VOLTBOOK / GTU DIPLOMA ELECTRICAL

Microcontroller and Its Applications

DETAILED OUTCOME-BASED PRACTICAL MANUAL

COURSE CODE	SEMESTER	PRACTICALS	EFFECTIVE FROM
DI04000171	4	17	2025-26

Prepared from the Suggested Course Practical List in the current GTU DI-series syllabus, effective 2025-26.

The organization follows the familiar outcome-based pattern used in legacy DTE laboratory manuals. All instructional text is independently written for this edition. This is not an official GTU, DTE or CTE publication.

Student name: _____

Enrollment no.: _____ Batch: _____

Institute: _____

UNIVERSITY-DRAFTED FIGURE EDITION 6.0 / 20 JULY 2026

Certificate

This is to certify that _____, enrollment number _____, has satisfactorily completed the prescribed practical work for Microcontroller and Its Applications (DI04000171) during the academic term _____ under the supervision of the department.

Laboratory faculty	Head of department	Principal
Signature and date	Signature and date	Signature and date

Preface

This manual turns the current syllabus practical list into a usable student record. Each practical includes an original experiment-specific vector diagram and is arranged from objective and outcomes through prerequisite theory, setup, resources, safety, procedure, observations, interpretation, questions, references and a 25-mark assessment rubric.

Students should complete pre-lab preparation before the session and record actual readings during the session. Faculty may adapt component values, instrument ranges, software versions and local assessment requirements without changing the intended practical outcome.

Diagram drafting benchmarks were reviewed from Aurora's Electrical Circuits and Simulation manual, MITS Electronic Devices and Circuits manual, Sree Vahini's Electrical Measurements manual, and MSBTE Electrical Estimating and Contracting practice. Edition 6.0 applies stricter university drafting: complete current paths, IEC-style junctions and terminals, protection, instrument coils, test points, load terminals and measurement notes. Every figure is newly drawn and aligned to the current GTU practical title.

Official syllabus reference

Open the referenced GTU syllabus PDF

Programme outcomes and course outcomes

Programme outcomes

Code	Outcome
PO1	Basic and discipline-specific knowledge: apply mathematics, science and engineering fundamentals.
PO2	Problem analysis: identify and analyze well-defined engineering problems using standard methods.
PO3	Design/development of solutions: develop solutions for well-defined technical problems.
PO4	Engineering tools, experimentation and testing: use modern tools and interpret test results.
PO5	Engineering practices for society, sustainability and environment: apply safe and responsible practice.
PO6	Project management: apply engineering management principles individually and in teams.
PO7	Lifelong learning: recognize the need for independent learning in changing technology.

Course competency

Develop, interface and test 8051-based programs for electrical control applications.

Course outcomes

CO	Course outcome
CO1	Describe 8051 architecture and its functional components.
CO2	Create Embedded C programs for basic arithmetic and control operations.
CO3	Implement timers, counters and interrupt-based logic.
CO4	Interface LEDs, displays, motors, buzzers and other peripherals.
CO5	Design and verify real-time 8051 applications.

Practical outcome to course outcome matrix

The mapping below is for learning guidance. Faculty should use the assessment scheme prescribed by the institute.

No.	Suggested practical	Mapped CO
1	Write a program to add two numbers and display the result at Port 1	CO2
2	Write a program to subtract two numbers and display the result at Port 0	CO2
3	Write a program to multiply two numbers and display the result at Port 2	CO2
4	Write a program to divide two numbers and display the result at Port 3	CO2
5	Write a C program to blink an LED connected to Port 1 continuously with delay	CO2
6	Read a switch and turn an LED ON or OFF accordingly	CO4
7	Blink multiple LEDs with different delays using a while loop	CO4
8	Display numbers 0 to 9 on a seven-segment display	CO4
9	Interface a 16x2 LCD and display WELCOME	CO4
10	Generate a one-second delay using Timer0 Mode 1 and toggle an LED	CO3
11	Generate a 1 kHz square wave using Timer1 and observe it on DSO or logic analyzer	CO3
12	Interface a buzzer and control it from an input condition	CO4
13	Read a switch and control an LED through a port-interface routine	CO4
14	Interface a DC motor through L293D and run it forward and reverse	CO4
15	Interface a stepper motor with an 8051 microcontroller	CO4
16	Create software PWM using loops and delays and observe it on DSO	CO5
17	Interface an 8-bit DAC with an 8051 microcontroller	CO5

Industry skills and laboratory guidance

Industry-relevant skills

- Embedded C project creation and debugging
- 8051 port and timer configuration
- Safe peripheral interfacing
- Simulation, hardware verification and test-case documentation

Guidelines for instructors

1. Confirm the practical outcome, risk controls, apparatus readiness and emergency arrangements before the session.
2. Demonstrate only the critical connection, software or measurement steps; require students to reason through the remaining work.
3. Check circuit polarity, earthing, isolation, ranges and ratings before energization.
4. Assess both process and result. Give credit for safe practice, honest data, teamwork and technically sound interpretation.
5. Adapt values and equipment to local facilities while preserving the mapped course outcome.

Instructions for students

1. Read the practical, write the prediction and prepare the setup before entering the laboratory.
2. Record instrument identification, range, least count and component ratings before use.
3. Enter raw readings directly with units. Strike through errors once; do not erase or fabricate data.
4. Switch OFF and verify isolation before changing a connection. Report damage, heating, smell or unstable readings immediately.
5. Attach graphs, code listings, drawings, estimates and technical evidence behind the relevant practical.

