure 2. Interfacing of LED to port of 8051

IX. Sample program

Problem statement: Write an ALP to turn on the LED connected to port 2.0 pin.	**Student activity : Write and execute a program to turn on 8 LEDs connected to port 2.**
Algorithm: 1. Start 2. Connect LED to port pin 2.0 3. Load registers A with 01H. 4. Move contents of A to port 2. 5. END	

Assembly language program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize		
MOV A,#01H	Load 01H in accumulator		
MOV P3,A	Move the contents of A on port3.		
SJMP HERE	Short jump here		
END	End of Program		

X. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Desktop PC with microcontroller simulation software	_____	01
2	8051 Development board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in power supply.	01

XI. Precautions to be Followed

1. Software is installed properly.
2. Appropriate microcontroller IC selection from the predefined list.
3. Program should be saved with correct extension after creating a new project.
4. Interface the LED properly with the port of 8051 microcontroller.

XII. Procedure

Steps for execute the program by Keil software:

Student shall create project and write sample assembly language programs using Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in practical no. 10

Steps to burn the program for external hardware in ROM memory of 8051:

- Connect the required hardware as per the connection diagram and follow the steps below to write the program on 8051 microcontroller IC.
- Click on the ISP-Pgm icon on the pc followng window will appear
- Click on the ‘open file’ in the window and select required Hex file from the proper location that has been created.
- Click on the Open for the selected file.
- Click on ‘write’ option and the selected Hex file will be copied on 8051 microcontroller IC.
- See the output on the desired port of 8051 microcontroller kit.

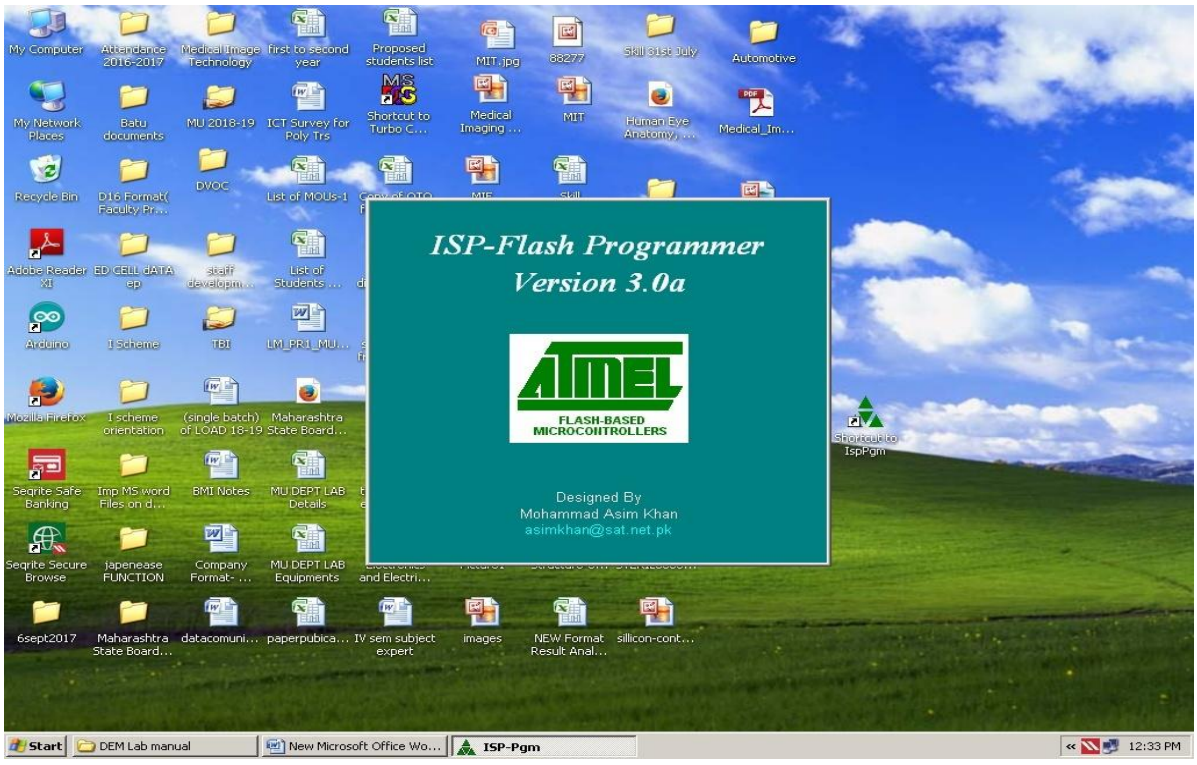

Figure. 1

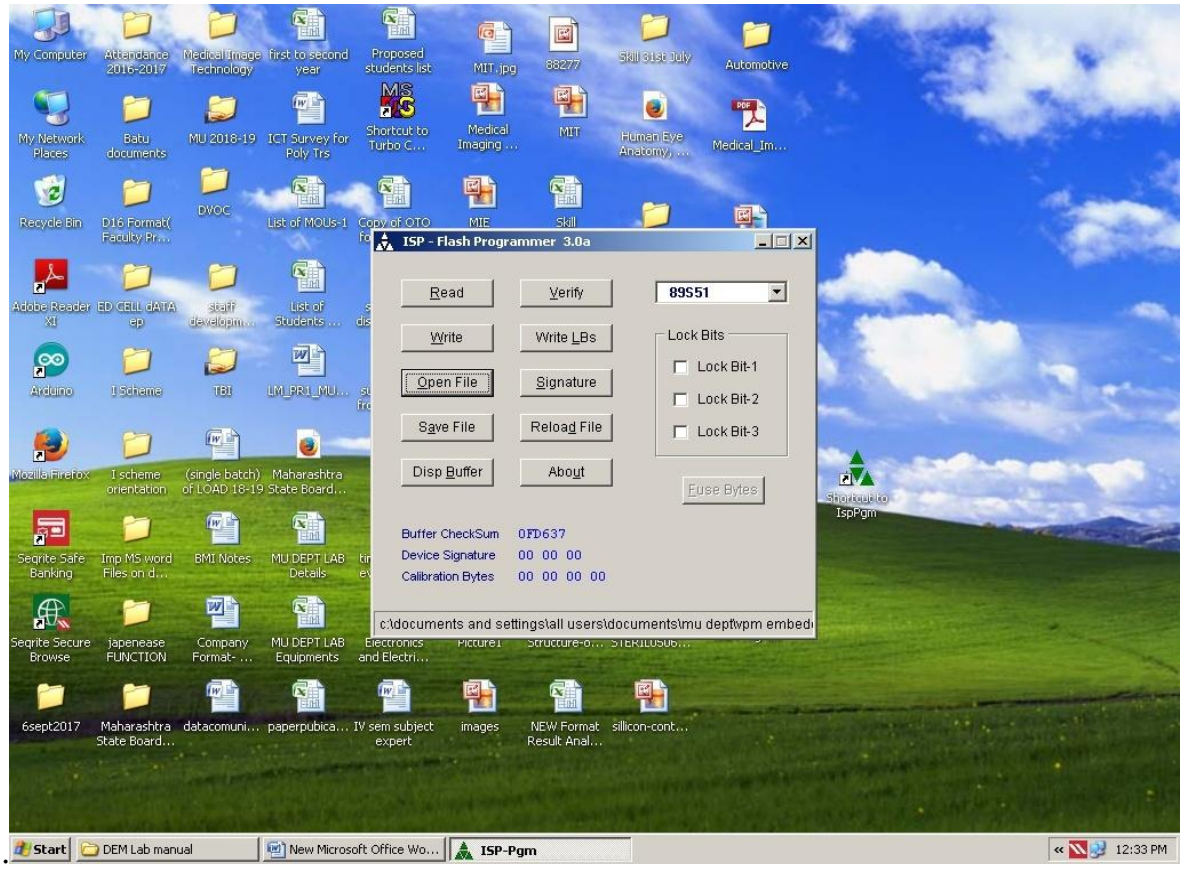

Figure.2

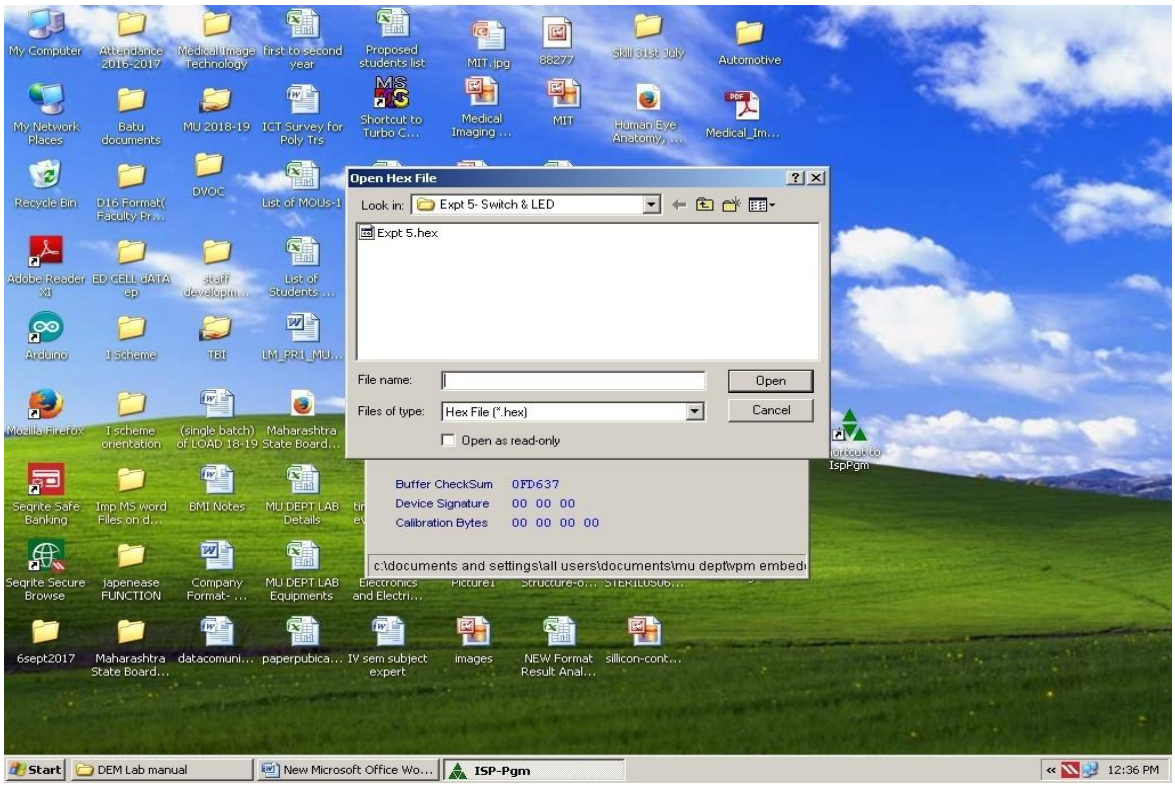

Figure.3

Figure. 4

XIII. Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIV. Actual Procedure Followed (use blank sheet provided if space not sufficient)

