GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: MICROCONTROLLER
(COURSE CODE: 3351101)

Diploma Programme in which this course is offered	Semester in which offered
Electronics and Communication Engineering	5th Semester

1. RATIONALE

Microcontroller is the sole of all embedded electronic equipments and is used in most of the areas of electronics. They include product ranges from tiny consumer electronic products to complex industrial process controllers. A diploma engineer needs to maintain such systems. Programming practices will further help the students to develop indigenous microcontroller based applications. Hence this course is designed to achieve the above.

2. LIST OF COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Maintain microcontroller based equipments/system.**

3. COURSE OUTCOMES

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

i. Identify features of various microcontroller
ii. Select appropriate microcontroller for different application
iii. Interface microcontroller with hardware for given application
iv. Write and execute assembly language programs(software) for given application
v. Develop small microcontroller based applications.

4. TEACHING AND EXAMINATION SCHEME

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

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment

5. COURSE DETAILS

Unit	Major Learning Outcomes (outcomes in Cognitive Domain)	Topics and Sub-topics
Unit – I. Introduction of Microcontrollers	1a. Describe functions of each block. diagram of generic digital computer 1b. Describe common features of Microcontrollers	1.1 Block diagram of microcontroller : CPU, input device, output device, memory and buses 1.2 common features of Microcontrollers : On-chip Oscillator, program and data memory, I/O Ports, Watchdog- timer reset, SFRs, Timers, Counters, Interrupts, ADC, PWM
	1c. Differentiate between microprocessor and microcontroller	1.3 microprocessor and microcontroller
	1d. Describe Evolution of Microcontrollers	1.4 Hierarchy of microcontrollers
	1e. Explain various architectures of microcontroller	1.5 architectures of microcontroller Harvard , Von Neumann RISC and CISC
	1f. Describe applications of microcontrollers	1.6 Applications: House hold , Communication, Office equipment and industrial automation
Unit– II 8051 Hardware	2a Explain functions of each block of 8051microcontroller	2.1 Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, Latch, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports
	2b Explain Pin Diagram of 8051	2.2 Functions of each pin of 8051
	2c Distinguish of clock, reset and machine cycle of 8051with the help of relevant waveform	2.3 Clock circuit, reset Circuit , phase and state in machine cycle of 8051
	2d Explain Memory organization of 8051	2.4 Memory organization of 8051: Program and Data memory Map, External Memory Addressing and Decoding Logic of 8051
	2e Differentiate Stack , Stack Pointer and stack operation	2.5 Stack, Stack Pointer and Stack operation
	2f Describe modes of operation of Timers/Counters	2.6 Timers/Counters logic diagram and its operation in various modes
	2g Explain function and structure of I/O Ports	2.7 I/O Ports structure: Port 0, Port 1, Port2, Port 3.
	2h Describe Serial communication	2.8 Serial Communication in various modes
	2i Justify need of Interrupt Mechanism	2.9 Interrupt structure, vector address, priority and operation

Unit	Major Learning Outcomes (outcomes in Cognitive Domain)	Topics and Sub-topics
	2j Differentiate various types of Interrupts	
	2k Explain various controlling modes of 8051	2.10 Modes of operation: Power down and idle mode
Unit– III 8051 Programming	3a Classify addressing modes of 8051 with example	3.1 Addressing Modes : Immediate, Register, Direct, Indirect, Indexed, Relative and bit addressing
	3b Sort the Instruction set of 8051as per functions performed by them	3.2 Instruction set :Data Transfer, Arithmetic, Logical, Branching, and Machine Control
	3c Explain following Programming concept: Looping, Counting and Indexing	3.3 Looping , Counting, sorting and Indexing
	3d Develop simple programs to perform the following operations: Data manipulation, Masking, Stack operation, Conditional execution	3.4 Data manipulation, Masking , Stack operation, Conditional programming
	3e Explain functions of Timer/ Counters and its application 3f Describe modes of timers	3.5 Configuration and programming of Timer/Counter using SFRs: TMOD, TCON, THx, TLx.
	3g Explain the interrupt mechanism with the help of suitable example	3.6 Configuration and programming of interrupts using SFRs: IE,IP
	3h Explain I/O Port Programming	3.7 Configuration and programming of I/O Port : P0,P1,P2,P3

Unit	Major Learning Outcomes (outcomes in Cognitive Domain)	Topics and Sub-topics
Unit–IV 8051 Interfacing	4a Interface Input Devices with 8051 microcontroller	4.1 Switch: Pushbutton, DIP, Thumbwheel, Tilt
	4b Interface Output devices with 8051 microcontroller	4.2 Relay,LED,7 segment LED,LCD
	4c Interface ADC with 8051 microcontroller	4.3 ADC0804
	4d Interface Analog Input devices with 8051 microcontroller	4.4 Temperature sensor LM35
	4e Interface DAC with 8051 microcontroller	4.5 DAC0808, ADC0804,
	4f Interface Analog Output devices with 8051 microcontroller	4.6 Damper Control, Hoper Control
	4g Interface actuator with 8051 microcontroller	4.7 DC Motor, Stepper motor
	4h Interface PC with 8051 microcontroller 4i Describe functions of MAX232	4.8 Serial communication using MAX 232,Hyperterminal
Unit-V 8051 Applications	5a List Various 8051 Applications	5.1 Application of microcontroller in various field
	5b Room Temperature Indicator	5.2 Using LM35, ADCC0804, Microcontroller, 7 segment LED
	5c Battery voltage logging system	5.3 Using Analog Multiplexer 4051,ADC0804,Microcontroller, 7 segment LED,MAX232
	5d GSM based Security Application	5.4 Using GSM Modem, Microcontroller, Relay, Switches
	5e RPM Meter	5.5 Using Photo interrupter, Microcontroller, 7 Segment LED
	5f Applications based on RTC DS1307	5.6 Using Pushbutton switches, Microcontroller, Relay, NVRAM

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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction of Microcontrollers	10	04	04	04	12
II	8051 Hardware	16	08	06	04	18
III	8051 Programming	12	06	05	05	16
IV	8051 Interfacing	10	04	06	04	14
V	8051 Applications	8	02	02	06	10
	Total	**56**	**24**	**23**	**23**	**70**

Legends: R = Remember U = Understand; A = Apply and above levels (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 LIST OF EXERCISES/PRACTICALS

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.