Progressive assessment rubric

Each practical is assessed out of 25 marks. The practical-specific rubric repeats at the end of every experiment.

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Suggested interpretation

Total	Level	Interpretation
21-25	Excellent	Independent, accurate, safe and well interpreted
16-20	Good	Sound performance with minor correction
11-15	Satisfactory	Outcome achieved with guidance
0-10	Needs improvement	Repeat preparation or practical work as directed

Safety acknowledgement

I understand that institute rules and faculty instructions take priority over this manual. I will not energize, modify or touch a circuit without authorization.

Student signature and date	Faculty signature and date

Continuous assessment record

Practical	Date	Marks /25	Faculty initials
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
TOTAL		/425	

Experiment index

PRACTICAL 01

Write a program to add two numbers and display the result at Port 1

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Write a program to add two numbers and display the result at Port 1.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO2: Create Embedded C programs for basic arithmetic and control operations.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

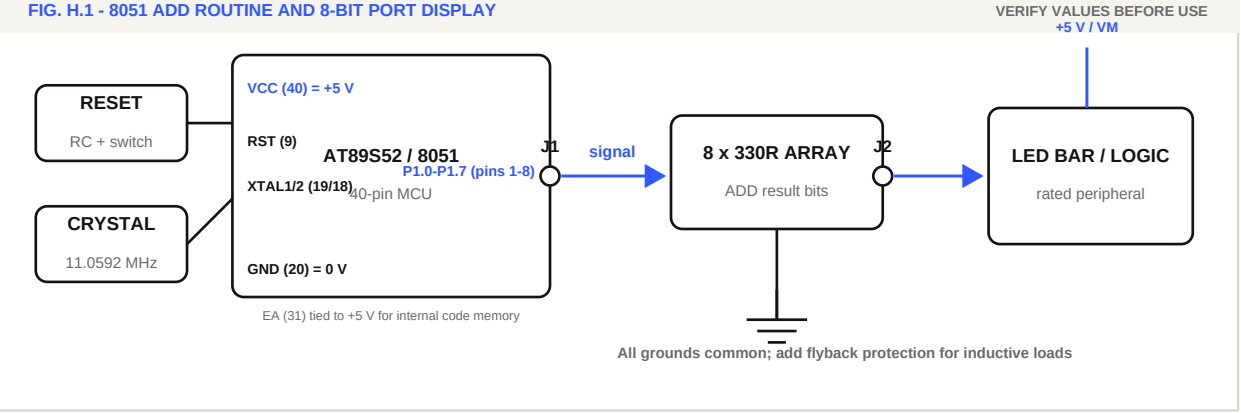
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.1 - 8051 ADD ROUTINE AND 8-BIT PORT DISPLAY



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Write a program to add two numbers and display the result at Port 1'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 02

Write a program to subtract two numbers and display the result at Port 0

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Write a program to subtract two numbers and display the result at Port 0.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO2: Create Embedded C programs for basic arithmetic and control operations.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

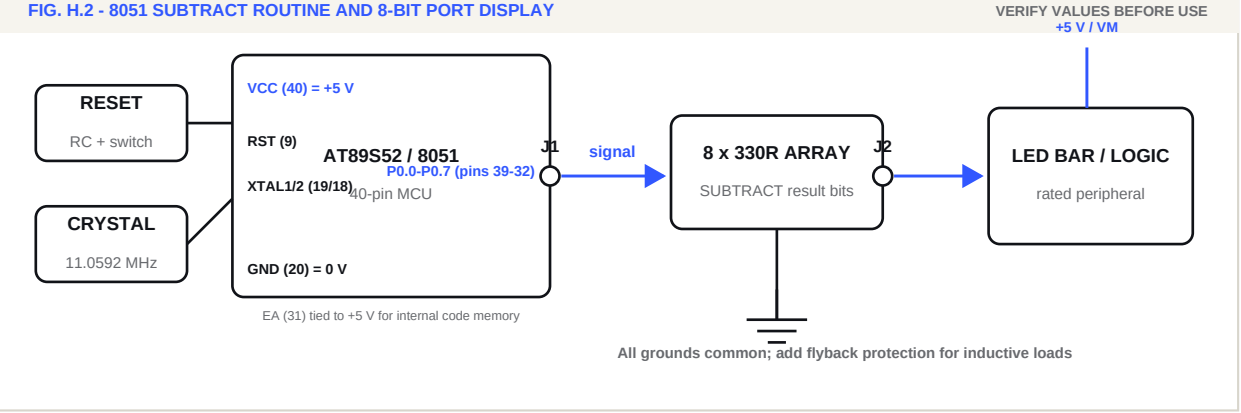
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.2 - 8051 SUBTRACT ROUTINE AND 8-BIT PORT DISPLAY



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Write a program to subtract two numbers and display the result at Port 0'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 03

Write a program to multiply two numbers and display the result at Port 2

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Write a program to multiply two numbers and display the result at Port 2.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO2: Create Embedded C programs for basic arithmetic and control operations.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

