GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Microprocessor & Microcontroller Systems
(Course Code: 1333202)

Diploma programme in which this course is offered	Semester in which offered
Information & Communication Technology	3rd semester

1. RATIONALE

The engineering technologists (i.e. diploma engineering holders) have to develop skills for system design of Automatic circuit operations in various fields. Microprocessors & Microcontroller are the sole of all embedded electronic equipment and are 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 system maintenance competency among students.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Demonstrate microprocessor-based system.**
- **Implement microcontroller-based system/equipment.**

3. COURSE OUTCOMES (COs)

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 basic features of microprocessor
ii. Explain architecture and working of microprocessor
iii. Illustrate microcontroller internal architecture
iv. Write and execute assembly language programs(software) for given application
v. Interface microcontroller with hardware for microcontroller-based system

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	-	2	4	30	70	25	25	150

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

5. SUGGESTED PRACTICAL EXERCISES

*Some of the **PrOs** marked **'*'** are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Explore various blocks of Microprocessor System.	I	02*
2	Learn architecture and pin diagram of Microprocessor chip 8085.	II	02*
3	Learn architecture and pin diagram of Microcontroller chip 8051.	III	02*
4	Use 8051 Simulation tool / Trainer kit for running ASM programs.	IV	02*
5	Write and execute assembly language programs based on Data transfer Instruction	IV	02*
6	Develop assembly language programs based on Arithmetic Instructions (e.g. 8 bit Addition, Subtraction, Multiplication, Division)	IV	02*
7	Develop Assembly Language Programs based on Logical Instructions (And, Or etc.)	IV	02*
8	Develop Assembly Language Programs based on Branch Instructions	IV	02
9	Develop Assembly Language Programs to introduce delay (e.g.1ms Delay) using Timer/Counter	IV	02*
10	Develop Programs for serial communication	IV	02
11	Develop a program to interface LED with 8051	V	02*
12	Develop a program to interface 7 segment Display with 8051	V	02*
13	Develop a program to Interface 8 bit DAC and ADC with 8051	V	02*
14	Develop a program to interface a DC Motor with 8051	V	02
15	Develop a program to interface LCD Module with 8051	V	02*
16	Develop a program to interface a LM35 with 8051	V	02
	Total		**32**

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 suggestive list**.**

ii. 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.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Lab Records	05
2	Question answer or Writing steps exercise	20
3	Executing of exercise	40
4	Printout/ Result	20
5	Viva voice	15
Total		**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

I. Computer

II. Projector

III. Trainer Kit

LIST OF SOFTWARE

I. Free Simulation tools

7. AFFECTIVE DOMAIN OUTCOMES

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

a) Work as a leader/a team member.

b) Follow ethical practices.

The ADOs are best developed through the 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

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students

and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Introduction to Microprocessor	1 a Introduce Microprocessor 1 b Describe Microprocessor & Microcomputer Architecture 1 c Microprocessor Architectures. 1 d Introduction to Instruction format	1.1 Definition & History of Microprocessor 1.2 CPU, Control Unit, Arithmetic logic Unit (ALU), Memory Unit, Power Unit and Input-Output unit 1.3 Von neumann & Harvard 1.4 RISC & SISC 1.5 Opcode, Operand, Instruction cycle, Machine cycle & T state
Unit – II Working of 8085 Microprocessor	2 a Describe Pins diagram of 8085 2 b Explain block diagram of 8085 2 c Working of 8085 Microprocessor 2 d Differentiate Microprocessor & Microcontroller	2.1 8085 microprocessor Pins, Address bus, Data bus, Control bus & Signals 2.2 Block diagram 2.3 Registers, Accumulator, Flags, Program Counter, Stack pointer, memory 2.4 Demultiplexing 2.5 Instruction fetching operation 2.6 Decoding and Execution of Instruction 2.7 Comparison of Microprocessor & Microcontroller
Unit– III Microcontroller Architecture	3 a Describe common features of Microcontrollers 3 b Explain functions of each block of 8051microcontroller 3 c Explain Pin Diagram of 8051 3 d Differentiate Stack, Stack Pointer and stack operation	3.1 Common features of Microcontrollers: On-chip Oscillator, program and data memory, I/O Ports, Reset, SFRs, Timers, Counters, Interrupts 3.2 Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports 3.3 Functions of each pin of 8051 3.4 Stack, Stack Pointer and Stack operation

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
	3 e Describe modes of operation of Timers/Counters, Serial Communication & Interrupt	3.5 Timers/Counters logic diagram and its operation in various modes 3.6 Serial communication modes, Interrupt Vector Address, Priority & Operations
Unit– IV **8051 Programming**	4 a Classify addressing modes of 8051 with example 4 b Define Instruction set of 8051as per functions performed 4 c Develop simple programs to perform the following operations: Data manipulation, Masking, Stack operation, Conditional execution	4.1 Addressing Modes: Immediate, Register, Direct, Indirect, Indexed, Relative and bit addressing 4.2 Instruction set: Data Transfer, Arithmetic, Logical, Branching, and Machine Control 4.3 Data manipulation, Masking, Stack operation, Conditional programming
Unit-V Interfacing & Microcontroller System	5 a Interface Input Devices with 8051 microcontroller 5 b Interface Output Devices with 8051 microcontroller 5 c Interface ADC & DAC with 8051 microcontroller 5 d Interface sensors & actuators with 8051 microcontroller 5 e List Various 8051 Applications	5.1 Push button Switch 5.2 Relay, LED, 7 segment LED, LCD 5.3 DAC0808, ADC0804 5.4 Room Temperature Controller System: LM35, ADC0804, Relay 5.5 Application of microcontroller in various field

