DEPARTMENT OF PRODUCTION TECHNOLOGY

MIT CAMPUS

ANNA UNIVERSITY: : CHENNAI – 600 044.

COURSE PLAN

COURSE DETAILS:

Degree	ME		
ProgrammeName	MECHATRONICS		
Course Code &Title	MR3203 : Embedded Systems		
Credits	5	Session	JAN 2024 – MAY 2024
Course Type	Program Core	Section	1
Name of the Faculty	Mr. S. Mohamed Shazuli, Teaching Fellow, Department of Production Technology, MIT Campus, Anna University, Chennai -44		

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. To familiarize the architecture and fundamental units of microcontroller.
2. To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
3. To design the interface circuit and programming of I/O devices, sensors and actuators.
4. To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
5. To acquaint the knowledge of real time embedded operating system for advanced system developments.

UNIT I MICROCONTROLLER 9

Fundamentals Functions of ALU · Microprocessor · Microcontrollers – CISC and RISC – Types Microcontroller · 8051 Family · Architecture · Features and Specifications · Memory Organization · Instruction Sets – Addressing Modes.

UNIT II PROGRAMMING AND COMMUNICATION 9

Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and IDE · C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming · Timer and Counter · Interrupts – Interfacing and Programming of Serial Communication, I2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

UNIT III PERIPHERAL INTERFACING 9

I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors · Relays · Solenoid Valve and Heater · Stepper Motors, DC Motors · PWM Programming – Closed Loop Control Programming of Servomotor – Overview of Advanced Microcontrollers.

UNIT IV ARM7 PROCESSOR 9

Introduction ARM 7 Processor · Internal Architecture – Modes of Operations – Register Set –

Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications

UNIT V REAL TIME MODELS, LANGUAGES AND OPERATING SYSTEMS 9

Models and Languages – State Machine and State Tables in Embedded Design – High Level Language Descriptions – Real Time Kernel - OS Tasks - Task Scheduling - Kernel Services – Real Time Embedded Operating Systems - Real Time Programming Languages - GPIO Programming – Comparative Overview of C and Python for Embedded Systems.

45 PERIODS

LIST OF EXPERIMENTS:

1. Assembly Language Programming and Simulation of 8051.
a) Data Transfer b) Arithmetic Instructions c) Counters d) Boolean and logical Instructions e) Code Conversion
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC &RTC Interfacing with 8051.
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. I2C Programming of 8051.
8. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
9. Interfacing and Programming of Sensor with Real Time Embedded Operating Systems.
10. Interfacing and Programming of Camera with Real Time Embedded Operating Systems.
11. Interfacing and Programming of Actuator with Real Time Embedded Operating Systems.
12. Interfacing and Programming of Serial Communication with Real Time Embedded Operating Systems.
13. GPIO Programming of Real Time Embedded Operating Systems.

60 PERIODS

TOTAL 105 PERIODS

COURSE OUTCOMES:

Students will able to

CO1: Define the fundamentals of Microcontroller, Processor and Single board computers

CO2: Recognize the architecture, functions and features of Microcontroller, Processor and SBC

CO3: Develop the skills in programming and communication with 8051 Microcontrollers, Processor and SBC

CO4: Apply the skills in interfacing with 8051 microcontroller, Processor and SBC to develop a system to a simulation model.

CO5: Create software to realize in controller to perform the task.

REFERENCES

1. Ball S.R., "Embedded Microprocessor Systems – Real World Design", Prentice Hall, 2006
2. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
3. James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.
4. John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005.
5. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003
6. Muhammad Ali Mazidi and Janice Gillispic Mazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.
7. Gay, W.W. (2014). The Raspberry Pi. In: Raspberry Pi Hardware Reference. A press, Berkeley, CA.

COURSE ARTICULATION MATRIX

CO	PO					
	1	2	3	4	5	6
1	1	1	1	1	-	2
2	1	1	1	1	1	2
3	1	1	1	2	1	-
4	1	1	1	2	1	1
5	2	1	1	-	1	1
CO/PO & PSO Average	1.2	1	1	1.5	1	1.2

The correlation levels:1: Low;2: Medium;3: High.

COURSE ALIGNED PROGRAMME OUTCOMES (PO)

PO	PROGRAMME OUTCOME
1	An ability to independently carry out research/investigation and development work to solve practical problems.
2	An ability to write and present a substantial technical report/document.
3	Students should be able to demonstrate a degree of mastery in the area of mechatronics.
4	Graduates will have a solid understanding of key concepts, methodologies, core components, and contemporary tools and techniques essential for unified mechatronics systems with intelligence.
5	Students will develop, analyze and optimize the solution for diverse engineering challenges using a mechatronics-based approach.
6	Graduates will be capable of constructing real-time or virtual mechatronic systems with considerations for industrial standards, environmental impact, ethical principles, and socio-economic factors.

COURSE TENTATIVE SCHEDULE / PLAN

Week	Day	Date	Hrs	Unit	Topics	Text / Ref.
1	TUE	23.01.2024	3,4	UI	Microprocessor – Microcontrollers – CISC and RISC – Types Microcontroller	T1,R1
	WED	24.01.2024	4		Fundamentals Functions of ALU	T1
2	WED	31.01.2024	4		Features and Specifications of 8051	T1
3	TUE	06.02.2024	7,8		PIN Diagram of 8051- Architecture of 8051 Family	T1
	WED	07.02.2024	4		Memory Organization	T1
4	TUE	13.02.2024	7,8		Instruction Sets – Addressing Modes	T1
	WED	14.02.2024	4	U II	Fundamentals of Assembly Language Programming	T1
5	TUE	20.02.2024	7,8		Instruction to Assembler – Compiler and IDE - C Programming for 8051 Microcontroller	T1
	WED	21.02.2024	4		Basic Arithmetic and Logical Programming	T1
6	TUE	27.02.2024	7,8		Timer and Counter - Interrupts Interfacing and Programming of Serial Communication	T1
	WED	28.02.2024	4		I2C, SPI and CAN of 8051 Microcontroller	T1
7	TUE	05.03.2024	7,8		Bluetooth and WI-FI interfacing of 8051 Microcontroller,	T1
	WED	06.03.2024	4	U III	I/O Programming , Interfacing of Memory	T1
8	TUE	12.03.2024	7,8		Key Board and Displays – Alphanumeric and Graphic , RTC	T1
	WED	13.03.2024	4		Interfacing of ADC and DAC, Sensors	T1
9	TUE	19.03.2024	7,8		Relays - Solenoid Valve and Heater, Stepper Motors,	T1
	WED	20.03.2024	4		DC Motors - PWM Programming	T1
10	TUE	26.03.2024	7,8		Closed Loop Control Programming of Servomotor – Overview of Advanced Microcontrollers.	T1
	WED	27.03.2024	4	U IV	Introduction ARM 7 Processor	T1
11	TUE	02.04.2024	7,8		Internal Architecture	T1
	WED	03.04.2024	4		Modes of Operations	T1
12	WED	10.04.2024	4		Register Set	T1
13	TUE	16.04.2024	7,8		Instruction Sets – ARM Thumb	T1
	WED	17.04.2024	4		- Thumb State Registers – Pipelining	T1

14	TUE	23.04.2024	7		Basic programming of ARM 7 - Applications.	T1
	TUE	23.04.2024	8	U V	Models and Languages in Embedded Design	T2
	WED	24.04.2024	4		State Machine and State Tables in Embedded Design	T2
15	TUE	30.04.2024	7,8		High Level Language Descriptions – Real Time Kernel - OS Tasks	T2
16	TUE	07.05.2024	7,8		Task Scheduling - Kernel Services – Real Time Embedded Operating Systems - Real Time Programming Languages	T2
	WED	08.052024	4		GPIO Programming – Comparative Overview of C and Python for Embedded Systems.	T2

Week	Day	Date	Hrs	Experiment
1	TUE	23.01.2024	1-4	1. Assembly Language Programming and Simulation of 8051. a) Data Transfer b) Arithmetic Instructions c) Counters d) Boolean and logical Instructions e) Code Conversion
2	TUE	06.02.2024	1-4	
3	TUE	13.02.2024	1-4	Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
4	TUE	20.02.2024	1-4	Input switches and keyboard interfacing of 8051.
5	TUE	27.02.2024	1-4	Sensor Interfacing with ADC to 8051 and DAC &RTC Interfacing with 8051.
6	TUE	05.03.2024	1-4	Timer, Counter and Interrupt Program Application for 8051.
7	TUE	12.03.2024	1-4	Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
8	TUE	19.03.2024	1-4	I2C Programming of 8051.
9	TUE	26.03.2024	1-4	Interfacing and Programming of Bluetooth and Wi-Fi with 8051
10	TUE	02.04.2024	1-4	Interfacing and Programming of Sensor with Real Time Embedded Operating Systems.
11	TUE	16.04.2024	1-4	Interfacing and Programming of Camera with Real Time Embedded Operating Systems
12	TUE	23.04.2024	1-4	Interfacing and Programming of Actuator with Real Time Embedded Operating Systems.
13	TUE	30.04.2024	1-4	Interfacing and Programming of Serial Communication with Real Time Embedded Operating Systems.
14	TUE	07.05.2024	1-4	GPIO Programming of Real Time Embedded Operating Systems

COURSE DELIVERY/INSTRUCTIONAL METHODOLOGIES:

✓Chalk & Talk	✓ Stud. Assignments	✓Web Resources
✓ LCD/~~Smartboards~~	✓ Stud. Seminars	☐ Add-On Courses

COURSE ASSESSMENT METHODOLOGIES-DIRECT

✓ University (End Semester) Examination		✓Internal Assessment Tests	
✓ Assignments	✓ Laboratory Practices	✓ Mini/Major Projects	✓Stud. Seminars
☐ Viva Voce	☐ Certifications	☐ Add-On Courses	☐ Others

COURSE ASSESSMENT METHODS

S.N.	Mode of Assessment	Test		Date	Duration		% Weight
1.	Continuous Assessment Theory (25%)	Assessment Test 1			1½ hr		25%
		Assessment Test 2			1½ hr		
2.	Continuous Assessment Laboratory (Total 25%)	Experiment and Midterm Test			3 hr		25 %
3.	End Semester Examination (50%)	Theory (25%)	Laboratory (25%)		3 hr	3 hr	50 %

COURSE ASSESSMENT METHODOLOGIES-INDIRECT

✓ Assessment of CO (By Feedback, Once)	✓ Student Feedback On Faculty (Once)
☐ Assessment of Mini/Major projects by Ext. Experts	☐ Others

COURSE (EXTRA) ESSENTIAL READINGS:
Will be provided to the students during the class hours.

1. https://nptel.ac.in/courses/106105193
2. https://onlinecourses.nptel.ac.in/noc22_ee12/preview

COURSE EXIT SURVEY (will be collected at end of the course)

The purpose of this survey is to find out from students about their learning experiences and their thoughts about the course.

Rating	1: Slight (Low)	2: Moderate (Medium)	3: Substantial (High)
CO1			
CO2			
CO3			
CO4			
CO5			

COURSE POLICY (Compensation Assessment)

1. Attending all the assessment is mandatory for every student
2. Course policy will be followed as per the academic course regulation

COURSE ACADEMIC DISHONESTY AND PLAGIARISM

1. All rules and regulation prescribed by the ACOE, University Departments, are applicable in the Internal Assessment Tests and University (End Semester) Examinations.
   (https://acoe.annauniv.edu/download_forms/student_forms/Guidelines.pdf)
2. In general, possessing a mobile phone, carrying bits of paper with materials, talking to other students, copying from other students during Internal Assessment Tests and University (End Semester) Examinations will be treated as Malpractice and punishable as per the rules and regulations. The misuse of Assignment / Project / Seminar works from others is considered as academic dishonesty and will be treated with the rules and regulations of the University.

COURSE ADDITIONAL INFORMATION

Queries / clarifications / discussion (if required) may be e-mailed to / contact the course instructors during their Office Hours.

For Approval

Course Faculty

Course Coordinator

Professor In Charge

Head of the Department