GANPAT UNIVERSITY

FACULTY OF DIPLOMA ENGINEERING

Programme	Diploma in Electronics and Communication Engineering		
Semester	IV	Version	1.0.0.0
Effective from Academic Year	2025-26	Effective for the batch Admitted in	JULY 2025
Course Code	1EC4102	Course Name	Fundamentals of Microprocessor and Microcontroller

I.TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Type	Course Code	Learning Scheme						Assessment Scheme										
		Actual Contact Hrs./Week			SLH	NLH	Credits	Theory				Practical				Based on SL		Total Marks
		CL	TL	LL				FA-TH	SA-TH	TOTAL		FA-PR	SA-PR	TOTAL		SLA		
								MAX	MAX	MAX	MIN	MAX	MAX	MAX	MIN	MAX	MIN	
DSC	1EC4102	3	-	2	3	8	4	40	60	100	40	30	20	50	20	20	8	170

Abbreviation:	**CL**- Classroom Learning	**TL**- Tutorial Learning	**LL**-Laboratory Learning
	SLH-Self Learning Hours	**NLH**-Notional Learning Hours	**SLA**-Self Learning Assessment
	FA-Formative Assessment (Term work + Mid Sem Exam Attendance)		**SA**-Summative Assessment

II. PRE-REQUISITES

The prerequisite for this syllabus is a fundamental understanding of basic electrical circuit laws and Digital Circuits.

III. INDUSTRY /EMPLOYER EXPECTED OUTCOMES

This course provides a comprehensive foundation in the architecture and pin configurations of the 8085 microprocessor and 8051 microcontroller. Students will progress from mastering assembly language programming to the practical interfacing of peripheral devices like sensors, motors, and displays.

IV. COURSE LEARNING OUTCOMES

At the end of the course, students will be able to achieve the following course learning outcomes:

CO1. Understand the architecture of the 8085 microprocessor.
CO2. Understand the architecture and operation of 8051 microcontrollers.
CO3. Develop and execute assembly language programs for 8051.
CO4. Interface I/O and Peripheral Devices with 8051 Microcontroller.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT:

Name of Unit	Theory Learning outcomes (TLO's) aligned to CO's	Learning Content mapped with Theory Learning outcomes (TLO's)&CO's	Marks	Hours
Unit-1: 8085 Microprocessor	**TLO1.1** Understand the basic evolution and applications of microprocessors. **TLO1.2**Trace the historical development of processing units. **TLO1.3** Identify real-world use cases for microprocessors. **TLO1.4**Understand the transition from general-	**1. 1** Introduction to Microprocessors **1.2** Evolution of microprocessors **1.3** Applications of microprocessors **1.4** Evolution of microcontrollers **1.5** Applications of microcontrollers **1.6** Differences: Microprocessor vs. Microcontroller **1.7** 8085 Microprocessor Architecture **1.8** 8085 Pin configuration	**10**	**08**

	purpose to embedded control. **TLO1.5**Identify specific domains where microcontrollers are used. **TLO1.6**Distinguish between microprocessors and microcontrollers based on hardware. **TLO1.7**Analyze the internal architectural design of the 8085. **TLO1.8**Identify and explain the function of each pin on the 8085 IC. **TLO1.9**Describe the flow of data within the internal buses of the 8085. **TLO1.10**Explain the role of the ALU, registers, and timing/control units.	**1.9** 8085 Internal architecture **1.10** 8085 Functional blocks		
Unit-2: 8051 Microcontroller Architecture	**TLO2.1** Define the core concept of a "computer on a chip." **TLO 2.2** List the hardware specifications (RAM, ROM, I/O ports) of 8051. **TLO 2.3** Understand the different versions (8031, 8751, etc.) available. **TLO 2.4** Identify the internal blocks and the 40-pin layout of the 8051. **TLO 2.5** Explain the Harvard architecture (separate program and data memory). **TLO 2.6** Understand direct addressing for internal RAM. **TLO 2.7** Understand indirect addressing using registers like R0 and R1. **TLO 2.8** Comprehend the dual-function nature of the four 8-bit ports. **TLO 2.9** Understand the LIFO mechanism and the SP register operation. **TLO 2.10** Analyze the hardware registers used for timing (T0, T1). **TLO 2.11** Analyze the hardware setup for counting external pulses.	**2.1** Introduction of Microcontroller **2.2** Features of 8051 microcontroller **2.3** Flavours of 8051 microcontroller **2.4** 8051 architecture & pin diagram **2.5** Memory organization **2.6** Direct Access of memory **2.7** Indirect Access of memory **2.8** IO ports (P0, P1, P2, P3) **2.9** Stack and stack pointer **2.10** Timers hardware **2.11** Counters hardware **2.12** Special function registers (SFRs) **2.13** Serial data I/O **2.14** Interrupts	**15**	**11**

