Programme : Diploma in Information Technology (Sandwich Pattern)

Course Code:IT	Course Title : Microcontroller and Embedded system

Compulsory / Optional: Compulsory

Teaching Scheme and Credits							Examination Scheme						
CL	TL	LL	SLH	NLH	Credits		FA-TH	SA-TH (2hr 30 min)	FA-PR	SA		SLA	Total
										PR	OR		
3	-	2	1	6	3		20	20 60	25	25@		25	175

Total IKS Hrs. for course:

Abbreviations: CL- Class Room Learning, TL- Tutorial Learning, LL- Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
1. FA-TH represents an sum of two class tests of 40 marks each conducted during the term.
2. SA-TH represents the end term examination.

I. Rationale

Microcontroller is heart of all domestic, industrial, consumer goods and other high end products. Automation in every field of life is being used and microcontroller is inbuilt element of these systems and devices. 8051 microcontroller architecture, peripheral interfacing to it and assembly language programming is covered in this course. Microcontroller is inbuilt element of embedded system. This course will also cover the concepts of embedded system. It covers Arduino and its programming.

II. Industry / Employer Expected Outcome

Students should have

1. Proficiency in Microcontroller Programming and Application Development
2. Expertise in Peripheral Interfacing and Control
3. Competence in Timer, Interrupt, and Communication Protocols
4. Foundation in Embedded Systems Design and Open Source Development

III. Course Outcomes: Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1	Comprehend the architecture and signal description of 8051.
CO2	Develop the program for 8051 for the given operations.
CO3	Interpret the program by using timer, interrupt and serial port/parallel port.
CO4	Interface various input and output devices to microcontroller.
CO5	Comprehend the concept of embedded systems, aurdino and its programming.

Course Content Details:

Unit No.	Theory Learning Outcomes (TLO's)aligned to CO's	Topics / Sub-topics
1	**TLO 1.1:** Explain the General architecture of Microcontroller. **TLO 1.2 :** Compare between Microprocessor and Microcontroller **TLO 1.3:** Describe the Architecture of 8051 **TLO 1.4:** Explain the Pin configuration aand function of each pin of 8051. **TLO 1.5**: Interpret the Memory Organization of 8051 **TLO 1.6**: Identify the Special features of 8051	**Basics of Microcontroller 8051** 1.1 General architecture of Microcontroller 1.2 Comparison of Microprocessor and Microcontroller 1.3 Architecture of 8051 1.4 Pin configuration and signal description of 8051 1.5 Memory Organization of 8051 1.6 Special features of 8051- Boolean Processor, Power saving options- idle and power down mode, Derivatives of 8051(8951, 8952, 8031, 8751). **Course Outcome- CO1 Teaching Hours – 08 Marks:** 10 (R- 4, U-6, A-0)
2	**TLO 2.1**: Interpret the Instruction set of 8051. **TLO 2.2:** Explain the Addressing Modes of 8051 **TLO 2.3:** Write Assembly language programs for given problem statement **TLO 2.4:**: Write C language program for given problem statement	**8051 Instruction set and Programming** 2.1 Instruction set (Data transfer, Arithmetic and Logical, Branching, Machine control, stack operation, Boolean) 2.2 Addressing modes 2.3 Assembly language programming 2.4 8051 programming in C **Course Outcome- CO2 Teaching Hours – 10 Marks: 14** (R- 0, U-0, A-14)
3	**TLO 3.1:** Explain the Timer/Counter operation and programming of 8051. **TLO 3.**2: Describe the Interrupt structure of 8051. **TLO 3.**3: Explain Serial Communication operation and programming of 8051. **TLO 3.**4: Explain Parallel communication I/O port structure and its programming	**Timer, Interrupts, Serial and Parallel communication** 3.1 8051 Timer/Counter: Logic and Modes, Programming of 8051 timer 3.2 8051 Interrupts: Interrupts and polling, SFRs- IE, IP, Priority level and interrupt sequence 3.3 Serial Communication: SCON, SBUF, Modes of serial communication, Programs on serial communication 3.4 Parallel communication: I/O port structure and its programming **Course Outcome- CO3 Teaching Hours – 08 Marks: 8** (R- 0, U-4, A-4)