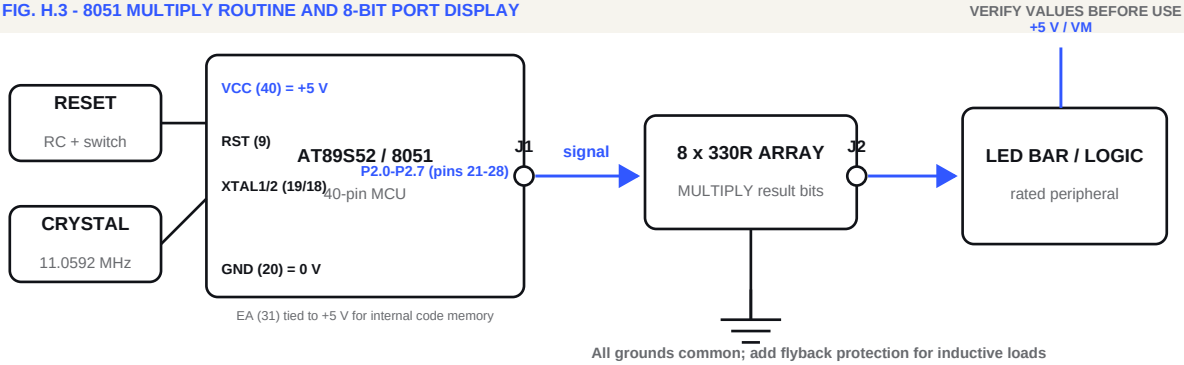
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.3 - 8051 MULTIPLY ROUTINE AND 8-BIT PORT DISPLAY



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Write a program to multiply two numbers and display the result at Port 2'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 04

Write a program to divide two numbers and display the result at Port 3

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Write a program to divide two numbers and display the result at Port 3.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO2: Create Embedded C programs for basic arithmetic and control operations.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

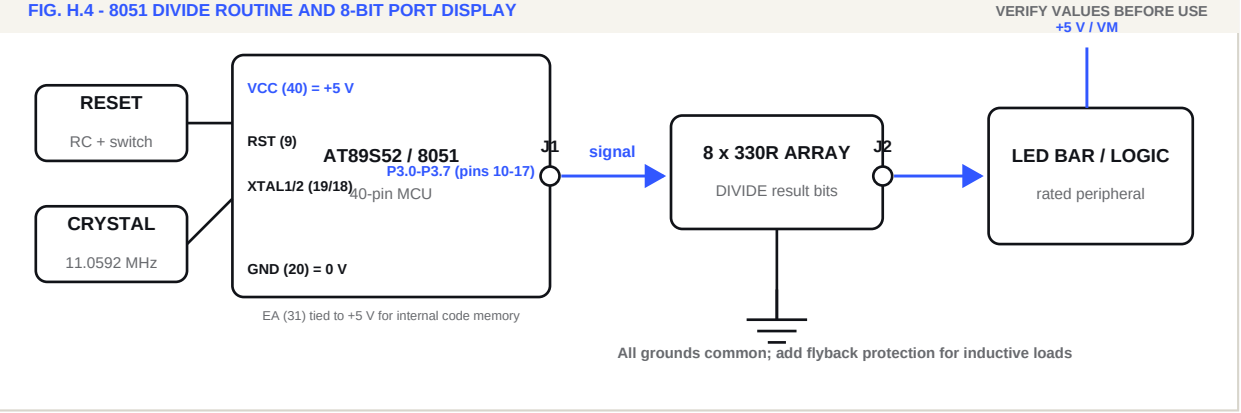
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.4 - 8051 DIVIDE ROUTINE AND 8-BIT PORT DISPLAY



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Write a program to divide two numbers and display the result at Port 3'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
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Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 05

Write a C program to blink an LED connected to Port 1 continuously with delay

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Write a C program to blink an LED connected to Port 1 continuously with delay.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO2: Create Embedded C programs for basic arithmetic and control operations.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

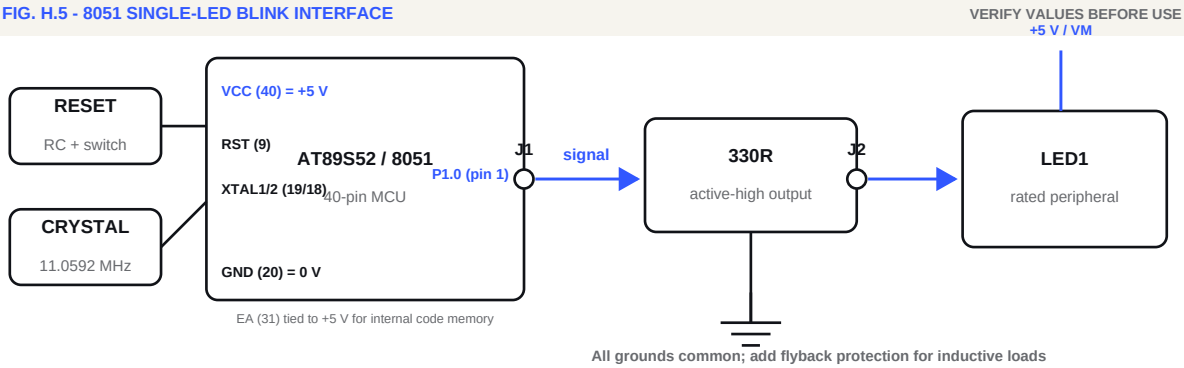
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.5 - 8051 SINGLE-LED BLINK INTERFACE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Write a C program to blink an LED connected to Port 1 continuously with delay'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 06

Read a switch and turn an LED ON or OFF accordingly

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Read a switch and turn an LED ON or OFF accordingly.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