	TLO 2.12 Explain registers like ACC, B, PSW, and TMOD. **TLO 2.13** Understand UART communication via TXD and RXD pins. **TLO 2.14** Analyze the 5 interrupt sources and their priority levels.			
Unit-3: 8051 Assembly Language Programming	**TLO 3.1** Understand the complete set of commands recognized by 8051. **TLO 3.2** Identify the five ways of specifying data in instructions. **TLO 3.3** Program the movement of data between registers and memory. **TLO 3.4** Perform calculations like addition, subtraction, and multiplication. **TLO 3.5** Perform bitwise operations like AND, OR, and XOR. **TLO 3.6** Create control loops and conditional jumps in code. **TLO 3.7** Develop complex logic programs using multiple instruction types. **TLO 3.8** Write code to read from and write to physical pins. **TLO 3.9** Develop code to generate accurate time delays using TMOD/TCON. **TLO 3.10** Configure and code for serial data transmission and reception.	**3.1** Instruction set **3.2** Addressing modes **3.3** Data transfer instructions **3.4** Arithmetic operation instructions **3.5** Logic operation instructions **3.6** Branch instructions **3.7**Assembly Programming (Combined) **3.8** I/O Port Programming **3.9** 8051 Timer Programming **3.10** 8051 Serial Port Programming	**20**	**15**
Unit-4: Interfacing with 8051 Microcontroller	**TLO 4.1** Wire and program LEDs for basic output. **TLO 4.2** Develop hardware connections and code for alphanumeric displays. **TLO 4.3** Program inputs to sense user interaction or switch states. **TLO 4.4** Interface high-power devices and sensors for mechatronic control**.**	**4.1** Interfacing display: LEDs **4.2** Interfacing display: 7-Segment and LCD **4.3** Interfacing: DIP and Push Button switches **4.4** Interfacing: Relay, Sensors, and DC motor	**15**	**11**

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL			
SR. NO	**PRACTICAL/LABORATORY LEARNING OUTCOME(LLO)**	**PRACTICAL TITLES**	**RELEVANT Cos**
1	**LLO1.1** Understand the physical hardware layout and functional blocks of the 8085 trainer kit.	**1.1** Understand the physical hardware layout and functional blocks of the 8085 trainer kit.	**CO1**
2	**LLO2.1** Familiarize with the 8051 hardware architecture and the development environment.	**2.1** Familiarize with the 8051 hardware architecture and the development environment.	**CO2**
3	**LLO3.1** Master the data transfer instructions for moving data between registers and memory.	**3.1** Master the data transfer instructions for moving data between registers and memory.	**CO3**
4	**LLO3.2** Perform mathematical operations using assembly language.	**3.2** Perform mathematical operations using assembly language.	**CO3**
5	**LLO3.3** Implement complex math operations in assembly.	**3.3** Implement complex math operations in assembly.	**CO3**
6	**LLO3.4** Understand logical manipulation of data bits.	**3.4** Understand logical manipulation of data bits.	**CO3**
7	**LLO3.5** Implement program flow control and looping structures.	**3.5** Implement program flow control and looping structures.	**CO3**
8	**LLO4.1** Control physical output pins for visual signaling.	**4.1** Control physical output pins for visual signalling.	**CO4**
9	**LLO4.2** Display numerical data on hardware modules.	**4.2** Display numerical data on hardware modules.	**CO4**
10	**LLO4.3** Interface and display alphanumeric strings.	**4.3** Interface and display alphanumeric strings.	**CO4**
11	**LLO4.4** Capture user input through mechanical switches.	**4.4** Capture user input through mechanical switches.	**CO4**
12	**LLO4.5** Control high-power mechanical devices via electrical signals.	**4.5** Control high-power mechanical devices via electrical signals.	**CO4**

VII. SUGGESTED MICRO PROJECT/ASSIGNMENTS/ACTIVITIES FOR SELF LEARNING/SKILL DEVELOPMENT (SELF LEARNING)

Micro Projects (Mini Applications / Use Cases)

1.Traffic Light Controller
Objective: To design and simulate a four-way traffic control system that manages vehicle flow using specific time delays.