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XV. Precautions Followed

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XVI. Observations (use blank sheet provided if space not sufficient)

Operation performed	Data stored in register /memory location for the operation	Result of the operation performed	Status of flags affected in PSW

XVII. Results (Are inclusive in the observations)

XVIII. Interpretation of Results

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XIX. Conclusions (Actions/decisions to be taken based on the interpretation of results**).**

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XX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Name few input output devices which can be interfaced with 8051.
2. How many LEDs can be interfaced simultaneously to the ports of 8051.

[Space for Answer]

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XXI. References / Suggestions for Further Reading

S, No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 9780070585959
4	Microcontroller Architecture Programming, Interfacing and System Design	Kamal, Raj	Pearson Education India, Delhi,2012, ISBN: 9788131759905

XXII. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……...
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No. 16: Interface 7-segment display to display decimal number from 0 to 9.

I. Practical Significance

A seven segment display is an electronic display device for displaying decimal numerals. It is a most commonly used output device in many gadgets and appliances like digital meters, digital clocks, microwave oven etc.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Learn to use simulation software for microcontroller programming.

IV. Relevant Course Outcomes

1. Write programs in assembly language for microcontrollers.
2. Interface the memory and I/O devices to microcontrollers.

V. Practical Learning Outcome

Interface 7-segment display to display decimal number from 0 to 9.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

- Seven segment displays contain arrangement of eight LEDs and dot (.).It is available in two different type common cathode and common anode. In common cathode all cathode of LED are connected together and connected to ground. Fig. 1.In common anode all anode terminals of LED are connected to +ve terminal. Fig 2.It is used to display numerical value on seven segments by providing appropriate hex numbers.
- In common cathode 1- Indicates LED is ON
  0-Indicates LED is OFF
- In common anode 0- Indicates LED is ON
  1-Indicates LED is OFF

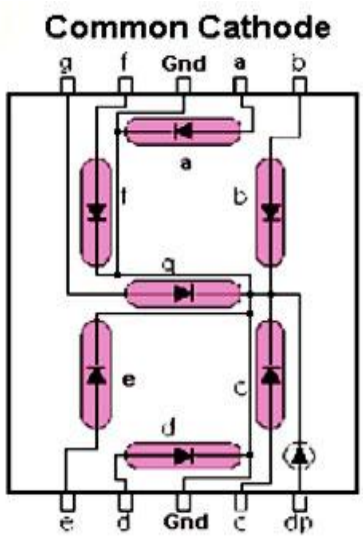

Figure. 1

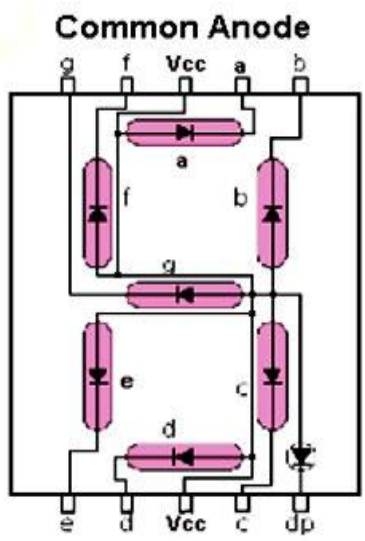

Figure. 2

VIII. Circuit diagram:

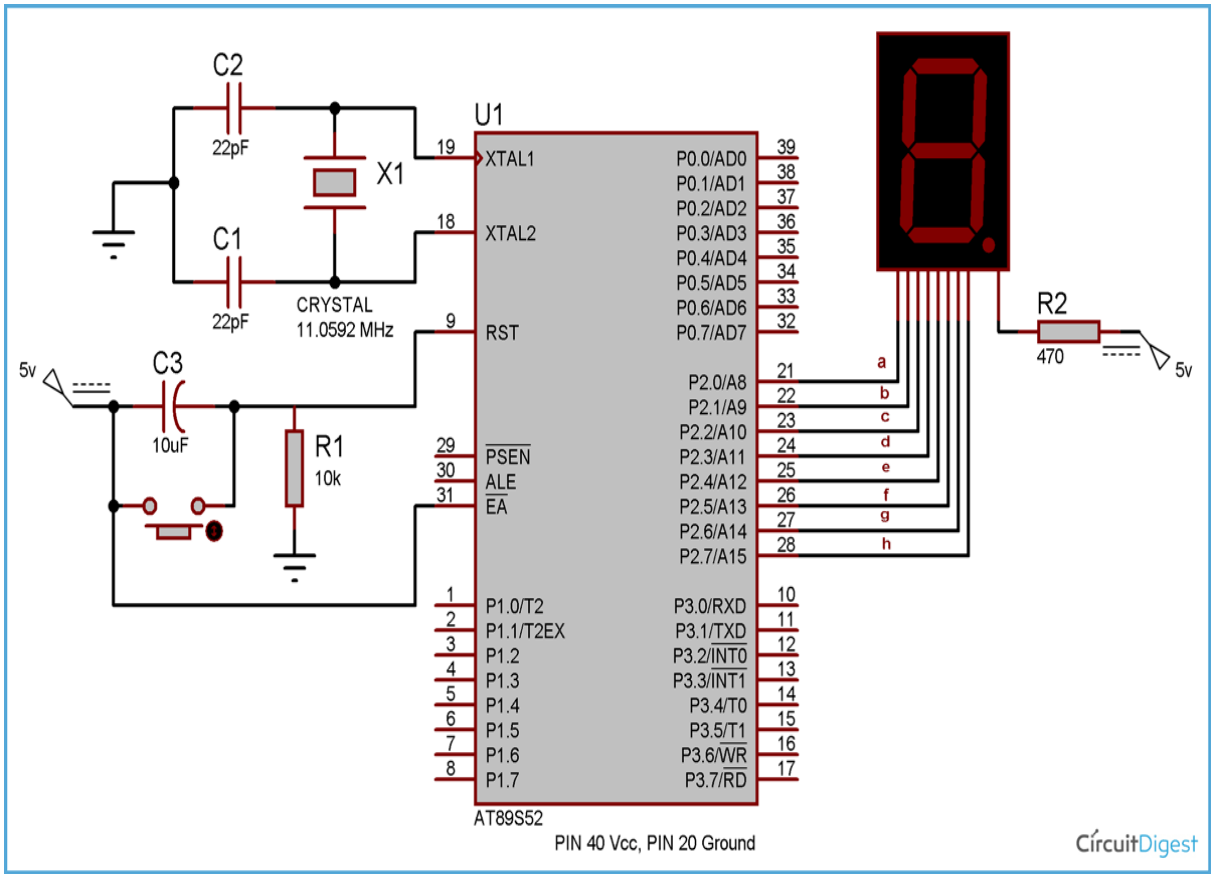

Figure. 3

IX. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1	Desktop PC with microcontroller simulation software	------	10	
2	8051 Development Board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display,PC keyboard interfacing facility, Hex keypad facility, single user cross,c-compiler,RS-232,USB, interfacing facility with built in power supply.	5	
3	7-segment LED Display	0.56 in 1-digit, common anode/common cathode	5	
4	Keil or smilar IDE	-------	For all PCs	

X. Precautions to be followed

1. For interfacing ensure the polarities of components and the pin configurations of ICs before connections.
2. Check the suitability of the power supply before connection.
3. The supply voltage to the IC should not exceed +5V.
4. Install the correct version of software (IDE) in PC.
5. Appropriate microcontroller IC should be selected from the predefined list.
6. Program should be saved with correct extension after creating a new project.

XI. Procedure

Student shall create project and write sample assembly language programusing Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in practical no. 10

Assembly language program:

Write an ALP to display decimal number from 0 to 9 by interfacing 7-segment display	**Comments** (Students should write comments)

ORG 0000H
LJMP 0050H
ORG 0BH
CLR TR0
CLR TF0
CLR A
MOVC A,@A+DPTR
MOV P0,A;
INC DPTR
INC R0	

MOV A,R0
CJNE A,#9H,CHK_CARY
CHK_CARY:JNC A_BIG
INC DPTR
INC R0
SJMP RETURN
A_BIG:MOV DPTR,#COD
MOV R0,#00
RETURN:
MOV TH0,#00H
MOV TH0,#00H
SETB TR0
RETI
ORG 50H
MOV P0,#00
MOV TMOD,#01H
MOV IE,#82H
MOV DPTR,#COD;
MOV TH0,#00H
MOV TL0,#00H
SETB TR0
HERE:SJMP HERE
ORG 100H
COD:DB
3FH,06H,5BH,4FH,66H,6DH,7CH,07H,7FH,67H
END	

Note: 7 Segments may display the numbers very fast one after theanother. The delay depends on crystal frequency.