9. SUGGESTED SPECIFICATION TABLE FOR QUESTIONPAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
1	Introduction to Microprocessor	6	4	4	2	10
2	Working of 8085 Microprocessor	12	8	6	4	18
3	Microcontroller Architecture	8	6	5	5	16
4	8051 Programming	10	5	6	5	16
5	Interfacing & Microcontroller System	6	2	4	4	10
Total		**42**	**25**	**25**	**20**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)*

10. SUGGESTED STUDENT ACTIVITIES

Other than the laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of each activity.

i) Prepare journals based on practical performed in laboratory.

ii) Prepare chart to represent the block diagram of different interfacing chips. Develop a practical application using 8051 Microcontroller

iv) Prepare General purpose board with all ports available as connector v) Prepare/Download a dynamic animation to illustrate the following

- Data transfer operation • Keypad Interfacing
- LCD Interfacing. • LM35 Interfacing

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a) Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

b) Guide student(s) in undertaking micro-projects.

c) Some ***of the topics/sub-topics*** is relatively simple and very easy to the students for ***self-learning***, but to be assessed using different assessment methods.

d) With respect to ***section No.09***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.

e) Guide students for using latest Technical Magazine.

f) Arrange visit to relevant industry

g) Show video lectures on Microcontroller Applications with help of internet.

h) Assembly level programming practices on simulators (free downloadable).

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, 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 will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive 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.

MICRO PROJECT 1: Prepare following Items.

1. Prepare Table for Instruction classification.
2. Design a chart of 8085/8051 Architecture.

MIICRO PROJECT 2: Prepare following Designs.

1. Design minimum hardware system for 8051 circuit.
2. Develop 8051 based application board/circuit on PCB.

MICRO PROJECT 3: Design Application oriented basic Project using 8051.

1. Design and Implement LED flasher circuit.
2. Design and Implement circuit for relay-based operation using switch.
3. Design and Implement LCD Interfacing circuit displaying your name on it.
4. Design and Implement Room Temperature controller circuit.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Microprocessor Architecture, Programming,	Ramesh Gaonkar	Penram Publications

S. No.	Title of Book	Author	Publication with place, year and ISBN
	and Applications with the 8085		
2	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Mazidi & Mazidi	Pearson Publication
3	The 8051 Microcontroller	Kenanth Ayala	Cengage Learning India

14. SOFTWARE/LEARNING WEBSITES

a) www.tutorialspoint.com
b) www.javatpoint.com
c) www.electronicshub.org
d) www.circuitdigest.com

15. PO-COMPETENCY-CO MAPPING

Program Outcomes (POs):

1. **Basic & Discipline specific knowledge**: An apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem Analysis:** Identify and analyze well defined engineering problems using codified standard methods.
3. **Design/ Development of Solution:** Design solutions for well-defined technical problems and assist with the design of systems, components or processes to meet specified needs.
4. **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and relevant technique to conduct standard tests and measurements.
5. **Engineering practices for Society, Environment and sustainability**: Apply relevant technology in context of Society, sustainability, environment and ethical practices.
6. **Project Management**: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. **Life-long learning**: Ability to analyze individual needs and engage in updating in the context of context of technological changes.

Program Specific Outcomes (PSOs):

1. Develop proficiency in Installation, maintenance and troubleshooting of elesssctronics and communication systems.
2. Create customized solution of real-life problems using hardware and software.

Semester III	Microprocessor & Microcontroller Systems

Competency & Course Outcomes	POs and PSOs								
	PO 1 Basic & Discipline specific knowledge	**PO 2** Problem Analysis	**PO 3** Design/ development of solutions	**PO 4** Engineering Tools, Experimentation &Testing	**PO 5** Engineering practices for society, sustainability & environment	**PO 6** Project Management	**PO 7** Life-long learning	**PSO 1**	**PSO 2**
Competency ***Use fundamentals of computer applications in various engineering applications***									
i. Identify basic features of microprocessor	3	2	2	2	1	2	2	2	3
i. Explain architecture and working of microprocessor	3	1	2	1	-	2	1	0	1
i. Illustrate microcontroller internal architecture	3	2	2	3	-	2	3	1	2
v. Write and execute assembly language programs(software) for given application	3	2	2	2	-	2	3	1	3
v. Interface microcontroller with hardware for microcontroller-based system	3	3	3	3	1	3	3	2	3

Legend: '**3'** for high, '**2**' for medium, **'1'** for low or **'-'** for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	**Mr. T P Chanpura HOD EC**	**GGP, Ahmedabad**	**9824280515**	**tchanpura@gmail.com**
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