2. Digital Clock on LCD
Objective: To create a functional digital clock that displays hours, minutes, and seconds.

3. Password-Based Door Lock System
Objective: To build a security system where a door (simulated by a motor or relay) opens only when a correct 4-digit code is entered.

4. Temperature Controlled Fan
Objective: To automate a cooling fan based on the ambient room temperature.

5. Object Counter using IR Sensor
Objective: To automatically count items moving on a conveyor belt or people entering a room.

Self-Learning / Skill Building Activities

1. Simulation and Software Proficiency

- Keil µVision IDE: Learn to write, compile, and debug 8051 Assembly programs. Use the simulator to observe register changes and memory updates without hardware.
- Proteus VSM: Learn to design virtual circuits by interfacing the 8051 with peripherals (LEDs, Motors, LCDs) to verify hardware-software integration.
- 8085 Simulator: Use web-based or standalone simulators to understand the 8085 flag register behavior and timing diagrams.

2. Hardware Exploration & Data Sheet Analysis

- Data Sheet Mastery: Download and analyze the data sheets for the Intel 8051 and Atmel AT89C51. Identify electrical characteristics, timing requirements, and power-saving modes.
- Pin-out Mapping: Create a comparative chart mapping the physical pins of the 8051 to their secondary functions (like TXD, RXD, INT0, INT1).

3. Advanced Programming Logic (Self-Paced Assignments)

- Look-up Tables: Develop a program to implement a "Square Root" or "Square" look-up table in the 8051 code memory to speed up mathematical calculations.
- Efficient Loops: Study and implement nested loops to create precise software time delays (msec/sec) based on the crystal frequency (11.0592 MHz).
- Code Conversion: Write algorithms to convert hexadecimal data to Decimal (ASCII) for display on an LCD or 7-segment module.

4. Online Courses and Virtual Labs

- NPTEL / SWAYAM: Enroll in the "Microprocessors and Microcontrollers" course by IIT Kharagpur/IIT Bombay to gain deeper theoretical insights.
- Virtual Labs (vlab.co.in): Perform experiments in a virtual environment to understand instruction execution cycles and bus architecture.

5. Industrial Case Studies

- Embedded Systems in Appliances: Research and prepare a report on how a microcontroller manages a specific consumer product (e.g., the control logic of a Microwave Oven or a Washing Machine).
- Comparative Study: Compare the 8051 (CISC) architecture with modern ARM-based (RISC) microcontrollers used in smartphones and IoT devices.

6. Collaborative Learning

- Troubleshooting Workshops: Work in small groups to debug common errors in assembly programming, such as infinite loops, stack overflows, or incorrect addressing modes.
- Technical Seminar: Prepare a presentation on "The Future of 8051 in the IoT Era" or "Evolution of Intel Processors from 8085 to Core i9."

VIII. LIST OF INSTRUMENTS / EQUIPMENT / TRAINER BOARD	
1	Microprocessor and Microcontroller Trainer Boards • 8085 Microprocessor Trainer Kit: Equipped with an onboard 8085 CPU, hex-keypad, 7-segment display, and system bus expansion headers.

	• 8051 Microcontroller Trainer Kit: Features the 8051/8031 core, internal/external memory access switches, and RS232 serial interface for PC communication. • Universal Embedded Trainer: A board capable of supporting multiple ICs (like AT89C51) with integrated breadboard areas for custom prototyping.
2	Interfacing Modules (Application Boards) • LED Interface Module: A board containing 8-16 LEDs to demonstrate I/O port programming. • 7-Segment Display Module: Multi-digit (usually 4-digit) multiplexed 7-segment displays. • LCD Module: 16x2 Character LCD display with backlight control. • Matrix Keypad Module: 4x4 or 3x4 Matrix keypad for user input experiments. • ADC/DAC Module: Hardware for Analog-to-Digital (ADC0804/0808) and Digital-to-Analog (DAC0800) conversion experiments. • Motor Driver Module: L293D or ULN2003 based drivers for controlling DC motors and Stepper motors. • Relay Interface: For controlling high-voltage AC/DC loads via a 5V microcontroller signal.
3	General Laboratory Equipment • Digital Storage Oscilloscope (DSO): To observe signal waveforms, clock pulses, and timing diagrams. • Logic Analyzer: (Optional) To debug complex data transmission and timing on the address/data bus. • Variable DC Power Supply: 0-30V, 2A regulated power supply to power peripheral circuits. • Digital Multimeter: For measuring voltage levels at port pins and checking circuit continuity. • Breadboards and Jumper Wires: For creating temporary connections between trainer kits and external components.
4	Computing and Software Tools • Desktop PC: Required for running development software and downloading code to trainer kits. • Keil µVision IDE: For writing, compiling, and debugging Assembly and C code. • 8085 Simulator: Software tool for virtual execution of 8085 assembly code. • Proteus VSM: For virtual hardware simulation and PCB design. • USB-to-Serial/ISP Programmer: Used to flash the HEX code from the computer onto the microcontroller IC.
5	Component Stock (Consumables) • Microcontroller ICs: Atmel AT89C51/AT89S52. • Sensors: LM35 (Temperature), IR Sensors (TSOP), Ultrasonic sensors. • Passive Components: Assorted Resistors, Capacitors, Crystal Oscillators (11.0592 MHz), and Reset switches.

