MICROCONTROLLER & APPLICATIONS | **Course Code : 314328**

Programme Name/s	**: Automation and Robotics/ Digital Electronics/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electronics & Communication Engg./ Electronics Engineering/ Instrumentation & Control/ Industrial Electronics/ Instrumentation/ Electronics & Computer Engg.**
Programme Code	**: AO/ DE/ EJ/ EK/ ET/ EX/ IC/ IE/ IS/ TE**
Semester	**: Fourth**
Course Title	**: MICROCONTROLLER & APPLICATIONS**
Course Code	**: 314328**

I. RATIONALE

Microcontrollers plays a very important role in the design, development of embedded systems. Automation is used in every field of engineering and microcontroller is inbuilt component of these systems. Diploma engineers have to deal with various microcontroller based systems and maintain them. This course will enable the students to develop the skills to use and maintain microcontroller based applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help students to attain the following industry/employer expected outcome through various teaching learning experiences:
• Maintain microcontroller based systems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret architecture of 8-bit microcontrollers.
- CO2 - Develop program in 8051 in assembly language for the given operation.
- CO3 - Develop program using timers and interrupts.
- CO4 - Interface the memory and I/O peripherals to 8051 microcontroller.
- CO5 - Maintain microcontroller based applications.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH	Credits	Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314328	MICROCONTROLLER & APPLICATIONS	MAA	DSE	3	-	4	1	8	4	3	30	70	100	40	25	10	25#	10	25	10	175

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Total IKS Hrs for Sem. : 0 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 List the features of 8051 Microcontroller. TLO 1.2 Explain the significance of selection factors while selecting Microcontroller for application. TLO 1.3 Describe the 8051 block diagram. TLO 1.4 Differentiate Microcontroller and Microprocessor for the given parameters. TLO 1.5 Compare Harvard architecture and Von-Neumann architecture. TLO 1.6 Explain functions of each block of 8051 Microcontroller. TLO 1.7 Compare the given derivatives of 8051 Microcontroller.	**Unit - I Microcontroller Overview and 8051 Architecture** 1.1 Features and selection factors for Microcontroller 1.2 Block diagram of 8051 Microcontroller: CPU, input device, output device, memory and buses 1.3 Comparison of Microcontroller and Microprocessor on basis of: Memory, Complexity, Type of Architecture, Cost, Applications, Typical examples of Microcontrollers and Microprocessors 1.4 Architectures of Microcontroller: Harvard , Von Neumann. Concept of pipelining 1.5 8051 