4	**TLO 4.1:** Understand the Memory Interfacing. **TLO 4.**2 : Explain I/O Interfacing of 8051. **TLO 4.**3 : Explain various applications of 8051	**Memory and I/O Interfacing** 4.1 Memory Interfacing: Interfacing of external program and data memory, Address map table 4.2 I/O Interfacing: Interfacing of LEDs, Relays, Keyboard, Seven segment display, LCD, Stepper motor, DC motor, ADC 0808, DAC 0808 4.3 Applications of 8051: Square wave generation using port pins of 8051, Triangular wave generation using DAC, Water level controller, Temperature controller using ADC, Stepper motor control for clockwise and anticlockwise rotation, Traffic light controller Programming can be in assembly language or C (student's choice) **Course Outcome- CO4 Teaching Hours: 04 Marks: 14 (R- 0, U-0, A-14)**
5	**TLO 5.1:** Block diagram of embedded system with hardware components. **TLO 5.1:** Harvard and Von Neumann architecture, RISC and CISC processors **TLO 5.1:** Characteristics of embedded system, Processor power, memory, operating system, reliability, performance, power consumption, unit cost size, flexibility, **TLO 5.1:** Classification of embedded system	**Introduction to embedded systems** 5.1 Block diagram of embedded system with hardware components. 5.2 Harvard and Von Neumann architecture, RISC and CISC processors 5.3 Characteristics of embedded system, Processor power, memory, operating system, reliability, performance, power consumption, unit cost size, flexibility, 5.4 Classification of embedded system **Course Outcome: CO5 Teaching Hours :4hrs Marks: 4 (R- 2, U-2, A-0)**
6	**TLO 6.1:** Understand Arduino Birth and Open source community **TLO 6.2:** Explain the functional block diagram of Arduino **TLO 6.3**: Interpret the functions of each pin of Arduino **TLO 6.4:** Explain the I/O functions, looping techniques, Decision making techniques. **TLO 6.5:** Understand the Programming of an Arduino.	**Open source embedded development board (Arduino)** 6.1 Arduino Birth, Open source community 6.2 Functional block diagram of Arduino 6.3 Functions of each pin of Arduino 6.4 I/O functions, looping techniques, Decision making techniques. 6.5 Programming of an Arduino: Interfacing LEDs, Seven segment display, LCD, ADC, DAC, Stepper motor, DC Motor. Various applications using Arduino. **Course Outcome: CO5 Teaching Hours :5hrs Marks: 10 (R- 0, U-4, A-6)**

IV. Laboratory Learning Outcome and Aligned Practical / Tutorial Experiences.

Sr No	Practical / Tutorial / Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant Cos
1	Demonstrate the ability to identify and describe the functions of various blocks and components on the 8051 microcontroller development board.	Identify various blocks of 8051 microcontroller development board	02	CO1
2	Develop and debug assembly language programs to perform basic arithmetic operations, demonstrating understanding of instruction sets and registers.	Write an assembly language program to perform arithmetic operations such as addition, subtraction, multiplication and division	02	CO2
3	Implement and test an assembly language program to identify the smallest and largest numbers from a set of data bytes	Write an ALP to find smallest /largest numbers from the given data bytes stored in internal /external data memory locations.	02	CO2
4	Write, debug, and execute an assembly language program to sort a list of numbers in ascending or descending order	Write an ALP to arrange numbers in ascending/descending order.	02	CO2
5	Interface an LED with a microcontroller and write a program in C or assembly language to control the LED	Interface LED with microcontroller and turn it ON for 1 sec. Write program either in C or assembly language.	02	CO3 CO4
6	Create and test an assembly language program to generate pulse and square wave signals using timer delays	Develop an ALP to generate pulse and square wave by using timer delay.	02	CO3
7	Interface a 7-segment display with the 8051 microcontroller and write a program to display numbers 0 to 9	Interface 7 segment display to 8051 and display numbers 0 to 9 on it.	02	CO4
8	Interface a 4x4 keyboard matrix with the 8051 microcontroller and write a program to detect key presses and display them on a 7-segment display	Interface 4X4 keyboard matrix with 8051 and display the key pressed on 7 segment display	02	CO4
9	Interface a stepper motor with the 8051 microcontroller and develop a program to control its rotation in both directions for specified angles	Interface stepper motor to 8051 and write a program to rotate in clockwise and anticlockwise direction for given angles	02	CO4
10	Write and implement a program to control the speed of a DC motor using Arduino	Write a Program to Control the speed of DC motor using Arduino.	02	CO5
11	Design and implement a line follower robot using Arduino	Implement line follower robot using Arduino.	02	CO5
12	Develop and test a water level controller using Arduino	Implement water level controller using Arduino	02	CO5
13	Implement a digital thermometer using Arduino,	Implement Digital Thermometer using Arduino	02	CO5
14	Interface a 4x4 keyboard matrix and a 16x2 LCD to Arduino and develop a program to display the key presses on the LCD	Interface 4x4 keyboard matrix and 16x2 LCD to Arduino	02	CO5
15	Interface a Digital-to-Analog Converter (DAC) with the 8051 microcontroller and	Interface DAC to 8051 and write ALP to generate square and triangular	02	CO5