Hardware interfacing procedure

- Connect the required hardware as per the connection diagram Fig. 3 and follow the steps below to write the program on 8051 microcontroller IC.
- Click on the ISP-Pgm icon on the pc, followng window will appear Fig. 4
- Click on the ‘open file’ in the window and select required Hex file from the proper location that has been created. Fig 5 & 6
- Click on the Open for the selected file. Fig 6
- Click on ‘write’ option and the selected Hex file will be copied on 8051 microcontroller IC. Fig 7
- See the output on the desired port of 8051 microcontroller kit.
- See the 7-segment display to displaying decimal numbers from 0 to 9.

Figure. 4

Figure. 5

Figure. 6

Figure. 7

XII. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII. Actual procedure followed

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XIV. Precautions followed

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XV. Observation:

Operation performed	Data stored in registers/Ports/memory locations for the operation	Result of the operation performed	Status of flags affected in PSW

XVI. Results (Are inclusive in the observations)

XVII. Interpretation of results

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XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Which type of seven segment display is used in the practical?
2. What is the mode of timer used in this program?
3. Draw Flowchart for the given program.

[Space for Answer]

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XIX References / Suggestions for Further Reading

Sr. No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice Gelispe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 97800705859591

XX Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No.17: Interface the given keyboard with 8051 and display the key pressed.

I. Practical Significance

Keypads are widely used input devices being used in various electronics and embedded projects. They are used to take inputs in the form of numbers and alphabets and feed the same into system for further processing. LED, Seven segment displays and LCDs can be interfaced to display the output in form of single digit, single character or alphanumeric character.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering problems.
- **Experiments and practice:** Plan to perform experiments and practices to use the results to solve broad-based Electrical engineering problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This practical is expected to develop the following skills for the industry identified competency ***'Use digital electronics and microcontroller based system.'***

1. Develop the program to interface LED using the port pins of 8051.
2. Ability to type, debug and execute the program by creating project in keil software.

IV. Relevant Course Outcome(s)

1. Write programs in assembly language for micro controllers.
2. Interface the memory and I/O devices to microcontrollers.

V. Practical Outcome

Interface the given keyboard with 8051 and display the key pressed.

VI. Relevant affective Domain related Outcomes

1. Follow safe practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical practices.

VII. Minimum Theoretical Background

Keyboards or keypads are used as primary input device for microcontroller. The keypad actually consist of a number of switches connected in matrix i.e. row and column arrangement. It is a multiple 'make 'and 'break' oscillations of contact during the key pressing, contact bounces results into a lot of noise as shown in figure1.a)

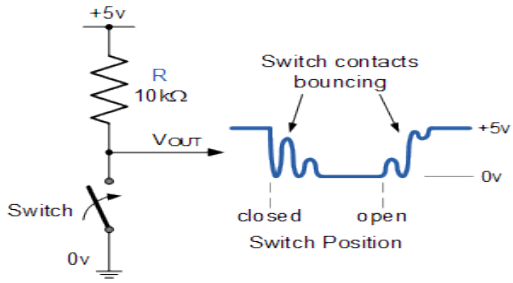


Figure 1 a) key pressed and depressed

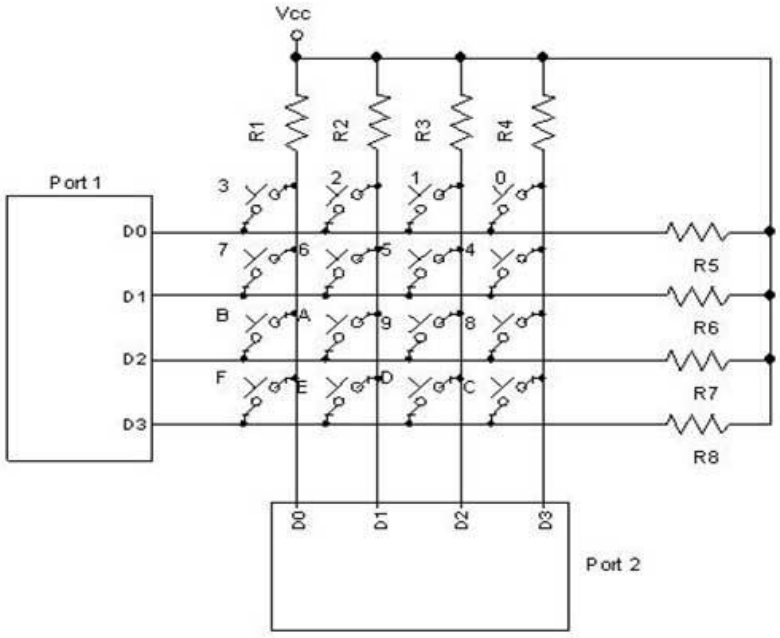


Figure 1b) 4X4 Matrix keyboard

Two ports are required to connect matrix keyboard. Rows are connected to an output and columns are connected to an input as shown in figure1.b)
8051 has 4 bidirectional I/O ports which can be used as input or output ports. LED s can be used as output devices to display the result obtained from the operation.

VIII. Interfacing diagram

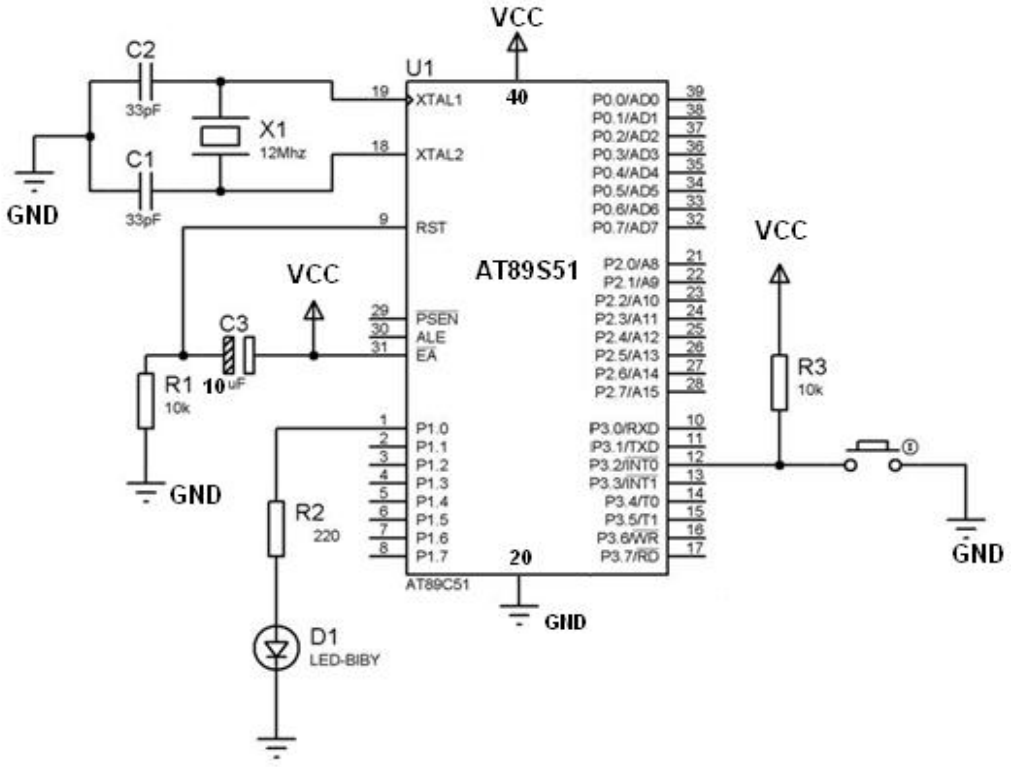
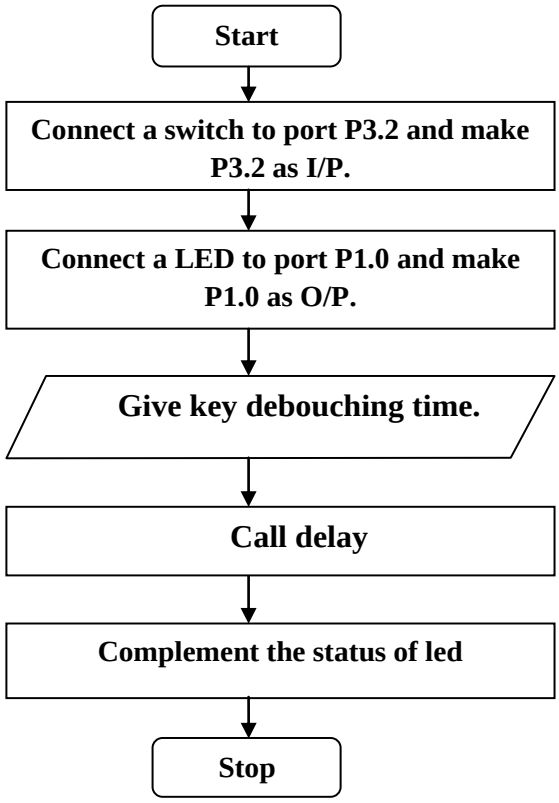


Figure 3. Interfacing of key switch at port 1 and LED on port 3

IX. Sample program

Problem statement: Write an ALP to turn on LED connected to P1.0. When the switch connected at P3.2 is pressed and turns OFF after some delay. Assume clock frequency to be 12MHz.	**Student activity : Write an ALP to turn on the 8 LEDs connected to P3 when the switch connected to P1.1 is pressed and turns OFF after some delay. Assume clock frequency to be 12MHz.**
Algorithm: 1. Connect a switch to Port P3.2 and make P3.2 as I/P. 2. Connect a LED to Port P1.0 and make P1.0 as O/P. 3. Give key debouching time. 4. Call delay 5. Complement the status of led 6. Repeat forever 7. Stop	**Algorithm:**

Flowchart:



Assembly language Program

Instructions	Comments	Instructions	Comments
SETB P3.2.	Set bit of Port 3.2		
CLR P1.0	Clear bit of Port 1.0		
HERE : JB P3.2,HERE	Jump if borrow		
ACALL DELAY	Call Delay		
CPL P1.0	Complement of Port P1.0		
SJMP HERE	Short jump to here		
DELAY: MOV R0,#0FFH	Load R0 by FFH		
L1 : MOV R1,#0FFH	LOAD R1 by FF		
L2 : DJNZ R1,L2	Decrement and jump if R1 not Zero		
DJNZ R0,L1	Decrement and jump if R0 not zero		
RET	Return		
END	stop		

X. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Desktop PC with microcontroller simulation software	_____	01
2	8051 Development board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back uP,16X4,16 X2, LCD display, PC keyboard interfacing facility, Hex keypad facility, single user cross c-comPiler,RS-232,USB, interfacing facility with built in Power supply.	01

XI. Precautions to be Followed

1. Ensure proper earthing to the equipment.
2. Ensure the power switch is in 'off' condition initially.
3. Ensure proper settings of trainer kit before use.

