SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution | Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with A++ Grade
Kuniamuthur, Coimbatore – 641008
Phone : (0422)-2678001 (7 Lines) | Email : info@skcet.ac.in | Website : www.skcet.ac.in

Curriculum & Syllabi

Regulation 2022

2023-2027 Batch

DEPARTMENT OF MECHATRONICS ENGINEERING

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
An Autonomous Institution | Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with A++ Grade
Kuniamuthur, Coimbatore – 641008
Phone : (0422)-2678001 (7 Lines) | Email : info@skcet.ac.in | Website : www.skcet.ac.in

DEPARTMENT OF MECHATRONICS ENGINEERING

(Batch 2023-2027)

VISION OF THE INSTITUTION

- To Produce Globally Competitive Engineers with High Ethical Values and Social Responsibilities

MISSION OF THE INSTITUTION

- To impart the highest quality state-of-the-art technical education by providing impetus to innovation, research, and development and empowering students with entrepreneurship skills
- To instill ethical values, imbibe a sense of social responsibility, and strive for societal well-being
- To identify the needs of society and offer sustainable solutions through outreach programs

DEPARTMENT OF MECHATRONICS ENGINEERING

VISION OF THE DEPARTMENT

- To provide world class education in the fields of Robotics and Automation to make Mechatronics Engineering the most preferred program among engineering aspirants

MISSION OF THE DEPARTMENT

To impart knowledge and skill to the students participating in the program by providing

M1: Expert Faculty to teach, inspire, mentor and motivate
M2: Excellent Infrastructure with facilities to learn Mechatronics, research and experiment
M3: Motivation towards self-learning, social responsibility and entrepreneurship
M4: Exposure to the latest technologies through industry-institute interaction
M5: Environment to develop their innovative thoughts, moral values, communication and multidisciplinary skills

I.	PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)
PEO 1	Apply knowledge of mathematics, science and engineering to solve contemporary engineering problems in the field of automation
PEO 2	Design, analyze, fabricate and test smart products
PEO 3	Exhibit the skills of simulation and experimentation using advanced engineering tools of industrial standards
PEO 4	Communicate and develop strong interpersonal abilities to prepare them for placement and higher studies
PEO 5	Be self-motivated towards lifelong learning and entrepreneurship

II.	PROGRAMME OUTCOMES (POs)
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	**Design/Development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO 6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO 7	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO 8	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO 9	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 10	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO 11	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

III. PROGRAMME SPECIFIC OUTCOMES (PSOs)	
The Graduates of B.E – MECHATRONICS ENGINEERING programme will be able to:	
PSO 1	Design, simulate and create automation systems for various applications
PSO 2	Apply the Knowledge of Robotics for addressing Societal, health and Safety Issues

III. MAPPING OF PEOs WITH POs and PSOs													
PEO	**POs**											**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**1**	**2**
1	3	2	3	1	2	3	2	3	3	3	2	3	3
2	3	3	2	2	3	2	1	2	2	2	3	3	3
3	3	3	3	2	1	3	2	2	3	1	3	3	3
4	3	2	3	1	2	3	2	2	3	3	3	2	2
5	3	3	3	1	2	3	2	2	3	1	3	2	2
	1- low, 2 - medium, 3 - high, '-' - no correlation												

IV. MAPPING OF PEOs WITH PSOs

	PSO 1	**PSO 2**
PEO 1	3	3
PEO 2	3	3
PEO 3	3	3
PEO 4	2	2
PEO 5	2	2

AUTONOMOUS CURRICULUM AND SYLLABI

Regulations 2022

SEMESTER I							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23MT101	Production Technology	3/0/0	3	3	60/40	PCC
2	23MT102	Sensors, Measurements, and Instrumentation	3/0/0	3	3	60/40	PCC
3	23MA101	Mathematics I	3/1/0	4	4	60/40	BSC
4	23AS101	Applied Science	4/0/0	4	4	60/40	BSC
Theory with Practical (Internal 50 Marks & External 50 Marks)							
5	23IT101	Application Development Practices	1/0/4	5	3	50/50	ESC
6	23CS101	Problem Solving using C++	1/0/4	5	3	50/50	ESC
Practical (Internal 60 Marks & External 40 Marks)							
7	23AS102	Applied Science Laboratory	0/0/4	4	2	40/60	BSC
8	23MT103	Production Technology Laboratory	0/0/2	2	1	40/60	PCC
Indian Knowledge System - Blended Learning (Internal 100 Marks)							
9	23TA101	Heritage of Tamils / தமிழர் மரபு	3 Weeks		1	60/40	HSMC
Mandatory Course (Internal 100 Marks)							
10	23MC101	Mandatory Course I: Induction Programme	3 Weeks		0	0/100	MC
TOTAL				**15/1/14**	**30**	**24**	**1000**

SEMESTER II							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23MT201	Applied Mechanics	3/0/0	3	3	60/40	PCC
2	23EC202	Digital System Design	3/0/0	3	3	60/40	PCC
3	23MA201	Mathematics II	3/1/0	4	4	60/40	BSC
Theory with Practical (Internal 50 Marks & External 50 Marks)							
4	23EN101	Oral and Written Communication Skills	2/0/2	4	3	50/50	HSMC

5	23CD201	Database Management Systems	1/0/4	5	3	50/50	ESC
6	23IT211	Introduction to Python Programming	1/0/4	5	3	50/50	ESC
Practical (Internal 60 Marks & External 40 Marks)							
7	23MT202	Computer Aided Drawing Laboratory for Mechatronics	0/0/2	2	1	40/60	PCC
8	23EC204	Digital System Design Laboratory	0/0/2	2	1	40/60	PCC
Indian Knowledge System - Blended Learning (Internal 100 Marks)							
9	23TA201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	1/0/0	1	1	60/40	HSMC
Mandatory Course (Internal 100 Marks)							
10	23MC1XX	Mandatory Course – II (EVS)	1/0/0	1	0	0/100	MC
TOTAL			**15/1/14**	**30**	**22**	**1000**	

SEMESTER III							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23MT301	Theory of Machines	3/0/0	3	3	60/40	PCC
2	23MT302	Basics of Mechatronics Systems	3/0/0	3	3	60/40	PCC
3	23GE301	Universal Human Values	3/0/0	3	3	60/40	HSMC
4	23MA302	Mathematics III	3/1/0	4	4	60/40	BSC
Theory with Practical (Internal 50 Marks & External 50 Marks)							
5	23EC302	Operating Systems for Electronic Devices	3/0/2	5	4	50/50	PCC
6	23CS311	Fundamentals of Java Programming	1/0/4	5	3	50/50	PCC
Practical (Internal 60 Marks & External 40 Marks)							
7	23MT303	Mechanics of Machines and Materials Laboratory	0/0/2	2	1	40/60	PCC
8	23MT304	Idea Lab for Mechatronics	0/0/2	2	1	40/60	PCC
TOTAL			**16/1/10**	**27**	**22**	**800**	

SEMESTER IV							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23MT401	Machine Design	3/0/0	3	3	60/40	PCC
2	23MT402	Electrical Machines for Mechatronics	3/0/0	3	3	60/40	PCC
3	23MT403	Fluid and Thermal Engineering	3/0/0	3	3	60/40	PCC
4	23MT404	Basics of Digital Signal Processing	3/0/0	3	3	60/40	PCC
5	23MTXXX	Professional Elective-I	3/0/0	3	3	60/40	PEC
Theory with Practical (Internal 50 Marks & External 50 Marks)							
6	23EC403	Embedded C++	3/0/2	5	4	50/50	PCC
Practical (Internal 60 Marks & External 40 Marks)							
7	23MT405	Fluid and Thermal Engineering Laboratory	0/0/2	2	1	40/60	PCC
Mandatory Course (Internal 100 Marks)							
8	23MC1XX	Mandatory Course – III	3 Weeks		0	0/100	MC
TOTAL			**18/0/4**	**22**	**20**	**800**	

SEMESTER V							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23MT501	Autotronics and Vehicle Intelligence	3/0/0	3	3	60/40	PCC
2	23MTXXX	Professional Elective-II	3/0/0	3	3	60/40	PEC
3	23XXXXX	Open / Emerging / Industrial Elective- I	3/0/0	3	3	60/40	OEC
Theory with Practical (Internal 50 Marks & External 50 Marks)							
5	23EE407	Control Theory	3/0/2	5	4	50/50	ESC
6	23MT502	Robotic Systems	3/0/2	5	4	50/50	PCC
7	23MT503	Hydraulics and Pneumatics System	3/0/2	5	4	50/50	PCC
Project (Internal 100 Marks)							
8	23MT507	Prototype lab	0/0/2	2	1	100	PROJ
TOTAL			**18/0/6**	**25**	**22**	**800**	

SEMESTER VI							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23MT602	Industrial Management and Professional Ethics	3/0/0	3	3	60/40	HSMC
2	23MT603	Computer Networks and Cyber Security	3/0/0	3	3	60/40	PCC
3	23XXXXX	Open / Emerging / Industrial Elective- II	3/0/0	3	3	60/40	OEC
4	23MTXXX	Professional Elective – III	3/0/0	3	3	60/40	PEC
5	23XXXXX	Open / Emerging / Industrial Elective- III	3/0/0	3	3	60/40	OEC
Theory with Practical (Internal 50 Marks & External 50 Marks)							
6	23MT601	Computer Integrated Manufacturing	3/0/2	5	4	50/50	PCC
7	23MT604	Industrial Automation	3/0/2	5	4	50/50	PCC
8	23MT605	Artificial Intelligence for Robotics	3/0/2	5	4	50/50	PCC
Mandatory Course (Internal 100 Marks)							
9	23MC1XX	Mandatory Course – III	3 weeks		0	0/100	MC
TOTAL			**24/0/6**	**30**	**27**	**900**	

SEMESTER VII							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/ Wk**	**Credits**	**Ext/Int**	**Cat.**
Theory (Internal 40 Marks & External 60 Marks)							
1	23XXXXX	Open / Emerging / Industrial Elective- IV	3/0/0	3	3	60/40	OEC
2	23MTXXX	Professional Elective – IV	3/0/0	3	3	60/40	PEC
3	23MTXXX	Professional Elective – V	3/0/0	3	3	60/40	PEC
4	23MTXXX	Professional Elective – VI	3/0/0	3	3	60/40	PEC
Project (Internal 60 Marks & External 40 Marks)							
5	23MT704	Project – I	0/0/4	4	2	40/60	PROJ
Internship (Internal 100 Marks)							
6	23EES01	Employability Enhancement Skills	-	-	2	0/100	EES
TOTAL			**12/0/6**	**18**	**16**	**600**	