IX. LIST OF REFERENCE BOOKS			
Sr.No	**Title**	**Author**	**Publication**
1	The 8051 Microcontroller & Embedded Systems using Assembly	K. J. Ayala, D. V. Gadre	Cengage Learning, India Edition
2	Programming and Customizing the 8051 Microcontroller	MykePredko	Tata Mcgraw Hill.
3	Microprocessor Architecture, Programming, and Applications with the 8085	Ramesh Gaonkar	Penram International Publishing (India) LTD
4	The 8051 Microcontroller and Embedded Systems Using Assembly and C	Muhammad Ali Mazidi	Janice Gillispie Mazidi and Rolin McKinlay
5	Microprocessor and Microcontroller	Prof. Saurabh Chaudhury	All India Council for Technical Education.

X. LINK OF LEARNING WEB RESOURCE	
1	1 https://archive.nptel.ac.in/courses/108/105/108105102/
2	https://nptel.ac.in/courses/108107029
3	https://onlinecourses.nptel.ac.in/noc21_ee18/preview

XI. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE							
Unit	**Unit Title**	**Aligned COs**	**Learning Hours**	**R-Level**	**U-Level**	**A-Level**	**Total Marks**
1	8085 Microprocessor	CO1	08	4	6	0	10
2	8051 Microcontroller Architecture	CO2	11	5	10	0	15
3	8051 Assembly Language Programming	CO3	15	4	6	10	20
4	Interfacing with 8051 Microcontroller	CO4	11	2	3	10	15
	Grand Total		**45**	**15**	**25**	**20**	**60**

XII. PROGRAMME OUTCOMES(POS) FOR DIPLOMA ENGINEERING	
PO'S	
PO1	Engineering Knowledge: Apply knowledge of mathematics, science, engineering fundamentals, and computer engineering principles to solve well-defined engineering problems.
PO2	Problem Analysis: Identify and analyse well-defined computer engineering problems using codified standard methods.
PO3	Design/ development of solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
PO4	Engineering Tools, Experimentation and IT Tools Usage: Apply modern engineering tools and appropriate techniques to conduct standard tests and measurements.

PO5	Project Management: Demonstrate knowledge of engineering and management principles and apply these to one's own work as a member and leader in a team.
PO6	Life-long Learning: Recognize the need for and engage in independent and lifelong learning in the context of technological change.
PO7	Entrepreneurship and Innovation: Demonstrate an ability to identify opportunities for innovation, develop entrepreneurial skills and apply them in professional contexts.
PSO	
PSO1	Software Development and Programming Skills: Apply programming knowledge, logic building, and software engineering principles to develop, test, and maintain computer applications and systems using modern tools and technologies.
PSO2	Networking and System Administration: Install, configure, and troubleshoot computer networks, operating systems, and hardware components while adhering to industry standards and cybersecurity practices.
PSO3	Entrepreneurship and Industry Readiness: Exhibit project management, teamwork, and entrepreneurial skills to design solutions, develop prototypes, and prepare for employment or self-employment in the tech industry.

XIII. COs AND POs AND PSOs MAPPING

Course Outcome (Cos)	**Programme Outcomes (POs)**							**Programme Specific Outcomes (PSOs)**		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	1	1	2	1	2
CO2	3	2	1	1	2	1	1	3	3	3
CO3	3	3	2	2	3	1	1	2	2	2
CO4	3	2	3	2	3	1	1	2	2	2

Legends: - *3-High; 2-Moderate/Medium; 1-Slight/Low; 0-None*