SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MR3492	Embedded Systems and Programming	PCC	2	0	2	4	3
2.	RA3501	Robot Path Planning and Programming	PCC	3	0	0	3	3
3.		Professional Elective I	PEC	-	-	-	-	3
4.		Professional Elective II	PEC	-	-	-	-	3
5.		Professional Elective III	PEC	-	-	-	-	3
6.		Professional Elective IV	PEC	-	-	-	-	3
7.		Mandatory Course-I[&]	MC	3	0	0	3	0
PRACTICALS								
8.	MR3561	Industrial Automation Laboratory	PCC	0	0	4	2	2
			TOTAL	**8**	**0**	**6**	**12**	**20**

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MC- I)

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	RA3601	Robot Dynamics and Control	PCC	3	0	0	3	3
2.		Open Elective – I*	OEC	3	0	0	3	3
3.		Professional Elective V	PEC	-	-	-	-	3
4.		Professional Elective VI	PEC	-	-	-	-	3
5.		Professional Elective VII	PEC	-	-	-	-	3
6.		Professional Elective VIII	PEC	-	-	-	-	3
7.		Mandatory Course-II[&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3[#]
PRACTICALS								
9.	RA3611	Robot Kinematics and Dynamics Laboratory	PCC	0	0	4	4	2
9.	RA3612	Mini Project	EEC	0	0	2	2	1
			TOTAL	**12**	**0**	**6**	**18**	**21**

***Open Elective – I shall be chosen from the emerging technologies.**

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under MC- II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

ELECTIVE – MANAGEMENT COURSES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Risk Reduction and Management	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with Traditional Practices -Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES : VERTICALS

VERTICAL 1: APPLIED ROBOTICS

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CRA331	Robots and Systems in Smart Manufacturing	PEC	3	0	0	3	3
2.	CRA332	Drone Technologies	PEC	3	0	0	3	3
3.	CRA333	Microrobotics	PEC	3	0	0	3	3
4.	CRA334	Agricultural Robotics and Automation	PEC	3	0	0	3	3
5.	CRA335	Collaborative Robotics	PEC	3	0	0	3	3
6.	CRA336	Robot Operating Systems	PEC	3	0	0	3	3
7.	CRA337	Medical Robotics	PEC	3	0	0	3	3
8.	CRA338	Humanoid Robotics	PEC	3	0	0	3	3

VERTICAL 2: DESIGN AND MANUFACTURING

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CRA339	Robot and Machine Elements Design	PEC	3	0	0	3	3
2.	CME341	Design for X	PEC	3	0	0	3	3
3.	CMR331	CNC Machine Tools and Programming	PEC	3	0	0	3	3
4.	ME3792	Computer Integrated Manufacturing	PEC	3	0	0	3	3
5.	CMR332	Advanced Manufacturing Systems	PEC	3	0	0	3	3
6.	CME339	Additive Manufacturing	PEC	2	0	2	4	3
7.	CMR350	Electronics Manufacturing Technology	PEC	3	0	0	3	3
8.	CMR333	Computer Aided Inspection and Testing	PEC	3	0	0	3	3

VERTICAL 3: SMART MOBILITY SYSTEMS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CME380	Automobile Engineering	PEC	3	0	0	3	3
2.	AU3791	Electric and Hybrid Vehicles	PEC	3	0	0	3	3
3.	CMR334	Automotive Mechatronics	PEC	3	0	0	3	3
4.	CMR335	Automotive System Modelling and Simulation	PEC	3	0	0	3	3
5.	CMR336	Vehicle Dynamics and Controls	PEC	3	0	0	3	3
6.	CMR337	Aircraft Mechatronics	PEC	3	0	0	3	3
7.	CMR338	Smart Mobility and Intelligent Vehicles	PEC	3	0	0	3	3
8.	CMR339	Advanced Driver Assistance Systems	PEC	3	0	0	3	3

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

VERTICAL 4: INTELLIGENCE SYSTEMS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CRA340	Applied Signal Processing	PEC	3	0	0	3	3
2.	CRA341	Applied Image Processing	PEC	3	0	0	3	3
3.	CRA342	Machine Learning for Intelligent Systems	PEC	3	0	0	3	3
4.	CMR340	Condition Monitoring and Fault Diagnostics	PEC	3	0	0	3	3
5.	CMR341	Systems Modelling and Simulation Methods	PEC	3	0	0	3	3
6.	CMR342	Optimization Techniques	PEC	3	0	0	3	3
7.	CMR343	Immersive Technologies and Haptics	PEC	3	0	0	3	3
8.	CMR344	Computer Vision and Deep Learning	PEC	3	0	0	3	3

