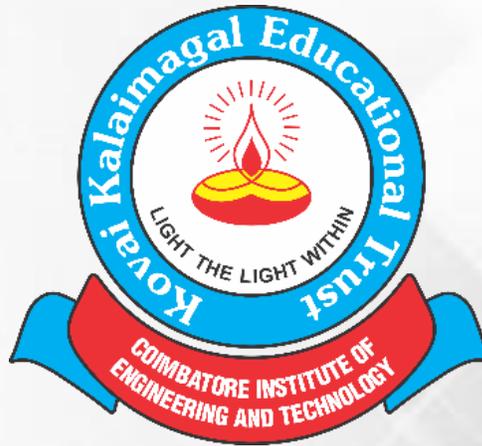




CIET

COIMBATORE INSTITUTE OF ENGINEERING AND TECHNOLOGY

Autonomous | Approved by AICTE | Affiliated to Anna University | Accredited by NAAC with "A" Grade



B.E. MECHATRONICS ENGINEERING

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

I TO VIII SEMESTER CURRICULUM

AND

I TO VI SEMESTER SYLLABI

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COIMBATORE INSTITUTE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution)

B.E MECHATRONICS ENGINEERING

Regulation 2023

(Students admitted from 2023 - 2024 onwards)

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE DEPARTMENT

Vision

To achieve excellence in academics and transforming knowledge in mechatronics engineering-based product development.

Mission

- M1** To impart quality education by synergistic and interdisciplinary integration of engineering concepts.
- M2** Provide opportunity for creative thinking and hands-on problem-solving skills by providing state of art laboratories.
- M3** Inculcate entrepreneurial skills for innovative product development through mechatronics system design.

Knowledge and Attitude Profile (WK)

- WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics, and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

- WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- WK9:** Ethics, inclusive behaviour, and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability, etc., with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

Engineering Graduates will be able to:

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals, and an engineering specialization as specified in WK1 to WK4 respectively to develop solutions for complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for public health and safety, whole-life cost, net zero carbon, culture, society, and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including the design of experiments, modelling, analysis, and interpretation of data to provide valid conclusions. (WK8)
- PO5: Engineering Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering & IT tools, including prediction and modelling, recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyse and evaluate societal and environmental aspects while solving complex engineering problems for their impact on sustainability with reference to economy, health, safety, legal framework, culture, and environment. (WK1, WK5, and WK7)
- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values,

diversity, and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Teamwork: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies iii) critical thinking in the broadest context of technological change. (WK8)

Programme Educational Objectives (PEOs)

The following Programme Educational Objectives are designed based on the department Mission

- Apply gained knowledge of Basic Sciences, Mathematics, and Mechatronics Engineering to achieve technical proficiency and to contribute to the development of Digital India.
- PE01**
- Utilize the multidisciplinary knowledge and problem-solving ability to address modern engineering problems.
- PE02**
- Participate in continuous learning utilizing cutting-edge technology to solve social challenges with ethical and flexible decision-making processes.
- PE03**
- Graduate shall conduct research in interdisciplinary topics and contribute to specific community/ Society/ Industry.
- PE04**

Program Specific Outcomes (PSOs)

- PSO1** Apply principles of mechanics, electronics, and computing to design and develop innovative mechatronic systems.
- PSO2** Utilize robotics, IoT, and automation tools to create intelligent, sustainable engineering solutions to real-world engineering problems.
- PSO3** Analyze, improve, and develop ethical, sustainable solutions addressing industry and societal challenges.

Mapping PEOs, POs & PSOs

PEOs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
PEO1	2	1	2	1	2	2	1	1	1	1	1	2	2	1
PEO2	2	2	1	1	1	1	1	1	2	1	1	2	1	1
PEO3	1	2	1	2	2	2	1	2	1	1	1	1	2	2
PEO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1
1 - Reasonably agreed 2- Moderately agreed 3 - Strongly agreed, - No Correlation														

SEMESTER I							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1.	U23EGT01	Communicative English	3	0	0	3	HS
2.	U23MAT01	Linear Algebra and Calculus	3	1	0	4	BS
3.	U23PYT02	Applied Physics	3	0	0	3	BS
4.	U23CST01	Problem solving and Programming in C	3	0	0	3	ES
5.	U23MET02	Engineering Graphics	2	2	0	4	ES
6.	U23TAT01	Heritage of Tamils	1	0	0	1	HS
	Practical						
7.	U23PYP01	Physics Laboratory	0	0	2	1	BS
8.	U23CSP01	Problem solving and Programming in C Laboratory	0	0	2	1	ES
9.	U23EEP01	Engineering Practices Laboratory	0	0	4	2	ES
	Mandatory						
10.	U23MTA01	Induction Programme	2	0	0	0	MC
Total Periods: 28			17	3	8	22	
SEMESTER II							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
	Theory						
1.	U23EGT02	Professional English	3	0	0	3	HS
2.	U23MAT02	Transforms and Boundary Value Problems	3	1	0	4	BS
3.	U23CYT02	Applied Chemistry	3	0	0	3	BS
4.	U23CST02	Python Programming	3	0	0	3	ES
5.	U23ECT03	Basics of Electrical, Electronics and Information Science	3	0	0	3	ES
6.	U23TAT02	Tamils and Technology	1	0	0	1	HS
	Practical						
7.	U23CYP01	Chemistry Laboratory	0	0	2	1	BS
8.	U23CSP02	Python Programming Laboratory	0	0	2	1	ES
9.	U23MEP01	Computer Aided Drafting Laboratory	0	0	4	2	ES
Total Periods: 25			16	1	8	21	

SEMESTER III							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
Theory							
1.	U23MAT04	Statistics and Numerical Methods	3	1	0	4	BS
2.	U23MET03	Engineering Mechanics	3	0	0	3	ES
3.	U23MCT01	Fluid Mechanics and Machinery	3	0	0	3	ES
4.	U23MCT02	Digital System Design and Microprocessor	3	0	0	3	PC
5.	U23MCT03	Electrical Machines	3	0	0	3	PC
Practical							
6.	U23MCP01	Fluid Mechanics and Machinery Laboratory	0	0	2	1	ES
7.	U23MCP02	Electrical Machines Laboratory	0	0	2	1	PC
Mandatory Course							
8.	-	Mandatory Course-1	2	0	0	0	MT
Total Periods: 22			17	1	4	18	
SEMESTER IV							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
Theory							
1.	U23MCT04	Theory of Machines	3	1	0	4	PC
2.	U23MGT02	Principles of Management	3	0	0	3	HS
3.	U23MCT05	Power Electronics and Drives	3	0	0	3	PC
4.	U23MET09	Mechanics of Solids	3	0	0	3	ES
5.	U23MCT06	Sensors and Signal Conditioning	3	0	0	3	PC
6.		Professional Elective I	3	0	0	3	PE
Practical							
7.	U23MCP03	Sensors and Signal Conditioning Laboratory	0	0	4	2	PC
8.	U23MCP04	Power Electronics and Drives Laboratory	0	0	4	2	PC
9.	U23MEP03	Computer Aided Machine Drawing Laboratory	0	0	4	2	ES
Mandatory Course							
10.	-	Mandatory Course-2	2	0	0	0	MT
Total Periods: 33			20	1	12	25	

SEMESTER V							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
Theory							
1.	U23MCT07	Control Systems Engineering	3	0	0	3	PC
2.	U23MCT08	Automobile Engineering	3	0	0	3	PC
3.	U23MET06	Manufacturing Technology	3	0	0	3	PC
4.	U23MCT09	Embedded Systems	3	0	0	3	PC
5.	U23MCT10	Applied Machine Design	3	0	0	3	PC
6.	-	Open Elective I	3	0	0	3	OE
Practical							
7.	U23MCP05	Manufacturing Technology Laboratory	0	0	4	2	PC
8.	U23MCP06	Embedded Systems Laboratory	0	0	2	1	PC
Employment Enhancement Course							
9.	U23MCO01	Internship/In-plant Training	0	0	2	1	EEC
10.	U23EGS01	English Expertise and Career Moxie	0	0	2	1	EEC
Total Periods: 28			18	0	10	23	
SEMESTER VI							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
Theory							
1.	U23MCT11	Computer Aided Design with Integrated Manufacturing Systems	3	0	0	3	PC
2.	U23MCT12	Fluid Power Systems and PLC	3	0	0	3	PC
3.	U23MCT13	Thermodynamics and Heat Transfer	3	0	0	3	PC
4.	U23MCT14	Internet of Things	3	0	0	3	PC
5.	-	Professional Elective II	3	0	0	3	PE
6.	-	Open Elective II	3	0	0	3	OE
Practical							
7.	U23MCP07	Computer Aided Design and Manufacturing Laboratory	0	0	4	2	PC
8.	U23MCP08	Fluid Power Systems and PLC Laboratory	0	0	2	1	PC
Employability Enhancement Course							
9.	U23MCO02	Industry Oriented Course - I	0	0	2	1	EEC
10.	U23MCJ01	Innovation Project	0	0	4	2	EEC
Total Periods: 30			18	0	12	24	

SEMESTER VII							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
Theory							
1.	U23MCT15	Robotics	3	0	0	3	PC
2.	-	Universal Human Values	3	0	0	3	HS
3.	-	Professional Elective III	3	0	0	3	PE
4.	-	Professional Elective IV	3	0	0	3	PE
5.	-	Professional Elective V	3	0	0	3	PE
6.	-	Professional Elective VI	3	0	0	3	PE
Practical							
7.	U23MCP09	Industrial Robotics Laboratory	0	0	2	1	PC
Employability Enhancement Course							
8.	U23MCO03	Industry Oriented Course - II	0	0	4	2	EEC
Total Periods: 27			18	0	6	21	
SEMESTER VIII							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
Employability Enhancement Course							
1.	U23MCJ02	Project Work	0	0	20	10	EEC
Total Periods: 20			0	0	20	10	

CAT - Category; BS - Basic Science; HS - Humanities and Social Science; ES - Engineering Science; PC - Professional Core; PE - Professional Electives; OE - Open Electives; EEC - Employability Enhancement Course; MT - Mandatory Course

SUMMARY OF CREDIT DISTRIBUTION										
CAT	Credits /Semester								Total Credits	Percentage of total credits
	I	II	III	IV	V	VI	VII	VIII		
HS	4	4	0	3	0	0	3	0	14	8.54
BS	8	8	4	0	0	0	0	0	20	12.20
ES	10	9	7	5	0	0	0	0	31	18.90
PC	0	0	7	14	18	15	4	0	58	35.37
PE	0	0	0	3	0	3	12	0	18	10.98
OE	0	0	0	0	3	3	0	0	6	3.66
EEC	0	0	0	0	2	3	2	10	17	10.37
MT	0	0	0	0	0	0	0	0	0	0.00
Total	22	21	18	25	23	24	21	10	164	100

PROFESSIONAL ELECTIVE COURSES – VERTICALS

VERTICAL -1	VERTICAL -2	VERTICAL -3	VERTICAL -4	VERTICAL -5	VERTICAL -6
Design and Manufacturing	Robotics Technology	Avionics and Drone Technology	Automotive and Smart Mobility Systems	Intelligent systems	Automation
Metrology and Measurements	Mobile Robotics	Drone Technologies	Battery Management System	Immersive Technologies and Haptics	Virtual Instrumentation
Micro Electro Mechanical Systems	Underwater Robotics	Flight Guidance and Control	Automotive Electronics	Computer Networks and Security	Cloud Computing
Production of Automotive Components	Micro robotics	Avionics	Electric and Hybrid Vehicles	Applied Signal Processing	Industrial control of Motion Drives
Design for X	Humanoid Robotics	Aircraft Mechatronics	Vehicle Dynamics and Controls	Applied Image Processing	Medical Mechatronics
Electronics Manufacturing Technology	Agricultural Robotics and Automation	Design of UAV systems	Smart mobility and Intelligent Vehicles	Computer Vision	Total Integrated Automation
Product Design and Development	Medical Robotics	Navigation and Communication System	Automotive System Modeling and Simulation	Artificial Intelligence for Robotics	Industrial Network Protocols
Total Quality Management	Robotic Operating System	Aerodynamics of Drones	Advanced Driver Assistance Systems	Intelligent Control Systems	Digital Twin and Industry 5.0

PROFESSIONAL ELECTIVE COURSES

VERTICAL - 1							
DESIGN AND MANUFACTURING							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MCV01	Metrology and Measurements	3	0	0	3	PE
2	U23MCV02	Micro Electro Mechanical Systems	3	0	0	3	PE
3	U23MCV03	Production of Automotive Components	3	0	0	3	PE
4	U23MCV04	Design for X	3	0	0	3	PE
5	U23MCV05	Electronics Manufacturing Technology	3	0	0	3	PE
6	U23MCV06	Product Design and Development	3	0	0	3	PE
7	U23MCV07	Total Quality Management	3	0	0	3	PE

VERTICAL - 2							
ROBOTICS TECHNOLOGY							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MCV08	Mobile Robotics	3	0	0	3	PE
2	U23MCV09	Underwater Robotics	3	0	0	3	PE
3	U23MCV10	Microrobotics	3	0	0	3	PE
4	U23MCV11	Humanoid Robotics	3	0	0	3	PE
5	U23MCV12	Agricultural Robotics and Automation	3	0	0	3	PE
6	U23MCV13	Medical Robotics	3	0	0	3	PE
7	U23MCV14	Robotic Operating System	3	0	0	3	PE

VERTICAL -3							
AVIONICS AND DRONE TECHNOLOGY							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MCV15	Drone Technologies	3	0	0	3	PE
2	U23MCV16	Flight Guidance and Control	3	0	0	3	PE
3	U23MCV17	Avionics	3	0	0	3	PE
4	U23MCV18	Aircraft Mechatronics	3	0	0	3	PE
5	U23MCV19	Design of UAV systems	3	0	0	3	PE
6	U23MCV20	Navigation and Communication System	3	0	0	3	PE
7	U23MCV21	Aerodynamics of Drones	3	0	0	3	PE

VERTICAL -4							
AUTOMOTIVE AND SMART MOBILITY SYSTEMS							
S.No.	Course Code	Course Title	Contact Periods/ week			Credits	Category
			L	T	P		
1	U23MCV22	Battery Management System	3	0	0	3	PE
2	U23MCV23	Automotive Electronics	3	0	0	3	PE
3	U23MCV24	Electric and Hybrid Vehicles	3	0	0	3	PE
4	U23MCV25	Vehicle Dynamics and Controls	3	0	0	3	PE
5	U23MCV26	Smart mobility and Intelligent Vehicles	3	0	0	3	PE
6	U23MCV27	Automotive System Modeling and Simulation	3	0	0	3	PE
7	U23MCV28	Advanced Driver Assistance Systems	3	0	0	3	PE

VERTICAL -5 INTELLIGENT SYSTEMS							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MCV29	Immersive Technologies and Haptics	3	0	0	3	PE
2	U23MCV30	Computer Networks and Security	3	0	0	3	PE
3	U23MCV31	Applied Signal Processing	3	0	0	3	PE
4	U23MCV32	Applied Image Processing	3	0	0	3	PE
5	U23MCV33	Computer Vision	3	0	0	3	PE
6	U23MCV34	Artificial Intelligence for Robotics	3	0	0	3	PE
7	U23MCV35	Intelligent Control Systems	3	0	0	3	PE

VERTICAL -6 AUTOMATION							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MCV36	Virtual Instrumentation	3	0	0	3	PE
2	U23MCV37	Cloud Computing	3	0	0	3	PE
3	U23MCV38	Industrial control of Motion Drives	3	0	0	3	PE
4	U23MCV39	Medical Mechatronics	3	0	0	3	PE
5	U23MCV40	Total Integrated Automation	3	0	0	3	PE
6	U23MCV41	Industrial Network Protocols	3	0	0	3	PE
7	U23MCV42	Digital Twin and Industry 5.0	3	0	0	3	PE

INDUSTRY ORIENTED/LINKAGE COURSES							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MCO01	Internship/In-plant Training	0	0	2	1	EEC
2	U23MCO02	Real-Time Embedded Systems	0	0	2	1	EEC
3	U23MCO03	Industrial Automation Controllers	0	0	4	2	EEC

MANDATORY COURSES							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23MTA02	Essence of Indian Traditional Knowledge	3	0	0	0	IKS
2	U23MTA03	Wellness through Yoga and Ayurveda	3	0	0	0	IKS
3	U23MTA04	Universal human values and Professional Ethics	3	0	0	0	UHV
4	U23MTA05	Gender, Culture and Development	3	0	0	0	Gender Sensitization
5	U23MTA06	Environmental Science	3	0	0	0	EVS
6	U23MTA07	Sustainable Development	3	0	0	0	SDG
7	U23MTA08	Disaster risk reduction and Management	3	0	0	0	SDG
8	U23MTA09	Vision for Humane Society	3	0	0	0	IKS

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENT							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Category
			L	T	P		
1	U23OE251	Industrial Automation and Control	3	0	0	3	OE
2	U23OE252	Product Development	3	0	0	3	OE
3	U23OE253	Introduction to Robotics	3	0	0	3	OE
4	U23OE254	Sensors and Data Acquisition Systems	3	0	0	3	OE
5	U23OE255	3D Printing Technology	3	0	0	3	OE

OPEN ELECTIVE COURSES (Students are encouraged to choose courses offered by other departments)							
S.No.	Course Code	Course Title	Contact Periods / week			Credits	Offering Department
			L	T	P		
1.	U23OE001	Industrial Waste Management	3	0	0	3	CIVIL
2.	U23OE002	Fundamentals of Nano Science	3	0	0	3	CIVIL
3.	U23OE003	Green Building	3	0	0	3	CIVIL
4.	U23OE004	Corrosion Science	3	0	0	3	CIVIL
5.	U23OE005	Environment and Agriculture	3	0	0	3	CIVIL
6.	U23OE051	Programming in JAVA	3	0	0	3	CSE
7.	U23OE052	Web Frameworks	3	0	0	3	CSE
8.	U23OE053	Fundamentals of Data Structures	3	0	0	3	CSE
9.	U23OE054	Database Technologies	3	0	0	3	CSE
10.	U23OE055	Basics of Software Engineering	3	0	0	3	CSE
11.	U23OE056	Operating System Concepts	3	0	0	3	CSE
12.	U23OE057	Open-Source Software	3	0	0	3	CSE
13.	U23OE057	Virtual Reality	3	0	0	3	CSE
14.	U23OE101	Industry 5.0	3	0	0	3	ECE
15.	U23OE102	Introduction to Internet of everything	3	0	0	3	ECE

16.	U23OE103	Principles of Analog and Digital Communication	3	0	0	3	ECE
17.	U23OE104	Mobile Communication	3	0	0	3	ECE
18.	U23OE105	Introduction to Neural Network	3	0	0	3	ECE
19.	U23OE151	Basics of Electrical Engineering	3	0	0	3	EEE
20.	U23OE152	Fundamentals of Drives and Control	3	0	0	3	EEE
21.	U23OE153	Renewable Energy Systems	3	0	0	3	EEE
22.	U23OE154	Electric Vehicle Technology	3	0	0	3	EEE
23.	U23OE155	Introduction to PLC Programming	3	0	0	3	EEE
24.	U23OE201	Applied Design Thinking	3	0	0	3	MECH
25.	U23OE202	Creativity and Innovation in Entrepreneurship	3	0	0	3	MECH
26.	U23OE203	Basics of Refrigeration and Air Conditioning	3	0	0	3	MECH
27.	U23OE204	Fundamentals of Mechanical Engineering	3	0	0	3	MECH
28.	U23OE205	Basics of Metrology and Measurements	3	0	0	3	MECH
29.	U23OE206	Testing of Materials	3	0	0	3	MECH
30.	U23OE301	Introduction to computer networks	3	0	0	3	IT
31.	U23OE302	Mobile application development	3	0	0	3	IT
32.	U23OE303	Health Informatics	3	0	0	3	IT
33.	U23OE304	Information Technology essentials	3	0	0	3	IT
34.	U23OE305	cloud computing technologies	3	0	0	3	IT
35.	U23OE351	Fundamentals of Data science	3	0	0	3	AI & DS
36.	U23OE352	Fundamentals of AI	3	0	0	3	AI & DS
37.	U23OE353	Data Visualization and its Applications	3	0	0	3	AI & DS
38.	U23OE354	Fundamentals of Data Analytics	3	0	0	3	AI & DS
39.	U23OE355	Introduction to Big data	3	0	0	3	AI & DS
40.	U23OE401	Cryptography Tools and Techniques	3	0	0	3	CSE(CS)
41.	U23OE402	Network Security Essentials	3	0	0	3	CSE(CS)
42.	U23OE403	Cyber Security Fundamentals	3	0	0	3	CSE(CS)
43.	U23OE404	Web Security	3	0	0	3	CSE(CS)
44.	U23OE405	Block chain Essentials	3	0	0	3	CSE(CS)
45.	U23OE451	Introduction to Artificial Intelligence and Machine Learning	3	0	0	3	CSE(AIML)

Mapping of Course Outcome and Programme Outcome

Year	Sem	Course Title	POs											PSOs		
			1	2	3	4	5	6	7	8	9	10	11	1	2	3
I	I	Communicative English	2.2	1.2	1.2	0.4	1.4	0.4	0.4	1.2	2.6	1.4	1.6	0.6	1.2	-
		Linear Algebra and Calculus	3	2	0.4	1.4	0.4	-	-	-	-	-	0.8	1.6	2.4	1.2
		Applied Physics	3.0	2.0	0.4	-	1.0	2.0	1.4	1.0	1.4	0.8	2.0	2.6	2.4	-
		Problem solving and Programming in C	3.0	3.0	1.5	3.0	3.0	-	-	2.0	2.0	-	1.0	3.0	3.0	-
		Engineering Graphics	3.0	-	-	-	1.0	-	-	-	-	-	-	1.6	-	-
		Heritage of Tamils	1.0	1.0	-	-	1.5	-	-	1.2	0.3	-	-	0.8	1.0	1.0
		Physics Laboratory	2.0	1.0	1.0	1.0	2.6	1.0	-	1.7	-	-	-	1.7	1.0	2.0
		Problem solving and Programming in C Laboratory	2.7	2.3	2.3	2.3	2.7	1.7	1	2.7	2.7	2	2.3	2.7	2.3	2.7
		Engineering Practices Laboratory	-	2.4	2.7	3	3	2.6	-	2.6	2.8	2.6	2.8	2.6	2.8	2.6
	Induction Programme															
	II	Professional English	3	1.5	1.3	3	2.4	0.6	-	-	2.2	2.8	0.4	2.8	1.3	1.4
		Transforms and Boundary Value Problems	3	2.8	2	2.4	1	-	-	-	-	-	-	2.6	-	2
		Applied Chemistry	3	2.6	2.4	2.4	1	-	-	-	-	-	-	2.6	2	2
		Python Programming	3	3	3	2	2.2	-	-	-	-	-	-	3	2	2
		Basics of Electrical, Electronics and Information Science	2.8	2.6	2.6	3	2.2	1	-	-	-	-	-	2.8	2	2
		Tamils and Technology	2.6	2.4	2.2	2.4	2	1	-	-	-	-	-	2.6	2.6	2.6
		Chemistry	3	3	2	2.3	3	-	-	-	-	-	-	2.3	2.3	1.7

		Laboratory														
		Python Programming Laboratory	3.0	3.0	3.0	2.7	3.0	2.7	1.7	1.0	-	-	-	3.0	3.0	2.7
		Computer Aided Drafting Laboratory	1.7	0.7	1.7	-	3	0.3	-	-	1.3	0.3	-	2.0	-	1.0
II	III	Statistics and Numerical Methods	2.8	2.6	2.6	2.4	2.6	1	1	1	1	-	-	2.6	2.2	2.2
		Engineering Mechanics	3	2.4	2.3	2	2	-	-	-	-	-	1	2.8	1.0	-
		Fluid Mechanics and Machinery	2.4	1.6	2	2	1.2	-	-	-	-	-	1	1.6	-	1
		Digital System Design and Microprocessor	3.0	3	2	-	1	-	-	-	-	-	-	2.6	2.3	-
		Electrical Machines	3.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	1.8	1.0	1.0
		Fluid Mechanics and Machinery Laboratory	3.0	-	2.0	-	2.3	-	-	-	-	-	-	3.0	-	3.0
		Electrical Machines Laboratory	2.0	1.0	1.0	-	1.3	-	-	-	-	-	-	2.0	1.0	1.0
	IV	Theory of Machines	2.2	1.6	1.0	1.0	1.0	-	-	-	-	-	-	2.0	1	1
		Principles of Management	2.5	2	-	-	3	3	3	3	3	-	-	-	-	-
		Power Electronics and Drives	3.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	1.4	1.0	1.0
		Mechanics of Solids	3.0	2.2	2.0	1.0	1.0	-	-	-	-	-	-	2.6	2.0	1.4
		Sensors and Signal Conditioning	3.0	1	2	-	1	-	-	-	-	-	-	2.2	2.3	2
		Sensors and Signal Conditioning Laboratory	3.0	2	3	-	2.0	-	-	-	-	-	-	2.3	1.7	1.0
		Power Electronics and Drives Laboratory	2.0	1.0	1.0	-	1.0	-	-	-	-	-	-	1.3	1.0	1.0
III	V	Computer Aided Machine Drawing Laboratory	2	1	3	-	3	-	-	-	2	-	-	2	-	1
		Control Systems Engineering	3.0	2.0	1.0	-	1.0	-	-	-	-	-	-	1.2	1.0	-
		Automobile Engineering	2.4	1.5	1	-	1	2	1	1	-	-	-	2.8	2.0	1.0
		Manufacturing Technology	3	-	-	-	2	-	-	1	-	-	1.0	2.8	2.0	-
		Embedded Systems	1.8	2	2.5	-	1	-	-	-	-	-	2	2.5	2	

		Applied Machine Design	3	2	2.4	-	2	-	-	-	-	-	-	2.6	2	2	
		Manufacturing Technology Laboratory	3.0	-	2.3	2.0	2.3	-	-	-	-	-	-	3.0	2.0	-	
		Embedded Systems Laboratory	3.0	-	2.3	-	2.0	-	-	-	-	-	-	2.0	2.5	1	
		Internship/In-plant Training	2.0	2.5	2.0	-	2.0	-	2.0	2.0	2.0	-	1.0	1.7	1.0	1.7	
		English Expertise and Career Moxie	-	-	-	-	-	-	-	2	2	2	2	-	-	-	
	VI	Computer Aided Design with Integrated Manufacturing Systems	2.8	-	2.2	-	2.4	-	-	-	-	-	-	2.4	-	-	
		Fluid Power Systems and PLC	2	1	2	-	2	-	-	-	-	-	-	1.8	2.5	1.5	
		Thermodynamics and Heat Transfer	2.8	2.0	2.0	-	2.0	-	-	-	-	-	-	2.0	2.0	-	
		Internet Of Things	2.6	1.0	-	-	2.0	-	-	-	-	-	-	-	3.0	3.0	
		Computer Aided Design and Manufacturing Laboratory	2.0	-	2.7	-	3.0	-	-	-	-	-	-	2.7	2.0	-	
		Fluid Power Systems and PLC Laboratory	2.0	1.7	2.0	1.0	1.0	-	-	-	-	-	1.3	1.0	1.0	1.3	
		Industry Oriented Course	1.6	1.6	1.6	-	1.3	-	-	-	-	-	1.0	1.6	1.3	1.3	
		Innovation Project	2.0	1.0	2.0	1.0	-	-	-	2.0	1.0	1.0	1.0	1.5	2.0	1.5	
IV		VII	Robotics														
	Industrial Robotics Laboratory																
	Employment Enhancement Course																
	VIII	Project Work															

Year	Sem	Course Title	POs											PSOs		
			1	2	3	4	5	6	7	8	9	10	11	1	2	3
Professional Elective		Metrology and Measurements	2.0	2.0	1.0	2.0	1.0	-	-	-	-	-	1.0	1.4	1.0	1.3
		Micro Electro Mechanical Systems	1.6	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.2	1.7	1.5
		Production of Automotive Components	1.0	-	1.0	-	1.0	-	-	-	-	-	-	1.0	-	1.0
		Design for X	1.6	1.0	1.0	-	1.0	-	-	-	-	-	1.0	1.0	2.0	1.0
		Electronics Manufacturing Technology	1.6	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	1.6	1.0	1.5
		Product Design and Development	1.0	1.2	1.4	-	1.0	1.0	1.0	-	-	-	1.0	1.0	-	1.0
		Total Quality Management	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	1.0	1.0	1.0	1.2
		Mobile Robotics	3.0	2	2	2	2.2	-	-	-	-	-	-	2.4	2.3	2
		Underwater Robotics	3.0	-	2	2	2.0	-	-	-	-	-	-	2.0	2	2
		Micro robotics	3.0	2.0	2.3	-	2.0	-	-	-	-	-	-	2.6	2	2
		Humanoid Robotics	3.0	2	2.3	-	1.0	-	-	-	-	-	-	2.4	2.3	2
		Agricultural Robotics and Automation	3.0	-	2	-	2.0	2	-	-	-	2	-	2.2	2	2
		Medical Robotics	3.0	-	2.3	-	2.0	2	-	-	-	-	-	2.2	2	2.2
		Robotic Operating System	3.0	-	2.2	-	2.0	-	-	-	-	-	-	2.6	2.3	2
		Drone Technologies	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	1.6	1.6	-
		Flight Guidance and Control	3.0	-	2.8	2.0	-	-	-	-	-	-	-	2.8	2.8	-
		Avionics	2.0	-	2.0	-	-	-	-	-	-	-	-	2.0	-	-
		Aircraft Mechatronics	2.0	2.0	1.6	1.0	-	1.3	1.0	-	-	-	-	2.0	1.4	-
		Design of UAV systems	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	2.0	1.6	-
		Navigation and Communication System	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	2.0	1.6	-
	Aerodynamics of Drones	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	2.0	1.6	-	

Battery Management System	1.8	1.0	2.0	1.0	1.0	1.0	-	-	1.0	1.0	1.0	1.0	1.0	1.0
Automotive Electronics	2.0	1.0	-	-	-	1.0	-	-	-	-	1.0	1.0	-	1.0
Electric and Hybrid Vehicles	1.6	1.0	1.0	-	1.0	-	-	-	-	-	-	1.2	1.4	1.0
Vehicle Dynamics and Controls	1.0	1.0	1.0	-	-	-	-	-	-	-	1.0	1.8	1.0	-
Smart mobility and Intelligent Vehicles	1.4	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.2	1.0
Automotive System Modeling and Simulation	1.6	1.0	1.0	1.0	1.0	-	-	-	-	-	1.0	1.0	1.4	-
Advanced Driver Assistance Systems	1.6	1.0	-	-	1.0	-	-	-	-	-	1.0	1.0	1.0	1.0
Immersive Technologies and Haptics	2.4	2	2	1	2	-	-	-	-	-	-	2.4	2	2
Computer Networks and Security	2.4	2.2	2	1	2	1	-	-	-	-	-	2.4	2	1.5
Applied Signal Processing	1.2	1.0	1	-	1.0	-	-	-	-	-	1.0	1.2	1.0	1.0
Applied Image Processing	2.4	-	2	-	3	-	-	-	-	-	-	3	3	3
Computer Vision	3.0	-	2	-	3	-	-	-	-	-	-	3	3	3
Artificial Intelligence for Robotics	2.6	2.4	2.6	2	1.7	-	-	-	-	-	-	2.2	2.5	3
Intelligent Control Systems	2	1.4	2	-	2	-	-	-	-	-	-	2	1.8	1.4
Virtual Instrumentation	2	1.8	1	1	1.2	-	-	-	1	-	-	2.2	1.8	1.3
Cloud Computing	2.0	1.8	1	1	1.2	-	-	-	1.0	-	-	2.6	1.6	1.5
Industrial control of Motion Drives	2	1.2	1.2	-	2	-	-	-	-	-	-	1.8	1	-
Medical Mechatronics	2.0	1.6	2.0	-	1.8	-	1.0	-	-	-	1.0	1.6	1.8	2.0
Total Integrated Automation	2.4	2.6	2.5	-	2.4	-	-	-	-	-	-	1.5	2	1
Industrial Network Protocols	1.8	1.4	-	1	2.0	-	-	-	-	-	-	1.4	1.8	1
Digital Twin and Industry 5.0	2	2	-	-	2.2	-	-	-	-	-	1.4	2	2.5	2.2

	Course Title	POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2	3
Mandatory Courses	Essence of Indian Traditional Knowledge	1.2	1.8	-	0.8	-	2	1	1	-	1.2	-	1.0	-	-
	Wellness through Yoga and Ayurveda	1.8	0.6	-	0.2	-	2	2	1.2	-	1	-	1.0	-	-
	Universal Human Values and Professional Ethics	1.6	1.4	0.4	-	0.4	2.8	2.6	2.8	-	2.2	0.4	-	-	-
	Gender, Culture and Development	1.6	2.2	0.8	-	-	2.8	2.6	3	-	2.2	1.2	-	-	-
	Environmental Science	2	2.2	0.4	1.6	0.4	3	3	1.2	0.4	2	2	-	0.4	-
	Sustainable Development	2	2	1.6	1.2	-	2.8	3	-	-	2	2	-	-	-
	Disaster Risk Reduction and Management	2	2.2	1.6	1.6	0.6	2.8	3	-	0.4	2.0	-	-	-	-
	Vision for Humane Society	-	-	1.6	-	-	2.6	2.2	2.8	1.8	2.2	2.0	-	-	-

Semester – I

U23EGT01	COMMUNICATIVE ENGLISH (Common to ALL branches)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Course Objectives:

- To enhance learners' English Language Acquisition skills
- To facilitate learners to acquire effective technical writing skills
- To prepare learners for placement and competitive exams
- To facilitate effective English language skills for academic purposes and real-life situations

Course Outcomes:

Upon completion of the course, students shall have ability to

	BT Level (highest level)
CO1 Demonstrate an understanding of communicative English principles, reading strategies, and basic grammar rules to communicate effectively.	K2
CO2 Analyze and use vocabulary, sentence structures, and grammar rules to convey meaning accurately in spoken and written communication.	K4
CO3 Apply technical communication skills to read, write, and speak about technical topics, using appropriate vocabulary and grammatical structures.	K3
CO4 Develop business communication skills to read, write, and speak effectively in professional contexts, using appropriate formats, vocabulary, and tone.	K5
CO5 Bespeak in professional English communication, including reading, writing, speaking, and presenting, using complex vocabulary and grammatical structures.	K6

Course Contents

Unit I COMMUNICATIVE ENGLISH 9

Introduction to Communicative English, **Reading:** Skimming and Scanning; Comprehensive questions (Multiple choice questions/ short questions/open - ended questions) **Speaking:** Self- introduction **Writing:** Formal and informal letters (Requisition, Complaint / Invitation /Accepting/ Declining/ Personal) Grammar: Parts of speech, Present Tense, **Vocabulary:** Synonyms/Antonyms, word formation, Prefixes /suffixes.

Unit II WORDS AND SENTENCES 9

Reading: Reading biographies on famous scientists and personalities/ newspaper articles/ movie reviews **Speaking:** Travelog with pictorial video /PPT **Writing:** Single line and extended definitions, Data interpretation (Pie chart, Bar chart, Table, Flow chart) **Grammar:** Modal verbs, Voices, Past Tense **Vocabulary:** Compound words, One-word substitutions.

Unit III TECHNICAL COMMUNICATION 9

Reading: Review on technology/gadgets, reading user manual, **Writing:** Writing Instructions; Recommendations **Speaking:** Pride activity (About hometown) **Grammar:** Cause and Effect, Prepositions, Future Tense **Vocabulary:** Phrasal Verbs, Collocations.

Unit IV BUSINESS COMMUNICATIONS 9

Reading: Reading and understanding general and technical articles **Writing:** Report writing (Industrial visit report, Feasibility report), Checklist **Speaking:** Cultural and heritage of hometown, Dialogue writing and Telephonic conversation Grammar: WH questions, If conditionals **Vocabulary:** Abbreviation and Acronyms, Misspelt words.



Unit V PROFESSIONAL ENGLISH

9

Reading: Brochures, Scientific Blogs. **Writing:** Jumbled Sentences, Note-making **Speaking:** team task(role play) **Grammar:** Types of sentences, Possessive case **Vocabulary:** Homonyms/ Homophones.

Total Periods: 45

Text Books:

1. Department of English, Anna University, “English for Engineers & Technologists”, 2020, Orient Blackswan Private Ltd. Hyderabad.
2. Dr. B. Vinoth & Prof. J. OormilaHeleena, “A workbook of Communicative English”, First edition, 2023, Sri Krishna Hitech publishing company Pvt Ltd, Coimbatore,
3. Ramalingam N, “Grammar for all”, Second edition, 2013, Himalaya Publishing House, Bengaluru.

Reference Books:

- 1 Norman Whitby, “Business Benchmark Pre-intermediate to intermediate Personal Study Book”, BEC and BULATS Edition, 2006, Cambridge University Press India Pvt Ltd, Delhi.
- 2 Anne Laws, “Writing Skills”, 2011, Summertown Publishing, Oxford, U.K.
- 3 Sinha DK, “Specimen of English Prose”, 2012, Orient Black Swan., Hyderabad.
- 4 Meenakshi Raman and Sangeetha Sharma. “Technical Communication- Principles and Practice”, 2009, Cambridge University Press India Pvt Ltd, Delhi.
- 5 Raymond Murphy. “English Grammar and Use” ,4th edition, 2004, Cambridge University Press India Pvt Ltd, Delhi.

Web URL(s):

- 1 <https://www.science.org/blogs>
- 2 <https://www.liveworksheets.com/worksheets/en>
- 3 <https://www.upsconline.nic.in/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

Mapping Cos, POs& PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	-	1	-	-	3	-	2	-	-	-
CO2	2	3	-	-	3	-	-	1	3	-	-	-	-	-
CO3	3	1	3	2	-	-	-	-	3	2	3	3	3	-
CO4	-	2	-	-	3	1	2	3	3	2	-	-	-	-
CO5	3	-	3	-	-	-	-	3	3	3	3	-	3	-
Average	2.2	1.2	1.2	0.4	1.4	0.4	0.4	1.2	2.6	1.4	1.6	0.6	1.2	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MAT01	LINEAR ALGEBRA AND CALCULUS (Common to ALL branches)	L	T	P	C
		3	1	0	4

Pre-Requisites : Concepts of basic matrices, differentiation and integration

Course Objectives:

To make the students

- Acquaint with the knowledge of vector space and its applications.
- Develop the use of matrix techniques for practical problems.
- Familiarize with functions of several variables.
- Understand the concepts of Gradient, Divergence and Curl through vector differentiation and integration.
- Interpret with mathematical tools needed in evaluating multiple integrals and their applications

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply the concepts of vectors to find the bases and dimensions.	K3
CO2	Apply the knowledge of matrices to solve the problems for respective areas of specialization.	K3
CO3	Analyses and model the realtime problems using differentiation techniques	K4
CO4	Compute gradient, curl and divergence using vector differentiation and evaluate line integral, area and volume using vector integration.	K3
CO5	Evaluate the function to get the surface area and volume using multiple integrals.	K3

Course Contents

Unit I LINEAR ALGEBRA **9+3**

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

Unit II MATRICES **9+3**

Determinant- Cramer’s rule-Eigen values and Eigen vectors of a real matrix-Properties-Cayley-Hamilton theorem(statement only)-Application-Elastic Membrane.

Unit III FUNCTIONSOFSEVERALVARIABLES **9+3**

Limits and Continuity (Geometrical interpretations) – Properties of continuous function – Partial derivatives-Total derivatives-Jacobians-Taylor's series for two variables.

Unit IV VECTOR CALCULUS **9+3**

Gradient and directional derivative – Divergence and curl - Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Volume integral - Green’s and Stoke’s theorems.

Unit V MULTIPLE INTEGRALS **9+3**

Double integration (Cartesian coordinates)-Region of integration-Triple integration in Cartesian coordinates- application of triple integrals.

Total Periods: 60



Text Books:

1. James Stewart., “Calculus: Early transcendentals”, 7th Edition, 2015, Cengage Learning, New Delhi.
2. Kreyszig. E, “Advanced Engineering Mathematics”, 10th Edition, 2016, John Wiley and Sons (Asia) Ltd, Delhi.

Reference Books:

1. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, 5th Edition, 2017, Narosa Publications, New Delhi.
2. Srimantha Pal and Bhunia. S.C., “Engineering Mathematics”, 2015, Oxford University Press, India
3. Lay.D.C., “Linear Algebra and Its Applications”, 5th Edition, 2015, Pearson Education, New Delhi

Web URL(s):

1. <https://archive.nptel.ac.in/courses/111/104/111104137/>
2. <https://archive.nptel.ac.in/courses/111/105/111105122/>
3. <https://archive.nptel.ac.in/courses/111/104/111104137/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO2	3	3	-	-	2	-	-	-	-	-	1	2	3	-
CO3	3	2	-	1	-	-	-	-	-	-	-	3	1	2
CO4	3	1	2	3	-	-	-	-	-	-	2	-	3	1
CO5	3	2	-	3	-	-	-	-	-	-	-	-	3	3
Average	3	2	0.4	1.4	0.4	-	-	-	-	-	0.8	1.6	2.4	1.2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23PYT02	APPLIED PHYSICS (Common to CIVIL, MECH and MCT)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Course Objectives:

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves.
- Gain the knowledge on magnetic and super conducting properties of materials.
- The students will have knowledge on the various phase diagrams and their applications.
- Understand the concept of ceramics, composites, metallic glasses and shape memory alloys.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 Apply the important concepts of mechanics in engineering field.	K3
CO2 Use the knowledge of electromagnetic waves in various engineering fields.	K3
CO3 Interpret the knowledge of magnetic and superconducting properties of materials, as well as their applications.	K3
CO4 Apply the principle to determine the different phases present in alloy materials.	K3
CO5 Develop knowledge on advanced engineering materials.	K3

Course Contents

Unit I MECHANICS 9

Basic definitions – Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of the system of particles. Types of motion– Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy – moment of inertia– torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule – torsional pendulum.

Unit II ELECTROMAGNETIC WAVES 9

Basic definitions: Gauss law for electric field, Faraday’s law and Ampere’s circuit law – Maxwell’s equations – Derivation of Maxwell’s Equations – wave equation: Plane electromagnetic waves in vacuum – properties of electromagnetic waves in vacuum: speed, amplitude, phase, orientation and waves in matter – Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure.

Unit III MAGNETIC MATERIALS AND SUPERCONDUCTIVITY 9

Introduction – Types of magnetic materials: Dia, Para and Ferromagnetism–domain theory of Ferromagnetism –hysteresis – Ferrites and application of Ferrites.

Superconductivity: Properties of Superconductor – Type I& Type II Superconductor. Application of Superconductor: Josephson junction – SQUID – Magnetic levitated Train.

Unit IV PHASE DIAGRAMS 9

Solid solutions – Hume Rothery's rules – the phase rule – single component system – one component system of iron – binary phase diagrams – isomorphous systems – the tie-line rule – the lever rule – isomorphous system – eutectic phase diagram – free energy composition curve for binary systems – microstructural change during cooling.



Unit V ADVANCED MATERIALS

9

Ceramics – types and applications – Composites – classification, role of matrix and reinforcement, processing of fiber reinforced plastics– Metallic glasses: types, glass forming ability of alloys, melt spinning process, applications –shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications.

Total Periods: 45

Text Books:

1. Kleppner D and Kolenkow R, “An Introduction to Mechanics”,2017, McGraw Hill Education (Indian Edition),New Delhi.
2. Purcell E M and Morin D J, “Electricity and Magnetism”,2013, Cambridge Univ.Press.United Kingdom.
3. Raghavan V, “Materials Science and Engineering: A First Course”, 2015, Prentice Hall India Learning Private Limited, New Delhi.

Reference Books:

1. Wolfson R, “Essential University Physics”. Volume 1 & 2, 2009, Pearson Education (Indian Edition), New Delhi.
2. William D. Callister J “Materials Science and Engineering”, 9th edition, 2014, John Wiley and sons,Inc, New Delhi.
3. Smith, W.F., Hashemi, J. & Prakash, R, “Materials Science and Engineering” 2014, Tata McGraw Hill Education Pvt. Ltd, New Delhi.

Web URL(s):

1. <http://nitttrc.edu.in/nptel/courses/video/115104094/115104094.html>
2. <http://nitttrc.edu.in/nptel/courses/video/115101005/115101005.html>
3. <https://archive.nptel.ac.in/courses/113/104/113104068/>
4. <https://nptel.ac.in/courses/113105081>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	1	2	1	1	2	1	2	3	-	-
CO2	3	3	-	-	-	2	2	1	1	-	1	2	3	-
CO3	3	2	-	-	1	2	1	2	2	1	2	2	3	-
CO4	3	1	2	-	2	3	2	1	2	1	3	3	-	-
CO5	3	2	-	-	1	2	1	1	1	1	2	3	3	-
Average	3.0	2.0	0.4	-	1.0	2.0	1.4	1.0	1.4	0.8	2.0	2.6	2.4	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23CST01	PROBLEM SOLVING AND PROGRAMMING IN C	L	T	P	C
		3	0	0	3

Pre-requisites : None

Course Objectives:

- To understand problem solving methodologies.
- To provide an overview of concepts in C language.
- To develop C programs using Arrays and Strings
- To develop modular applications in C using Functions.
- To develop skills in using Pointers. Structures, Unions and File handling.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

C01	Understand and apply problem-solving techniques and basic C programming constructs.	K3
C02	Identify and apply appropriate conditional and looping statements for developing applications.	K3
C03	Apply concepts of Arrays and Strings to store and manipulate data efficiently in programming applications.	K3
C04	Utilize Functions and Pointers to solve computational problems.	K3
C05	Develop applications in C using Structures, Unions, and File Processing.	K3

Course Contents

UNIT-I PROBLEM SOLVING FUNDAMENTALS 9

Fundamentals of Computing – Identification of Computational Problems -Problem solving- Flow Chart, Algorithm, Pseudo code – Introduction to C – Structure of a C program- Keyword- Identifiers - Data Types – Variables - Constants – Input/output statements Operators – Type Conversion and Type casting

UNIT-II CONDITIONAL STATEMENTS AND LOOPING CONSTRUCTS 9

Conditional Branching Statements: if, if-else, else-if ladder, nested-if, switch constructs - Looping constructs: for, while, do-while constructs – Nested loops - Usage of break continue, return and go to statements

UNIT-III ARRAYS AND STRINGS 9

1D Array –Declaration, Initialization, 2D Array - Declaration, Initialization – Operations on Arrays- Multi-dimensional Arrays, Strings: Declaration and Initialization - String operations: length, compare, concatenate, copy

UNIT-IV FUNCTIONS AND POINTERS 9

Functions: Built-in Functions, User defined functions – Function Prototypes–Command Line Arguments -Arrays and Functions – Strings and Functions- Scope of Variables – Storage classes – Recursion- Pointers: Declaration – Pointer operators – Pointer expressions -Passing Pointers to a Function – Pointers and one-dimensional arrays – Pointers and Strings - Dynamic Memory Allocation.

UNIT-V STRUCTURES, UNIONS AND FILE HANDLING 9

Structure: Creating a Structure-Member initialization - Accessing Structure Members - Nested structures – Pointer and Structures – Array of structures - Self Referential Structures – typedef – Unions – Bit fields – Enumerated data types - Files- Opening and Closing a Data File, Reading and writing a data file- Pre-processor Directives

Total Periods: 45

Text Books:

1. David Riley and Kenny hunt, “Computational Thinking for the Modern problem solver”, 2014, Chapman & Hall, CRC, USA.



2. SparnkleM, "Problem solving and programming concepts", 9th edition, 2011, Pearson Education, New Delhi.
3. ReemaThareja, "Programming in C", Second Edition, 2016, Oxford University Press, New Delhi.
4. Herbert Schildt, "C – The Complete Reference", 2017, Tata McGraw Hill Publishing Company, New Delhi.
5. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", 2015, Prentice Hall of India Private Limited, New Delhi.

Reference Books:

1. Deitel and Deitel, "C How to Program", 2011, Pearson Education, New Delhi.
2. Byron S. Gottfried and Jitendar Kumar Chhabra, "Programming with C", 2011, Tata McGraw Hill Publishing Company, New Delhi.
3. PradipDey and ManasGhosh, "Programming in C", 2009, Oxford University Press, New Delhi.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
2. <https://www.udemy.com/topic/c-programming/>
3. <https://www.coursera.org/courses?query=c%20programming>
4. <https://alison.com/tag/c-programming>
5. <https://nptel.ac.in/courses/106105171>

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	-	3	3	-	-	2	2	-	1	3	3	-
CO2	3	3	-	3	3	-	-	2	2	-	1	3	3	-
CO3	3	3	3	3	3	-	-	2	2	-	1	3	3	-
CO4	3	3	3	3	3	-	-	2	2	-	1	3	3	-
CO5	3	3	3	3	3	-	-	2	2	-	1	3	3	-
Average	3.0	3.0	1.5	3.0	3.0	-	-	2.0	2.0	-	1.0	3.0	3.0	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MET02	ENGINEERING GRAPHICS (Common to MECH, MCT and CIVIL)	L	T	P	C
		2	2	0	4

Pre-Requisites : None

Course Objectives:

- To develop graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national BIS standards related to technical drawings.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 Construct the basic engineering curves,	K3
CO2 Construct the projecting of lines and plane surfaces using rotating line and object methods respectively.	K3
CO3 Show orthographic projections of a simple solids with its axis inclined to one of the principal planes.	K3
CO4 Construct the true shape of the sectioned simple solids in simple vertical positions and develop its lateral surface.	K3
CO5 Develop freehand sketch and isometric projection of simple three dimensional objects.	K3

Course Contents

Unit I ENGINEERING CURVES 12

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Unit II PROJECTION OF LINES AND PLANE SURFACES 12

Orthographic projection- principles-Principal planes -First angle projection of straight lines inclined to both the principal plane - Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both principal plane by rotating object method.

