GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: MICROCONTROLLER APPLICATIONS IN MEDICAL TECHNOLOGY
(COURSE CODE: 3350301)

Diploma Programmes in which this course is offered	Semester in which offered
Biomedical Engineering	5th Semester

1.   RATIONALE

Microcontrollers are being excessively used in the field of automation in medical equipments. The controller is the brain of medical instrumentation system. Most of medical instruments are dependent on microcontrollers and hence for a biomedical engineering student, it is important to know the architecture of typical microcontroller and general idea of automation provided by microcontroller. Therefore, this course on microcontrollers is designed to develop the requisite skills to program and interface microcontrollers and debug/troubleshoot microcontroller-based systems.

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:

- **Troubleshoot microcontroller based medical instruments systems.**

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. Compare the different blocks of microcontroller with microprocessor.
 ii. Use hardware concepts of microcontroller 8051 in bio medical applications.
iii. Develop logic for data transfer operations.
 iv. Develop logic for arithmetic, logical, branching and looping operations.
  v. Interface various peripheral devices and systems with microcontroller 8051.

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	
4	0	2	06	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 (in cognitive domain)	Topics and Sub-topics
Unit – I Introduction to Microcontrollers	1.a. Understand the basic block dia. Of microcontroller. 1.b. Draw and explain basic block diagram of micro Computer system. 1.c. Compare the microcontroller With microprocessor. 1.d. Give the specification of basic microcontroller and Microprocessor.	1.1. Microprocessor : general idea and Block diagram. 1.2. Block diagram of a micro Controller. 1.3. Introduction to micro controller. 1.4. Operating principle. 1.5. Comparison between microprocessor and micro Controller.

Unit– II 8051 Microcontroller Hardware	2.a. Write the specification and features of microcontroller 8051.
	2.b. Draw and explain microcontroller 8051 Hardware model.
	2.c. Draw and explain Programming model of 8051.
	2.d. Draw and explain pin-out Diagram of 8051.
	2.e. Describe the ceramic Resonant circuit in 8051.
	2.f. Describe the all special function registers with Figure.
	2.g. Draw and explain Internal RAM organization and ROM.
	2.h. Elaborate all ports with pin Configuration and circuit.
	2.i. Describe the external memory interfacing with 8051.
	2.j. Explain all timer modes of 8051.
	2.k. Understand serial communication of microcontroller 8051 with External peripheral devices.
	2.l. Evaluate all serial communication modes in 8051.
	2.m. Explain need of interrupts And its type in detail.
		2.1 Introduction.
		2.2 8051 micro controller hardware.
		2.3 8051 block diagram.
		2.4 8051 Programming model.
		2.5 8051 DIP Pin assignment.
		2.6 8051 oscillator and clock.
		2.7 Ceramic resonator oscillator Circuit.
		2.8 Program counter and data pointer.
		2.9 A and B CPU registers.
		2.10 Flags and the program status Word (PSW).
		2.11 Internal memory.
		2.12 Internal RAM.
		    2.12.1. Internal RAM Organization.
		2.13 Stack and stack pointer.
		2.14 Special function registers.
		2.15 Internal ROM.
		2.16 Input / output Pins Ports and Circuits.
		    2.16.1.Port 0 Pin configuration
		    2.16.2. Port 1 pin configuration
		    2.16.3. Port 2 pin configuration
		    2.16.3. Port 3 pin configuration
		2.17 External memory.
		    2.17.1. Connecting external memory
		2.18 Counters and timer.
		    2.18.1. TCON and TMOD function registers
		    2.18.2.TCON (Timer control) function registers
		    2.18.3. TMOD Time mode control Function

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics

		Register
		    2.18.4. Timer counter interrupts
		    2.18.5. Timer mode 1, 2 & 3
		2.19 Serial Data input / output.
		2.20 Interrupts.
		    2.20.1. Introduction
		    2.20.2. Types of interrupts

Unit– III Moving Data Instruction Set.	3.a. Classify various Instruction set. 3.b. Describe different instruction syntax and It's memory Occupation. 3.c. Write a simple programs Using different instructions. 3.d. Explain different addressing modes and Demonstrate data moving Instructions.	3.1 Addressing Modes. 3.2 External Data Moves. 3.3 Code memory Read-only Data Moves. 3.4 Push and Pop opcodes. 3.5 Data exchanges. 3.6 Example programs.
Unit – IV Arithmetic and Logical Operations	4.a. Describe different types of programming techniques & write simple programs on different programming Techniques.	4.1 Byte Level Logical Operation. 4.2 Bit Level Logical Operation. 4.3 Rotate and Swap Operation. 4.4 Flags. 4.5 Incrementing and Decrementing. 4.6 Additions. 4.7 Subtraction. 4.8 Multiplications and Division. 4.9 Decimal Arithmetic. 4.10 Example Programs. 4.11 Jump and Call Program Range. 4.12 Calls and Subroutines. 4.13 Interrupts and Returns.

Unit – V Biomedical Applications using Microcontroller	5.a. Elaborate microcontroller Design and specifications.
	5.b. Describe the microcontroller interfacing with external peripherals like keyboard, LCD, LED, ADC etc.
	5.c. Draw and explain Patient data acquisition system using 8051.
		5.1 Micro controller specifications.
		5.2 A micro controller design.
		    5.2.1. External memory and memory space decoding
		    5.2.2 Reset and clock circuit
		    5.2.3 Expanding I/O
		5.3 Interface keyboards to 8051 based Micro controller.
		5.4 Interface LED & LCD display.
		5.5 Interface the micro controller System to A/D and D/A Converters.
		5.6 Patient data acquisition systems.

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 to microcontrollers	08	06	04	02	12
II	8051 microcontroller hardware	16	14	05	04	23
III	Moving Data Instruction Set	08	02	03	02	07
IV	Arithmetic and Logical Operations	10	02	04	08	14
V	Biomedical Applications using microcontroller	14	02	02	10	14
	Total	**56**	**26**	**18**	**26**	**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

S. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Hrs. required
1	II	Check the 8051 oscillator circuit and timing diagram.	02
2	II	Develop Timer / counter control logic using 8051.	02
3	II	Interface External memory circuit with 8051.	02
4	II	Check interrupts circuits using 8051.	02
5	III	Use commands to move data for for the biomedical applications using 8051.	02
6	IV	Perform addition programming using 8051.	02
7	IV	Perform subtraction programming using 8051.	02
8	IV	Perform multiplication and division programming using 8051.	02
9	III	Demonstrate byte and bit logical operation using assembly level programming.	02
10	V	Interface LED display using 8051.	02
11	V	Interface A to D converter using 8051.	02
12	V	Interface D to A converter using 8051.	02

S. No.	Unit No.	Practical Exercises (Outcomes in Psychomotor Domain)	Hrs. required
13	V	Interfacing Matrix Keyboard using 8051.	02
14	V	Interfacing LED and LCD Displays with 8051.	02
15	V	Interfacing stepper motor with 8051 and test.	02
16	V	Program the flash memory in 8051.	02
17	V	Write assembly language program for the given application in bio medical instrumentation using 8051 and test	02
Total (Perform any practical for total 28 hours so that most units are covered)			**34**

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:
  i. Student should perform various tasks related to microcontroller 8051 in laboratory.
 ii. Student should perform various practical using 8051 trainer kit in laboratory.

9. SPECIAL INSTRUCTIONAL STRATEGIES (if any)
   i. Class Test
  ii. Assignment
 iii. Seminar/Symposium
  iv. Collection/Records
   v. Group discussion/Debate
  vi. Continuous evaluation of lab activity
 vii. Arranging Industrial visit.

10. SUGGESTED LEARNING RESOURCES
A) List of Books

S. No.	Title of Book	Author	Publication/Year
1.	The 8051 Micro controller Architecture, Programming and Applications	Ayala, Kenneth J.	Wiley Eastern, Ltd. New Delhi, Latest edition
2.	Microprocessor and Micro controllers	Singh, B. P.	TMH, New Delhi, Latest edition
3.	The 8051 Microcontroller and Embedded Systems : Using Assembly and C	Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay	Pearson Education India, New Delhi, Latest edition
4.	8051 Microcontrollers: MCS51 family and its variants by,	Shah, Satish	Oxford University Press, New Delhi, Latest edition
5.	8051 Microcontroller: Internals, Instructions, Programming and Interfacing	Ghoshal, Subrata	Pearson Education, New Delhi, Latest edition
6.	The 8051 Microcontrollers: Architecture, Programming and Applications	Rao, K Uma, Andhe Pallavi	Pearson Education, New Delhi, Latest edition
7.	Bio Medical Instrumentation and measuremens 2 ed	Jog	EEE (PHI)

B)   List of Major Equipment/ Instruments with Broad Specifications

   i.   Microcontroller Trainer Kit with bio medical instrumentation application interfacing cards for (ECG, Heart Rate, Blood Pressure , Temperature).
  ii.   Computer
 iii.   Printer

C)   List of Software/Learning Websites

   i.   http://www.electronics-tutorials.com/
  ii.   http://www.efymag.com/
 iii.   Microcontroller Simulators like Keil C51 software, EdSim51DI^{TM} Simulator, MCU 8051 IDE ,etc.
  iv.   seminarprojects.net/c/application-of-microcontroller-in...
   v.   www.ijareeie.com/upload/2014/january/10_Biometric.pdf
  vi.   www.datasheetarchive.com/**biomedical**%20using%20microcontroller-dat.
 vii.   www.ti.com/lit/ml/slyp161/slyp161.pdf
viii.   grietinfo.in/.../6-DOC-MICROCONTROLLER%20BASED%20PATIENT.

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

   Faculty Members from Polytechnics

- **Prof. N.D. Makwana**, Lecturer, Dept. of Biomedical Engineering, G.P.Gandhinagar
- **Prof. A.K. Bula**, Lecturer, Dept. of Instrumentation Engineering, G.P.Gandhinagar
- **Prof. M.H. Dave**, Lecturer ,Dept. of Biomedical Engineering, G.P.Gandhinagar
- **Prof. S.S. Malkan** Lecturer, Dept. of Biomedical Engineering, G.G.P.Ahmedabad
- **Prof. B .C. Changela**, Lecturer, Dept of Biomedical engineering, A.V.P.T.I. Rajkot

   Faculty Members from NITTTR

- **Prof. (Mrs.) Susan S. Mathew,** Associate Professor, Dept. of Electrical and Electronics Engineering.
- **Prof. (Dr.) Joshua. Earnest,** Professor, Department of Electrical and Electronics Engineering.