GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Microprocessor and Controller Applications
(Course Code:4360902)

Diploma programmer in which this course is offered	Semester in which offered
ELECTRICAL ENGINEERING	6th

1. RATIONALE

The microprocessor is challenging and very dynamic field. This course explores architecture of a microprocessor and its programming in assembly language. The student will be able to apply logics to various given problems and develop programs using assembly language construct that would help them to develop real time microprocessor based application programs.

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 microprocessor and microcontroller-based applications. Hence this course is designed to achieve the system maintenance competency among students.

Under this subjects Architecture and instruction sets of 8 bit processor have been discussed. Microcontroller (MC) may be called computer on the chip since it has basic features of a microprocessor with internal ROM, RAM, Parallel and serial ports within a single chip. Microcontroller is a programmable digital processor with necessary peripherals. Both microcontrollers and microprocessors are complex sequential digital circuits meant to carry out job according to the program / instructions. Sometimes analog input/output interface makes a part of microcontroller circuit of mixed mode (both analog and digital nature).

2. 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:

- **Maintain microprocessor-based system.**
- **Maintain 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 :-Interpret the salient features of 8085 microprocessor.

       II :- Interpret the salient features of 8051 microcontrollers.

       III :- Apply knowledge of microprocessor and microcontroller in various applications.

       IV :-Maintain PLC and SCADA 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	0	2	4	30	70	25	25	150

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.

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

5. SUGGESTED PRACTICAL EXERCISES:

The following practical outcomes (PrOs) are the sub-components of the Course Outcomes (Cos)

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1	Explore various blocks of Microprocessor System.	I	2
2	Demonstrate the architecture of 8085 microprocessor.	I	2
3	Test and verify the features of 8085 Trainer Kit.	I	2
4	Test and verify the features of 8051 Trainer Kit.	II	2
5	Identify various pin of Microprocessor chip 8085.	I	2

6	Identify various pin of Microcontroller chip 8051.	II	2
7	Learn architecture of Microcontroller chip 8051.	II	2
8	Demonstrate of kit/simulator of 8085.	I	2
9	Use 8085 Simulation tool / Trainer kit for running ASM programs.	I	2
10	Develop assembly language program for arithmetic addition of two 8-bit numbers using µP 8085 kit/8085 Simulator.	I	2
11	Develop assembly language program for arithmetic subtraction of two numbers using µP 8085 kit/8085 Simulator.	I	2
12	Develop assembly language program for arithmetic multiplication of two numbers using µP 8085 kit/8085 Simulator.	I	2
13	Develop assembly language program to find One's Complement of an 8-bit Number.	I	2
14	Develop assembly language program to find Two's Complement of an 8-bit Number.	I	2
15	Use 8051 Simulation tool / Trainer kit for running ASM programs.	II	2
16	Implement a program to exchange the content of two memory locations.	I	2
17	Implement a program to perform Exclusive OR of two numbers.	I	2
18	Use 8085 microprocessor for SCR firing angle control.	III	2
19	Design 1-kilobyte Memory Interface with 8085 microprocessor.	III	2
20	Use arithmetic function of PLC for a typical application	IV	2
21	Use timer function of PLC for a typical application(introduce delay).	IV	2
22	Develop an application of PLC using Up-Down Counter.	IV	2
23	Study hardware and software associated with PLC.	IV	2
24	Understand Simple Ladder program of PLC using kit/Virtual lab.	IV	2
25	Study computational / arithmetic instructions used in PLC ladder programming using kit/Virtual lab.	IV	2
	Minimum10 Practical Exercises		28

Note:

a) More Practical Exercises can be designed and offered by there respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.

b) 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 %
1	Prepare and operate experimental setup	30
2	Follow safe practices	10
3	Executing of exercise	30
4	Interpret the result and conclude	10
5	Quality of Answer related to experiment(Q&A)	20
	Total	100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

Sr.No.	Equipment Name with Broad Specifications
1	8085 microprocessor trainer kit with necessary accessories.
2	Microcontroller 8051 trainer kit with necessary accessories.
3	Free simulation tools
4	Computer System
5	Multimedia Projector
6	Kit for add on cards for performing different applications of PLC.
7	Power supply for above kits and applications

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 course competency.

    a) Work as a leader/a team member(while doing a micro-project).
    b) Follow ethical practices.
    c) Work as a group member (while performing experiments and taking readings).
    d) Practice environmental friendly methods and processes. (Environment related).