VERTICAL 5: AUTOMATION

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMR345	Object Oriented Programming in C++	PEC	3	0	0	3	3
2.	EE3591	Power Electronics	PEC	3	0	0	3	3
3.	CMR358	Computer Architecture and Organisation	PEC	3	0	0	3	3
4.	CMR359	Virtual Instrumentation	PEC	3	0	0	3	3
5.	CMR346	Industrial Network Protocols	PEC	3	0	0	3	3
6.	CMR347	Motion Control System	PEC	3	0	0	3	3
7.	CMR348	Total integrated Automation	PEC	3	0	0	3	3
8.	CMR349	Digital Twin and Industry 5.0	PEC	3	0	0	3	3

VERTICAL 6: AVIONICS AND DRONE TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CAE347	Avionics	PEC	3	0	0	3	3
2.	CAE348	Control Engineering	PEC	3	0	0	3	3
3.	CAE349	Guidance and Control	PEC	3	0	0	3	3
4.	CAE350	Navigation and Communication System	PEC	3	0	0	3	3
5.	CAE351	Design of UAV systems	PEC	3	0	0	3	3
6.	CAE352	Aerodynamics of Drones	PEC	3	0	0	3	3

MR3492 **EMBEDDED SYSTEMS AND PROGRAMMING** **L T P C**
2 0 2 3

COURSE OBJECTIVES:

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 INTRODUCTION TO MICROCONTROLLER 6

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 6

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, I^2C, SPI and CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

UNIT III PERIPHERAL INTERFACING 6

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 – Traffic Light

UNIT IV ARM PROCESSOR 6

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 SINGLE BOARD COMPUTERS AND PROGRAMMING 6

System on Chip - Broadcom BCM2711 SoC – SBC architecture - Models and Languages – Embedded Design – Real Time Embedded Operating Systems - Real Time Programming Languages -– Python for Embedded Systems- GPIO Programming – Interfacing

TOTAL: 30 PERIODS

EMBEDDED SYSTEMS LAB

LIST OF EXPERIMENTS

1. Assembly Language Programming and Simulation of 8051.
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. UART Serial and Parallel Port Programming of 8051.
8. I^2C, SPI and CAN Programming of 8051.
9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
10. Programming of ARM Processor for Sensor Interface.
11. Stepper Motor and Servo Motor Control Using ARM Processor.
12. Serial Communication of ARM Processor with Computation Platform.
13. Wireless Communication of ARM Processor with Computation Platform.
14. GPIO Programming of Real Time Embedded Operating Systems.
15. IOT application using SBC.

(any 7 experiments) **TOTAL:30 PERIODS**

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO 1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.

CO 2: Recognize the role of each functional units in microcontroller, processors and system- on-chip based on the features and specifications.

CO 3: Interface the sensors, actuators and other I/O's with microcontroller, processors and system on chip based interfacing

CO 4: Design the circuit and write the programming microcontroller, processors and system on chip

CO 5: Develop the applications using Embedded system.

TEXT BOOKS:

1. Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.
2. Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2003.

REFERENCES:

1. Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.
2. Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015
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.

Mapping of COs with POs and PSOs

COs/POs & PSOs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1	1	2	2						1	3	1	3
CO2	3	2	1	1	2	2						1	3	1	3
CO3	3	2	1	1	2	2						1	3	1	3
CO4	3	2	1	1	2	2						1	3	1	3
CO5	3	2	1	1	2	2						1	3	1	3
CO/PO & PSO Average	3	2	1	1	2	2						1	3	1	3
1 – Slight, 2 – Moderate, 3 – Substantial															

RA3501 ROBOT PATH PLANNING AND PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES

1. Introduce basic trajectory planning problems.
2. Provide a basic review of various path planning theory of manipulator.
3. Provide a basic review of various path planning theory of mobile robot.
4. Introduction to the most widely used classical motion planning algorithms.
5. Introduce sufficient terminology and concepts in ROS for robot programming.

UNIT - I TRAJECTORY PLANNING APPROACHES 9

Definitions – Task planning and Trajectory planning – Representation of end-effector: Cartesian and joint space schemes. Workspace Analysis: work envelope of a multi DOF manipulator. Applications: Point to point motion and continuous path motion.

UNIT - II TRAJECTORY PLANNING OF MANIPULATOR 9

Joint space techniques – Motion profiles – Cubic polynomial, Linear Segmented Parabolic Blends and cycloidal motion - Cartesian space technique – Straight line and circular trajectories.

UNIT - III PATH PLANNING OF MOBILE ROBOT 9

Introduction - Representation of the Robot's Environment - Review of configuration spaces - Visibility Graphs - Voronoi diagrams - Potential Fields – Attractive and Repulsive – Cell Decomposition - Planning with moving obstacles - Probabilistic Roadmaps - Random trees - Execution of the Quadtree- Based Path Planner Program.

UNIT - IV PATH PLANNING ALGORITHMS 9

Planning - A* Algorithm - the D∗ algorithm - Path control. Graph search and discrete planning algorithms. - Sensor-Based Motion Planning Algorithms – the "Bug" algorithms – the Tangent Bug algorithm.