XII. Procedure

Steps for execute the program by Keil software:

Student shall create project and write sample assembly language programs using Keil or similar IDE. They should observe the execution and results of assembly language program by following the steps mentioned in Practical no. 10
Steps to burn the Program for external hardware in ROM memory of 8051:

- Connect the required hardware as per the connection diagram and follow the steps below to write the program on 8051 microcontroller IC.
- Click on the ISP-pgm icon on the PC followng window will appear.
- Click on the 'open file' in the window and select required Hex file from the proper location that has been created.
- Click on the Open for the selected file.
- Click on 'write' option and the selected Hex file will be copied on 8051 microcontroller IC.
- See the output on the desired port of 8051 microcontroller kit.

Figure. 1

Figure.2

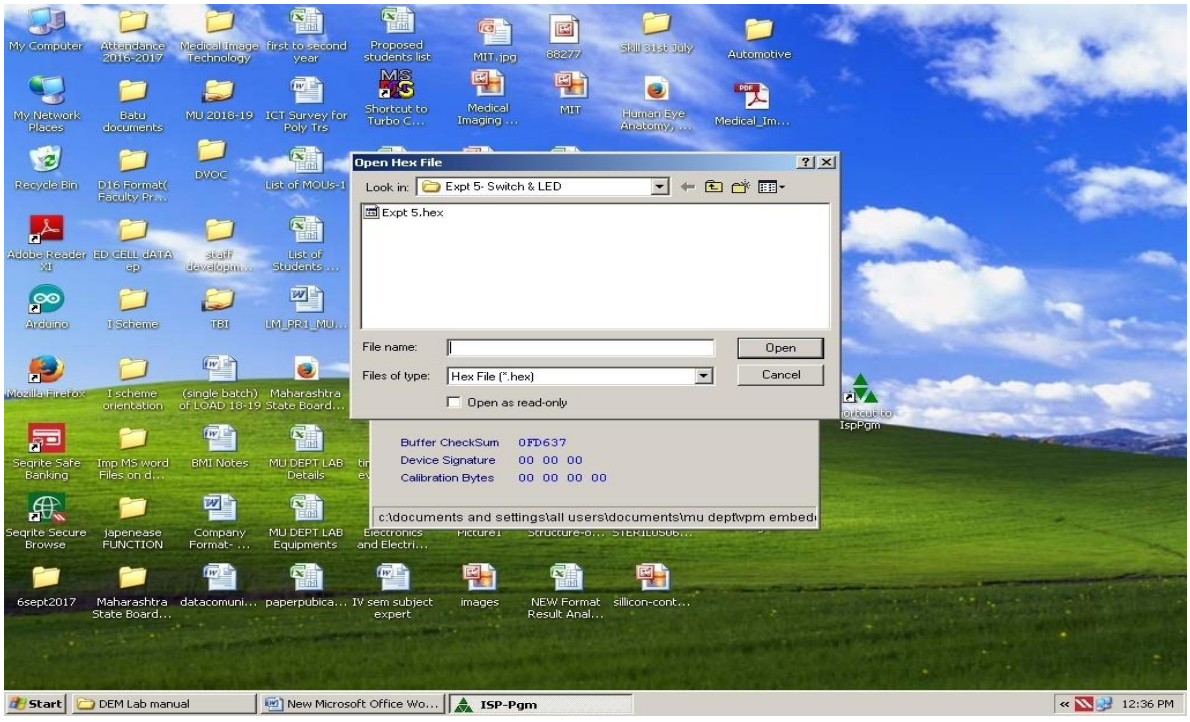


Figure.3

Figure. 4

XIII. Resources Used

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIV. Actual Procedure Followed (use blank sheet Provided if space not sufficient)

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XV. Precautions Followed

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XVI. Observations (use blank sheet Provided if space not sufficient)

Operation Performed	Data stored in register /memory location for the operation	Result of the operation Performed	Status of flags affected in PSW

XVII. Results (are inclusive in the observations)

XVIII. Interpretation of results

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XIX. Conclusions

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XX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. What do you understand by key debouncing?
2. Which Port is used as input which Port is used as output in this interfacing?

[Space for Answer]

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XXI. References / Suggestions for Further Reading

S.No.	Title of Book	Author	Publication
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2	Microcontroller PrinciPle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 9780070585959
4	Microcontroller Architecture Programming, Interfacing and System Design	Kamal, Raj	Pearson Education India, Delhi,2012, ISBN: 9788131759905

XXII. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
Total (25 Marks)		**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related (20)	**Product Related (05)**	**Total (25)**	

Practical No. 18 Interface LCD with 8051 Microcontroller to display the alphabets and decimal numbers.

I. Practical Significance

LCD (Liquid Crystal Display) is an alphanumeric display. It is available in various sizes. We use LCD display for displaying the messages in a more interactive way to operate the system or displaying error messages etc. The selection of LCD is based on application. Generally 16 X 2 LCD is widely used.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering Problems.
- **Experiments and Practice:** Plan to Perform experiments and Practices to use the results to solve broad-based Electrical engineering Problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This Practical is expected to develop the following skills for the industry identified Competency **'Use digital electronics and microcontroller based system'**

1. Learn to use simulation software for microcontroller Programming.

IV. Relevant Course Outcomes

1. Write programs in assembly language for microcontrollers.
2. Interface the memory and I/O devices to microcontrollers.

V. Practical Learning Outcome

Interface LCD with 8051 microcontroller to display the alphabets and decimal numbers.

VI. Affective domain outcomes

1. Follow safety practices.
2. Demonstrate working as a leader/a team member.
3. Maintain tools and equipment.
4. Follow ethical Practices.

VII. Minimum Theoretical Background

16 X 2 LCD is widely used in many practical applications. In 16 X2 LCD, 16 characters are displayed on two lines. It can be used in embedded Projects like digital voltmeter / ammeter, digital clock, home automation displays, status indicator display, digital code locks, digital speedometer/ odometer, display for music players etc.Using software, data on the display is controlled. LCD accepts only ASCII data. It consists of data register and command register. Data register holds the data to display. Commands in the command register control the display.

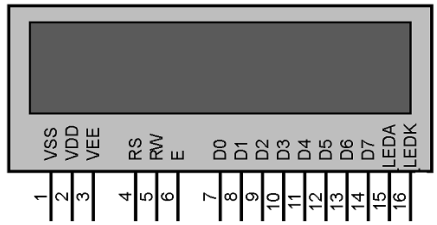


Figure 1 Pin Diagram of 16X 2 LCD display

Functions of RS, RW and E Pin of LCD:

Pin No.	Name	Function
1	**V_{SS}**	This pin must be connected to the ground
2	**V_{DD}**	Positive supply voltage Pin (5V DC)
3	**V_{EE}**	Contrast adjustment
4	**RS**	Register select, RS=1 Data Register, RS=0 command Register
5	**R/W**	Read or write R/W=1 Read, R/W= 0 Write
6	**E**	Enable
7	**D0**	Data
8	**D1**	Data
9	**D2**	Data
10	**D3**	Data
11	**D4**	Data
12	**D5**	Data
13	**D6**	Data
14	**D7**	Data
15	**LED_A**	Back light LED+
16	**LED_K**	Back light LED-

- RS (Register select)):- Logic level on this Pin selects either data register or command register. When it is high, data register is selected else command register is selected.
- RW (Read/Write):- This pin is used to control read or write operation. When logic level on this pin is low, Write operation is Performed else read operation.
- E (Enable):- A high to low pulse on this pin latches the data or command into the selected register.

LCD Instructions:

LCD instructions are used to configure LCD. An apropriate instruction is given to LCD on data bus. These instructions are latched into command register. The following table lists all the instructions for16 X2 LCD.