SEMESTER VIII							
S. No	**Course Code**	**Course Title**	**L/T/P**	**Contact Hrs/Wk**	**Credits**	**Ext/Int**	**Cat.**
Project (Internal 60 Marks & External 40 Marks)							
1	23MT801	Project - II	0/0/24	24	12	40/60	PROJ
TOTAL					**165**	**100**	

SCHEME OF CREDIT DISTRIBUTION – SUMMARY											
S. No.	Stream	Credits/Semester								C	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences Including Management (HSMC)	1	4	3	-	-	3	-	-	11	6.67
2	Basic Sciences (BSC)	10	4	4	-	-	-	-	-	18	10.91
3	Engineering Sciences (ESC)	6	6	-	-	4	-	-	-	15	9.09
4	Professional Core (PCC)	7	8	15	17	11	15	-	-	73	44.24
5	Professional Electives (PEC)	-	-	-	3	3	3	9	-	18	10.91
6	Open/Emerging/Industry (OEC)	-	-	-	-	3	6	3	-	12	7.27
7	Project Work (PROJ)	-	-	-	-	1	-	4	12	18	10.91
8	Mandatory Course (MC) / Spoken Hindi	-	-	-	-	-	-	-	-	0	0.00
Total		24	22	22	20	22	27	16	12	165	100.00

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM			
S. No.	Course Work - Subject Area	AICTE Suggested Credits	SKCET Credits (XXX)
1.	Humanities and Social Sciences (HS), including Management;	12*	11
2.	Basic Sciences (BS) including Mathematics, Physics, Chemistry, Biology;	21*	18
3.	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	-	15
4.	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required	101*	73
5.	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	6*	18
6.	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	6*	12
7.	Project Work, Seminar and/or Internship in Industry or elsewhere.	17*	18

8.	Mandatory Courses (MC)	Non-credit	**0**
	Total	**163**	**165**
**Minor Variations is allowed as per need of the respective disciplines*			

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT (11 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/ P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
1.	23EN101	Oral and Written Communication Skills	2/0/2	4	3	50/50	HSMC
2.	23TA101	Heritage of Tamils / தமிழர் மரபு	3 weeks		1	60/40	HSMC
3.	23TA201	Tamils and Technology / தமிழரும் தொழில்நுட்பமும்	1/0/0	1	1	60/40	HSMC
4.	23GE301	Universal Human Values	3/0/0	3	3	60/40	HSMC
5.	23MT602	Industrial Management and Professional Ethics	3/0/0	3	3	60/40	HSMC

BASIC SCIENCE COURSES (18 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
1.	23MA101	Mathematics I	3/1/0	4	4	60/40	BSC
2.	23AS101	Applied Science	4/0/0	4	4	60/40	BSC
3.	23AS102	Applied Science Laboratory	0/0/4	4	2	40/60	BSC
4.	23MA201	Mathematics II	3/1/0	4	4	60/40	BSC
5.	23MA302	Mathematics III	3/1/0	4	4	60/40	BSC

ENGINEERING SCIENCE COURSES (15 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
1.	23IT101	Application Development Practices	1/0/4	5	3	50/50	ESC
2.	23CS101	Problem Solving using C++	1/0/4	5	3	50/50	ESC
3.	23CD201	Database Management Systems	1/0/4	5	3	50/50	ESC
4.	23IT211	Introduction to Python Programming	1/0/4	5	3	50/50	ESC
5.	23EE407	Control Theory	3/0/2	5	4	50/50	ESC

PROFESSIONAL CORE COURSES (73 Credits)							
S. No.	Course Code	Course Title	L/T/P	Contact hrs./Wk.	C	Ext/ Int	Cat.
1.	23MT101	Production Technology	3/0/0	3	3	60/40	PCC
2.	23MT102	Sensors, Measurements, and Instrumentation	3/0/0	3	3	60/40	PCC
3.	23MT103	Production Technology Laboratory	0/0/2	2	1	40/60	PCC
4.	23MT201	Applied Mechanics	3/0/0	3	3	60/40	PCC
5.	23MT202	Computer Aided Drawing Laboratory for Mechatronics	0/0/2	2	1	40/60	PCC
6.	23EC202	Digital System Design	3/0/0	3	3	60/40	PCC
7.	23EC204	Digital System Design Laboratory	0/0/2	2	1	40/60	PCC
8.	23MT301	Theory of Machines	3/0/0	3	3	60/40	PCC
9.	23MT302	Basics of Mechatronics Systems	3/0/0	3	3	60/40	PCC
10.	23CS311	Fundamentals of Java Programming	1/0/4	5	3	50/50	PCC
11.	23EC302	Operating Systems for Electronic Devices	3/0/2	5	4	50/50	PCC
12.	23MT303	Mechanics of Machines and Materials Laboratory	0/0/2	2	1	40/60	PCC
13.	23MT304	Idea Lab for Mechatronics	0/0/2	2	1	40/60	PCC
14.	23MT401	Machine Design	3/0/0	3	3	60/40	PCC
15.	23MT402	Electrical Machines for Mechatronics	3/0/0	3	3	60/40	PCC
16.	23MT403	Fluid and Thermal Engineering	3/0/0	3	3	60/40	PCC
17.	23MT404	Basics of Digital Signal Processing	3/0/0	3	3	60/40	PCC
18.	23EC403	Embedded C++	3/0/2	5	4	50/50	PCC
19.	23MT405	Fluid and Thermal Engineering Laboratory	0/0/2	2	1	40/60	PCC

20.	23MT501	Autotronics and Vehicle Intelligence	3/0/0	3	3	60/40	PCC
21.	23MT502	Robotic Systems	3/0/2	5	4	50/50	PCC
22.	23MT503	Hydraulics and Pneumatics System	3/0/2	5	4	50/50	PCC
23.	23MT603	Computer Networks and Cyber Security	3/0/0	3	3	60/40	PCC
24.	23MT601	Computer Integrated Manufacturing	3/0/2	5	4	50/50	PCC
25.	23MT604	Industrial Automation	3/0/2	5	4	50/50	PCC
26.	23MT605	Artificial Intelligence for Robotics	3/0/2	5	4	50/50	PCC

PROFESSIONAL ELECTIVE COURSES (18 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
ELECTIVE STREAM I – APPLIED ROBOTICS							
1.	23MT901	Mobile Robotics	3/0/0	3	3	60/40	PEC
2.	23MT902	Agricultural Robotics and Automation	3/0/0	3	3	60/40	PEC
3.	23MT903	Bio-Mechatronics	3/0/0	3	3	60/40	PEC
4.	23MT904	Robot Operating System	3/0/0	3	3	60/40	PEC
5.	23MT905	Micro Robotics	3/0/0	3	3	60/40	PEC
6.	23MT906	Humanoids	3/0/0	3	3	60/40	PEC
7.	23MT937	Introduction to Marine and Aerial Robotics	3/0/0	3	3	60/40	PEC
8.	23MT938	Robot Motion Planning	3/0/0	3	3	60/40	PEC
9.	23MT939	Robot Control	3/0/0	3	3	60/40	PEC
ELECTIVE STREAM II - DESIGN AND MANUFACTURING							
1.	23MT907	Product Design and Manufacturing	3/0/0	3	3	60/40	PEC
2.	23MT908	Robots and System in Smart Manufacturing	3/0/0	3	3	60/40	PEC
3.	23MT909	CNC Machines and Part Programming	3/0/0	3	3	60/40	PEC
4.	23MT910	Additive Manufacturing Processes	3/0/0	3	3	60/40	PEC
5.	23MT911	Robotic Welding Technology	3/0/0	3	3	60/40	PEC
6.	23MT912	Digital Manufacturing	3/0/0	3	3	60/40	PEC
7.	23MT940	Micro and Nano Manufacturing	3/0/0	3	3	60/40	PEC
8.	23MT941	Industrial Metrology	3/0/0	3	3	60/40	PEC
9.	23MT942	Micro Electro Mechanical Systems	3/0/0	3	3	60/40	PEC

