GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM COURSE TITLE: MICROPROCESSOR AND MICROCONTROLLER IN INSTRUMENTATION (COURSE CODE: 3351705)

Diploma Programmes in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	5 th semester

1. RATIONALE

Microprocessors and Microcontrollers are being extensively used in the field of Instrumentation and Control Engineering. The students studying this subject are required to have a thorough knowledge of architecture of a typical Microprocessor and Microcontroller and also acquire fundamental programming skills in the assembly language. Students further need to be aware of various Microprocessors and Microcontrollers employed in industries. The course in addition, cover general hardware aspects along with some applications and interfacing of microcontrollers in instrumentation and control discipline which would equip the student with skills for designing an embedded microcontroller based instrumentation system .

2. **LIST OF COMPETENCY**

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

• Design, Operate and Maintain microcontroller based process instruments

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 out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- i. Identify the different block of microprocessor and microcontroller.
- ii. Use microcontrollers in instrumentation applications
- iii. Develop simple assembly language program using above instructions for given application.
- iv. Program 8051 microcontroller for various for internal organization use
- v. Interface peripheral devices with 8051 microcontroller for instrumentation applications

Teaching Scheme		Total	Examination Scheme					
((In Hours)		Credits $(\mathbf{I} + \mathbf{T} + \mathbf{P})$	Theory Marks		Prac	ctical	Total Morks
						Marks		Marks
L	Т	Р	С	ESE	PA	ESE	PA	150
3	0	2	05	70	30	20	30	150

4. Teaching and Examination Scheme

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

5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes	Topics and Sub-topics		
	(in cognitive domain)			
Unit – I Overview of 8085 Microproce ssor and microcontr oller	 1a. Describe basic architecture of microprocessor of 8085. 1b. Draw and describe block diagram of microprocessor 8085. 1c. Describe functional block diagram of 8051 microcontroller with sketches and pin diagram 1d. Compare microprocessor and microcontroller. 	 1.1 Microprocessor Architecture 1.2 8085 Microprocessor: Block Diagram 1.3 Microcontroller 8051 		
Unit– II 8051 Microcontr oller	 2a. State functions of following in microcontroller: Oscillator, Clock and Reset circuit. Program counter and data pointer. A and B CPU register and PSW. 2b. Describe functions of internal RAM organization. 2c. State applications of stack operation and function registers 2d. Describe functions of internal RAM and ROM organization with sketches. 	 2.1 8051 microcontroller hardware 2.2Programming Model: Oscillator and Reset circuit, Program Counter, Data Pointer, A and B CPU registers, Flags and program status word (PSW) 2.3Memory organization: Internal RAM, The stack and stack pointer, Special function registers, Internal ROM and External memory connections 2.4 Input/output pins, ports and Circuits. 		
Unit– III 8051	3a State the applications of addressing	3.1 Addressing modes:		
0001 Accombly	Thoues.	Indirect Indexed Polotive		
Assembly Language	3c Explain application of Instructions	and bit addressing		

Unit Major Learning Outcomes To		Topics and Sub-topics		
	(in cognitive domain)			
Programmi ng	with suitable example.3d Formulate simple assembly language program using above instructions for given application.	 3.2 Instructions: Moving data Arithmetic operation, Logica operation, Jump and Cal instructions 3.3 Simple programs 		
Unit – IV Application programmi ng of 8051	 4a State applications of TCON and TMOD register of timer. 4b List various timer modes of 8051. 4c Develop simple programs on timers which include square wave generation and delay. 4d State application of serial communication, SBUF, SCON and PCON registers, 4e Develop program for transmitting and receiving single word. 4f List interrupts of 8051 4g State the application of IP and IE registers. 	 4.1 8051 Timer/counter:TCON, TMOD, Modes of timer 4.2 Simple Programs on timer 4.3 Serial Communication of 8051: Basics, SBUF register, SCON and PCON registers, Modes of operation 4.4 Simple program of serial communication 4.5 8051 Interrupts: Interrupt priority and interrupt vector, IP and IE register 		
Unit – V Microcontr oller Application s in Instrument ation	 5a. Describe Applications of 8051 microcontroller in Instrumentation Room Temperature Indicator, Level detection, car parking -(Motion and obstacle sensing), frequency counter, RPM meter SMART instruments 5b.Explain interfacing of 8051 for the instrumentation listed: relay, DC Motor, stepper motor and temperature sensor LM35/LM 34, Analog Output devices for Damper and Hopper Control 5c. State the steps to maintain the above instrumentation applications and interfaced devices 5dDraw interfacing diagram of 8051 with devices listed: LED, LCD, ON/OFF switch, Hex keyboard, A/D converter with ADC 0804 and D/A converter 0808. 	 5.1 Application s in Instrumentation - Room Temperature Indicator, Level detection application, car parking - (Motion and obstacle sensing), frequency counter RPM meter, SMART Instruments ,DC Motor, stepper motor, relay, Analog Output devices for Damper and Hopper Control, Analog Multiplexer 4051 5.2Interfacing of 8051 with devices : LED, LCD, Switch: Pushbutton, DIP, ON/OFF, Thumbwheel, Tilt Hex keyboard, A/D converter with ADC 0804 and D/A converter 0808 		

Unit	Unit Title	Teaching	Distribution of Theory Marks			
No.		Hours	R	U	Α	Total
			Level	Level	Level	Marks
Ι	Overview of Microprocessor and	02	03	04	00	07
	microcontroller					
II	8051 Microcontroller.	10	07	10	04	21
III	8051 assembly language programming	12	03	04	07	14
IV	Application programming of 8051	10	03	04	07	14
V	Microcontroller Applications in	08	03	04	07	14
	Instrumentation.					
	Total	42	19	26	25	70