Code (Hex)	Instruction to command Register
01	Clear Display Screen
02	Return Home
04	Decrement curser(Shift cursor to left)
06	Increment curser(Shift cursor to right)
05	Shift display right
07	Shift display left
08	Display off, curser off
0A	Display off, curser on
0C	Display on, curser off
0E	Display on ,curser blinking

Code (Hex)	Instruction to command Register
0F	Display on ,curser blinking
10	Shift cursor Position to left
14	Shift curser Position to right
18	Shift the entire display to the left
1C	Shift the entire display to the right
80	Force cursor to beginning to 1st line
C0	Force curser to beginning to 2nd line
38	2 lines and 5*7 matrix (8 data lines)
28	2 lines and 5*7 matrix(uPPer 4 data lines)

VIII. Circuit diagram:

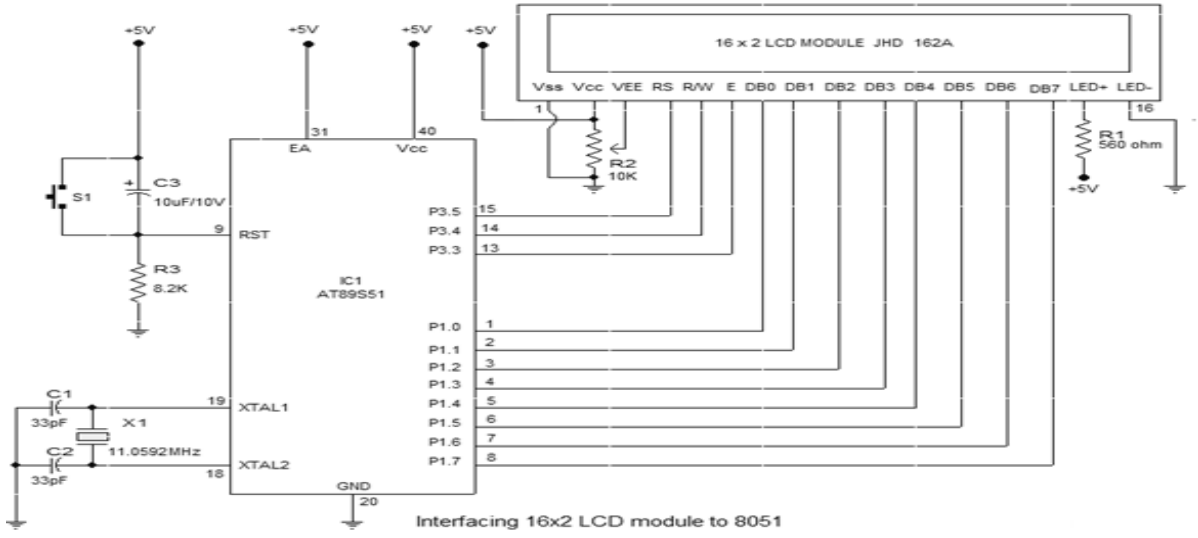


Figure. 2 Interfacing diagram of LCD with 8051

IX. Resources required

Sr. No.	Instrument /Object	Specification	Quantity	Remarks
1	Desktop PC with microcontroller simulation software		10	
2	8051 Development Board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery back up,16X4,16 X2, LCD display,PC keyboard interfacing facility, Hex keypad facility, single user cross,c-compiler,RS-232,USB, interfacing facility with built in Power supply.	5	
3	LCD Display	16X2PC keyboard interfacing facility, Hex keypad facility,	5	
4	Keil or similar IDE		For all PCs	

X. Precautions to be followed

1. For interfacing ensure the Polarities of components and the Pin configurations of ICs before connections.
2. Check the suitability of the Power supply before connection.
3. The supply voltage to the IC should not exceed +5V.
4. Install the correct version of software (IDE) in PC.
5. Appropriate microcontroller IC should be selected from the Predefined list.
6. Program should be saved with correct extension after creating a new Project.

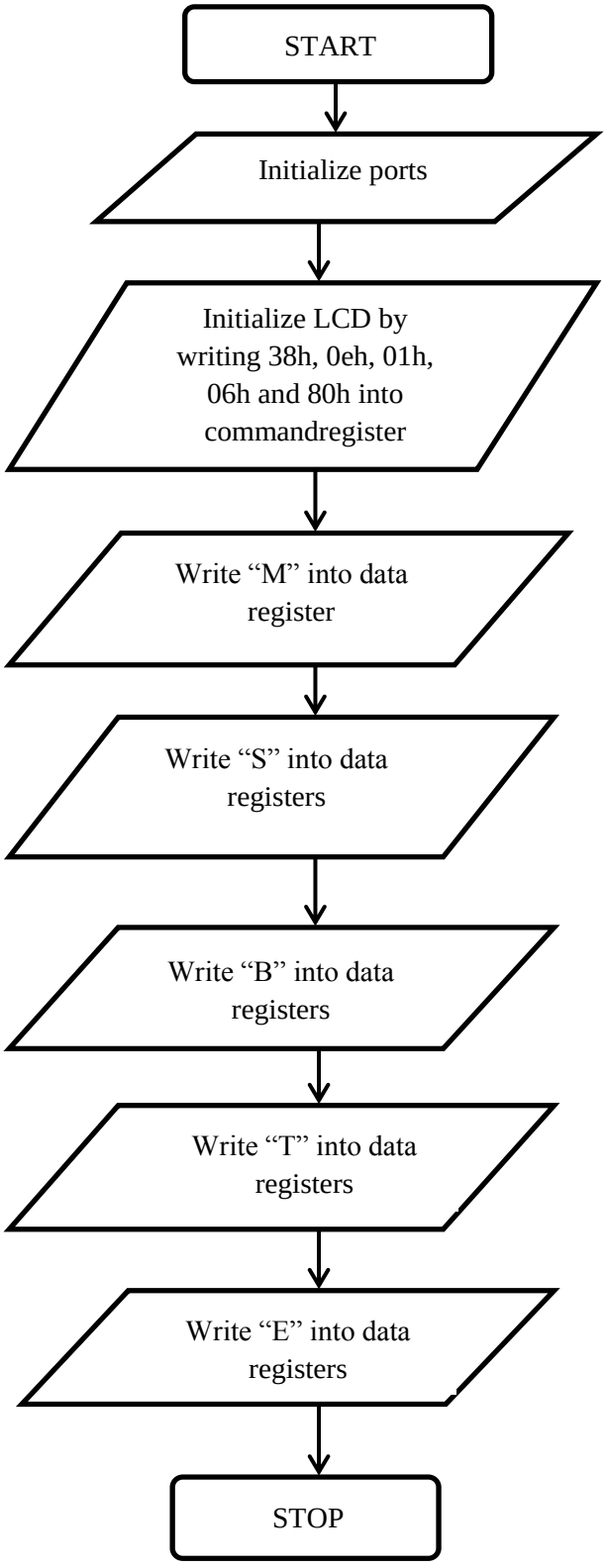
XI. Procedure

Student shall create Project and write sample assembly language Program using Keil or similar IDE. They should observe the execution and results of assembly language Program by following the steps mentioned in Practical no. 10

Assembly language Program:

Problem statement: Develop and execute ALP to display "MSBTE" on first line of LCD.	Student activity: Develop and execute C language Program to display "WELCOME" on first line and "2019" on second line of LCD.
Algorithm: 1. Declare Ports. 2. Write LCD commands 38h,0Eh,01h,06h into command register of LCD. 3. Select first line by writing 80h LCD command into command register of LCD 4. Write "M" into data register of LCD. 5. Write "S" into data register of LCD. 6. Write "B" into data register of LCD. 7. Write "T" into data register of LCD. 8. Write "E" into data register of LCD. Stop	

Flow Chart:


START
Initialize ports
Initialize LCD by writing 38h, 0eh, 01h, 06h and 80h into commandregister
Write “M” into data register
Write “S” into data registers
Write “B” into data registers
Write “T” into data registers
Write “E” into data registers
STOP

```
ORG 0000H    ;
MOV A, #38H    ; INITIATE LCD
ACALL COMMWRT    ;
ACALL DELAY    ;

MOV A, #0EH    ; DISPLAY ON CURSOR ON
ACALL COMMWRT    ;
ACALL DELAY    ;

MOV A, #01H    ; CLEAR LCD
ACALL COMMWRT    ;
ACALL DELAY    ;

MOV A, #84H    ; CURSOR AT LINE 1
POSITION 4
ACALL COMMWRT    ;
ACALL DELAY    ;

MOV A, #'M'    ; SEND ASCII DATA
ACALL DATAWRT    ;
ACALL DELAY    ;

MOV A, #'S'    ; SEND ASCII DATA
ACALL DATAWRT    ;
ACALL DELAY    ;

MOV A, #'B'    ; SEND ASCII DATA
ACALL DATAWRT    ;
ACALL DELAY    ;

MOV A, #'T'    ; SEND ASCII DATA
ACALL DATAWRT    ;
ACALL DELAY    ;

MOV A, #'E'    ; SEND ASCII DATA
ACALL DATAWRT    ;
ACALL DELAY

AGAIN :SJMP AGAIN    ;

COMMWRT:
MOV P1, A    ;
CLR P2.3    ; RS = 0 FOR COMMAND
REGISTER
CLR P2.4    ; R/W = 0 FOR WRITE
SETB P2.5    ; E = 1 FOR HIGH PULSE
ACALL DELAY    ;
CLR P2.5    ; E = 0 FOR LOW PULSE
RET
```

```
DATAWRT:
MOV P1, A    ;
SETB P2.3    ; RS = 1 FOR DATA REGISTER
CLR P2.4     ; R/W = 0 FOR WRITE
SETB P2.5    ; E = 1 FOR HIGH PULSE
ACALL DELAY    ;
CLR P2.5     ; E = 0 FOR LOW PULSE
RET

DELAY :
MOV R3, #50H ;
BACK:
MOV R4, #255H ;
HERE:
DJNZ R4, HERE ;
DJNZ R3, BACK ;
RET
END
```

Hardware interfacing Procedure

- Connect the required hardware as per the connection diagram Fig. 2 and follow the stePs below to write the program on 8051 microcontroller IC.
- Click on the ISP-Pgm icon on the Pc, followng window will aPPear Fig. 3
- Click on the 'open file' in the window and select required Hex file from the Proper location that has been created. Fig 4 & 5
- Click on the Open for the selected file. Fig 5
- Click on 'write' option and the selected Hex file will be copied on 8051 microcontroller IC. Fig 6
- See the output on the desired Port of 8051 microcontroller kit.
- See the LCD display, displaying the given alphanumeric data. Fig 7