ELECTIVE STREAM III - SMART MOBILITY SYSTEMS							
1.	23MT913	Advanced Driver Assistance Systems	3/0/0	3	3	60/40	PEC
2.	23MT914	Vehicle Ergonomics	3/0/0	3	3	60/40	PEC
3.	23MT915	Autonomous Underwater Vehicles	3/0/0	3	3	60/40	PEC
4.	23MT916	Electric and Hybrid Vehicles	3/0/0	3	3	60/40	PEC
5.	23MT917	Automobile Engineering	3/0/0	3	3	60/40	PEC
6.	23MT918	Battery Management System	3/0/0	3	3	60/40	PEC
7.	23MT943	Connected Vehicles	3/0/0	3	3	60/40	PEC
8.	23MT944	Safety, Ethics and Regulations for Driverless Cars	3/0/0	3	3	60/40	PEC
9.	23MT945	Foundations of Autonomous Vehicles	3/0/0	3	3	60/40	PEC
ELECTIVE STREAM IV – INTELLIGENCE SYSTEMS							
1.	23MT919	Introduction to Machine Learning	3/0/0	3	3	60/40	PEC
2.	23MT920	AI for Perception Planning and Control	3/0/0	3	3	60/40	PEC
3.	23MT921	Condition Monitoring and Fault Diagnostics	3/0/0	3	3	60/40	PEC
4.	23MT922	Intelligent Control System	3/0/0	3	3	60/40	PEC
5.	23MT923	Haptics	3/0/0	3	3	60/40	PEC
6.	23MT924	Computer Vision and Deep Learning	3/0/0	3	3	60/40	PEC
7.	23MT946	Reinforcement Learning for Robotics	3/0/0	3	3	60/40	PEC
8.	23MT947	Virtual Reality and its Applications	3/0/0	3	3	60/40	PEC
9.	23MT948	Augmented and Mixed Reality	3/0/0	3	3	60/40	PEC
ELECTIVE STREAM V – AUTOMATION							
1.	23MT925	Embedded System for Automation	3/0/0	3	3	60/40	PEC
2.	23MT926	Robotic Process Automation	3/0/0	3	3	60/40	PEC
3.	23MT927	Industrial Networking	3/0/0	3	3	60/40	PEC
4.	23MT928	Virtual Instrumentation and its Applications	3/0/0	3	3	60/40	PEC
5.	23MT929	Digital Twin and Industry 5.0	3/0/0	3	3	60/40	PEC
6.	23MT930	Internet of Things for Mechatronics	3/0/0	3	3	60/40	PEC
7.	23MT949	AI and Machine Learning in Automation Testing	3/0/0	3	3	60/40	PEC
8.	23MT950	Planning and Decision Making in Robotics	3/0/0	3	3	60/40	PEC
9.	23MT951	Automation in Production Systems and Management	3/0/0	3	3	60/40	PEC
ELECTIVE STREAM VI – AVIONICS AND DRONE TECHNOLOGY							
1.	23MT931	Avionics	3/0/0	3	3	60/40	PEC
2.	23MT932	Drone Technologies	3/0/0	3	3	60/40	PEC
3.	23MT933	Navigation and Communication System	3/0/0	3	3	60/40	PEC
4.	23MT934	Unmanned Aerial Vehicles	3/0/0	3	3	60/40	PEC
5.	23MT935	Aircraft Stability and Control	3/0/0	3	3	60/40	PEC
6.	23MT936	Aircraft Mechatronics	3/0/0	3	3	60/40	PEC
7.	23MT952	Introduction to Aircraft Control System	3/0/0	3	3	60/40	PEC
8.	23MT953	Introduction to Airplane Performance	3/0/0	3	3	60/40	PEC
9.	23MT954	Introduction to Aircraft design	3/0/0	3	3	60/40	PEC

OPEN/ EMERGING/ INDUSTRY (12 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
OPEN ELECTIVES (OE): Offered to other departments							
1.	23MT001	Basics of Robotics	3/0/0	3	3	60/40	OEC
2.	23MT002	Basics of Automation Systems	3/0/0	3	3	60/40	OEC
3.	23MT003	Smart Sensors for IoT	3/0/0	3	3	60/40	OEC
4.	23MT004	Basics of Unmanned Aerial Vehicles	3/0/0	3	3	60/40	OEC
5.	23MT005	Fundamentals of Arduino and Raspberry Pi	3/0/0	3	3	60/40	OEC
EMERGING ELECTIVES (EE): Offered to MCT							
1.	23MT006	Collaborative Robotics	3/0/0	3	3	60/40	OEC
2.	23MT007	Design Thinking and Entrepreneur Development	3/0/0	3	3	60/40	OEC
3.	23MT008	Brain Computer Interface	3/0/0	3	3	60/40	OEC
4.	23MT009	Social Robotics	3/0/0	3	3	60/40	OEC
5.	23MT010	Cognitive Robotics	3/0/0	3	3	60/40	OEC
6.	23MT011	Data Analytics for Robotics and Automation	3/0/0	3	3	60/40	OEC
7.	23MT012	Ethical Hacking	3/0/0	3	3	60/40	OEC
8.	23MT013	Communication Networks in IoT	3/0/0	3	3	60/40	OEC
9.	23MT014	Vision Guided Robots	3/0/0	3	3	60/40	OEC

PROJECT WORK (16 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
1.	23MT507	Prototype lab	0/0/2	2	1	100	PROJ
2.	23MT704	Project – I	0/0/4	4	2	40/60	PROJ
3.	23MT801	Project - II	0/0/24	24	12	40/60	PROJ

PROFESSIONAL ELECTIVE COURSES: VERTICALS					
Vertical I	**Vertical II**	**Vertical III**	**Vertical IV**	**Vertical V**	**Vertical VI**
APPLIED ROBOTICS	**DESIGN AND MANUFACTURING**	**SMART MOBILITY SYSTEMS**	**INTELLIGENCE SYSTEMS**	**AUTOMATION**	**AVIONICS AND DRONE TECHNOLOGY**
23MT901- Mobile Robotics	23MT907- Product Design and Manufacturing	23MT913- Advanced Driver Assistance Systems	23MT919 - Introduction to Machine Learning	23MT925- Embedded System for Automation	23MT931-Avionics
23MT902-Agricultural Robotics and Automation	23MT908- Robots and System in Smart Manufacturing	23MT914- Vehicle Ergonomics	23MT920- AI for Perception Planning and Control	23MT926- Robotic Process Automation	23MT932-Drone Technologies
23MT903- Bio-Mechatronics	23MT909- CNC Machines and Part Programming	23MT915- Autonomous Underwater Vehicles	23MT921- Condition Monitoring and Fault Diagnostics	23MT927- Industrial Networking	23MT933-Navigation and Communication System
23MT904- Robot Operating System	23MT910-Additive Manufacturing Processes	23MT916-Electric and Hybrid Vehicles	23MT922- Intelligent Control System	23MT928-Virtual Instrumentation and its Applications	23MT934- Unmanned Aerial Vehicles
23MT905- Micro Robotics	23MT911-Robotic Welding Technology	23MT917- Automobile Engineering	23MT923- Haptics	23MT929-Digital Twin and Industry 5.0	23MT935- Aircraft Stability and Control
23MT906-Humanoids	23MT912- Digital Manufacturing	23MT918-Battery Management System	23MT924- Computer Vision and Deep Learning	23MT930- Internet of Things for Mechatronics	23MT936-Aircraft Mechatronics
23MT937 - Introduction to Marine and Aerial Robotics	23MT940 - Micro and Nano Manufacturing	23MT943 - Connected Vehicles	23MT946- Reinforcement Learning for Robotics	23MT949 - AI and Machine Learning in Automation Testing	23MT952 - Introduction to Aircraft Control System

23MT938 - Robot Motion Planning	23MT941 - Industrial Metrology	23MT944- Safety, Ethics and Regulations for Driverless Cars	23MT947 - Virtual Reality and its Applications	23MT950 - Planning and Decision Making in Robotics	23MT953 - Introduction to Airplane Performance
23MT939 - Robot Control	23MT942 - Micro Electro Mechanical Systems	23MT945 - Foundations of Autonomous Vehicles	23MT948 - Augmented and Mixed Reality	23MT951 - Automation in Production Systems and Management	23MT954 - Introduction to Aircraft design

INTERNSHIP (2 Credits)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
1.	23EES01	Employability Enhancement Skills	-	-	2	0/100	EES

VALUE ADDED COURSES (Based on student's interest)			
S. No	**Course Code**	**Course Title**	**Sem**
1.	23VA600	Solidworks	III/IV
2.	23VA601	MATLAB programming	III/IV
3.	23VA602	Android Studio	III/IV
4.	23VA603	Intellectual Property Rights & Entrepreneurship	III/IV
5.	23VA604	Financial Literacy	III/IV
6.	23VA605	Automation Studio	IV/V
7.	23VA606	Electric Vehicle Design & Fabrication	IV/V
8.	23VA607	Mastering Embedded Systems: Unleash the Power of Controller Boards	IV/V
9.	23VA608	Programming with Labview	IV/V

MANDATORY COURSES (Non-Credits) (Courses conducted either by internal faculty or through MOOCs)							
S. No.	**Course Code**	**Course Title**	**L/T/P**	**Contact hrs./Wk.**	**C**	**Ext/ Int**	**Cat.**
1.	23MC101	Induction Programme	3 weeks		0	0/100	MC
2.	23MC102	Environmental Sciences	3 weeks		0	0/100	MC
3.	23MC103	Soft Skills	3 weeks		0	0/100	MC

4.	23MC104	Management Organizational Behavior	3 weeks	0	0/100	MC
5.	23MC105	General Aptitude	3 weeks	0	0/100	MC
6.	23MC106	Life Skills and Ethics	3 weeks	0	0/100	MC
7.	23MC107	Stress Management	3 weeks	0	0/100	MC
8.	23MC108	Constitution of India	3 weeks	0	0/100	MC
9.	23MC109	Essence of Indian Traditional Knowledge	3 weeks	0	0/100	MC
10.	23MC110	Biology	3 weeks	0	0/100	MC

L: Lecture **T:** Tutorial **P:** Practical **C:** Credit **O:** Outside Class hours **Cat.:** Category

HSMC : Humanities and Social Sciences including Management
BSC : Basic Science Courses
ESC : Engineering Science Courses
PCC : Professional Core Courses
PEC : Professional Elective Courses
OEC : Open and Emerging Elective Courses
PRJ : Project Work
INT : Internship
MC : Mandatory Course

Definition of Credit:

L – Lecture	1 Hr. Lecture (L) per week	1 credit
T – Tutorial	1 Hr. Tutorial (T) per week	1 credit
P - Practical/Practice (Project and Industry based Courses)	1 Hr. Practical (P) per week	0.5 credit

SEMESTER – V

23MT501	AUTOTRONICS AND VEHICLE INTELLIGENCE	3/0/0/3

Nature of Course : Theory

Pre requisites :Nil

Course Objectives:

1.	To interpret the basic electronic engine control used in automobiles
2.	To select appropriate sensors and actuators for engines
3.	To learn and illustrate electronic fuel injection, ignition system and advanced control system in automobiles

Course Outcomes:

Upon completion of the course, students shall have ability to

C501.1	Illustrate the role of electronic control in vehicles	[U]
C501.2	Interpret various roles of sensors and actuators in automobiles	[U]
C501.3	Identify various electronic injection and ignition systems	[AP]
C501.4	Outline various chassis and safety system operation and applications	[U]
C501.5	Infer the operation of various engine control systems	[U]

AUTOMOTIVE SYSTEM AND SENSORS **15 Hours**

Introduction to Automotive electronics – Emission norms -Engine components and their functions, Drivetrain and suspension systems, ABS and steering systems, Fuel supply systems and components. Vehicle Interoceptive sensors: Knock sensors, oxygen sensors, crankshaft angular, position sensor, temperature sensor, speed sensor, Pressure sensor, Mass air flow sensor, Manifold Absolute Pressure Sensors, crash sensor, Coolant level sensors, Brake fluid level sensor.