write an assembly language program to generate square and triangular waveforms	waveforms.		
	Total	30	

V. Suggested Micro Project / Assignment/ Activities for Specific Learning / Skills Development (Self Learning):

1. Create a detailed presentation or a report that compares the 8051 with other microcontrollers like 8951, 8952, 8031, and 8751.
2. Create a project where an LED blinks with a specific pattern controlled by timers and interrupts.
3. Develop a report or presentation highlighting the characteristics and classifications of embedded systems, and provide real-world examples.
4. Develop a series of projects using Arduino, such as:
   - Blinking LEDs with different patterns.
   - Displaying information on an LCD.
   - Reading analog values from a sensor and displaying them.
   - Controlling a DC motor with a PWM signal.
   - Creating a simple weather station that reads temperature and humidity.

5. Select an embedded system (e.g., a smart thermostat, a wearable fitness tracker) and analyze its hardware components, architecture, and performance characteristics. Prepare a detailed case study.

VI. Specification Table:

Unit No	Topic Title	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	**Basics of Microcontroller 8051**	2	4	4	10
2	**8051 Instruction set and Programming**	4	4	6	14
3	**Timer, Interrupts, Serial and Parallel communication**	2	4	2	08
4	**Memory and I/O Interfacing**	4	4	6	14
5	**Introduction to embedded systems**	-	2	2	04
6	**Open source embedded development board (Arduino)**	2	4	4	10
	Total	14	22	24	**60**

VII. Assessment Methodologies/Tools

Formative assessment (Assessment for Learning)

- Rubrics for continuous assessment based on process and product related performance indicators (__25_ marks)

Summative Assessment (Assessment of Learning)

- End term examination, Viva-voce, Workshop performance (__marks)

VIII. COs - POs Matrix Form

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-		2	1	-	2		1
CO2	1	3	2	2	-	-	1		2	-
CO3	-	2	-	-	3	1	2	2	-	-
CO4	2	-	2	--	-	2	-	3	-	-
CO5	2	-	-	2	2	-	1	-	2	-
CO6	-	2	-	-	3	1	-	1		1
CO7	1	-	1	2	-	-	3	-	3	-

Legends: - High:03, Medium:02, Low:01, No Mapping: --

IX. Suggested Learning Materials / Books

Sr. No	Author/ Publisher	Title	ISBN
1	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Mazidi, Pearson Education India; 2 edition 2007	978-8131710265
2	The 8051 Microcontroller & Embedded Systems Using Assembly and C with CD	Kenneth Ayala, Delmar Cengage Learning; First edition , January 2010	978-8131511053
3	Introduction to Embedded System	Shibu K. V., MC Graw Hill, First edition, 2009	978-1259081514
4	Beginning Arduino	Michael McRoberts, Technology in action, First edition 2010	978-1430232414
5	Programming Arduino Getting started with sketches	Simon monk, MC Graw Hill, First edition, 2012	978-0071784238

X. Learning Websites & Portals

Sr.No	Link / Portal
1	https://www.coursera.org
2	https://www.edx.org/
3	https://www.udemy.com/
4	https://ocw.mit.edu/
5	https://www.allaboutcircuits.com/
6	https://www.hackster.io/
7	https://swayam.gov.in/

XI. Academic Consultation Committee/Industry Consultation Committee:

Sr. No	Name	Designation	Institute/Organization
1	Dr. Hemant Pardeshi	Lecturer in Electronics Engineering	Government Polytechnic Mumbai
2	Mr. Anjum Mujawar	Director	Discover Technologies Thane
3	Dr. N D Chavan	Lecturer in Electronics Engineering	L J Somaiya Polytechnic, Mumbai

Coordinator,   Head of Department

Curriculum Development,   Department of _____ Engineering

Department of _____ Engineering

I/C, Curriculum Development Cell   Principal