

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

**COURSE CURRICULUM
COURSE TITLE: MICROCONTROLLERS
(COURSE CODE: 3362001)**

Diploma Programme in which this course is offered	Semester in which offered
Mechatronics	Sixth

1. RATIONALE

The objective of introducing course on Microcontrollers is to impart knowledge of programming expertise for embedded systems to the students of Mechatronics Engineering. Microcontroller is the sole of all embedded electronic equipments and is used in most of the areas of automation. They include product ranges from tiny consumer electronic products to complex industrial process controllers. Hence, this advance course will assist student in programming practices to develop indigenous microcontroller based applications.

2. COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in the students so that they are able to acquire the following competency:

- **Design and maintain various applications based on 8051 microcontroller.**

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- Identify features of various microcontroller
- Develop and execute assembly language programs for given application
- Interface microcontroller with hardware for given application

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
4	0	2	6	70	30	20	30	

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I 8051 Architecture	1a. Describe function of each block of 8051 microcontroller 1b. Explain function of each pin of 8051 1c. Differentiate clock, reset and machine cycle of 8051 with the help of relevant waveform 1d. Sketch internal memory organization of 8051 1e. Describe function and structure of I/O Ports	1.1 Specific Features of 8051 1.2 8051 microcontroller 1.3 Program Status Word of 8051 1.4 Pin Diagram of 8051 1.5 Clock, Reset and Machine Cycle of 8051 1.6 Internal RAM Organization of 8051 1.7 Special Function Registers of 8051 1.8 I/O Ports of 8051
Unit – II 8051 Instruction Set	2a. Classify addressing modes of 8051 with example 2b. Sort the Instruction set of 8051 as per functions performed by them 2c. Differentiate Stack, Stack Pointer and its operation 2d. Classify Bit Level and Byte Level instructions 2e. Describe Jump and Call Range	2.1 Addressing Modes 2.2 Data Transfer and Data Exchange Instructions 2.3 Stack Operation 2.4 Arithmetic Instructions 2.5 Bit and Byte Level Logical Instructions 2.6 Rotate and Swap Instructions 2.7 Jump and Call range 2.8 Branch Instructions 2.9 CALL and RET instructions
Unit – III 8051 Programming	3a. Develop simple programs to perform Data moves and data exchange. 3b. Develop simple programs to perform arithmetic operations. 3c. Develop simple programs to perform logical operations. 3d. Develop simple programs to perform branch operations.	3.1 Programs based on Data Transfer Instructions 3.2 Programs based on Data Exchange Instructions 3.3 Programs based on Arithmetic Instructions 3.4 Programs based on Logical Instructions 3.5 Programs based on Jump Instructions
Unit – IV 8051 Special Function Register	4a. Describe format of TCON and TMOD 4b. Describe modes of Timer/Counters 4c. Develop program to generate square wave 4d. Describe format of SCON	4.1 Timers/Counters Registers (TMOD, TCON) 4.2 Modes of Timers/Counters 4.3 Program to Generate Square Wave using Timer/Counter 4.4 Program to Generate Delay using Timer/Counter

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	4e. Develop program to transmit and receive character serially 4f. Describe format of IE and IP 4g. Classify types of interrupts with their vector address 4h. Describe format of PCON	4.5 Serial Data Communication (SCON) 4.6 Program to transmit data serially 4.7 Program to receive data serially 4.8 Types of Interrupt (IE, IP) 4.9 Power Modes of 8051 (PCON)
Unit – V 8051 Applications	5a. Interface External memory with 8051 5b. Interface Display Devices with 8051 5c. Interface Keyboard with 8051 5d. Interface ADC with 8051 5e. Interface Motors with 8051	5.1 External Memory Interfacing 5.2 LED Interfacing 5.3 Seven Segment Interfacing 5.4 LCD Interfacing 5.5 4 x 4 Matrix Keyboard Interfacing 5.6 ADC 0804 Interfacing 5.7 Relay Interfacing 5.8 Stepper Motor Interfacing 5.9 DC Motor Interfacing

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	8051 Architecture	12	06	08	04	18
II	8051 Instruction Set	10	06	06	02	14
III	8051 Programming	10	00	04	06	10
IV	8051 Special Function Register	10	02	06	06	14
V	8051 Applications	14	02	02	10	14
Total		56	16	26	28	70