AUTOMOTIVE CONTROL AND COMFORT SYSTEMS **15 Hours**

Starting System -Charging System - Batteries - Electronic Engine Control system– Electronic Fuel Control System - Analysis of Intake Manifold Pressure-Ignition system- Electronic spark timing control, Automatic Transmission System - Variable Valve timing control - Integrated engine control system - Vehicle motion control-Active suspension system – Traction control system Electronic steering control-Electronic stability program. In-vehicle Networks. Onboard diagnostics

EV AND ADVANCED SYSTEMS **15 Hours**

Electric Vehicle - batteries- electric motor and controller, regenerative braking Control of hybrid vehicles - Advanced Driver Assistance Systems (ADAS): Lane Departure, Active Cruise Control, Blind Spot Detection, Parking Assist, Autonomous Emergency Braking, Night Vision, Traffic Sign Recognition, Intelligent High beam Assistant, Tire Pressure Monitoring, Adaptive Lighting, Driver Drowsiness Detection, Hill Descent Control. Connected and Autonomous Vehicles (CAVs).

Total hours: **45**

Text Books:

1	B.William Ribbens, '' Understanding Automotive Electronics: An engineering Perspective", 8th Edition, Butterworth- Heinemann, Woburn, 2017.
2	Tom Denton, "Automobile Electrical and Electronic Systems", 5th Edition, Taylor and Francis group, 2018.

Reference Books:

1	Tom Denton and Hayley Pells, "Electric and Hybrid Vehicles", 3rd Edition, Routledge, 2020.
2	Tom Denton, "Automated Driving and Driver Assistance Systems, Routledge, 2019

Web Resources:

1	https://www.dieselnet.com/standards/in/
2	https://onlinecourses.nptel.ac.in/noc23_de01/preview
3	https://en.wikipedia.org/wiki/Bharat_Stage_emission_standards
4	https://www.eulermotors.com/en/charging-network

23MT919	INTRODUCTION TO MACHINE LEARNING	3/0/0/3

Nature of Course : Theory

Pre Requisites : Nil

Course Objectives:

1	To understand the basic concepts and techniques of machine learning.
2	To become acquainted with supervised and unsupervised learning methods in Machine Learning
3	To understand the underlying mathematical relationships of various algorithms

Course Outcomes:
Upon completion of the course, students shall have ability to

C919.1	Outline the basic concepts of various learning methods	[U]
C919.2	Illustrate the working of neural networks	[U]
C919.3	Compare the working of various algorithms used for supervised learning	[AN]
C919.4	Identify the different algorithms used for unsupervised learning	[AP]
C919.5	Apply reinforcement learning for robotic applications	[AP]

MACHINE LEARNING MODELS AND NEURAL NETWORKS **15 Hours**

Introduction, Types, Applications, Tools and Issues – Preparing to Model – Modelling and Evaluation – Basics of Feature Engineering – Basics of Neural Networks – Backpropagation - Minimization of cost function and Gradient Descent - Application of Neural Networks in manufacturing and process control applications.

SUPERVISED LEARNING **15 Hours**

Supervised Learning: Regression: Linear regression - Logistic regression – Discriminant Analysis - Bias-Variance tradeoff - Cross-validation- Decision Tree – Support Vector Machines – Bayesian Classification - Hidden Markov Model – Obstacle avoidance, Navigation and path planning of a mobile robot.

UNSUPERVISED AND REINFORCEMENT LEARNING **15 Hours**

Unsupervised Learning: K-Means clustering, Hierarchical clustering – Expectation Maximization Algorithm - Dimensionality Reduction - Principal Component Analysis - Restricted Boltzmann Machine - Sparse Representation – Reinforcement Learning: Markov Decision Process - Temporal Difference Learning - Function Approximation - Introduction to Convolutional Networks and Deep Learning.

Total hours: 45

Text Books:

1	Kevin P. Murphy, "Probabilistic Machine Learning: An Introduction", The MIT Press, Cambridge, 2022.
2	Ethem Alpaydin, "Introduction to Machine Learning", Fourth Edition, The MIT Press, Cambridge, 2020.
3	R S Sutton, A G Barton, “Reinforcement Learning: An Introduction”, Second Edition, The MIT Press, 2018.

Reference Books:

1	Tom M Mitchell , "Machine Learning", Mc Graw Hill, 2017.
2	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

Web References:

1	onlinecourses.nptel.ac.in/noc21_cs24/preview
2	https://www.coursera.org/learn/machine-learning
3	https://www.datacamp.com/tracks/machine-learning-with-python
4	http://scikit-learn.org/stable/tutorial/basic/tutorial.html
5	https://machinelearningmastery.com/machine-learning-in-python-step-by-step/

23EE407	CONTROL THEORY	3/0/2/4

Nature of Course : Theory

Pre requisites :Nil

Course Objectives:

1.	To understand the methods of system representation and to derive their transfer function models.
2.	To provide an adequate knowledge of systems in time domain and its stability analysis.
3.	To accord basic knowledge in obtaining the open loop and closed loop frequency responses of systems.
4.	To introduce the design of controllers and compensators

Course Outcomes:
Upon completion of the course, students shall have ability to

C407.1	Construct the mathematical model of various control systems and obtain the transfer function of a system.	[AP]
C407.2	Analyze the first and second order systems in time domain.	[AN]
C407.3	Analyze the frequency response using Bode plot and Polar plot and examine the stability of the control systems using Root locus, Routh-Hurwitz criteria methods.	[AN]
C407.4	Design the controllers and compensators.	[AP]
C407.5	Explain the design steps of electro-mechanical system and fuzzy logic controller.	[U]

Course Contents:

SYSTEM MODELLING **15**

Basic elements of control systems - Open loop and closed loop systems - Transfer function modelling: Electrical systems and Mechanical system - Translational, Rotational. State-space modeling: Electrical systems and Mechanical system - Block diagram models - Signal flow graph - Introduction to stepper and servo motor - Case study: Modelling of inverted pendulum-cart system.

TIME AND FREQUENCY RESPONSE ANALYSIS **15**

Time domain specifications - Types of test signals - Step response of first and second order system - Steady state error - Generalized error coefficients - Concept of stability - Routh Hurwitz criterion - Root locus technique - Frequency domain specifications - Bode plot - Polar plot.

CONTROLLERS AND COMPENSATORS **15**

Design of P, PI, PD and PID controllers - Compensators: Introduction to lag, lead and lag-lead networks - Lag compensator design using Bode plot - Controllability and Observability - Electro-Mechanical Systems: Introduction - problem setup and design requirements, optimal control of electro-mechanical systems using PID controller - Introduction to Fuzzy Logic Controllers: Architecture, major components and design steps.

TOTAL PERIODS (THEORY): 45

Total hours:	**45**

LIST OF EXPERIMENTS

1. Model the mechanical, electrical system and simulate its behaviour to derive its transfer function.
2. Simulate different block arrangements and reduce as a single transfer function.
3. Determination of transfer function of armature-controlled DC motor.
4. Determination of transfer function of field-controlled DC motor.
5. Position control of servo motor and stepper motor systems.
6. Study and operation of inverted pendulum system using V-lab.
7. Determination of response for different test inputs of first and second order system using V-lab.
8. Time response analysis for a second order system using simulation.
9. Analyse the stability of a linear system by Bode plot and Polar plot using V-lab.
10. Design of P, PI, PD and PID controllers for type-0 and type-1 system using simulation.
11. Design of lag compensator for uncompensated system using simulation.
12. Controller realization for an electro-mechanical system using MATLAB/Simulink.
13. Design of fuzzy logic controller for real time applications using MATLAB/Simulink.

TOTAL PERIODS (LAB): 30

Text Books:	
1	I. J. Nagrath and M. Gopal, “Control Systems Engineering”, 7th Edition, New Age International Publishers, 2022.
2	Katsuhiko Ogata, “Modern Control Engineering”, 5th edition, Pearson, New Delhi, 2015.
3	Farid Golnaraghi and Benjamin C. Kuo, “Automatic Control systems”, 10th Edition, Wiley,2017
Reference Books:	
1	Norman S. Nise, “Control Systems Engineering”, 8th edition, Wiley, New Delhi, 2024.
2	Richard C. Dorf, Robert H.Bishop, “Modern Control Engineering”, 13th Edition, Pearson Education, New Delhi, 2016.
3	A.Nagoorkani, “Control Systems Engineering”, RBA Publications, 2018.
Web Resources:	
1	https://archive.nptel.ac.in/courses/107/106/107106081/
2	https://www.coursera.org/learn/modeling-feedback-systems
3	https://onlinecourses.nptel.ac.in/noc22_ee21/preview
4	https://www.udemy.com/course/fuzzy-logic-matlab/?couponCode=NVDIN35
5	https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/systems-and-controls

23MT502	ROBOTIC SYSTEMS	3/0/2/4
Nature of Course	Theory	
Course Pre-requisites	-	

Course Objectives:

1	To acquire the concepts and techniques in robot manipulator control and robot dynamics
2	To impart knowledge on design and implementation of robot applications and their relationship to other automated technologies.
3	To understand the basics of machine vision and its application in robotics
4	To explore various robotic components and end effectors
5	To introduce students to the Robotic Operating System (ROS) and mobile robotic systems

Course Outcomes:
Upon completion of the course, students shall have ability to

C502.1	Outline the basic concepts of Robotics and Robot components	[U]
C502.2	Choose appropriate the concept of end effectors in robotics and basic robot programming techniques	[AP]
C502.3	Analyze the robot kinematic position and dynamic equations	[AN]
C502.4	Illustrate the concept of Robotic Operating system	[U]
C502.5	Apply the basic concepts of wheeled mobile robotics	[AP]

Course Contents:

ROBOT COMPONENTS **15 Hours**

Introduction-Laws of robotics- Robot Anatomy- Configuration of Robot- Work Volume- Robot Drive Systems- Control System- Precision of Movement- Robot Application. Robot end effectors- Types of end effectors-Mechanical Grippers-Types of gripper mechanisms-Tools as end effectors- Lead through Programming

ROBOT DYNAMICS AND KINEMATICS **15 Hours**

Introduction- Lagrangian Mechanics- Effective moment of Inertia- Dynamic Equations for multiple DOF Robots. Basics of trajectory planning. Robot kinematics: Introduction to Manipulator Kinematics- Position representation- Forward and Reverse transformation of 2DOF arm- 3DOF arm in 2D- Homogeneous transformations and robot kinematics- DH Representation of forward kinematic equations of robot.