Microcontroller: Architecture, Pin Configuration, Memory Organisation, Power saving options 1.6 Derivatives of 8051 (8951, 8031, 8751). Comparison between derivatives	Learning using Chalk-Board Blended Classroom Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Explain the function of the given software development tools. TLO 2.2 Classify addressing modes of 8051 with examples. TLO 2.3 Describe the function of the given instruction with suitable example. TLO 2.4 Explain the use of the given assembler directives with examples. TLO 2.5 Develop simple programs to perform the following operations: Data manipulation, Masking, Stack operation, Branching execution.	**Unit - II 8051 Programming** 2.1 Software Development Cycle: Editor, Assembler, Compiler, Cross-Compiler, Linker, Locator 2.2 Addressing Modes : Immediate, Register, Direct, Indirect, Indexed 2.3 Instruction set :Data Transfer, Arithmetic, Logical, Branching, Machine control and Boolean 2.4 Assembler Directives: ORG, DB, EQU, END, CODE, DATA 2.5 Assembly Language Programming (ALP): Data manipulation, Masking , Stack operation, Branch related programming	Lecture using Chalk-Board Presentations Blended Learning
3	TLO 3.1 Describe the functions of Timer/ Counters, their applications, and modes of Timers. TLO 3.2 Generate the waveforms by using the given mode of Timer. TLO 3.3 Explain the interrupt mechanism with the help of suitable example. TLO 3.4 Explain the operation of given mode for Serial communication. TLO 3.5 Explain I/O Port Programming.	**Unit - III 8051 Timers, Interrupts, Serial and Parallel Communication** 3.1 Configuration and Programming of Timer/Counter using Special Function Registers [SFRs]: TMOD, TCON, THx, TLx, Simple programs to generate the time delays 3.2 Configuration and Programming of interrupts using SFRs: IE, IP 3.3 Serial Communication SFRs: SCON, SBUF, PCON, Modes of serial communication, Simple Programs on serial communication. Serial Communication using MAX 232 3.4 Configuration and Programming of I/O Port : P0, P1, P2, P3	Lecture using Chalk-Board Hands-on Blended Learning
4	TLO 4.1 Interface Input/Output Devices with 8051 microcontroller. TLO 4.2 Interface ADC with 8051 microcontroller. TLO 4.3 Interface DAC with 8051 microcontroller. TLO 4.4 Describe with neat sketch the interfacing of the given external memory. TLO 4.5 Describe the procedure to troubleshoot the given I/O device.	**Unit - IV 8051 Interfacing** 4.1 I/O Interfacing: Keyboard, Relays, LED, LCD, Seven Segment display 4.2 Interfacing ADC 0808/09 with 8051. Simple programs for ADC interfacing 4.3 Interfacing DAC 0808/09 with 8051. Simple programs for DAC interfacing 4.4 Memory Interfacing: Program and Data Memory	Lecture using Chalk-Board Hands-on Blended Learning Presentations

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Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Generate the given waveform using 8051 and DAC. TLO 5.2 Interface Analog Input devices with 8051 microcontroller. TLO 5.3 Program 8051 for the given application. TLO 5.4 Interface Stepper motor to 8051. TLO 5.5 Describe the procedure to troubleshoot the given microcontroller based application.	**Unit - V 8051 Applications** 5.1 Square and Triangular waveform generation using DAC 5.2 Temperature sensor (LM35) interfacing using ADC to 8051 5.3 Water Level controller design using 8051 5.4 Stepper Motor Interfacing to 8051 to rotate in clockwise and anticlockwise direction	Lecture using Chalk-Board Hands-on Blended Learning Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify the functions of various blocks of 8051 microcontroller development board.	1	* Identification of various blocks of 8051 microcontroller development board	2	CO1
LLO 2.1 Develop an Assembly Language Program (ALP) for addition of two numbers using various addressing modes and assembler directives.	2	Assembly Language Program using various addressing modes	2	CO2
LLO 3.1 Develop an ALP to perform arithmetic operations: addition, subtraction, multiplication and division on 8-bit data.	3	* ALP to perform arithmetic operations on 8-bit data	2	CO2
LLO 4.1 Develop an ALP to perform arithmetic operations: addition, subtraction on 16-bit data.	4	* ALP to perform arithmetic operations on 16- bit data	2	CO2
LLO 5.1 Develop an ALP to perform addition of BCD data stored at external memory and store result in internal memory.	5	* ALP to perform addition of BCD data	2	CO2
LLO 6.1 Develop an ALP for sum of series of numbers stored in RAM locations 40-49H. Find the sum of the values at the end of the program, store the lower byte in 30H and the higher byte in 31H.	6	* ALP for series addition	2	CO2
LLO 7.1 Develop an ALP to transfer data from source to destination locations of internal/ external data memory.	7	* Array data transfer from source locations to destination locations	2	CO2
LLO 8.1 Develop an ALP to exchange block of data from source to destination location of internal/ external data memory.	8	* Block exchange of data from source locations to destination location	2	CO2
LLO 9.1 Develop an ALP for identifying smallest number from the given data bytes stored in internal/ external data memory.	9	* Finding the smallest number from the given data bytes	2	CO2
LLO 10.1 Develop an ALP for identifying largest number from the given data bytes stored in internal/ external data memory.	10	Finding the largest number from the given data bytes	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Develop an ALP for arranging numbers in ascending order stored in internal/ external data memory.	11	* Arranging the numbers in ascending order	2	CO2
LLO 12.1 Develop an ALP for arranging numbers in descending order stored in internal/ external data memory.	12	Arranging numbers in descending order	2	CO2
LLO 13.1 Write an ALP to generate delay using timer register.	13	* Generate delay using timer register	2	CO3
LLO 14.1 Develop an ALP to transfer 8 bit data serially on serial port.	14	* Serial 8 bit data transfer on serial port	2	CO3
LLO 15.1 Interface LED with microcontroller and turn it 'ON' with microcontroller interrupt.	15	LED interfacing to 8051	2	CO4
LLO 16.1 Develop an ALP to generate pulse and square wave by using timer delay.	16	Generating Pulse and Square wave using timer delay	2	CO4
LLO 17.1 Interface 4 X 4 LED matrix with 8051 to display various pattern.	17	LED matrix Interfacing to 8051	2	CO4
LLO 18.1 Interface 7-segment display to display the decimal number from 0 to 9.	18	* Seven Segment Display interface for displaying decimal numbers	2	CO4
LLO 19.1 Interface relay with microcontroller and turn it 'ON' and 'OFF'.	19	* Relay interfacing to Microcontroller	2	CO4
LLO 20.1 Interface LCD with 8051 microcontroller to display the characters and decimal numbers.	20	* LCD interfacing to 8051 to display characters and decimal numbers	2	CO4
LLO 21.1 Interface the given keyboard with 8051 and display the key pressed.	21	Keyboard interfacing to 8051	2	CO4
LLO 22.1 Interface ADC with 8051 microcontroller and verify input/output.	22	* ADC interfacing to 8051	2	CO4
LLO 23.1 Interface DAC with 8051 microcontroller to generate square wave.	23	* DAC Interfacing to generate the square waveform	2	CO5
LLO 24.1 Interface DAC with 8051 microcontroller to generate triangular wave, saw-tooth wave.	24	DAC interfacing to generate the triangular waveforms	2	CO5
LLO 25.1 Interface stepper motor to microcontroller and rotate in clockwise direction at the given angles.	25	* Stepper Motor interfacing to 8051	2	CO5
LLO 26.1 Interface stepper motor to microcontroller and rotate in anti-clockwise direction at the given angles.	26	Stepper Motor interfacing to 8051 for rotating anti-clockwise	2	CO5
LLO 27.1 Design water level controller using any suitable open source simulation software to detect and control the water level in a tank.	27	Water Level Controller using 8051	4	CO5
LLO 28.1 Interface temperature sensor LM35 to 8051 to read temperature, convert it to decimal and send the value to Port 0 with some delay.	28	Temperature Sensor interfacing to detect and measure temperature	4	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
Note : Out of above suggestive LLOs - • '*' Marked Practicals (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes.				

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Build a class period bell using microcontroller 8051.
- Build a circuit using 8051 microcontroller to blink LED.
- Build a circuit to display number 0 to 9 with a given delay.
- Build digital clock with 8051 microcontroller.
- Develop Fire Detection System using smoke and temperature sensor.

Student Activity

- Prepare power point presentation on applications of microcontroller.
- Undertake a market survey of different microcontrollers.

Assignment

- Prepare a chart of various features using data sheets of 8051 microcontroller and its derivatives.
- Prepare chart of stepper motor to display its features and steps for its operations using data sheets.
- Prepare a chart of various types of ADC and DAC to display its features and pin functions using data sheets.
- Prepare a chart of various types of LCDs to display its features , pin functions and steps of operations using data sheets.
- Prepare a power point presentation on 8051 interfacing/applications.

> **Note :**
>
> - Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
> - The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
> - If a microproject is assigned, it is expected to be completed as a group activity.
> - SLA marks shall be awarded as per the continuous assessment record.
> - For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
> - If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number

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Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	DSO with Bandwidth : 50-100 MHz TFT colour LCD Dual channel real time sampling1GSa/s equivalent sampling 25 GSa/s Memory 1Mbpts 10 waveforms and 10 Set up scan be stored.	13,16,23,24
2	4X4 LED matrix suitable to interface with 8051 trainer kit	17
3	7-segment LED Display	18
4	Relay trainer board suitable to interface with 8051 trainer kit	19
5	LCD trainer board	20
6	Keyboard: 4 x 4 trainer board	21
7	ADC(0808) trainer board	22
8	DAC (0808) trainer board	23,24
9	Stepper Motor: 50/100 rpm	25,26
10	Water level controller kit	27
11	Temperature Controller trainer board	28
12	Temperature Sensor LM35: 5V operating voltage, Operating temperature range (°C) -55 to 150, analog output	28
13	8051 Microcontroller kit: On-chip 64 KB ISP+IAP flash, 1KB SRAM, 5V operating voltage, 0 to 40 MHz 64 kB of on-chip Flash program memory	All
14	Desktop PC with microcontroller simulation software.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Microcontroller Overview and 8051 Architecture	CO1	11	2	6	6	14
2	II	8051 Programming	CO2	8	4	4	4	12
3	III	8051 Timers, Interrupts, Serial and Parallel Communication	CO3	10	4	4	6	14
4	IV	8051 Interfacing	CO4	10	4	6	8	18
5	V	8051 Applications	CO5	6	2	4	6	12
		Grand Total		**45**	**16**	**24**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two offline unit tests of 30 marks and average of two unit test marks will be consider for out of 30 marks.
- For formative assessment of laboratory learning 25 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End semester assessment is of 70 marks.
- End semester summative assessment is of 25 marks for laboratory learning.

XI. SUGGESTED 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	1	1	1	1	-	1			
CO2	2	2	2	2	1	-	2			
CO3	2	2	2	1	1	1	2			
CO4	2	2	2	2	1	-	2			
CO5	2	3	2	2	1	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Mazidi Muhammad Ali, Mazidi Janice Gillispe, Mckinlay Rolin D	The 8051 Microcontroller and Embedded Systems: Using Assembly and C	Pearson Publication, 2017 ISBN: 9788131710265
2	Ayala Kenneth J	The 8051 Microcontroller	Thomson Delmar Learning, 2004 ISBN: 9781401861582
3	Deshmukh Ajay V	Microcontroller: Theory and Application	McGraw Hill,2011 ISBN: 9780070585959
4	Pal Ajit	Microcontrollers: Principle and Application	PHI Learning, 2014 ISBN: 978812034394
5	Chattopadhyay Santanu	Microcontroller and Applications	All India Council for Technical Education, 2023 ISBN: 9788196057602

XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	http://vlabs.iitkgp.ac.in/rtes/#	Keyboard-MCU interfacing take a input from keypad and display on LCD
2	https://studytronics.weebly.com/8051microcontroller.html	8051 Microcontroller Architecture, Internal Memory , Instruction Set, Timers and Counters, Interrupts
3	https://archive.nptel.ac.in/courses/108/105/108105102/	S. Chattopadhyay, SWAYAM/NPTEL course on "Microprocessors and Microcontrollers"
4	https://www.keil.com/download/product/	Introduction to KEIL tool for 8051 programming
5	https://www.dnatechindia.com/Interfacing-LCD-to-8051.html	Interfacing LCD to 8051
6	https://web.mit.edu/6.115/www/document/8051.pdf	MCS@51 Microcontroller family user's manual

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Sr.No	Link / Portal	Description
7	https://econtent.msbte.edu.in/econtent/marathi_econtent.php	Microcontroller and Applications Learning Material In Marathi-English

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

MSBTE Approval Dt. 21/11/2024   **Semester - 4, K Scheme**