Legends: R = Remember, U = Understand, A= Apply and above Level (Bloom's revised taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7. SUGGESTED EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical/Exercise (Outcomes in Psychomotor Domain)	Apprx. Hrs.
1	I	Identify different modules of 8051 Simulation tool	02
2	I	Test and verify the features of 8051 Trainer Kit	02
3	II	Execute assembly language programs based on Internal Data transfer Instructions (e.g. data moves, stack operation, data exchange)	02
4	II	Execute assembly language programs based on External Data transfer Instructions with memory (e.g. MOVX, MOVC)	02
5	III	Develop and execute assembly language programs based on Arithmetic Instructions (e.g. 8 bit Addition, Subtraction, Multiplication, Division)	02
6	III	Develop and execute assembly language programs based on Logical Instructions (AND, OR etc.)	02
7	III	Develop and execute assembly language programs based on Rotate and Swap Instructions	02
8	III	Develop and execute assembly language programs based on Branch Instructions	02
9	IV	Develop and execute assembly language programs to generate square wave using Timer/Counter	02
10	IV	Develop and execute assembly language programs to design delay (e.g. 1ms Delay) using Timer/Counter	02
11	IV	Develop and execute assembly language programs to transmit a character serially	02
12	IV	Develop and execute assembly language programs to receive a character serially	02
13	V	Interface LED with 8051	02
14	V	Interface 7 segment Display with 8051	02
15	V	Interface LCD Module with 8051	02
16	V	Interface 4 x 4 matrix Keyboard with 8051	02
17	V	Interface ADC 0804 with 8051	02
18	V	Interface a relay with 8051	02
19	V	Interface a Stepper Motor with 8051	02
20	V	Interface a DC Motor with 8051	02
Total			40
Note: Perform any of the practical exercises from above list for total of minimum 28 hours depending upon the availability of resources so that skills matching with the most of the outcomes of every unit are included.			

8. SUGGESTED STUDENT ACTIVITIES

S. No.	Activity
1	Prepare journals based on practical performed in laboratory.
2	Prepare chart to represent the instruction set of 8051 microcontroller.
3	Develop a practical application using 8051 Microcontroller
4	Show a dynamic animation to illustrate the following <ul style="list-style-type: none"> • 7 Segment Interfacing • LCD Interfacing • Stepper Motor • DC Motor Interfacing

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any).

S. No.	Unit	Unit Name	Strategies
1	I	8051 Architecture	Show PPT on Microcontroller 8051.
2	II	8051 Instruction Set	Assemble level instruction practices on simulators
3	III	8051 Programming	Assemble level programming practices on simulators
4	IV	8051 Special Function Register	Show PPT on special function register and perform programs on simulator.
5	V	8051 Applications	Use Interfacing Trainer boards, Live projects, Video Lectures with the help of internet.

10. SUGGESTED LEARNING RESOURCES

A) Books

S. No.	Author	Title of Book	Publication
1.	Mazidi, Muhammad Ali; Mazidi, Janice Gillispie; McKinlay Rolin D.	The 8051 microcontroller and embedded systems	PHI Learning, New Delhi, (2 nd edition, 2005)
2.	Ayala, Kenneth J.	The 8051 Microcontroller: Architecture, Programming, and Applications	Thomson Delmar Learning, (3 rd edition, 2004)
3.	Pal, Ajit	Microcontrollers : Principles And Applications	PHI Learning ,New Delhi, (1 st edition, 2011)
4.	Rao, K Uma	The 8051 Microcontrollers: Architecture, Programming and Applications	Pearson Education India, New Delhi, (2 nd edition, 2011)

B) Major Equipment/ Instrument with Broad Specifications

S. No.	Equipment/ Instrument	Specification
1	Microcontroller 8051 trainer Kit with User manual	Operating at 11.0592MHz, 32KB EPROM, 64KB Flash memory, On chip Timer, I/O Ports, RS-232 Interface, PC interface, Selectable baud rate
2	8051 Simulator tool	EdSim51, Keil, MCU8051IDE
3	Computer System	Pentium-IV and latest version
4	Interfacing Cards	Seven Segment Display, Keyboard, LCD
5	Application Board using 8051 microcontroller	External Memory Interface, DC Motor, Stepper Motor

C) Software/Learning Websites.

- i. www.academia.edu
- ii. www.nptel.iitm.ac.in
- iii. www.8052.com
- iv. <http://www.slideshare.net/aismahesh/memory-8051>
- v. <http://www.intorobotics.com/8051-microcontroller-programming-tutorialssimulators-compilers-and-programmers/>
- vi. <http://www.ikalogic.com/part-1-introduction-to-8051-microcontrollers>
- vii. <http://www.edsim51.com>
- viii. <http://www.8051projects.net/download-c4-8051-projects.html>
- ix. <http://cse.iitkgp.ac.in/~soumya/embs/the-8051-microcontroller-314772782.pdf>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE**Faculty Members from Polytechnics**

- **Prof. H. A. Momaya**, Senior Lecturer, Department of Electronics & Communication Engineering, B. S. Patel Polytechnic, Kherva, Mehsana.
- **Prof. V. I. Patel**, Senior Lecturer, Department of Electronics & Communication Engineering, B. S. Patel Polytechnic, Kherva, Mehsana.
- **Prof. K. P. Patel**, Head of Department, Department of Mechanical Engineering, B. S. Patel Polytechnic, Kherva, Mehsana.

Coordinator and Faculty Members from NITTTR Bhopal

- **Dr. V. Somkuwar**, Associate Professor, Department of Mechanical Engineering.
- **Dr. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering.