GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI

Course Title: Microcontrollers-8051
(Course Code: 4362001)

Diploma programmer in which this course is offered	Semester in which offered
Mechatronics Engineering	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 equipment's 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 Troubleshoot various applications based on 8051 microcontroller.**

1. 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.

i. Identify features of various microcontroller
ii To Study Various Instructions Regarding 8051 Microcontroller.
iii. Write and Execute Assembly Language programs for given application.
iv. Identify Various Special Function Registers for given application.
v. Interface 8051 Microcontroller with hardware for given application.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	30*	70	25	25	150

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

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

5. SUGGESTED PRACTICAL EXERCISES:

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.

Sr. No	Unit No	Practical/Exercise (Outcomes in Psychomotor Domain)	Approx. Hrs
1.	I	Introduction to EdSim Software	2
2.	II	Execute assembly language programs based on Internal Data transfer Instructions (Data moves)	2
3.	II	Execute assembly language programs based on Internal Data transfer Instructions (Data exchange)	2
4.	II	Execute assembly language programs based on External Data transfer Instructions with memory (e.g. MOVX, MOVC)	2
5.	III	Develop and execute assembly language programs based on Arithmetic Instructions (e.g. 8 bit Addition , Subtraction, Multiplication, Division)	2
6.	III	Develop and execute assembly language programs based on Logical Instructions (AND, OR etc.)	2
7.	III	Develop and execute assembly language programs based on Rotate and Swap Instructions	2
8.	III	Write a Program to Find Maximum Number.	2
9.	V	Interface LED with 8051	2
10.	V	Interface a relay with 8051	2
11.	V	Interface LCD Module with 8051	4
12.	V	Interface a DC Motor with 8051	4
Total (Hours) -			**28**

Note: I. More Practical Exercises can be designed and offered by the respective course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a representative list.

II. Care must be taken in assigning and assessing the study report as it is a Second-year study report. The study report, data collection, and analysis report must be assigned to a group. A teacher has to discuss the type of data (which and why)before the group starts their market survey.

The following are some sample 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above-listed Practical Exercises of this course required, which are embedded in the Cos and ,ultimately, the competency.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
Experimentation/performance type PrOs (PrOs Number: 2,3,4,5,6,7,8,9,10 &11)		
1	Knowledge	30
2	Quality of Report	30
3	Participation	20
4	Punctuality	20
Total		**100**
For Demonstration type PrOs (PrOs Number: 1&12)		
1	Knowledge	20
2	Procedure follows	30
3	Observation Skill	20
4	Conclusion/ Summary	10
5	Quality of Report	10
6	Punctuality	10
Total		**100**

Sample rubrics Performance Indicators for the PrOs

Demonstration type PrOs (PrOs Number 1 &12)					
Criteria	**%**	**10**	**9-8**	**7-6**	**5**
Knowledge	30%	Students give the correct answers 90% or more	Student give the correct answers between 70-89%	Student give the correct answers between 50-69%	Student give the correct answers less than 50%

Quality of Report	30%	Neat Handwriting, figure, and table. Complete labeling of figure and table.	Only formatting is not proper (Location of figures/tables, use of pencil and scale)	A few required elements (labeling/ notations) are missing	Several require elements (content in paragraph, labels, figures, tables) are missing
Participation	25%	Excellent focused attention in the exercise	Moderately focused attention on exercise	Focused limited attention in the exercise	Participation is minimum
Punctuality	15%	Timely Submission	Submission late by one laboratory	Submission late by two laboratories	Submission late by more than two laboratories

Experimentation/performance type PrOs (PrOs number 2,3,4,5,6,7,8,9,10 & 11)					
Criteria	**%**	**10**	**9-8**	**7-6**	**5**
Knowledge	20%	Student give the correct answers 90% or more	Student give the correct answers between 70-89%	Student give the correct answers between 50-69%	Student give the correct answers less than 50%
Procedure follows	30%	Student follow all the procedure with precaution in a logical order	Student follow all the procedure with some precaution in a logical order	Student follow all the procedure without precaution in a logical order	Student follow all the procedure without precaution in an illogical order
Observation Skill	20%	Excellent focused attention in the exercise	Moderately focused attention on exercise	Focused limited attention in the exercise	Participation is minimum

Conclusion/ Summary	10%	Student concept is mostly clear	Student concept is partly clear	Student concept is somewhat clear	Student concept is not clear
Quality of Report	10%	Neat Handwriting, figure, and table. Complete labeling of figure and table.	Only formatting is not proper (Location of figures/tables, use of pencil and scale)	A few required elements (labeling/ notations) are missing	Several require elements (content in paragraph, labels, figures, tables) are missing
Punctuality	10%	Timely Submission	Submission late by one laboratory	Submission late by two laboratories	Submission late by more than two laboratories

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr.No.	Equipment Name with Broad Specifications	PrO. No.
1	8051 Simulator tool EdSim51, Keil, MCU8051IDE	
2	Computer System Pentium-IV and latest version	
3	Interfacing Cards Seven Segment Display, Keyboard, LCD	
4	Application Board using 8051 microcontroller External Memory Interface, DC Motor, Stepper Motor	

7. AFFECTIVE DOMAIN OUTCOMES

The following sample Affective Domain Outcomes (ADOs) are embedded in many of the COs mentioned above and PrOs. More could be added to fulfill the development of this course competency.

a. Work as a leader/team member.
b. Follow safety practices.
c. Follow ethical practices
d. Maintain tools and equipment
e. Practice environment-friendly methods and processes.(Environment related)

The ADOs are best developed through laboratory/field-based exercises. Moreover, the level of achievement of the ADOs, according to Krathwohl's' Affective Domain Taxonomy, 'should gradually increase as planned below:
I. 'Valuing Level' in 1st year
II. 'Organization Level' in 2nd year.
III. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY:

Based on the higher level UOs of Revised Bloom's taxonomy formulated for developing COs and competency, the primary underpinning theory is given below. If required, more such UOs could be included by the course teacher to focus on attaining COs and competency.

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 and reset of 8051. 1d. Sketch internal memory organization of 8051	1.1 Block diagram of 8051 1.2 Program Status Word of 8051 1.3 Pin Diagram of 8051 1.4 Clock and Reset of 8051 1.5 Internal RAM Organization of 8051
Unit – II **8051 Instruction Set**	2a. Classify addressing modes of 8051 with example 2b.Sort the Instruction set of 8051as per functions performed by them 2c.Differentiate Stack, Stack Pointer and its operation 2d.Classify Bit Level and Byte Level instructions 2e. Describe Jump 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 Jump and Call range
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 format of SCON 4c.Develop program to transmit and receive character serially 4d. Describe format of IE and IP 4e. Classify types of interrupts with their vector address 4f.Describe format of PCON	4.1Timers/Counters Registers(TMOD, TCON) 4.2 Modes of Timers/Counters Serial Data Communication (SCON) 4.3 Program to transmit data serially 4.4 Program to receive data serially Types of Interrupt (IE, IP)
Unit – V **8051 Applications**	5a.Interface External memory with 8051 5b.Interface Display Devices with 8051 5c.Interface Keyboard with 8051 5d.Interface Motors with 8051	5.1 External Memory Interfacing 5.2 LED Interfacing 5.3 LCD Interfacing 5.4 4 x 4 Matrix Keyboard Interfacing 5.5 Relay Interfacing 5.6 DC Motor Interfacing

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN:

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	8051 Architecture	08	04	08	04	16
II	8051 Instruction Set	10	06	06	02	14
III	8051 Programming	06	02	04	06	12
IV	8051 Special Function Register	10	02	06	06	14
V	8051 Applications	08	02	02	10	14
Total		**42**	**16**	**26**	**28**	**70**

10. SUGGESTED STUDENT ACTIVITIES

Sr. No.	Activity
1	Prepare journals based on practical performed in laboratory.
2	Prepare chart to represent the instruction set of 8051 microcontroller.
3	Prepare a Power point Presentation of given topic.
4	Show a dynamic animation to illustrate the following • Relay Interfacing • LCD Interfacing • Stepper Motor • DC Motor Interfacing

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Sr. 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	8051Programming	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	Live projects, Video Lectures with the help of internet.

12. SUGGESTED Micro-PROJECT LIST

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her at the beginning of the semester. In the first four semesters, the micro-projects are group-based (groups of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based, or field-based. Each micro-project should encompass two or more COs which are, in fact, an integration of PrOs, UOs, and ADOs. Each student must maintain a dated work diary consisting of individual contributions to the project work and give a seminar presentation before submission. The duration of the micro project should be about **14-16** ***(fourteen to sixteen) student engagement hours*** during the course. The students ought to submit a micro-project by the end of these semester to develop the industry-oriented COs.

A representative list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher or using suggested student activity.

A representative list of micro-projects is given here. The concerned faculty could add similar micro-projects in any form (chart/presentation/report/model):

1) Student Must Prepare using Simulation software according to 8051 Instructions.

2) Student Prepare a PPT Topic given by the Subject Teacher.

13. SUGGESTED LEARNING RESOURCES

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

14. 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/embcs/the-8051-microcontroller-314772782.pdf

15. PO-COMPETENCY-CO MAPPING:

Semester VI	Microcontroller - 8051 (Course Code:4362001)						
	POs						
Competency & Course Outcomes	PO1 **Basic and Discipline specific knowledge:**	PO2 **Problem analysis**	PO3 **Design/ development of solutions**	PO4 **Engineering Tools, Experimentation and Testing**	PO5 **Engineering practices for society, sustainability and environment**	PO6 **Project Management**	PO7 **Life-long learning**
Competency	**Design and Troubleshoot various applications based on 8051 microcontroller.**						
Course Outcomes CO1	3	-	1	1	2	-	3

Identify features of various microcontroller							
CO2 To Study Various Instructions Regarding 8051 Microcontroller.	2	3	-	-	1	2	-
CO3 Write and Execute Assembly Language programs for given application.	2	3	2	2	-	2	1
CO4 Identify Various Special Function Registers for given application.	2	1	-	1	-	-	-
CO5 Interface 8051 Microcontroller with hardware for given application.	1	3	3	3	2	3	2

*Legend: '**3'** for high, '**2**' for medium, **'1'** for low and **'-'** for no correlation of each CO with PO.*

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

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