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

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/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 members 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 (Outcomes' in Psychomotor Domain)	Approx Hrs. required
1	Ι	Demonstrate Hardware and Software development tool for 8085.	02
2	Ι	Demonstrate Hardware and Software development tool for 8051.	
3	Ι	Study family of microprocessor and microcontroller.	02
4	II	Develop and Execute Programs on 8 bit data transfer.	
5	III	Develop and Execute Programs on 16 bit data transfer instructions	02
6	III	Develop and Execute Programs on 8 bit data transfer for a block of data from external memory.	02

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Approx Hrs. required	
7	III	Develop and Execute Programs on 8 bit Arithmetic instructions.	02	
8	III	Develop and Execute Programs on 16 bit Arithmetic instructions.	02	
9	III	Develop and Execute Programs on Byte level Logical instructions.	02	
10	III	Develop and Execute Programs on Bit level Logical instructions.	02	
11	III	Develop and Execute Programs on Rotate and SWAP instruction.	02	
12	III	Check status of given registers after execution of given programs.	02	
13	III	Develop and Execute Programs on branching instructions.	02	
14	III	Develop and execute program for delay (without using timers).	02	
15	IV	Develop and execute program for delay using timers.	02	
16	IV	Develop and execute program for generating square wave using timers.	02	
17	IV	Develop and execute programs on serial transmission with different baud rates		
18	IV	Develop and execute programs on interrupts handling.	02	
19	V	Interface 8051 with external memory.*	02	
20	V	nterface 8051 with LED.* 02		
21	V	Interface 8051 with Seven Segment LED.*	02	
22	V	Interface 8051 with LCD.*	02	
23	V	Interface 8051 with input switches.*	02	
24	V	Interface 8051 with Hex Key board.*	02	
25	V	Interface 8051 with ADC 0804/ADC 0808/ any available.*	02	
26	V	Interface 8051 with DAC 0808/ any available.*	02	
27	V	Interface 8051 with relay.*	02	
28	V	Interface 8051 with stepper motor.*	02	
29	V	V Interface 8051 with temperature sensor / any available linear 02 v sensor.*		
Tota	l (prac	tical for 28 hours from above representing each unit may be	58	
selected)				
* No	te: The	ese experiments can be either conducted using hardware interfacing	modules or	
using simulated software like Labview.				

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

- i. Student should develop a small application related to micro controller as a mini project in laboratory.
- ii. Prepare evolution chart for microprocessor and microcontroller families.
- iii. Students should explore internet for keeping themselves up-to-date with latest upgraded versions and facilities related with micro controllers and make presentations in seminars.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)

- i. Class Test
- ii. Assignment
- iii. Seminar/Symposium
- iv. Collection/Records
- v. Group discussion/Debate for continuous evaluation of lab activity
- vi. Mini project

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication	
1.	The 8051 microcontroller	Ayala, Kenneth	Cengage learning, New Delhi	
2.	Microcontroller and embedded systems	Mazidi and Mazidi	Pearson, New Delhi	
3.	The 8051 microcontroller	Mackenzie, I.S.	Pearson, New Delhi	
4.	Microprocessor 8085: architecture, programming and application	GAONKAR, R.S.	Peneram International Publishing (India), New Delhi	
5.	8051 Microcontroller: Internals, Instructions, Programming and Interfacing	Ghoshal, Subrata	Pearson Education, New Delhi	
6.	The 8051 Microcontrollers: Architecture, Programming and Applications	Rao, K. Uma Andhe Pallavi	Pearson Education, New Delhi	

B) List of Major Equipment/ Instrument with Broad Specification

- i. Microprocessor trainer kit
- ii. Microcontroller 8051 Trainer kit
- iii. Computers
- iv. Microcontroller Simulators
- v. Microcontroller 8051 based interfacing study cards with components listed in Unit-5.

C) List of Software/Learning Websites

- i. ce.kashanu.ac.ir/sabaghian/download/micro/6.ppt
- ii. www.engineersgarage.com/.../8051projects/interface-lcd-at89c51-circuit
- iii. courses.cs.washington.edu/courses/cse477/.../ppt/.../MicrocontrollersII.pp.
- iv. nptel.iitk.ac.in/courses/.../IIT.../microcontrollers/.../Course_home2_13.ht...
- v. seminarprojects.com/s/microcontroller-8051-ppt-by-iit
- vi. freevideolectures.com > Electronics > IIT Kharagpur
- vii. www.youtube.com/watch?v=0SZPr4iGACg

- viii. www.vlab.co.in/ba_labs_all.php?id=1
 - ix. 59.181.142.81/Virtual Labs (Electronics), IIT Bombay.. Microcontrollers
 - x. nptel.ac.in/courses/Webcourse-contents/IIT.../Course_home2_5.htm
 - xi. cse.iitkgp.ac.in/~soumya/.../the-8051-microcontroller-0314772782.pdf
- xii. http://www.bipom.com/documents/lectures/Microcontroller%20to%20Sensor%20 Interfacing%20Techniques.pdf
- xiii. NI Lab view evaluation version

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE Faculty Members from Polytechnics

- Prof. M. V. Dabhi Sr. Lecturer IC Engineering, Govt. Polytechnic, Gandhinagar
- Prof. A.M. Patel I/C Head, Lecturer IC Engineering, Govt. Polytechnic, Palanpur
- Prof. S. K. Raval, Lecturer IC Engineering, Govt. Polytechnic, Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. (Dr) Joshua Earnest.** Professor, Department of Electrical and Electronics Engineering
- **Prof. (Dr)** N.P.Patidar. Professor, Department of Electrical and Electronics Engineering