Key relations / checks

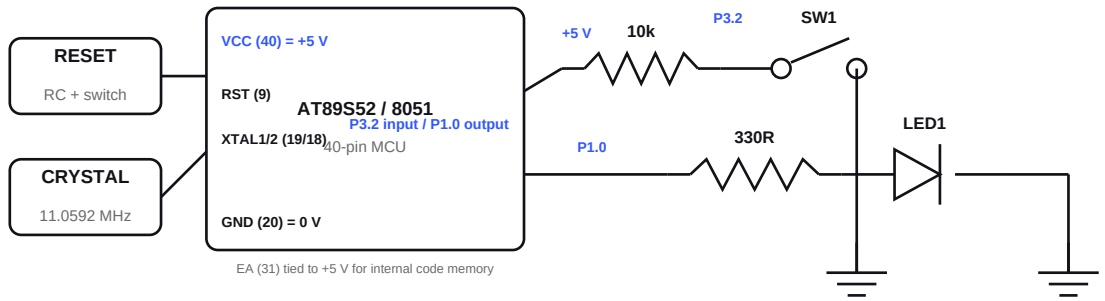
- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.6 - 8051 SWITCH INPUT AND LED OUTPUT WITH PULL-UP

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Read a switch and turn an LED ON or OFF accordingly'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 07

Blink multiple LEDs with different delays using a while loop

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Blink multiple LEDs with different delays using a while loop.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

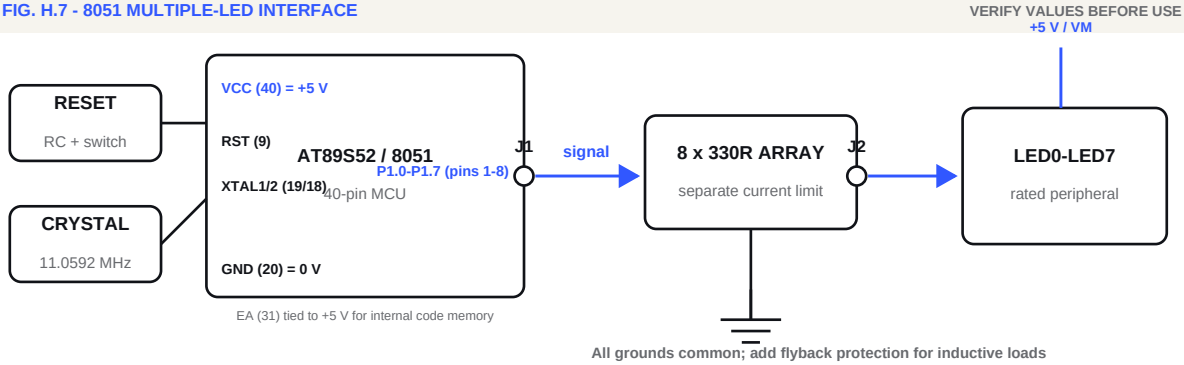
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.7 - 8051 MULTIPLE-LED INTERFACE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Blink multiple LEDs with different delays using a while loop'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 08

Display numbers 0 to 9 on a seven-segment display

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Display numbers 0 to 9 on a seven-segment display.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

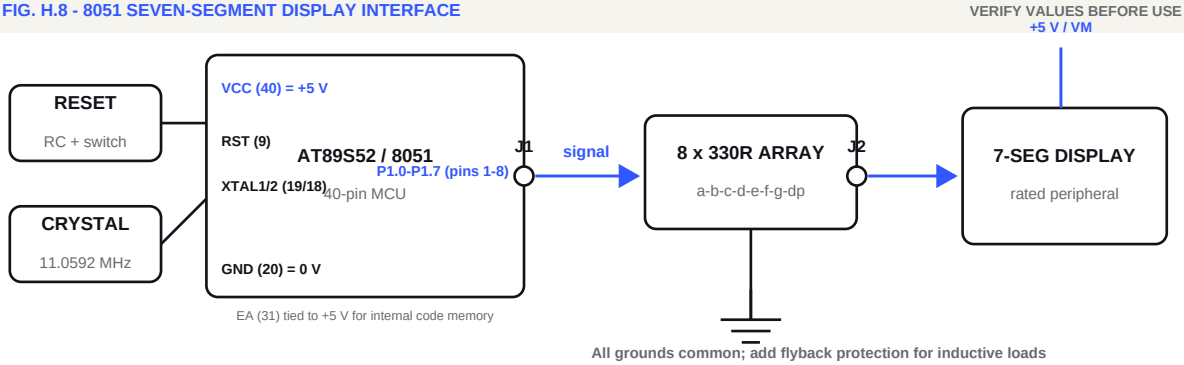
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.8 - 8051 SEVEN-SEGMENT DISPLAY INTERFACE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Display numbers 0 to 9 on a seven-segment display'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 09

Interface a 16x2 LCD and display WELCOME

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Interface a 16x2 LCD and display WELCOME.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