ROBOT OPERATING SYSTEM AND MOBILE ROBOTS **15 Hours**

Introduction - difference from other meta-operating systems–services – Robot Operating System (ROS) framework- Introduction to Wheeled Mobile Robots – Locomotion - Motion control - Perception - Sensors for mobile robots: wheel sensor, heading sensor, accelerometers, inertial measurement - Localization - localization-based navigation. Case study- Mobile robot in military application

Total Hours:	**45**

Lab Component:

S. No.	List of Experiments
1	Using the Robot Studio Software simulate the following experiments a) Write your short name using six axis ABB robot b) Simulate the pick and place operation using six axis ABB robot
2	Simulate the pick and place operation in a six-axis robot using software.
3	Simulate the path following mobile robot using software.
4	Open loop and PID control system for a simple mobile robot.

5	Perform Trajectory planning for Robot Manipulators.
6	Simple, rapid programming using Teach pendant.
7	Teach Work object and TCP setting to ABB six axis robot using Teach pendant
8	Teach the ABB six axis robot a) To identify the given components are Metal or Non – metal using Teach pendant b) Machine tending operation of ABB six axis robot using Teach pendant
9	Teach the ABB six axis robot a) Welding simulation of ABB six axis robot using Teach pendant b) Painting simulation of ABB six axis robot using Teach pendant
10	Teach the ABB six axis robot a) Matrix palletizing operation of ABB six axis robot using Teach pendant with single suction cup b) Cartoon palletizing operation of ABB six axis robot using Teach pendant with multi suction cup
Total Hours	**30**
Text Books:	
1	M.P.Groover, "Industrial robotics- Technology, programming and Applications", McGrawHill, 2017
2	Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", 2nd edition Pearson Education India, 2015
3	Roland Siegwart, IllahR.Nourbakhsh, "Introduction to Autonomous Mobile Robots", 2nd Edition, 2011
Reference Books:	
1	King Sun Fu, Rafael C. González, C. S. George Lee, "Robotics: control, sensing, vision, and intelligence", Tata Mcgraw-Hill Publication, 2016
2	Robin R Murphy, “Introduction to AI Robotics”, Fourth Edition, MIT Press, 2016.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc23_me51/preview
2	https://www.robotbooks.com/
3	http://nptel.ac.in/courses/112101099/
4	https://www.toptal.com/robotics/introduction-to-robot-operating-system
5	https://www.coursera.org/learn/robotics-engineering--applications
6	https://www.coursera.org/learn/modernrobotics-course2

23MT503	**HYDRAULICS AND PNEUMATICS SYSTEM**	**3/0/2/4**

Nature of Course	Theory
Course Pre-requisites	-

Course Objectives:

1	To understand the concepts of hydraulics and pneumatics
2	To develop a measurable degree of competence in the design, construction and operation of hydraulic circuits
3	To apply the pneumatic principles to design various sequential circuits
4	To develop hydraulic and pneumatic circuits for various industrial applications
5	To develop the sequential and cascading method of pneumatic circuits

Course Outcomes:
Upon completion of the course, students shall have ability to

C503.1	Outline the basic concept of hydraulics and pneumatics and working of pumps	[U]
C503.2	Summarize the working principle of hydraulic actuators and control components	[U]
C503.3	Demonstrate different types of hydraulic circuits and systems	[U]
C503.4	Explain the basic pneumatic components and working of different pneumatic circuits	[U]
C503.5	Design the pneumatic circuit according to the given sequence using cascade and step counter method	[AP]

FLUID POWER PRINCIPLES AND COMPONENTS **15 Hours**

Introduction to Hydraulics and pneumatics - Advantages and Applications - Types of fluids - Pascal's Law and its application- Principles of flow, Pumping Theory – Pump Classification, Construction, Working, Advantages, Disadvantages, Selection criterion of Linear, Rotary - Fixed and Variable displacement pumps – Properties of air – Perfect Gas Laws - Symbols of hydraulic and pneumatic elements.

HYDRAULICS ELEMENTS AND CIRCUITS **15 Hours**

Hydraulic system design and typical Industrial applications - Sizing and selection of power pack elements – actuators – intensifiers – valves (pressure, flow and directional control valves) – hydraulic pumps and motors - accumulators - deceleration circuit, regenerative circuits, speed control circuits, sequencing circuits, synchronizing circuits, fail safe circuits - Introduction to digital hydraulics.

PNEUMATIC AND ELECTRO-PNEUMATIC CIRCUITS **15 Hours**

Compressors - Filter, Regulator, Lubricator, Muffler, Air control valves, Actuators. Pneumatic Circuits: Speed control, Quick exhaust, Air-Oil-reservoir circuit - Design of pneumatic circuit by cascade method and step counter method – Introduction to Electro hydraulics and pneumatics & PLC - Applications of fluid power in excavators & pick and place robot.

Total Hours:	**45**

Lab Component:

S. No.	List of Experiments
1	Study of pneumatic and hydraulic components
2	Simulation and actuation of hydraulic linear & rotary actuator
3	Simulation and actuation of speed control in hydraulic actuator
4	Simulation and actuation of an accumulator circuit
5	Simulation and actuation of an counter balancing and regenerative circuits

6	Simulation and actuation of single and double acting pneumatic cylinder, parallel and series circuit	
7	Simulation and actuation of pneumatic logical circuits using Shuttle valve & two pressure valve	
8	Simulation and actuation of metering in and metering out pneumatic circuit	
9	Simulation and actuation of sequential pneumatic circuit (2 & 3 cylinder circuit)	
10	Simulation and actuation of cascading pneumatic circuit (2 & 3 cylinder circuit)	
11	Develop pneumatic circuit to operate single acting cylinder directly https://pc-coep.vlabs.ac.in/exp/direct-single-acting-cylinder/	
12	Develop pneumatic circuit to operate double acting cylinder indirectly https://pc-coep.vlabs.ac.in/exp/indirect-double-acting-cylinder/	
	Total Hours	**30**
Text Books:		
1	Anthony Esposito, “Fluid Power with Applications”, Pearson Education, South Asia, Seventh edition 2016.	
2	Srinivasan. R, “Hydraulic and Pneumatic controls”, McGraw Hill Education Pvt. Ltd, Third edition, 2019.	
3	Andrew Parr, “Hydraulics and Pneumatics – A technicians and Engineers guide”, Third Edition, Butterworth-Heinemann, 2018.	
Reference Books:		
1	S. R. Majumdar, “Pneumatic System Principle and Maintenance” Tata McGraw-Hill. New Delhi, 2017	
2	J. Michael, Pinches and G. John Ashby, “Power Hydraulics”, Prentice Hall, New Delhi,2018	
3	V. Jayakumar, “Applied Hydraulics and Pneumatics”, Lakshmi Publications, Chennai, Latest Edition, June 2014.	
Web References:		
1	https://pneumaticmfg.com/blog/hydraulics-and-pneumatics/	
2	https://uk.rs-online.com/web/content/discovery/ideas-and-advice/pneumatics-hydraulics-overview	
3	https://www.iqsdirectory.com/articles/hydraulics/difference-between-hydraulics-and-pneumatics.html	
4	https://www.mdpi.com/1996-1073/14/24/8589	
5	https://archive.nptel.ac.in/courses/112/106/112106300/	
6	https://whyps.com/applications-of-hydraulics-and-pneumatics	

23MT507	PROTOTYPE LAB	0/0/2/1
Nature of Course	Practical / Project	
Pre Requisites	-	
Course Objectives:		
1	To apply theoretical knowledge to practical problems	
2	To demonstrate the ability to work effectively in teams	
3	To develop technical skill, presentation skill and interpersonal behaviour	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C507.1	Analyze system requirements to identify suitable components and subsystems for prototype development	[AN]
C507.2	Apply appropriate tools and techniques for simulation, hardware integration, and prototyping	[AP]
C507.3	Develop technical skill, presentation skill and interpersonal behaviour	[AP]
C507.4	Demonstrate interdisciplinary skill, ethical values and teamwork	[U]
C507.5	Analyze the performance of the prototype through testing and debugging	[AN]

Introduction: Identifying an Innovation Challenge, Needs Finding, Observation Techniques, Techniques for Organizing Data. **Ideate:** Rules of Brainstorming, Brainstorm Facilitation. **Prototype:** Role of DT in your work, Prototyping Techniques, Testing Prototypes. **Experiments:** Introduction to Experimental Design, Types of Experiments, Business model canvas. Introduction and need for intellectual property rights.

1. Each student is expected to do a prototype and form a team of 3 to 4 members.
2. Every team shall have a guide who is a member of the faculty of the institution. Identification of faculty guide has to be completed within a week from the day of beginning of semester.
3. The student has to identify and fabricate his/her idea into the project working model by conducting literature survey and finalising it.
4. A project report to this effect has to be submitted by the team. Also, the complete design project report has to be submitted by the team.
5. Three mid semester reviews and one end semester review of the progress of the prototype have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member of the faculty team.
6. During the end semester exam, one internal examiner and one external examiner, appointed by the COE will examine the prototype done by the students.

Summative assessment based on Continuous and End Semester Examination

Activity	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Prototype Evaluation -I	30	100
Prototype Evaluation-II	30	
Prototype Evaluation-III	40	

SEMESTER – VI

23MT602	INDUSTRIAL MANAGEMENT AND PROFESSIONAL ETHICS	3/0/0/3

Nature of Course: Theory

Pre requisites : -

Course Objectives:

1. To understand the basic principles of management and the types of organization
2. To understand the inventory and production planning analysis through various approaches
3. To understand ethics and its procedure in all aspects

Course Outcomes:
Upon completion of the course, students shall have ability to

C602.1	Outline the role of management in achieving the organizational Goals	[U]
C602.2	Classify the layout of plants and to provide the optimum inventory for the production	[U]
C602.3	Apply the Quality function deployment and Six sigma	[AP]
C602.4	Develop work ethics and computer ethics in organizations	[AP]
C602.5	Interpret IPR, copyright and trademark procedure	[U]

PRINCIPLES OF MANAGEMENT **15 Hours**

Management- Definition- Scientific Management- Significance and Features of Scientific Management-Functions of Management-Planning-Organizing-Staffing-Departmentalization-Centralization-Decentralization-Staffing-selection and training-Performance Appraisal Directing-Controlling-Coordinating-Management by Objective- Case study: Management as a Science and Management as an Art.

INVENTORY MANAGEMENT AND QUALITY CONTROL **15 Hours**

Materials Management- Significance of Inventory-Functions of Inventory- ABC Analysis- V-E-D Analysis- Enterprise Resource Planning (ERP) -Production Planning and Control- Functions of Production Planning- Facility Planning – Muther's Principle of Facility Layout- Types of Plant Layout- Statistical Quality Control- Quality function Deployment (QFD) – Introduction to six sigma.

ENGINEERING ETHICS AND RIGHTS **15 Hours**

Moral and values- Work Ethics- Engineering Ethics- Kohlberg's Theory- Gilligan's Theory-Consensus and Controversy- Theories about right action- Uses of Ethical theories- Occupational Crimes-Professional rights- Employee Rights- Intellectual Property Rights Copyrights and its Infringement- Trademark and its Infringement-Environmental Ethics- Computer Ethics- Ten Commandments of Computer Ethics-Engineering as Experimentation- Rights of Engineers.

Total hours: 45

Text Books:	
1.	N.V.S.Raju, "Industrial Engineering and Management", Cengage, Delhi, 1st edition, 2023
2.	Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, Fourth edition, 2023
Reference Books:	
1.	Stephen P.Robbins, Timothy A.Judge, Katherine E.Breward, "Essentials of Organizational Behaviour", Canada,Pearson Publication, 2022.
2.	George Reynolds. "Ethics In Information Technology",Cengage,5th Edition, Noida,2023
Web Resources:	
1	https://www.managementstudyguide.com/
2.	https://www.sciencedirect.com/topics/computer-science/computer-ethics

23MT603	COMPUTER NETWORKS AND CYBER SECURITY	3/0/0/3

Nature of Course: Theory

Pre requisites : Nil

Course Objectives:

1. To understand the concepts of computer networking
2. To describe the different protocols associated with each layer
3. To comprehend the cybersecurity concepts and vulnerabilities

Course Outcomes:

Upon completion of the course, students shall have ability to

C603.1	Outline the fundamentals of computer networks	[U]
C603.2	Apply the error detection techniques in Data Link Layer	[AP]
C603.3	Identify various network routing protocols	[AP]
C603.4	Interpret Transport Layer and Application Layer protocols	[U]
C603.5	Illustrate Cybersecurity concepts and Vulnerabilities	[U]

COMPUTER NETWORKS **15 Hours**

Data communication Components: Representation of data and its flow, Networks, Types - OSI model - Physical Layer: Transmission Media, Networking Devices: Hubs, Bridges, Switches, Routers and Gateways – Switching: Circuit Switched Networks, Packet Switched Networks - Data Link Layer: Addressing, Error Detection: Parity, CRC, Hamming Code – Protocols: Sliding Window, Stop-and-wait Protocol- Random Access

ROUTING PROTOCOLS **15 Hours**

Network Layer: Internet Protocol: IPv4, IPv6 – ARP, DHCP, ICMP – Distance Vector Routing, Link State Routing, Classless Inter-domain routing. Transport Layer - Process to Process Delivery: User Datagram Protocol (UDP), Transmission Control Protocol (TCP), Congestion Control - Application Layer: Domain Name Space (DNS), Electronic Mail, File Transfer Protocol (FTP), WWW, HTTP.

CYBER SECURITY **15 Hours**

Cyber Security Concepts: Introduction to Cyber Security, CIA, Risks, Breaches, Threats, Attacks, Exploits, Need of Cyber Security, Cyber Crime – Types, Cyber Security Vulnerabilities & Safe Guards, Internet Security -Fundamentals of cryptography

Total hours: **45**

Text Books:

1.	Behrouz A. Forouzan, “Data Communications and Networking” 5th Edition, McGraw Hill Education, 2017
2.	Andrew S. Tanenbaum, Nickolas Feamster, “Computer Networks”, Pearson Education, 2019

Reference Books:

1.	Charles J. Brooks, Christopher Grow, Philip A. Craig, Jr., Donald Short, “Cybersecurity Essentials”, Wiley, 2018
2.	Linda Lavender, “Principles of Cybersecurity”, Goodheart-Willcox Company, Incorporated, 2018

Web References:

1	https://nptel.ac.in/courses/106105183
2.	https://www.geeksforgeeks.org/basics-computer-networking/
3.	https://www.edx.org/learn/computer-networking
4.	https://in.coursera.org/specializations/intro-cyber-security
5.	https://www.futurelearn.com/courses/introduction-to-cyber-security

23MT601	COMPUTER INTEGRATED MANUFACTURING	3/0/2/4

Nature of Course: Theory skill based

Pre requisites : Nil

Course Objectives:

1 To provide the overview of evolution of automation, CIM and NC system
2 To train students to apply group technology, FMS and process planning in manufacturing
3 To learn the various Automation tools, various material handling systems
4 To introduce the basics of data transaction, information integration and control of CIM

Course Outcomes:
Upon completion of the course, students shall have ability to

C601.1	Infer the working of CIM and NC machines and its various elements	[U]
C601.2	Outline the overview of group technology, part classifications and coding system	[U]
C601.3	Develop computer aided process planning for manufacturing of various components	[AP]
C601.4	Identify the different types of FMS layouts, AGVs and material handling storage and retrieval systems	[AP]
C601.5	Interpret the modeling methods with their impact on the designed systems	[U]

CIM AND CNC PROGRAMMING **15 Hours**

CAD/CAM Integration - CIM wheel and Components: Evolution, Needs and Benefits – CIM business functions - NC System - NC Motion control system - Applications of NC – NC Part Programming using G and M codes - Drilling, Turning and Milling. Part families – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – layout configurations – Computer control systems – FMS planning and implementation issues – applications and benefits.

AUTOMATED MANUFACTURING SYSTEMS **15 Hours**

Process planning – classification, selection of manufacturing processes. Computer Aided Process Planning – module and data base – Variant process planning – Generative process planning. Automated production line – Fundamentals of Automated assembly system – Overview of material handling equipments – Automated Guided Vehicle system – Types & applications – Storage system – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system – Smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing.

PROCESS CONTROL SYSTEMS **15 Hours**

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology – Automatic data capture technologies - Quality management (SPC) and automated inspection.

Total hours: **45**

List of Experiments

1. Introduction to FEA and ANSYS Commands - Structural analysis of Beams and Trusses
2. Structural analysis of a L Bracket
3. Thermal analysis of a Heat sink
4. Introduction to CAM and CNC Machining
5. Automated CNC Tool path & G - Code generation using Master CAM - Turning
6. Automated CNC Tool path & G - Code generation using Master CAM - Milling
7. Turn-mill & Multi axis CNC tool path using Master CAM
8. Turning operations using Fanuc simulator software.

9. Milling operation using Fanuc simulator software.
10. Drilling using Fanuc simulating software.
11. Introduction to SAP.

Total Hours:30

Text Books:	
1.	Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India Private Ltd., New Delhi, 2016
2.	Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 2023
Reference Books:	
1.	Cheng, “Computer Aided Manufacturing”, Pearson India, 2017
2.	Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016
Web References:	
1	https://nptel.ac.in/courses/112104289
2.	https://www.sciencedirect.com/topics/engineering/computer-integrated-manufacturing
3.	https://www.n-ix.com/computer-integrated-manufacturing-use-cases/

23MT604	INDUSTRIAL AUTOMATION	3/0/2/4

Nature of Course : Theory

Pre requisites :Nil

Course Objectives:

1. To understand the concept of Industrial Automation
2. To study about the hardware and programming software of PLC
3. To explain the control functions involved in DCS and SCADA
4. To give adequate information about the interfaces used in HMI

Course Outcomes:
Upon completion of the course, students shall have ability to

C604.1	Illustrate the PLC architecture, selection for industrial automation and networking concepts	[U]
C604.2	Select the PLC peripherals and build ladder logic programming	[AP]
C604.3	Infer the concepts of DCS and its architecture, reliability, and SCADA systems	[U]
C604.4	Construct real-time systems, SCADA-PLC interfacing, and FPGA fundamentals	[AP]
C604.5	Interpret the concepts of HMI for diverse industrial applications, emphasizing cybersecurity measures	[U]

PLC AND NETWORKING **15 Hours**

Industrial Automation: Overview, Types, Control Elements - PLC architecture: Parts, CPU, Memory, Input/output modules, Timers and Counters – Instruction set - Selection of PLC based on input and output - PLC programming languages: Ladder logic – Wiring of PLC - Industrial Networking: Modbus – Profibus – Fieldbus – Ethernet.

DCS AND SCADA **15 Hours**

Distributed Control System (DCS): Architecture, Database organization, System elements - Field station - Intermediate station - Central computer station, Reliability parameters - SCADA: Introduction, Architecture, Application areas, Major elements, Considerations and benefits - Real time systems - Interfacing of SCADA with PLC and other field devices - Comparison of SCADA, DCS and PLC.

HMI AND APPLIED AUTOMATION **15 Hours**

Human Machine Interface (HMI) –Automation system structure, Instrumentation subsystem, control subsystem, Human interface subsystem-operator panel-construction of the panel- Interfacing with control sub system-Types of Mimic panels, Advance HMI system-Intelligent operator panel - Interfacing PLC to HMI – Basics of Cyber security in Industrial automation – Applied Automation : PLC in wind turbine control - DCS in cement plants - HMI in Material Transfer application.

Total hours: **45**

Text Books:

1. Jon Stenerson, “Industrial Automation and Process Control”, 4th edition, Prentice Hall, 2018.
2. Frank D Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Publications, 6th edition, 2019.

Reference Books:

1. Stuart A Boyer, “SCADA-supervisory control and data acquisition”, International Society of automation, 4th edition, 2016.
2. Dobrivoje Popovic and Vijay Bhatkar, “Distributed control for Industrial Automation”, Marcel Dekker Inc, 5th edition, 2017.
3. Webb, John W, “Programmable Logic Controllers - Principles and applications”, PHI Publication, 5th edition, 2016.

Web Resources:

1	https://nptel.ac.in/courses/108106022/8
2	https://instrumentationtools.blogspot.com/2019/03/plc-study-material.html
3	https://examsdaily.in/dcs-study-materials
4	https://nptel.ac.in/courses/108106022/8

23MT605	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	3/0/2/4

Nature of Course : Theory skill based

Pre requisites : Nil

Course Objectives:

1.	To study the idea of intelligent agents and search methods
2.	To understand about various robotic paradigms
3.	To gain idea about localization, planning and natural language processing

Course Outcomes:

Upon completion of the course, students shall have ability to

C605.1	Infer the history of AI and intelligent agents	[U]
C605.2	Examine the various search strategies in AI	[AN]
C605.3	Illustrate various robotic paradigms and architectures	[U]
C605.4	Choose appropriate path planning and localization methodologies	[AP]
C605.5	Identify language models in natural language processing	[AP]

INTELLIGENT AGENTS AND SEARCHING STRATEGIES **15 Hours**

Introduction to AI: Foundations, History - Intelligent Agents - Agents and Environments, Structure of agents - Problem solving agents - Problem formulation – Search Algorithms - Uninformed search strategies: Breadth-first search, Depth-first search, Iterative deepening search, Uniform-cost search – Informed search strategies: Best-first search, Greedy best-first search, A* search, IDA* – Heuristic functions.

ROBOTIC PARADIGMS **15 Hours**

Overview of the Three Paradigms - Hierarchical Paradigm: attributes – representative architectures - Reactive paradigm: attributes - subsumption architecture - potential field methodologies - Designing a reactive implementation: a primitive move-to-goal behavior, an abstract follow-corridor behavior - Designing a Reactive Behavioral System - The Hybrid Deliberative/Reactive Paradigm- Attributes - Architectural Aspects- Managerial Architectures- State-Hierarchy Architectures Model-Oriented Architectures

NAVIGATION AND NATURAL LANGUAGE PROCESSING **15 Hours**

Topological Path Planning: Landmarks and gateways - relational methods – associative methods - case study – Metric Path Planning: Configuration space – Cspace representations – Graph based planers – Wavefront based planers - Localization and Map making: Sonar sensor model – Bayesian – Localization – Exploration – Learning and Natural language: Forms of learning – NLP - Language models – Natural language for communications - Speech recognition.

Total hours	**45**

List of Experiments

1. Implement basic search strategies: 8-Puzzle, 8 – Queens problem
2. Implement A* algorithm.
3. Solve Depth First Search and Breadth First Search in Prolog
4. Implement the Traveling Salesman Problem
5. Implement a four-wheels mobile robot.
6. Implement obstacle avoidance and path planning in the mobile robot using AI based algorithms
7. Develop AI based algorithms for connected cars to avoid traffic congestion and reduce travel times.
8. Develop AI based algorithms for healthcare robots to read and store the vitals of a patient and predict ill-health.

9. Write a python program to implement a simple Chatbot. 10. Write a program to POS (Parts of Speech) tagging for the sentence using natural language toolkit. 11. Write a python program to remove stop words for a given passage from a text file using NLTK.	
Total Hours	**30**
Text Books:	
1	Murphy RR, 'Introduction to AI Robotics', Second Edition, MIT Press, Cambridge, London, 2019
2	Stuart Russel and Peter Norvig, 'Artificial Intelligence: A Modern Approach', Fourth Edition, Pearson Education Limited, UK, 2022
Reference Books:	
1	Francis X. Govers, "Artificial Intelligence for Robotics", Packt, 2018
2.	Elaine Rich, Kevin Knight, SB Nair, "Artificial Intelligence", Third Edition, McGraw Hill, 2017
Web References:	
1	https://www.coursera.org/learn/introduction-to-ai
2	http://nptel.ac.in/courses/106105077
3	https://www.coursera.org/learn/ai-for-everyone

PROFESSIONAL ELECTIVES

23MT912	DIGITAL MANUFACTURING	3/0/0/3

Nature of Course: Theory

Pre requisites : -

Course Objectives:

1. To inculcate the importance of DM in Product Lifecycle and Supply chain Management.
2. To formulate IoT and smart manufacturing systems in the digital work environment
3. To elaborate the significance of the digital twin.

Course Outcomes:
Upon completion of the course, students shall have ability to

C912.1	Infer the concepts and phases of the digital product life cycle	[U]
C912.2	Interpret collaborative product development strategies	[U]
C912.3	Demonstrate the principles and technologies of Smart Factories and Industry 4.0	[U]
C912.4	Apply cloud computing and cybersecurity standards in smart manufacturing environments	[AP]
C912.4	Identify the architecture and application of Digital Twins	[AP]

DIGITAL LIFE CYCLE **(15 Hours)**

Overview and Aspects of Digital Manufacturing: Product life cycle, Smart factory, and value chain management. Collaborative Product Development, Mapping Requirements to specifications – Part Numbering, Engineering Vaulting, and Product reuse – Engineering Change Management, Bill of Material and Process Consistency – Digital Mock up and Prototype development – Virtual testing and collateral.

SMART FACTORY AND INDUSTRY 4.0 **(15 Hours)**

Smart Factory – Levels – Benefits – Technologies – Smart Factory in IoT- Key Principles – Creating a Smart Factory – Smart Factories and Cybersecurity - Industrial Internet of Things – Framework - Connectivity devices and services – Cyber physical systems- Cybersecurity Standards – Machine to Machine communication- Intelligent networks of manufacturing – Cloud computing – Data analytics

DIGITAL TWIN **(15 Hours)**

Basic Concepts – Features and Implementation - Digital Thread and Digital Shadow- Building Blocks – Types – Characteristics of a Good Digital Twin Platform – Benefits, Impact & Challenges – Future of Digital Twins: Industrial Case study of Smart factory

Total hours: 45

Text Books:

1.	Chandrakant D. Patel and Chun-Hsien Chen, Digital Manufacturing: Key Elements of a Digital Factory, Elsevier - Health Sciences Division,2023
2.	Ronald R. Yager and Jordan Pascual Espada, “New Advances in the Internet of Things”, Springer, Switzerland, 2018.
3	Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing The Digital Transformation”, Springer Series in Advanced Manufacturing., Switzerland, 2017

Reference Books:

1.	Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, A press, 2016.
2.	Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, “Digital Twin Driven Smart

	Manufacturing", Elsevier Science., United States, 2019.
3	Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
Web Resources:	
1	https://onlinecourses.nptel.ac.in/noc21_mg83/preview
2.	https://www.coursera.org/learn/digital-twins
3.	https://www.classcentral.com/course/udemy-introduction-to-industry-50-405027

23MT925	EMBEDDED SYSTEM FOR AUTOMATION	3/0/0/3

Nature of Course : Theory

Pre requisites : Nil

Course Objectives:

1. To understand the basic concept of Embedded systems.
2. To know about the working principles of buses and devices for Embedded networking
3. To study the concept of Real time operating systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C925.1	Outline the concepts of Embedded system hardware and its software	[U]
C925.2	Explain Devices and Buses used in Embedded networking	[U]
C925.3	Apply task synchronization using Inter Process communication and develop programs using Embedded C	[AP]
C925.4	Illustrate knowledge on various Real Time Operating Systems	[U]
C925.5	Utilize embedded system in various applications	[AP]

ESSENTIALS OF EMBEDDED SYSTEMS **(15 Hours)**

Introduction to embedded systems - Hardware and software in a system, Structural Units of advanced processor, Selection of Processors, System on Chip- I/O Devices- Timer and counting devices, Serial Communication Buses: USB, I2C, CAN Bus.

EMBEDDED PROGRAMMING **(15 Hours)**

Programming in C- Header, Source Files, Preprocessor Directives, Macros, Functions, Data types, Queue, Stacks, Loops, Pointers - Processes, Tasks and Task scheduler, Task synchronization using Inter Process communication, Priority inversion, Embedded C Program for 7 segment display, Timer/Counter Calculations in 8051.

REAL TIME OPERATING SYSTEM **(15 Hours)**

MicroC/OS-II, VxWorks, Basics of Embedded Linux: Architecture of Embedded Linux, Hardware Abstraction Layer (HAL), Cross compilation tool chain – Boot loaders, Board Support Package, Case studies: Embedded system in Adaptive Cruise Control Systems in a Car, ATM Machine, Home Automation.

Total hours:	**45**

Text Books:

1	Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw-Hill, Third Edition, 2017.
2	Marilyn Wolf, "Computers as Components: Principles of Embedded Computer Systems Design, Elsevier Publications, Fourth Edition, 2017.

Reference Books:

1	David E Simon, — An Embedded Software Primerǁ, Pearson Education India, New Delhi, 2013.
2	Neelakandan, S., Raghavan, P., Lad, A, “Embedded Linux System Design and Development” CRC Press, 2019.

Web Resources:

1	https://www.elprocus.com/basics-and-structure-of-embedded-c-program-with-examples-for-beginners/
2	https://nptel.ac.in/courses/108/102/108102045/
3	https://microcontrollerslab.com/embedded-linux/
4	https://www.embedded.com/home-automation-system-design-the-basics/

23MT934	UNMANNED AERIAL VEHICLES	3/0/0/3

Nature of Course : Theory

Pre requisites :Nil

Course Objectives:

1. To learn the major subsystems and the fundamental design concepts of Unmanned Air Vehicle
2. To learn the important design concepts like reliability, stealth, and maintenance of UAV
3. To know the various communication media, navigation systems, control, and stability of UAVs
4. To learn the development, testing, certification, and deployment of UAV

Course Outcomes:

Upon completion of the course, students shall have ability to

C934.1	Infer the knowledge of performance characteristics of UAV systems	[U]
C934.2	Interpret the basic aerodynamics and structures concepts for the design of UAV	[U]
C934.3	Model the applications of UAV	[AP]
C934.4	Identify the appropriate communication and navigation systems for the UAVs as per the role requirements	[AP]
C934.5	Apply the different techniques used to achieve the control and stability of UAV systems	[AP]

UNMANNED AERIAL VEHICLES AND APPLICATIONS **(15 Hours)**

Introduction - History of Unmanned Aerial Vehicles (UAV) –Models and prototypes – Classes and Missions of UAVs- Performance of Air vehicle - Drones: Types and Characteristics- Applications of UAV: Agriculture- Surveillance - Remote sensing.

AERODYNAMICS PRINCIPLES **(15 Hours)**

Aerodynamics: Structures and mechanisms - Lift-induced Drag - Parasitic Drag- Rotary-wing aerodynamics; Response to air turbulence- Airframe configurations scale Effects-Packaging Density- Propulsion System-Modular Construction-Ancillary equipment.

COMMUNICATION DEVICES **(15 Hours)**

Communications-Media-Radio Communication-Mid-Air Collision Avoidance - Control and Stability: HTOL Aircraft-Helicopters- Air Vehicle and Payload Control- Planning and Navigation: Global Positioning System (GPS) - vertical take-off and landing (VTOL) UAV-Sensors: Airspeed Sensor-Attitude Sensors-Imaging Sensors-Meteorological Sensors.

Total hours: **45**

Text Books:

1	Paul Gerin Fahlstrom & Thomas James Gleason, Introduction To UAV Systems, A John Wiley & Sons, Ltd., Publication, United Kingdom,2012.
2	Reg Austin., Unmanned Aircraft Systems, John Wiley and Sons., 2010.

Reference Books:

1	Richard K. Barnhart, Stephen B. Hottman, Douglas M. Marshall, Eric Shappee, (eds.), Introduction to Unmanned Aircraft Systemsll, CRC Press, 2012.
2	Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing,2016.

Web Resources:

1	https://nptel.ac.in/courses/101104073
2	http://ardupilot.org/copter/docs/advanced-multicopter-design.html

3	https://www.dronezon.com/learn-about-drones-quadcopters/

23MT937	INTRODUCTION TO MARINE AND AERIAL ROBOTICS	3/0/0/3

Nature of Course: Theory

Pre requisites : Nil

Course Objectives:

1. To introduce the basic principles and the key elements of marine and aerial robot components.
2. To acquire Knowledge about the various categories of marine and aerial robots.
3. To gain Knowledge on the various navigation control systems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C937.1	Infer the basic concepts of the marine and aerial robots.	[U]
C937.2	Illustrate the proper selection of robots for the specific marine application.	[U]
C937.3	Explain the basic principles of operation on aerial robots on its autonomous function.	[U]
C937.4	Build the navigation systems for the path trajectory detection.	[AP]
C937.5	Outline the appropriate selection of control system on aerial robots.	[U]

INTRODUCTION TO MARINE AND AERIAL ROBOTS **(15 Hours)**

Overview of a Robot - marine robotics and robotic configurations - Key components - Navigation and positioning - Sensors - Power systems - Communication - Types of marine robots - Systems & subsystems - Hydrostatics, Buoyancy and Stability of marine robots - Aerial robotics System & configuration - Core Components of Aerial Robots - Flight Controller

MARINE ROBOTICS AND CONTROL **(15 Hours)**

Marine Robots - Remotely Operated Vehicles (ROVs) - Autonomous Underwater Vehicles (AUVs) - Hybrid ROVs/AUVs (HROVs) - Gliders - Micro/Mini ROVs/AUVs - Work-Class ROVs - Inspection-Class ROVs - AUV Size Classes) - Remote Control Assisted Control - Supervised Autonomy - Conditional Autonomy - High Autonomy - Full Autonomy

AERIAL ROBOTICS AND CONTROL **(15 Hours)**

Aerial Robots - Multi-rotor - Fixed-wing - Single Rotor Helicopter - Hybrid VTOL - Remotely Piloted - Semi-Autonomous - Fully Autonomous – Swarming -Manipulation - Interaction guidance - navigation - control - mission control systems - Algorithms for simultaneous - localization and mapping (SLAM) - fault detection/tolerance systems - Maneuver and control of aerial robot at constant altitude - Inertial Navigation System - INS drift - Magnetometer - Barometer - Global Positioning System.

Total hours:	**45**

Text Books:

1	Daniel Tal, John Altschuld “Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation”, John Wiley & Sons, Inc, 2021.
2	Anibal Ollero, Bruno Siciliano, “Aerial Robotic Manipulation: Research, Development and Applications”, Springer International Publishing, 2019.

3	Ikuo Yamamoto, “Practical Robotics and Mechatronics: Marine, Space and Medical Applications”, The Institution of Engineering and Technology, 2016.
Reference Books:	
1.	Steven W. Moore, Harry Bohm, Vickie Jensen, “Underwater Robotics : Science, Design and Fabrication”, Marine Advanced Technology Edu, 2010
2.	Yasmina Bestaoui Sebbane, “A First Course in Aerial Robots and Drones”, CRC Press, 2022.
3.	Luc Jaulin,Andrea Caiti , “Marine Robotics and Applications”, Springer International Publishing, 2018.
Web Resources:	
1	https://archive.nptel.ac.in/courses/112/105/112105249/
2.	https://www.maritimerobotics.com/
3.	https://www.ieee-ras.org/marine-robotics
4	https://www.environmental-robotics.com/aerial-robotics/

23MT003	SMART SENSORS FOR IoT	3/0/0/3

Nature of Course : Theory

Pre requisites : Nil

Course Objectives:

1. To learn the measurement techniques and various types of sensors.
2. To acquire the basic knowledge on applications of smart and advanced sensors.
3. To impart knowledge on IoT, Cloud computing & its applications.

Course Outcomes:
Upon completion of the course, students shall have ability to

C003.1	Infer the basics of sensors technology with its characteristics.	[U]
C003.2	Illustrate the various transducers used to measure various physical parameters.	[U]
C003.3	Utilize various sensors in smart systems.	[AP]
C003.4	Outline the basic concepts of IoT & Cloud computing	[U]
C003.5	Identify the core technologies behind IoT & Cloud computing applications.	[AP]

MEASUREMENT

Basics of Measurement - Main technical requirement and trends - Units and standards - Performance Measures of Sensors - Classification of Sensors - Static and Dynamic Characteristics of Transducers – Sensor Calibration Techniques - Errors & its Classification - Sensor Output Signal Types. **(15 Hours)**

SENSORS

Motion sensors – Potentiometers, Resolver, Encoders - Semiconductor sensor - Acoustic sensors - Film sensor, MEMS & Nano sensors, LASER sensors - Humidity Sensor: Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor - GPS, Bluetooth - Laser Range Sensor (LIDAR). **(15 Hours)**

IoT AND CLOUD

Internet of things (IoT): Hardware and software requirements, Characteristics, architecture - Domain Specific IoTs Applications: Smart Home Automation, Smart Sustainable Cities and Smart Buildings, Smart Energy Management system, Environment, Agriculture, IoT for Defense. Cloud Computing: Introduction - Characteristics, Models – Cloud based services & Applications for Energy systems, Transportation systems, Education & Mobile communication.

(15 Hours)

Total	**45**

Text Books:

1	Jacob Fraden, “Hand Book of Modern Sensors: Physics, Designs and Application” Fourth edition, Springer, 2010.
2	Vijay Madisetti , Arshdeep Bahga, “Internet of Things (A Hands on-Approach)”, 2014

Reference Books:

1	IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2	Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-On Approach”, Universities Press, 2014

Web Resources:

1	https://archive.nptel.ac.in/courses/108/108/108108147/

2	https://archive.nptel.ac.in/courses/106/105/106105166/

23MT005	FUNDAMENTALS OF ARDUINO AND RASPBERRY Pi	3/0/0/3

Nature of Course : Theory

Pre requisites :Nil

1. To educate the students on the fundamentals of Arduino & Raspberry pi boards
2. To make the students to understand the basic principles of interfacing I/O devices with controllers
3. To facilitate the students with the knowledge of readily available Arduino prototyping shields
4. To encourage the students in building real time embedded applications

Course Outcomes:
Upon completion of the course, students shall have ability to

C005.1	Outline the features, architecture and functionality of Arduino Uno & Raspberry pi.	[U]
C005.2	Identify the different supporting Arduino Shields and its applications	[AP]
C005.3	Analyse the interface of I/O devices with Arduino	[AN]
C005.4	Illustrate the fundamentals of Raspberry pi and its usage in building real time Applications	[AP]
C005.5	Build systems by interfacing peripherals with Raspberry pi	[U]

ARDUINO

Introduction to Arduino – Arduino Uno- ATMEGA328 architecture, General Purpose and Status Register, Data Memory –. Arduino Programming Structure, Arithmetic and logical Instructions, Serial Interfaces – USART, SPI and TWI, Timer/Counter, Interrupts, Watchdog Timer.

(15 Hours)

INTERFACING WITH ARDUINO

Interfacing I/O Devices with Arduino: IDE programming - Light Emitting Diode, Push Button/Switch, Sensors - Fire, Passive Infrared, Ultrasonic, Temperature, Humidity sensors. Actuators – Servo Motor, Stepper Motor. **(15 Hours)**

RASPBERRY PI

Introduction to Raspberry Pi- Architecture – Features-Operating systems- Interfacing Hardware-GPIO pin Connections- Sending and Receiving Signals Using GPIO Pins- Analog & Digital Outputs. Case studies – Autonomous Rover & Web-Controlled Rover.

(15 Hours)

Total hours: 45

Text Books:

1	J. M. Hughes,"Arduino: A technical Reference – A Handbook for technicians, Engineers and Makers",O'Reilly Media.,2016.
2	Simon Monk, "Programming the Raspberry Pi, Getting started with python", Second Edition, McGraw-Hill Education, 2018.

Reference Books:

1	Michael Margolis and Nicholas Weldin, "Arduino Cookbook" First Edition, O Reily Media, 2016.
2	Rajesh Singh, Anita Gehlot, Bhupendra Singh and Sushabhan Choudhury, "Arduino – based Embedded Systems: Interfacing, Simulation and LabVIEW GUI", CRC Press, 2018
3.	Derek Molloy,"Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux, Wiley Publications; 1st edition (1 July 2016)

Web Resources:

1	https://archive.nptel.ac.in/courses/106/105/106105166/
2	https://www.coursera.org/specializations/iot

3	https://www.udemy.com/course/arduino-programming-and-interfacing/