

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM COURSE TITLE: MICROCONTROLLER FOR POWER ELECTRONICS (COURSE CODE: 3352404)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics	5 th Semester

1. RATIONALE

Today microcontrollers have become an integral part of all automatic and semi-automatic machines. Therefore, there is a growing need of engineers / technicians in this field. Hence, it is necessary to understand the microcontroller basics, hardware and its programming. This course includes microcontroller 8051 architecture, its instruction set, programming and applications. After undertaking this course of study, the student would be able to develop and execute small programs for microcontroller based applications specially used for field of power electronics.

2. LIST OF COMPETENCY

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

- Use microcontroller for controlled operation of various equipments

3. COURSE OUTCOMES

The theory should be taught and practical should be undertaken in such a manner that students are able to acquire different learning outcomes in cognitive, psychomotor and affective domains to demonstrate the following course outcomes:

- i. Explain need of microcontroller.
- ii. Describe architecture and operation of microcontroller 8051
- iii. Develop assembly language programs using instruction set of 8051
- iv. Develop programs using interrupts.
- v. Develop various applications of microcontrollers specially for power electronics need.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
4	1	2	7	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 DETAILS

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
Unit – I Microcontroller Basics	1a. State the need of microcontroller with examples of its applications 1b. Describe the generalized block diagram of microcontroller. 1c. Distinguish between microcontroller and microprocessor. 1d. Compare the features of currently available commercial microcontrollers.	1.1 Microcontrollers: need, generalized block diagram, features of microprocessor and microcontroller 1.2 Commercial microcontroller devices.
Unit – II 8051 Architecture	2a. Explain microcontroller 8051 block diagram. 2b. Describe the functions of various registers of 8051. 2c. State the functions of SFR, and DPTR	2.1. 8051 microcontroller: Block diagram, Registers; General purpose or working registers, Stack Pointer, Program counter, Special function registers (SFR), Program Status word, Data pointer (DPTR), Timer registers, Ports, Control registers
Unit – III 8051 Connections, I/O Ports and Memory Organization	3a. Describe pin diagram of 8051. 3b. Explain clock circuit and ports of 8051. 3c. Explain the RAM organization in 8051 with sketches	3.1. 8051 microcontroller: pin description, connections, Parallel I/O ports, RAM organization
Unit – IV 8051 Addressing Modes and Instructions	4a. Describe the need for assembling of program.	4.1. 8051 microcontroller: assembler and assembling 8051 program, Software simulators.
	4b. Explain addressing modes of 8051 with suitable examples.	4.2. Addressing modes of 8051
	4c. Formulate programs for various operations using relevant instruction sets.	4.3. Instruction set and Examples using various instructions: moving data operation, port programming, arithmetic operations, logical operations, jump and loop operations.
Unit – V 8051 Interrupts, Timer/Counters and Serial Communication	5a. State the interrupts in 8051 5b. State the need for the initializing and priority of interrupts.	5.1. Interrupts: Interrupts in 8051, Initializing, priorities.
	5c. Explain timer and counter operation modes.	5.2. Timers and counters: timer counter registers and modes, programming timer interrupts.
	5d. Develop programs using hardware interrupts.	5.3. Programming hardware interrupts.

Unit	Major Learning Outcomes (Major outcomes in cognitive domain)	Topics and Sub-topics
	5e. Describe serial communication modes. 5f. Develop sample programs using interrupts programming.	5.4. Serial communication: serial communication registers and modes, programming serial communication interrupts.
Unit – VI Microcontrollers Applications for Power Electronics	6a. Develop various programs based various power electronics applications.	6.1. Square wave and rectangular wave generation 6.2. Pulse generation, Pulse width modulation (PWM) generation 6.3. Frequency counter 6.4. Programs based various power electronics applications viz. Interfacing small keyboards, relay, stepper motor, DC motor.

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	Microcontroller Basics	4	5	0	0	5
II	8051 Architecture	6	4	4	0	8
III	8051 connections, I/O ports and memory organization	4	3	2	0	5
IV	8051 addressing modes and instructions	20	6	8	10	24
V	8051 interrupts, timer/counters and serial communication	10	4	5	4	13
VI	Microcontrollers Applications for Power Electronics	12	0	0	15	15
Total		56	22	19	29	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/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/course outcomes. Following is the list of practical exercises for guidance.

Note: *outcomes in psychomotor domain are listed here 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 Exercises (Major Outcomes in Psychomotor Domain)	Approx. Hrs. Required
1.	IV	Demonstrate and understand use of software simulator / assembler for programming.	2
2.	IV	Develop any four sample program of data moving operations.	4
3.	IV	Develop any six sample program of different arithmetic operations.	6
4.	IV	Develop any four sample program of logical operations.	4
5.	IV	Develop any four sample program of port programming.	4
6.	IV	Develop any six different sample program using jump and call operations.	6
7.	V	Develop any two sample program using timer.	4
8.	V	Develop any two sample program using counter.	4
9.	V	Develop any two sample program using hardware interrupt.	4
10.	V	Develop any two sample program using serial communication.	4
11.	VI	Develop any four sample application program for power electronics applications.	8
		Total (Perform any practical for total 28 hours so that most units are covered)	50

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. Search practical applications of microcontroller in their day to day life and list their controlling parameters.
- ii. Develop and simulate the program for power electronics application as well day to day life applications.

9. SPECIAL INSTRUCTIONAL STRATEGY (If Any)

- i. Give as many programming exercises for micro controller applications as possible for students to do and provide opportunities to them to test the programmes developed by them.
- ii. Give microcontroller based mini projects to students.

10. SUGGESTED LEARNING RESOURCES

A. List of Books

S. No.	Title of Books	Author	Publication/Year
1.	The 8051 Microcontroller And Embedded Systems: Using Assembly And C	Muhammad Ali Mazidi, Rolin McKinlay, Janice Gillispie Mazidi	Pearson Education, New Delhi, 2nd Edition (2007 or latest)
2.	Microcontrollers theory and applications	Ajay V Deshmukh	TMH, New Delhi
3.	8051 microcontrollers	Ayala Kenneth J	Cengage Learning, New Delhi, 3rd Edition(2007 or latest)
4.	8051 Microcontroller: Internals, Instructions, Programming and Interfacing	Subrata Ghoshal	Dorling Kindersley , New Delhi, 1st Edition (2010 or latest)
5.	8051 Micro; MCS 51 Family And Its Variant	Satish Shah	Oxford University Press, New Delhi, 1st Edition(2010 or latest)

B. List of Major Equipment/Materials

- i. Microcontroller 8051 Training kit with various interface like LED, Stepper Motor, Keyboard, H bridge card, Inverter card etc.
- ii. Digital Oscilloscope
- iii. Any one simulation software

C. Learning Websites/ List of Software

- i. edsim51 (freeware)
- ii. keil (demo freeware)
- iii. <http://www.8051projects.net/microcontroller-tutorials/>
- iv. <http://www.8052.com/tut8051>
- v. <http://www.yourepeat.com/g/8051/>
- vi. <http://www.intorobotics.com/8051-microcontroller-programming-tutorials-simulators-compilers-and-programmers/>

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. S. A. Patel**, LPE, Dept. of Power Electronics, Dr. S. & S. S. Ghandhy College of Engg. and Technology, Surat

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. A. S. Walkey**, Associate Professor, Dept. of Electrical & Electronics Engg,
- **Dr. Joshua Earnest**, Professor, Dept. of Electrical & Electronics Engg,