Key relations / checks

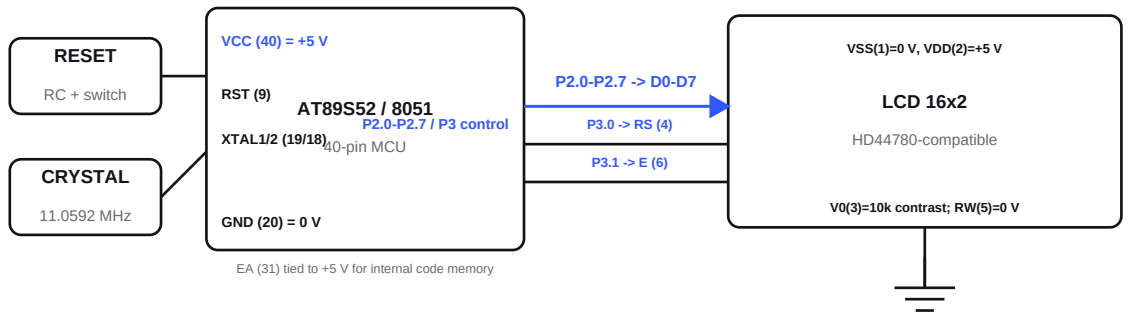
- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.9 - 8051 TO 16X2 LCD INTERFACE IN 8-BIT MODE

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Interface a 16x2 LCD and display WELCOME'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 10

Generate a one-second delay using Timer0 Mode 1 and toggle an LED

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Generate a one-second delay using Timer0 Mode 1 and toggle an LED.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO3: Implement timers, counters and interrupt-based logic.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

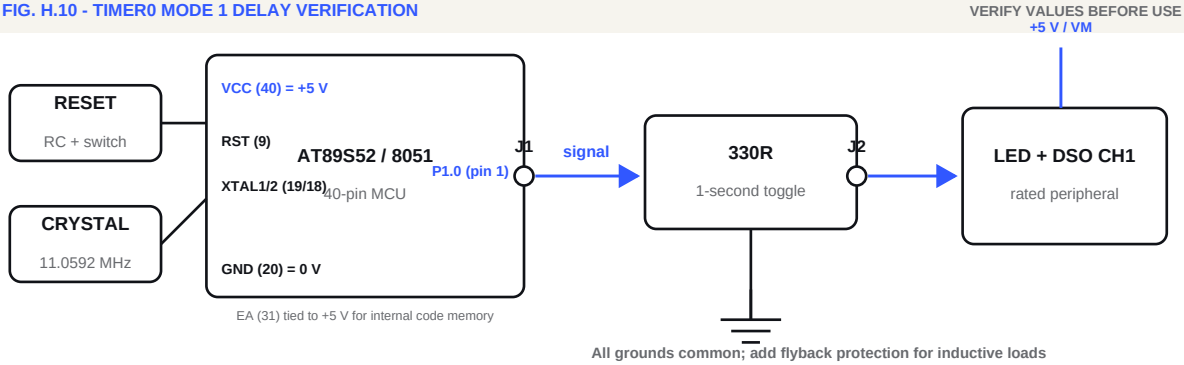
Key relations / checks

- Machine-cycle period depends on oscillator and core architecture
- Timer preload = maximum count - required counts
- Verify timing with DSO or logic analyzer

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.10 - TIMER0 MODE 1 DELAY VERIFICATION



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Generate a one-second delay using Timer0 Mode 1 and toggle an LED'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 11

Generate a 1 kHz square wave using Timer1 and observe it on DSO or logic analyzer

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Generate a 1 kHz square wave using Timer1 and observe it on DSO or logic analyzer.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO3: Implement timers, counters and interrupt-based logic.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

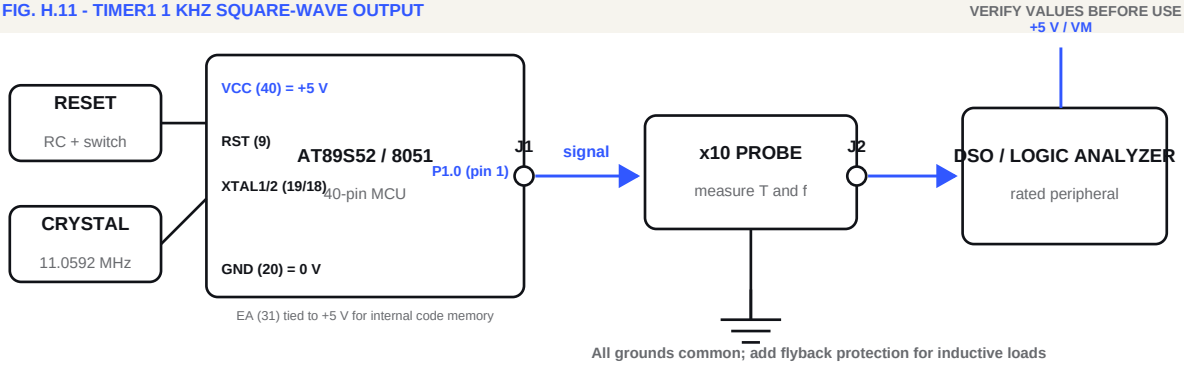
Key relations / checks

- Machine-cycle period depends on oscillator and core architecture
- Timer preload = maximum count - required counts
- Verify timing with DSO or logic analyzer

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.11 - TIMER1 1 KHZ SQUARE-WAVE OUTPUT



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Generate a 1 kHz square wave using Timer1 and observe it on DSO or logic analyzer'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 12

Interface a buzzer and control it from an input condition

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Interface a buzzer and control it from an input condition.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