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.   'ValuingLevel'in1styear
    II.   'OrganizationLevel'in2ndyear.
    III.   'CharacterizationLevel'in3rd year.

8. UNDERPINNING THEORY:

The major underpinning theory is given below based on the higher level UOs of *Revised Bloom's taxonomy* that are formulated for development of the Cos and competency. If required, more such UOs could be included by the course teacher to focus on attainment of CO s and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit I: Basics of Microprocessor	1a.Distinguish between a microprocessor and a microcomputer. 1b.List advantages and disadvantages of microprocessor control.	1.1 Introduction of Microprocessor, microcomputer. 1.2 Von-Neumann architecture 1.3 Advantages and disadvantages of microprocessor control.
	1c.Explain microprocessor based system with bus Architecture. 1d. Define various buses and their functions	1.4 Organization of a Microprocessor-Based System. 1.5 CPU, Control Unit, Arithmetic logic Unit (ALU), Memory Unit, Power Unit and Input-Output unit. 1.6 Concept of Bus, Microprocessor Bus organization : Data Bus, Address Bus and Control Bus.
	1e.Explain the difference between machine language and assembly language of the 8085 microprocessor. 1f. Explain low level language and high level language. 1g. Describe ASCII code.	1.7 Define machine language ,assembly language, low level language and high-level language. 1.8 Define ASCII code.

	1h.List the operations of microprocessor	1.9 Operations of microprocessor: internal data operations, microprocessor initiated operations and peripheral or external initiated operations.
	1i. Describe Pins diagram of 8085 microprocessor.	1.10 Pin details of 8085 and related signals.
	1j.Explain block diagram of 8085 microprocessor. 1k. Classify interrupts. 1l. Explain various flags in 8085 microprocessor. 1m.Explain Demultiplexing of Address/Data Bus. 1n. Describe Working of 8085 microprocessor.	1.11 Architecture of intel-8085- registers, timing and control, add buffer and add data, decoders, interrupts, serial input and output control. 1.12 Registers, Accumulator, Flags, Program Counter, Stack pointer, memory 1.13 Demultiplexing of address and data bus by ALE signal. 1.14 Instruction fetching operation 1.15 Decoding and Execution of Instruction
	1o. Interpret addressing modes and operations with various types of instruction. 1p. Classify Instruction Word Size 1q. Develop simple assembly language programs	1.16 List Various addressing modes 1.17 Instruction set of 8085. 1.18 Instruction Word Size 1.19 Simple programs with 8085 instruction (only simple arithmetic operations- addition, subtraction, One's Complement, Two's Complement)
UNIT: II. Basics of Microcontroller 8051	2a.Describe the function of each pins of 8051 chip	2.1 Introduction to microcontroller. 2.2 Pin diagram of 8051 microcontroller and Functions of each pin of 8051.
	2b.Explain 8051 architecture with block diagram. 2c.Explain brief internal memory and external memory in reference to 8051 microcontroller. 2d. Define Special Function Registers in 8051	2.3 Blocks of Microcontroller 8051: ALU, PC, DPTR, PSW, Internal RAM, Internal ROM, SFRs, General purpose registers, Timer/Counter, Interrupt, Ports. 2.4 Concept of Internal memory and 2.5 External memory (RAM and ROM) 2.6 Internal RAM structure. 2.7 Various registers and SFRs of 8051.