Figure. 3

Figure. 4

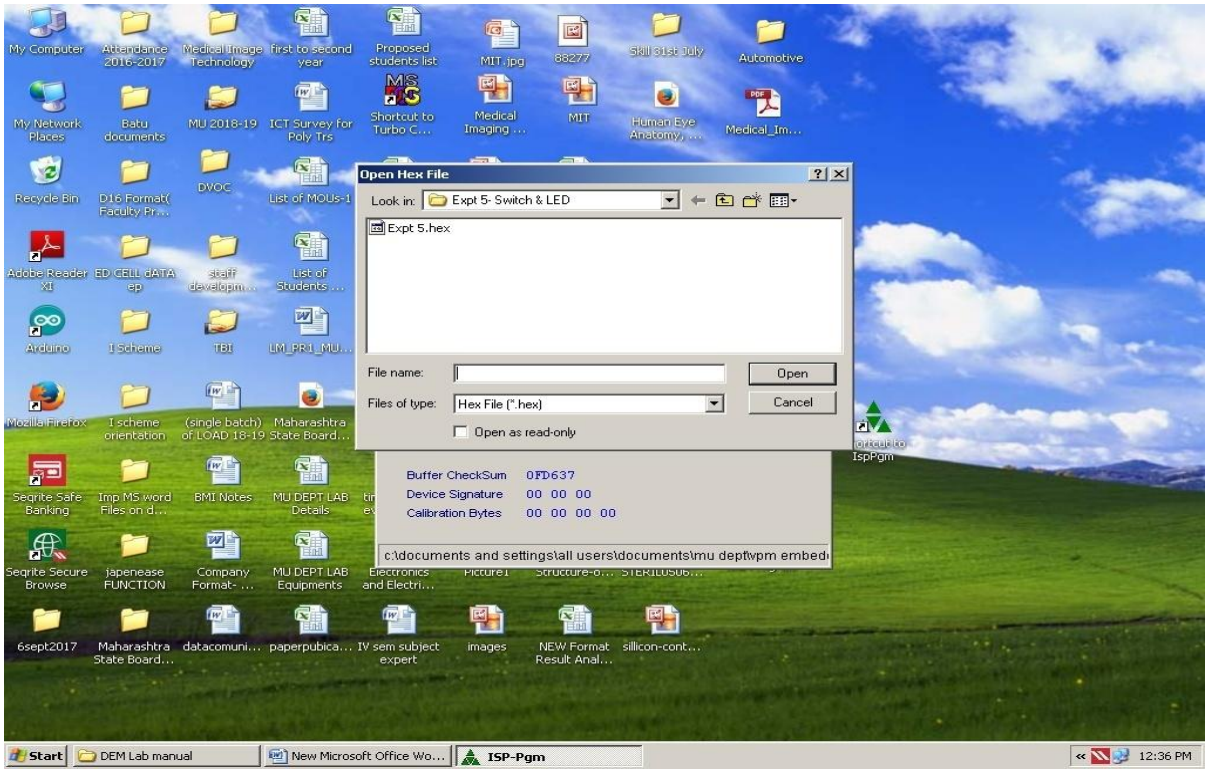


Figure. 5

Figure. 6

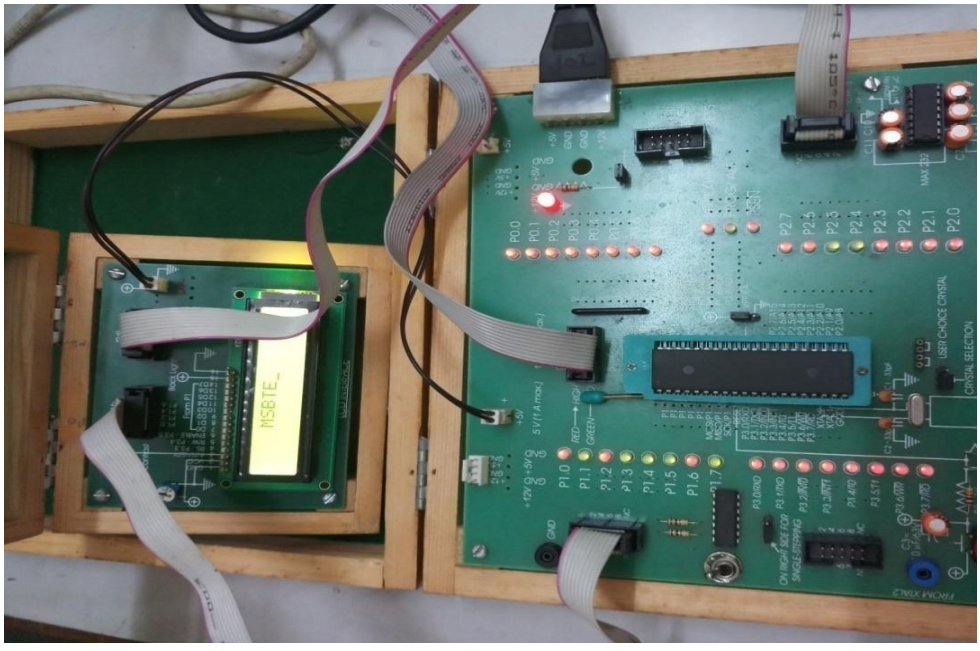


Figure.7

XII. Resources used (with major specifications)

S. No	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIII. Actual Procedure followed

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XIV. Precautions followed

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XV. Observations

Operation Performed	Data stored in registers/Ports/memory locations for the operation	Result of the operation Performed	Status of flags affected in PSW

XVI. Result(Are inclusive in the observations)

XVII. Interpretation of results

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XVIII. Conclusion

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XIX. Practical related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1) State the functions of RS, RW and E Pins.
2) How to display the message on 5^{th} column of first line.
3) How does LCD distinguish between data and command?

[Space for Answer]

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XX References / Suggestions for Further Reading

Sr. No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice GelisPe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Ajit Pal	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Ajay Deshmukh	McGraw Hill., New Delhi,2011, ISBN- 97800705859591

XXI Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. ……
2. ……
3. ……
4. ……

Marks Obtained			Dated signature of Teacher
Process Related(20)	**Product Related(05)**	**Total (25)**	

Practical No.19: Interface stepper motor and write ALP to rotate stepper motor in clockwise and anticlockwise direction at given angles.

I. Practical Significance

Stepper motors are widely used in industrial, medical, consumer electronics applications ie. Especially anywhere Precision rotation or Positioning of an object is needed, stepper motors are used along with a microcontroller.

II. Relevant Program Outcomes (POs)

- **Basic knowledge:** Apply knowledge of basic mathematics, sciences and basic engineering to solve the broad-based Electrical engineering Problems.
- **Experiments and Practice:** Plan to Perform experiments and Practices to use the results to solve broad-based Electrical engineering Problems.
- **Engineering tools:** Apply relevant Electrical technologies and tools with an understanding of the limitations.

III. Competency and Skills

This Practical is expected to develop the following skills for the industry identified competency '***Use digital electronics and microcontroller based systems.***'

1. Interfacing of stepper motor with 8051microcontroller.
2. Ability to develop an assembly language Program to rotate stepper motor in clockwise and anticlockwise direction.
3. Ability to generate delay by using counter, timer or interrupt.

IV. Relevant Course Outcome(s)

1. Write Programs in assembly language for micro controllers.
2. Interface the memory and I/O devices to microcontrollers.

V. Practical Outcome

Write an assembly language Program to interface a stepper motor with Port of 8051 and write a Program to rotate the motor in clockwise and anticlockwise direction

VI. Relevant affective Domain related Outcomes

1. Follow safe Practices
2. Demonstrate working as a leader or a team member.
3. Maintain tools and equipment.
4. Follow ethical Practices.

VII. Minimum Theoretical Background

Stepper motor is a brushless motor which converts electrical Pulses into mechanical rotation. As the name indicates it rotates insteps according to the input Pulses. A stepper motor usually have a number of field coils(Phases) and a toothed rotor (as shown in Figure1).

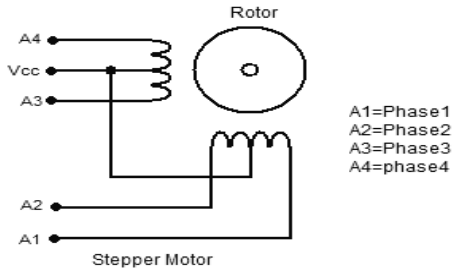


Figure 1 Windings of a stePPer motor

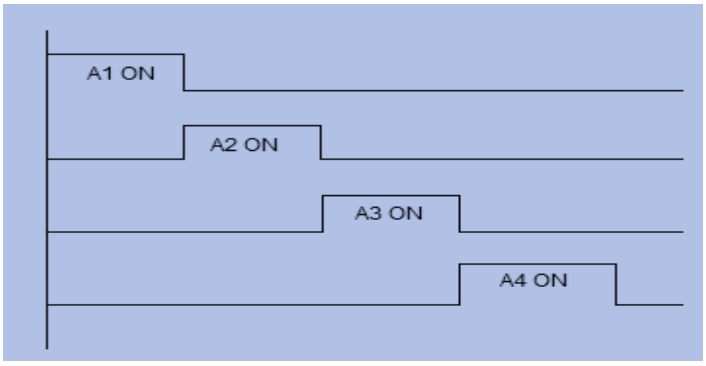


Figure 2 Timing of a stepper motor

The step size of the motor is determined by the number of phases and number of teeth on the rotor. Step size is the angular displacement of the rotor in one step. For. example, if a stepper motor has 4 Phases and 50th teeth, it takes 50*4 =200 steps to make one complete rotation. So step angle will be 360/200=1.8°.