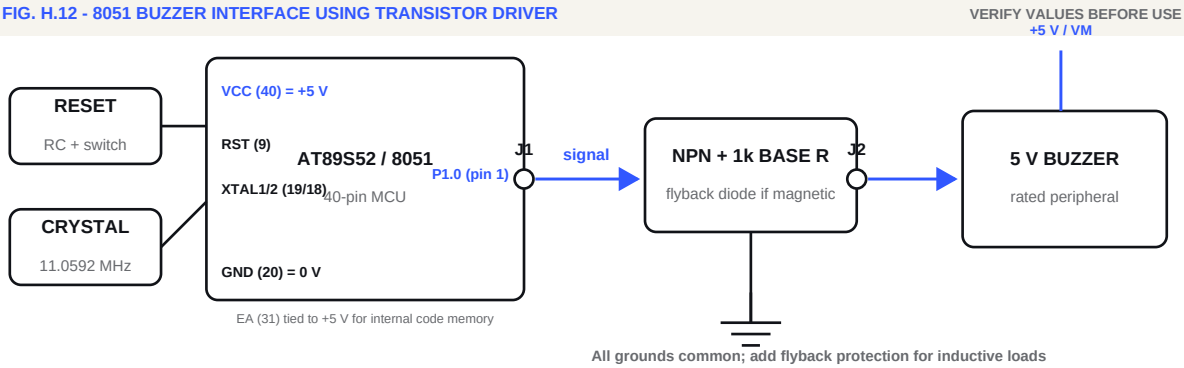
Key relations / checks

- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.12 - 8051 BUZZER INTERFACE USING TRANSISTOR DRIVER



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Interface a buzzer and control it from an input condition'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 13

Read a switch and control an LED through a port-interface routine

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Read a switch and control an LED through a port-interface routine.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

Key relations / checks

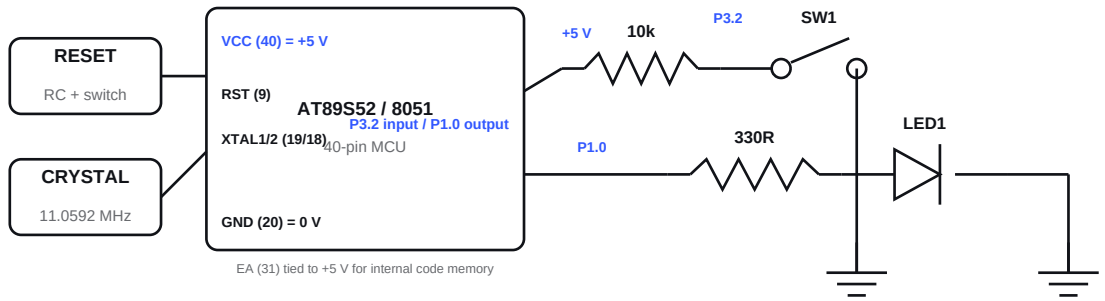
- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.13 - 8051 SWITCH INPUT AND LED OUTPUT WITH PULL-UP

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Read a switch and control an LED through a port-interface routine'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 14

Interface a DC motor through L293D and run it forward and reverse

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Interface a DC motor through L293D and run it forward and reverse.

B. Expected programme outcomes

PO1, PO2, PO4, PO5, PO6.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

Key relations / checks

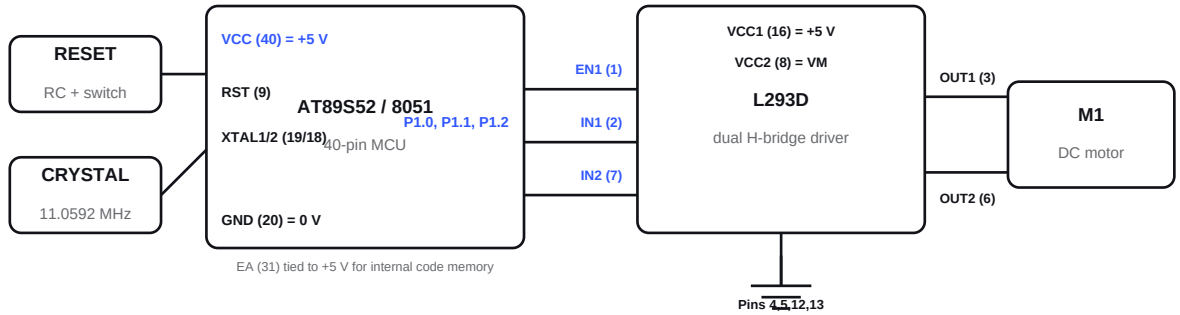
- Initialize ports before use
- Use current limiting and driver stages where required
- Check reset state and common ground

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.14 - 8051 BIDIRECTIONAL DC MOTOR INTERFACE THROUGH L293D

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Interface a DC motor through L293D and run it forward and reverse'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 15

Interface a stepper motor with an 8051 microcontroller

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Interface a stepper motor with an 8051 microcontroller.