UNIT - V ROS PROGRAMMING 9

Robot language classification - Programming methods: Lead through method, teach pendent method - Syntax features and applications of various programming languages – Examples - Inter locking commands - Safety features - Introduction to Robot Operating System (ROS) - ROS examples - Introduction to programming using ROS - Industrial ROS - ROS examples - Programming for point to point /continuous – operations - Case Study

TOTAL:45 PERIODS

COURSE OUTCOME

CO1: Recognize various trajectory planning and path planning for mobile robot and Manipulator.
CO2: Classify trajectory planning and path planning for mobile robot and Manipulator.
CO3: Choose appropriate Path and Trajectory planning algorithm for various Industrial Applications.
CO4: Plan the path and trajectory for various Industrial robots and mobile robots for specific Applications.
CO5: Program the developed path and trajectory into real time robot applications.

TEXT BOOKS

1. Niku S B, "Introduction to Robotics, Analysis, Control, Applications", John-Wiley & Sons Inc, 2011.
2. Howie Choset, Kevin Lynch Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, Sebastian Thrun , "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge, 2005

REFERENCES:

1. Planning Algorithms by Steve LaValle (Cambridge Univ. Press, New York, 2006).
2. Principles of Robot Motion: Theory, Algorithms, and Implementations (by Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun.
3. Robot Motion Planning by J.C. Latombe.
4. Patnaik, Srikanta , "Robot Cognition and Navigation An Experiment with Mobile Robots", Springer-Verlag Berlin and Heidelberg, 2007.
5. Reza N Jazar , "Theory of Applied Robotics", Springer, 2010.
6. Morgan Quigley, Brian Gerkey, William D. Smart, Programming Robots with Ros: A Practical Introduction to the Robot Operating System, First Edition, 2016, ISBN 9352132793; 978-9352132799

Mapping of COs with POs and PSOs															
COs/Pos &PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	**3**	**2**	**1**	**1**								**1**	**2**	**2**	**3**
CO2	**3**	**2**	**1**	**1**								**1**	**2**	**2**	**3**
CO3	**3**	**2**	**1**	**1**								**1**	**2**	**2**	**3**
CO4	**3**	**2**	**1**	**1**								**1**	**2**	**2**	**3**
CO5	**3**	**2**	**1**	**1**								**1**	**2**	**2**	**3**
CO/PO & PSO Average	**3**	**2**	**1**	**1**								**1**	**2**	**2**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial															

MR3561 **INDUSTRIAL AUTOMATION LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES

1. To familiar and exercise the design procedure of various types of pneumatic and hydraulic fluid power circuits.
2. To practice the fundamentals of Programmable Logic Controller.
3. To practice the Data Communication between PLC.

LIST OF EXPERIMENTS

FLUID POWER DRIVES

1. Experimental Verification of Speed Control Circuits in Pneumatic and Hydraulic Trainer.
2. Experimental Verification of Single and Double Acting Cylinder Circuits Using Different Directional Control Values.
3. Experimental Verification of Electro-Pneumatic Circuits.
4. Experimental Verification of Pneumatic Sequencing Circuits.
5. Experimental Verification of Logic, Metre-in and Metre-out Pneumatic Circuits.
6. Experimental Verification of Electro Pneumatic Sequencing Circuits.
7. Control of PLC Based Electro Pneumatic Sequencing Circuits.
8. Control of PLC Based Electro Hydraulic Sequencing Circuits.

Any 6 Experiments

INDUSTRIAL AUTOMATION

1. Design a Ladder Logic Program for various Logic Gates AND, OR, NOT, NOR, NAND, EX-OR and EX-NOR.
2. Develop Ladder Diagram Programming to set Timer and Counter in PLC.
3. Develop PLC Program to Control Traffic Light.
4. Develop PLC Program to Maintain the Pressure and Level in a Bottle Filling System.
5. Develop Ladder Diagram Program in PLC For Material Filling, Object Shorting, Orientation Check and Material Property Check.
6. Develop the Ladder Diagram Program in PLC for Material Handling, Delaying Conveyor, Feeding, Pick and Place Operation.
7. Sensor and Actuator Interfacing in PLC and PLC to PLC Communication.

Any 6 Experiments

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon the completion of this course, the students will be able to;

CO1: Design and simulate the fluid power circuits.

CO2: Test the simulated output by constructing the fluid power circuits using suitable actuators and valves.

CO3: Practice the PLC programming, Interfacing with IO and establish the communication between stations.

Mapping of COs with POs and PSOs															
COs/POs & PSOs	**POs**												**PSOs**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	1	1	2	2						1	2	2	3
CO2	3	2	1	1	2	2						1	2	2	3
CO3	3	2	1	1	2	2						1	2	2	3
CO/PO & PSO Average	3	2	1	1	2	2						1	2	2	3
1 – Slight, 2 – Moderate, 3 – Substantial															