	2e. Differentiate Stack, Stack Pointer and stack operation	2.8 Stack, Stack Pointer and Stack operation
	2f. Describe External Memory Interfacing with 8051. 2g. Compare microprocessors and microcontrollers.	2.9 External Memory Interfacing with 8051. 2.10 Comparison between microprocessor and microcontroller.
UNIT: III Microprocessor and Microcontroller Applications	3a. Compare various types of semiconductor memories. 3b. Explain interfacing of microprocessor with memory. 3c. Explain Data transfer scheme in microprocessor based system. 3d. Describe use of microprocessor/microcontroller for temperature control of furnace 3e. Describe use of microprocessor for SCR firing angle control 3f. Explain Data acquisition system.	3.1 Different types of memories: ROM, RAM, PROM, EPROM, EEPROM. 3.2 Memory Interfacing. 3.3 Data transfer Techniques in microprocessor based system. 3.4 Simple application of microprocessor and microcontroller: 3.4.1 Temperature control of furnace using microprocessor 3.4.2 SCR firing angle control using micro processor, 3.5 Data acquisition system.
UNIT: IV Recent trends in controller.	4a. Explain working of each module of PLC. 4b. Compare relay panel and PLC. 4c. State the criteria for selection of PLC for the given application. 4d. Explain architecture of PLC. 4e. Give advantages and disadvantages of PLC. 4f. List the applications of PLC. 4g. Describe the functions of SCADA. 4h. State the applications of SCADA.	4.1 Introduction of Programmable logic controller 4.2 Basic difference between PLC and digital computer. 4.3 Role of automation in Industries. 4.4 Benefits of Automation 4.5 Necessity of PLC 4.6 History and evolution of PLC 4.7 Difference between relay panel and PLC. 4.8 Simple Block diagram of PLC 4.9 Architecture of PLC 4.10 Inputs/Outputs 4.11 Some terms regarding PLC: Souring and Sinking, Set-Reset, Latch-Unlatch. 4.12 Programming of PLC: Entering programme in PLC. 4.13 Advantages and disadvantages of PLC 4.14 Types of PLC 4.15 Selecting a PLC

		4.16 Applications of PLC 4.17 Introduction to SCADA 4.18 SCADA functions 4.19 Components of SCADA and Block diagram 4.20 Configuration of communication system 4.21 Applications of SCADA.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN:

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Basics of Microprocessor	14	8	10	6	24
II	Basics of Microcontroller 8051	10	7	7	2	16
III	Microprocessor and Microcontroller Applications	10	6	6	4	16
IV	Recent trends in Controller	08	5	7	2	14
	Total	42	26	30	14	70

Legends:*R=Remember,U=Understand,A=Applyandabove(RevisedBloom'staxonomy)*

> ***Note****:Thisspecificationtableprovidesgeneralguidelinestoassiststudentsfortheirlearnin gandtoteacherstoteachandquestionpaperdesigners/setterstoformulatetestite ms/questionstoassessthe attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, UandA)in thequestion paper mayslightlyvaryfrom abovetable.*

10.   SUGGESTED STUDENT ACTIVITIES
Following is the list of proposed student activities like:
  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.
iii. Develop any module of to be useful in real life applications.
 iv. Multimedia presentation of module developed by the students.
  v. Library/E-book survey regarding assembly language programming used in computer industries.

vi. Prepare power point presentation for showing different types of Assembly language programming applications.

vii. Undertake a market survey of different devices based on microprocessor and microcontroller applications.

viii. Find and utilize web based/simulator, android application related to microprocessors and microcontrollers.

ix. Interface microprocessor and microcontroller with external devices for developing mini project.

x. Prepare chart and assembly language programming for basic arithmetic operations.

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) Guide students for using latest Technical Magazine.

e) Arrange visit to relevant industry

f) Show video lectures on Microprocessor and Microcontroller Applications with help of internet.

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

12.   SUGGESTED PROJECT LIST:

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. Students groups have to be formed for micro-projects, the number of students in the group should *not exceed four.*

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. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course. The student have 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. Similar micro-projects could be added by the concerned course teacher.