B. Expected programme outcomes

PO1, PO2, PO4, PO5, PO6.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO4: Interface LEDs, displays, motors, buzzers and other peripherals.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

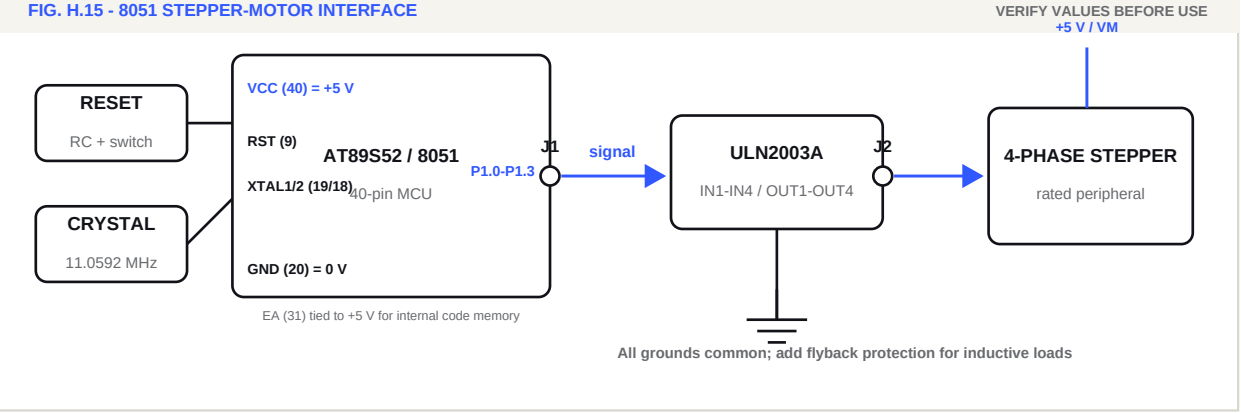
Key relations / checks

- Vpeak = vertical divisions x volts/division
- T = horizontal divisions x time/division
- f = 1/T
- For a sine wave Vrms = Vpeak/sqrt(2)

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.15 - 8051 STEPPER-MOTOR INTERFACE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Interface a stepper motor with an 8051 microcontroller'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 16

Create software PWM using loops and delays and observe it on DSO

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Create software PWM using loops and delays and observe it on DSO.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO5: Design and verify real-time 8051 applications.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

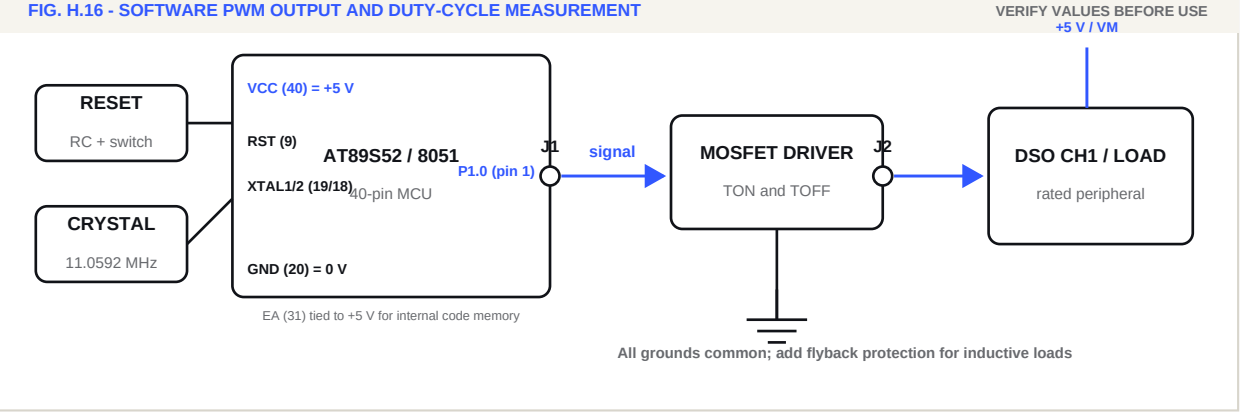
Key relations / checks

- Duty cycle = TON/(TON + TOFF) x 100
- PWM frequency = 1/(TON + TOFF)
- Use a driver for loads beyond port-current limits

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.16 - SOFTWARE PWM OUTPUT AND DUTY-CYCLE MEASUREMENT



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

I. Resources and equipment required

Resource	Specification / range	Quantity
8051 trainer / simulator	5 V trainer or Proteus model	1
Development software	Keil uVision, compatible target	1
Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
4. Observe IC/device orientation, common ground and current limits; avoid static discharge.

K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
6. Program the controller or run the simulation, apply the specified inputs, and observe the output at the named port/device.
7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Create software PWM using loops and delays and observe it on DSO'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
2. Kenneth J. Ayala, The 8051 Microcontroller
3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
Correct circuit/interface/drawing interpretation	Complete, correct and independently prepared	Minor correction needed	Adequate with guidance	Major error, unsafe or incomplete	/5
Practical skill, measurement and safety	Systematic, accurate and safe	Sound method; small lapse	Acceptable with guidance	Weak method or unsafe practice	/5
Professional conduct and team contribution	Ethical, orderly and constructive	Responsible with minor lapse	Generally acceptable	Poor discipline or contribution	/5
Result interpretation and conclusion	Evidence-based and insightful	Correct with minor omission	Basic valid conclusion	Unsupported or incorrect	/5
Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

PRACTICAL 17

Interface an 8-bit DAC with an 8051 microcontroller

DATE	BATCH	ROLL / ENROLLMENT NO.	FACULTY SIGN

A. Objective

Interface an 8-bit DAC with an 8051 microcontroller.

B. Expected programme outcomes

PO1, PO2, PO4, PO7.

C. Expected competency

Develop, interface and test 8051-based programs for electrical control applications.

D. Expected course outcome

CO5: Design and verify real-time 8051 applications.

E. Practical learning outcomes

1. Prepare the program flow and interface connections for the stated task.
2. Build, simulate and test the Embedded C program using defined test cases.
3. Relate the observed port, timing or peripheral response to the program logic.

F. Affective-domain outcomes

1. Follow electrical safety, laboratory discipline and good housekeeping.
2. Record observations honestly with units, dates and traceable corrections.
3. Share instruments responsibly and complete the work within the allotted time.