VIII. Interfacing diagram

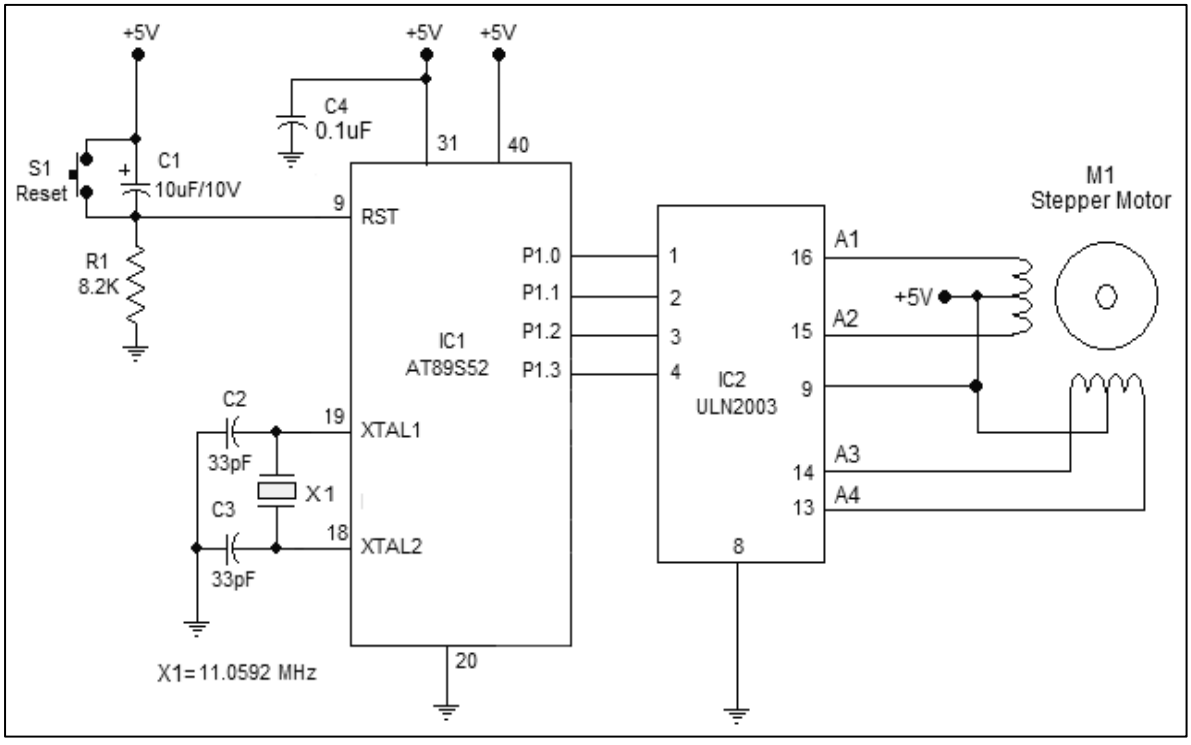
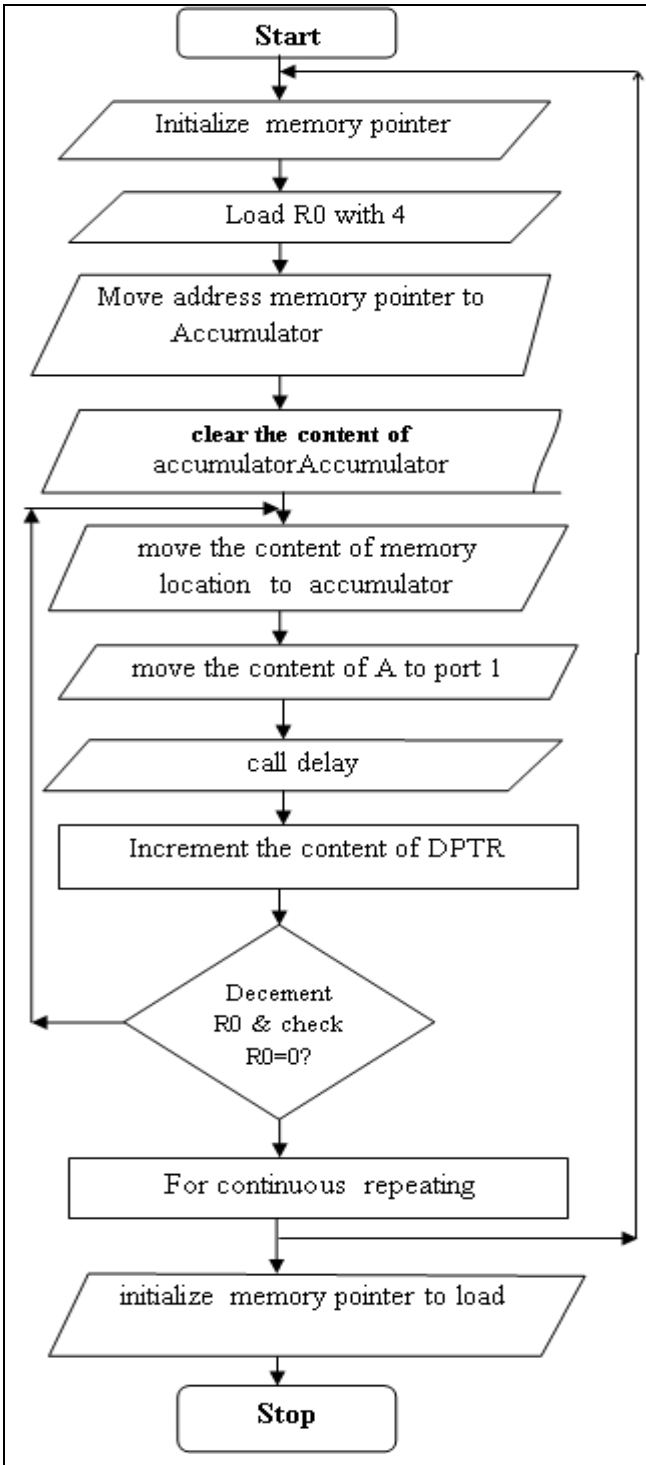


Figure 3 Interfacing diagram of stepper motor with 8051 through ULN2003

IX. Sample Program

Problem statement: Write an ALP for rotating stepper motor in clockwise direction in 4 step sequence	**Student Activity:** Write an ALP for rotating stepper motor in anti-clockwise direction in 4 step sequence
Algorithm: Step 1 : Initialize memory Pointer Step 2 : load R0 by 4 Step 3 : move address memory Pointer to Accumulator Step 4 : clear the content of accumulator Step 5 : move the content of memory location to accumulator Step 6 : move the content of A to Port 1 Step 7 : call delay Step 8 : Increment the content of DPTR Step 9 : decrement the content of R0 and repeat the Procedure upto content of R0 becomes zero go to step 5 Step10 : go to step no1 Step 11: initialize memory Pointer to load step sequence Step12: End	


Start
Initialize memory pointer
Load R0 with 4
Move address memory pointer to Accumulator
clear the content of accumulatorAccumulator
move the content of memory location to accumulator
move the content of A to port 1
call delay
Increment the content of DPTR
Decement R0 & check R0=0?
For continuous repeating
initialize memory pointer to load
Stop

Assembly language Program:

Instructions	Comments	Instructions	Comments
ORG 0000H	Initialize memory Pointer		
START: MOV R0,#04	Load R0 by 4		
MOV DPTR,#0100H	Move address memory Pointer to accumulator		
CLR A	Clear content of accumulator		
RPT : MOVC A,@A+DPTR	Move the content of memory location to accumulator		
MOV P1,A	Pass the content of A to Port 1		
ACALL Delay	Call delay		
INC DPTR	Increment the content of DPTR		
DJNZ R0,RPT	Decrement the content of R0 and repeat Procedure upto content of R0 becomes zero		
SJMP START	Go to step no1		
ORG 0100H	Initialize memory Pointer		
DB8,4,2,1	To load step sequence		
END	Stop		

X. Resources Required

S. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Desktop PC with microcontroller simulation software	_____	01
2	8051 Development board	Microcontroller kit :-single board systems with 8K RAM,ROM memory with battery backup,16X4,16 X2, LCD display,PC keyboard interfacing facility, Hex keypad facility, single user cross c-compiler,RS-232,USB, interfacing facility with built in Power supply.	01
3	Stepper motor	Stepper Motor, 50/100 RPM	01

XI. Precautions to be Followed

Stepper motor should be handled carefully, it should not run beyond its rated speed.

XII. Procedure

Steps to execute the Program by Keil software:

Student shall create Project and write sample assembly language Programs using Keil or similar IDE. They should observe the execution and results of assembly language Program by following the steps mentioned in Practical no. 10
Steps to burn the Program for external hardware in ROM memory of 8051:

- Connect the required hardware as per the connection diagram and follow the stePs below to write the Program on 8051 microcontroller IC.
- Click on the ISP-Pgm icon on the Pc followng window will appear
- Click on the 'open file' in the window and select required Hex file from the proper location that has been created.
- Click on the Open for the selected file.
- Click on 'write' option and the selected Hex file will be copied on 8051 microcontroller IC.
- See the output on the desired Port of 8051 microcontroller kit.

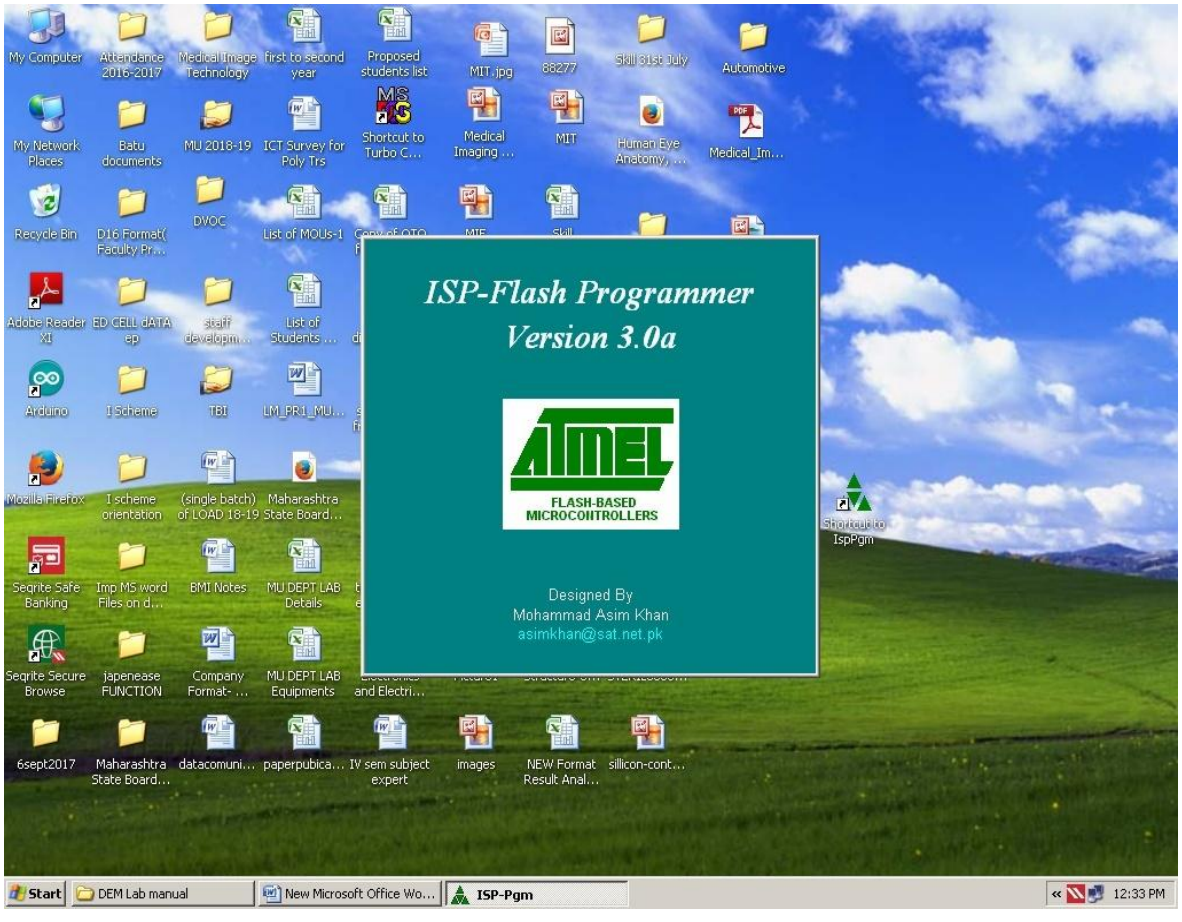


Figure.1

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Figure.2

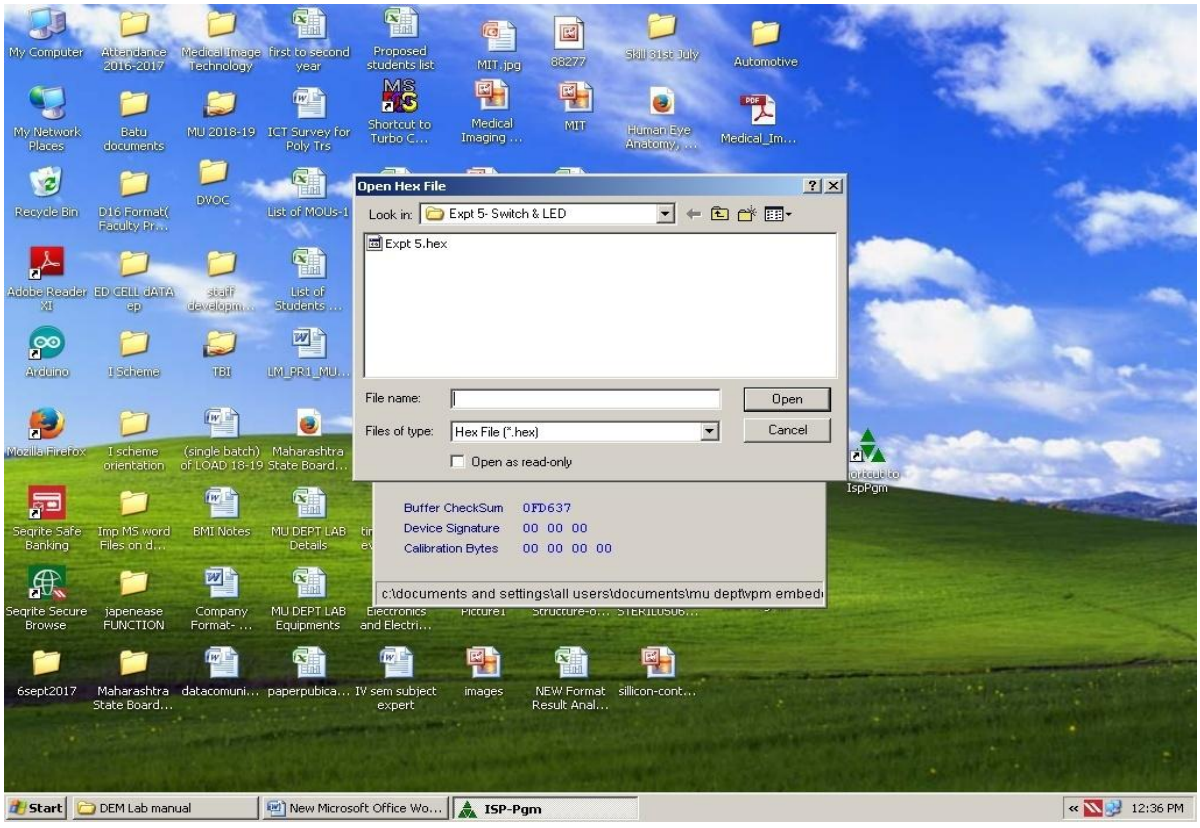

Figure.3

Figure. 4

XIII. Resources Used

S. No.	Name of Resource	Broad Specifications		Quantity	Remarks (If any)
		Make	Details		
1.					
2.					
3.					
4.					

XIV. Actual Procedure Followed (use blank sheet Provided if space not sufficient)

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XV. Precautions Followed

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XVI. Observations (use blank sheet Provided if space not sufficient)

Operation Performed	Data stored in register /memory location for the operation	Result of the operation Performed	Status of flags affected in PSW

XVII. Results (Are inclusive in the observations)

XVIII. Interpretation of Results

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XIX. Conclusions (Actions/decisions to be taken based on the interpretation of results).

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XX. Practical Related Questions

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO.

1. Give the specifications of the stepper motor used in the experiment.
2. What is the function of ULN2003 driver in interfacing of stepper motor?

[Space for Answer]

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XXI. References / Suggestions for Further Reading

S, No.	Title of Book	Author	Publication
1	The 8051 Microcontroller and Embedded system	Mazidi, Mohmad Ali; Mazidi, Janice GelisPe; MckinlayRoline D.	Pearson Education, Delhi,2008, ISBN 978-8177589030
2	Microcontroller Principle and Application	Pal, Ajit	PHI Learning,New Delhi,2014, ISBN13: 978-81-203-4392-4
3	Microcontroller Theory and Application	Deshmukh, Ajay	McGraw Hill., New Delhi,2011, ISBN- 9780070585959
4	Microcontroller Architecture Programming, Interfacing and System Design	Kamal, Raj	Pearson Education India, Delhi,2012, ISBN: 9788131759905

XXII. Assessment Scheme

Performance Indicators		Weightage %
Process Related (15)		**60%**
1	Program writing	20 %
2	Proper Execution of the program	20 %
3	Observations and conclusions	20 %
Product Related (10)		**40%**
4	Answer to given questions	20 %
5	Timely submission	20 %
	Total (25 Marks)	**100%**

Names of Student Team Members

1. …….
2. …….
3. …….
4. …….

Marks Obtained			Dated signature of Teacher
Process Related(15)	**Product Related(10)**	**Total (25)**	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101W
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics Engineering	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	C Language programming	22218
15	Basic Electronics	22225
16	Programming in C	22226
17	Fundamental of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
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17	Principles Of Database	22321
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19	Electrical Circuits	22324
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26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

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1	Hydraulics	22401
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3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemical	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
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10	Electric Motors And Transformers	22418
11	Industrial Measurement	22420
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13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048
20	Micro Project & Industrial Training Assessment Manual	22049

Fifth Semester:

1	Network Management & Administration	17061
2	Solid Modeling	17063
3	CNC Machines	17064
4	Behavioral Science(Hand Book)	17075
5	Behavioral Science (Assignment Book)	17075
6	Windows Programming using VC++	17076
7	Estimation and Costing	17501
8	Public Health Engineering	17503
9	Concrete Technology	17504
10	Design of Steel Structures	17505
11	Switchgear and Protection	17508
12	Microprocessor & Application	17509
13	A.C. Machines	17511
14	Operating System	17512
15	Java Programming	17515
16	System Programming	17517
17	Communication Technology	17519
18	Hydraulic & Pneumatics	17522
19	Advanced Automobile Engines	17523
20	Basic Electrical & Electronics	17524
21	Measurement and Control	17528
22	Power Engineering	17529
23	Metrology & Quality Control	17530
24	Computer Hardware & Networking	17533
25	Microcontroller	17534
26	Digital Communication	17535
27	Control System & PLC	17536
28	Audio Video Engineering	17537
29	Control System	17538
30	Industrial Electronics and applications	17541
31	Heat Transfer Operations	17560
32	Chemical Process Instrumentation & control	17561

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
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13	Testing & Maintenance of Electrical Equipments	17637
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18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
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Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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