MICRO PROJECT 1: Prepare following Items.

1. Prepare Table/chart for Instruction classification.
2. Design a chart for pin diagram of 8085 microprocessor.
3. Design a chart of 8085/8051 Architecture.
4. Design a chart for pin diagram of 8051 microcontroller.

5. Test and verify the features of 8085 Trainer Kit.
6**.** Test and verify the features of 8051 Trainer Kit.

MICRO 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 Water Level Indicator/controller circuit.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Microprocessor Architecture, Programming, and Applications with the 8085	Ramesh Gaonkar	Penram Publications
2	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Mazidi&Mazidi	Pearson Publication
3	The 8051 Microcontroller	Kenanth Ayala	Cengage Learning India
4	Microprocessor and interfacing (Programming and hardware)	Hall, Douglas V.	McGraw Hill Education.
5	Microprocessors and microcontrollers	Latha, c., Murugeshwari,B.	SCITECH PUBLICATIONS, CHENNAI.
6	Microprocessor and its application	Ram, B.	BPB, New Delhi, latest edition
7	Microprocessors and Microcontrollers	Kumar, Senthil, Saravanan, Jeevananthan	Oxford University , New Delhi, latest edition
8	Introduction to Microprocessor	Mathur, A.P.	TMH, New Delhi, latest edition

9	Programmable Logic Controllers And Applications	Webb, John W Ronald Reis. A.	Prentice Hall of India, New Delhi, (latest Edition)
10	Programmable Logic Controllers Programming Methods and Applications	John R. Hackworth, Frederick D., Hackworth Jr.,	PHI Publishers
11	SCADA supervisory control and data acquisition	Stuart A Boyer	ISA, 4th Revised edition
12	Introduction to Programmable Logic Controllers	Gary Dunning	Thomson, Latest Edition
13	Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086,8051,8096	Krishna Kant	PHI Publishers, Latest Edition

14.   SOFTWARE/LEARNING WEBSITES

i.   Simulator such as : http://8085simulator.codeplex.com/ http://gnusim8085.org/ or its equivalent
ii. Latest processor configuration : http://www.intel.com/pressroom/kits/quickreffam.htm
iii. Intel 8085 microprocessor architecture: http://www.cpu-world.com/Arch/8085.html
iv. 8085 sample programs :http://www.8085projects.info/page/free-programs-for-8085-microprocessor.aspx
v.   8085 ppts: http://www.slideshare.net/shashank03/assembly-language-programming-of-8085.
vi. www.tutorialspoint.com
vii. www.javatpoint.com
viii. www.electronicshub.org
ix. www.circuitdigest.com
x.   http://www.academia.edu/
xi. http://www.nptel.iitm.ac.in/
xii. http://www.8051.com/
xiii. www.keil.com/
xiv. www.allaboutcircuits.com
xv. www.nmbtc.com
xvi. http://nptel.ac.in/courses/Webcourse-contents/IIT -KANPUR/microcontrollers/micro/ui/Course_home1_1.htm
xvii. Go for free open source software wherever applicable

15. PO-COMPETENCY-CO MAPPING:

Semester VI	MICROPROCESSOR AND CONTROLLER APPLICATIONS (Course Code:4360902)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/ development of solution	PO4 Engineering Tools, Experimentation& Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency							
Course Outcomes CO1 Interpret the salient features of 8085 microprocessor.	3	2	2	2	-	-	-
CO2 Interpret the salient features of 8051 microcontrollers.	3	-	-	2	-	-	-
CO3 Apply knowledge of microprocessor and microcontroller in various applications.	3	2	2	2	-	-	-
CO4 Maintain PLC and SCADA based system.	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
GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	DIPA J. KAPUPARA Lecturer-Electrical Engg.	A.V.P.T.I. -RAJKOT	6352400310	dipakapupara.ee@gmail.com
2.	DHARA V. SODHA Lecturer-Electrical Engg.	GP-JUNAGADH	9429215260	dharasodha18@yahoo.com