Note: It is preferable to use 8051 Trainer kits rather than Simulation tools for better hands on practice.

S. No.	Unit No.	Practical Exercises (outcomes in Psychomotor Domain)	Approx Hours.
1	I	Use 8051 Simulation tool	2
2	I	Test and verify the features of 8051 Trainer Kit	2
3	II	Write and execute assembly language programs based on Data transfer Instructions	2
4	II	Develop assembly language programs based on Arithmetic Instructions (e.g. 8 bit Addition , Subtraction, Multiplication, Division)	2
5	II	Develop Assembly Language Programs based on Logical Instructions (And, Or etc.)	2
6	II	Develop Assembly Language Programs based on Branch Instructions	2
7	II	Develop Assembly Language Programs based on Looping ,Counting and Indexing concept	2
8	III	Develop Assembly Language Programs to introduce delay (e.g.1ms Delay) using Timer/Counter	2
9	III	Develop Assembly Language Programs for Interrupts	2
10	III	Develop Programs for serial communication	2
11	IV	Develop a program to interface LED with 8051	2
12	IV	Develop a program to interface 7 segment Display with 8051	2
13	IV	Develop a program to Interface 8 bit DAC with 8051	2
14	IV	Develop a program to interface a DC Motor with 8051	2
15	V	Develop a program to interface LCD Module with 8051	2
16	V	Develop a 4 bit binary counter with 8051 and display out put on LCD	2
17	V	Develop a program to interface a Stepper Motor with 8051	2
18	V	Develop a data acquisition system using ADC0804 and Microcontroller	2
Total Hours (perform practical form every unit so that 28 hours are utilized)			**36**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities:

i. Prepare journals based on practical performed in laboratory.
ii. Prepare chart to represent the block diagram of different interfacing chips.
iii. Develop a practical application using 8051 Microcontroller
iv. Prepare ISP board of 89V51RD2Hxx with all ports available as connector
v. Prepare/Download a dynamic animation to illustrate the following
   - Data transfer operation
   - Keypad Interfacing
   - LCD Interfacing
   - DC Motor Interfacing

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

i. Arrange visit to relevant industry.
ii. Show video lectures on Microcontroller Applications with help of internet.
iii. Assemble level programming practices on simulators (free downloadable).

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
1.	Microcontrollers : Principles And Applications	Pal Ajit	EEE, PHI ,New Delhi,(Latest edition)
2.	The 8051 Microcontrollers: Architecture, Programming and Applications	Rao Dr. K Uma	Pearson Education India, New Delhi,(Latest edition)
3.	The 8051 microcontroller and embedded systems	Mazidi Ali, Muhammad Mazidi Gillispie Janice	PHI, New Delhi,(Latest edition)
4.	The 8051 Microcontroller: Architecture, Programming, and Applications	Kenneth Ayala J.	Thomson Delmar learning,(latest Edition)
5.	The 8051 Microcontroller,	Mackenzie	Pearson Education India, New Delhi,(Latest edition)
6.	Programming and customizing the 8051 microcontroller	Predko Michael	McGraw-Hill, International edition

B) List of Major Equipment/ Instrument with Broad Specifications

i. Microcontroller 8051 trainer Kit
ii. 8051 Simulator software (Free downloadable)
iii. Computer System(p-IV and latest version)
iv. Peripheral Interfacing Trainer kits

C) List of Software/Learning Websites

i. www.academia.edu
ii. www.learners TV.com
iii. www.nptel.iitm.ac.in
iv. www.8052.com

v. http://www.slideshare.net/aismahesh/memory-8051
vi. http://www.intorobotics.com/8051-microcontroller-programming-tutorials-simulators-compilers-and-programmers/
vii. http://electrofriends.com/articles/electronics/microcontroller-electronics-articles/8051-8951/80518951-microcontroller-instruction-set/
viii. http://www.ikalogic.com/part-1-introduction-to-8051-microcontrollers
ix. http://www.edsim51.com
x. http://www.mikroe.com/chapters/view/64/chapter-1-introduction-to-microcontrollers/
xi. http://www.8051projects.net/download-c4-8051-projects.html
xii. http://cse.iitkgp.ac.in/~soumya/embcs/the-8051-microcontroller-0314772782.pdf

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof**. **T P Chanpura,** Sr. Lecturer (EC) ,Government Polytechnic Ahmedabad
- **Prof**. **D H Ahir,** Sr.Lecturer (EC),Government Polytechnic Rajkot
- **Prof**. **N M Rindani**, Sr.Lecturer (EC) ,AVPTI Rajkot
- **Prof. N B Shah**, Sr.Lecturer (EC),Government Polytechnic Vadnagar
- **Prof**. **Krunal Pithadia**, Lecturer (EC),B & B Polytechnic Vallabh Vidhyanagar

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Mrs.) Anjali Potnis,** Department of Electrical and Electronics Engineering.