G. Prerequisite theory

The 8051 uses memory-mapped and bit-addressable resources to control its I/O ports, timers and external devices. Correct port configuration, timing, current limiting and driver isolation are essential. The program should be built without errors, simulated first where possible, then verified on hardware using measured outputs.

Key relations / checks

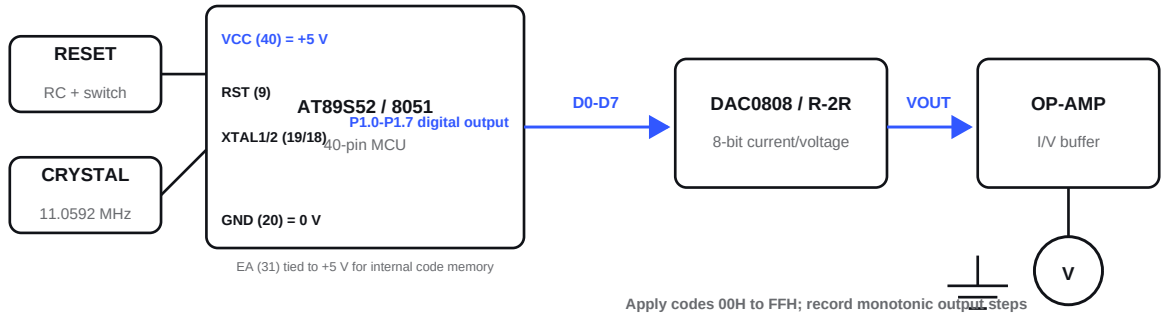
- Vpeak = vertical divisions x volts/division
- T = horizontal divisions x time/division
- f = 1/T
- For a sine wave Vrms = Vpeak/sqrt(2)

H. Experimental setup / drawing

Study the 8051 interface below. Confirm the port pins, supply, reset, clock, current-limiting or driver components, peripheral rating and common ground.

FIG. H.17 - 8051 8-BIT DAC INTERFACE AND ANALOG-OUTPUT MEASUREMENT

VERIFY VALUES BEFORE USE



Engineering-diagram note: Confirm the actual component values, ratings, terminal numbers, instrument ranges and protective measures issued by your laboratory. Faculty approval is mandatory before energizing.

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Resource	Specification / range	Quantity
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Interface device	As named; rated driver where needed	1 set
DMM / DSO	Suitable range and bandwidth	1
Leads and 5 V supply	Inspected, current limited	1 set

J. Safety and precautions

1. Do not energize or alter a circuit without instructor approval.
2. Use intact leads, correct instrument ranges, rated components and required PPE.
3. Switch OFF, isolate and verify absence of voltage before touching conductors.
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K. Procedure

1. Draw the interface diagram and confirm port pins, supply voltage, current-limiting components and driver requirements.
2. Create an 8051 project in Keil uVision and select the laboratory device or a compatible generic 8051 target.
3. Write the program with clear initialization, comments and a controlled main loop; avoid unbounded hardware current.
4. Build the project, remove all errors and review warnings; verify the logic in the simulator before hardware use.
5. Connect the trainer with power OFF. Ask the instructor to check the wiring, polarity and common ground.
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7. Record the program, input/output states, measured timing or waveform, and explain any difference from the expected result.

L. Observations and calculations

Record the program version, oscillator frequency, pin assignments and each test case. Attach a complete code printout if the space below is insufficient.

Test case	Input / initial state	Expected output	Observed output	Pass / fail

PROGRAM / ALGORITHM / TIMER CALCULATION

WAVEFORM / PORT STATE / DEBUG NOTES

M. Interpretation of results

COMPARE OBSERVED AND EXPECTED BEHAVIOUR; EXPLAIN ERROR, LIMITATIONS OR DESIGN TRADE-OFFS

N. Conclusion

STATE WHETHER THE PRACTICAL OUTCOME WAS ACHIEVED AND SUPPORT IT WITH KEY EVIDENCE

O. Practical-related questions

No.	Question / answer
1	What physical principle or engineering rule is verified in 'Interface an 8-bit DAC with an 8051 microcontroller'? Answer: _____
2	Which 8051 port, register or timer resource is used, and how is it initialized? Answer: _____
3	How would the program or interface behave after reset or an invalid input? Answer: _____
4	What safety step must be completed before changing a connection or configuration? Answer: _____

P. References and suggestions

1. Muhammad Ali Mazidi, Janice Mazidi and Rolin McKinlay, The 8051 Microcontroller and Embedded Systems
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3. Current GTU syllabus DI04000171 and institute laboratory instructions

Q. Assessment rubric (25 marks)

Assessment criterion	5 - Excellent	4 - Good	3 - Satisfactory	2/1/0 - Needs improvement	Marks
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Timely completion and record quality	Complete, neat and on time	Nearly complete and timely	Usable record	Late, unclear or incomplete	/5
TOTAL					/25

Faculty remarks	Student response / correction completed

Final submission checklist

1. Every practical has a date, mapped outcome, actual readings or evidence, calculations and a signed conclusion.
2. Circuit diagrams, programs, graphs, estimates, reports and test sheets are attached where required.
3. Instrument ranges, component ratings, source dates and safety precautions are recorded.
4. Technical sources are acknowledged and all assumptions are stated.
5. Faculty feedback and required corrections have been completed.

FACULTY REMARKS