Unit III PROJECTION OF SOLIDS 12

Projection of simple solids like prisms, pyramids, cylinder, cube and cone when the axis is inclined to one of the principal planes by rotating object method.

Unit IV SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids – Prisms, pyramids, cylinders and cones.

Unit V FREE HAND SKETCHING AND ISOMETRIC PROJECTIONS

12

Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids,cylinders, cones- combination of two solid objects in simple vertical positions and conversion of orthographic views to isometric.

Total Periods: 60

Text Books:

1. Venugopal K. and Prabhu Raja V, “Engineering Graphics”, 2019, New Age International (P) Limited, New Delhi.
2. Natarajan K.V., “A text book of Engineering Graphics”, 2018, Dhanalakshmi Publishers, Chennai.

Reference Books:

1. Bhatt N.D. andPanchal V.M, “Engineering Drawing”,53rd Edition, 2019, Charotar Publishing House, New Delhi.
2. Gopalakrishna K. R., “Engineering Drawing”, (Vol. I&II combined), 27th Edition, 2017, Subhas Stores, Bangalore.
3. Parthasarathy, N. S. and Vela Murali, “Engineering Drawing”, 2015, Oxford University, Press, New Delhi.

Web URL(s):

1. <https://nptel.ac.in/courses/112103019>
2. <https://archive.nptel.ac.in/courses/112/105/112105294/>
3. <https://archive.nptel.ac.in/courses/112/102/112102304/>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	1	-	-	-	-	-	-	1	-	-
CO3	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO4	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	1	-	-	-	-	-	-	2	-	-
Average	3	-	-	-	1	-	-	-	-	-	-	1.6	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23TAT01	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

Pre-Requisites : None

Course Objectives:

To make the students to:

- Understand and appreciate the secular nature and ethical concepts of Sangam literature and the evolution of Tamil literature through different periods.
- Explore and analyze the traditional and modern art forms, including sculpture and folk arts, and their significance in Tamil culture and society.
- Evaluate the historical and cultural impact of Tamil heritage, including traditional sports, Agam and Puram theories, and the role of Tamil contributions in the Indian national movement and knowledge dissemination.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Understand the secular nature of Sangam literature and its ethical concepts.	K2
CO2	Apply knowledge of ancient and modern sculpture techniques to analyze various art forms.	K3
CO3	Evaluate the role of traditional sports in Tamil society and their impact on community life.	K3
CO4	Understand the Agam and Puram theories from ancient Tamil texts.	K2
CO5	Assess the historical significance of Tamil printing and its role in the dissemination of knowledge.	K3

Course Contents

Unit I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

Unit II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

Unit III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

Unit IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

Unit V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total Periods: 15

Text-cum-Reference Books:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	-	-	1	-	-	-	-	-	-
CO2	-	3	-	-	3	-	-	2	1	-	-	-	3	-
CO3	-	-	-	-	3	-	-	2	-	-	-	-	3	-
CO4	1	1	-	-	-	-	-	2	-	-	-	1	-	-
CO5	1	-	-	-	-	-	-	1	-	-	-	-	-	3
Average	1	1	-	-	1.5	-	-	1.2	0.3	-	-	0.8	1	1
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23PYP01	PHYSICS LABORATORY	L	T	P	C
	(Common to ALL branches)	0	0	2	1

Pre-Requisites : None

Course Objectives:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.

Course Outcomes:

Upon completion of the course, students would be able to

**BT
Level
(highest
level)**

- | | |
|--|-----------|
| CO1 Use the different components and equipments in physics practical. | K3 |
| CO2 Solve problems individually and summarize the experimental results effectively. | K3 |
| CO3 Use graphical models to analyze laboratory data and develop skills to impart practical knowledge in real time solution. | K3 |

List of Experiments

1. Determination of Wavelength of Laser.
2. Determination of Particle Size and Acceptance angle of the fiber using laser.
3. Determination of young's modulus by Uniform bending.
4. Determination of thickness of a thin wire by Air wedge method.
5. Determination of thermal conductivity of bad conductor.
6. Determination of Rigidity modulus by Torsion pendulum.
7. Determination of wavelength of mercury spectrum – Spectrometer grating.
8. Determination of bandgap of a semiconductor.
9. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyse, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	1	-	3	-	-	1	-	-	-	-	-	1
CO2	2	-	1	3	3	1	-	1	-	-	-	2	-	2
CO3	2	3	1	-	2	2	-	3	-	-	-	3	1	3
Average	2	1	1	1	2.6	1	-	1.7	-	-	-	1.7	1	2
3 -High; 2-Medium; 1 -Low; - No Correlation														

U23CSP01	PROBLEM SOLVING AND PROGRAMMING IN C LABORATORY (Common to ALL branches)	L 0	T 0	P 2	C 1
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Pre-Requisites : None

Course Objectives:

This Course aims to develop comprehensive competence in C programming by practicing problem solving skills.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1 Apply C programming constructs to develop efficient programs.	K3
CO2 Apply knowledge to develop robust programs incorporating arrays, strings, functions, and pointers.	K3
CO3 Create and implement structured, efficient, and error-free C programs.	K6

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions
2. Decision-making constructs: if-else, go to, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, multi-dimensional arrays
5. Strings: Operations
6. Functions: call, return, passing arrays to function, Passing string to functions, Recursion
7. Pointers: Pointers to Functions, Arrays and Strings, Passing parameters to functions
8. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions
9. Files: reading and writing, File pointers, File operations, Preprocessor directives
10. Mini project

Total Periods: 30

Reference Books:

1. ReemaThareja, "Programming in C", Second Edition, 2016, Oxford University Press.
2. Herbert Schildt, "C – The Complete Reference", 2017, Tata McGraw Hill Publishing Company, New Delhi.
3. Kernighan B. W. and Ritchie D. M., "C Programming Language (ANSI C)", 2015, Prentice Hall of India Private Limited, New Delhi.
4. Deitel and Deitel, "C How to Program", 2011, Pearson Education, New Delhi.
5. Byron S. Gottfried and Jitendar Kumar Chhabra, "Programming with C", 2011, Tata McGraw Hill Publishing Company, New Delhi.
6. PradipDey and ManasGhosh, "Programming in C", 2009, Oxford University Press, New Delhi.

Web URL(s):

1. <https://cse02-iiith.vlabs.ac.in/List%20of%20experiments.html>

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	2	2	3	1	-	3	3	1	2	3	3	3
CO2	3	2	2	2	2	2	-	3	2	2	2	3	2	3
CO3	3	2	3	3	3	2	2	2	3	3	3	3	2	3
Average	2.7	2.3	2.3	2.3	2.7	1.7	1	2.7	2.7	2	2.3	2.7	2.3	2.7
3 –High; 2–Medium;1 –Low; - No Correlation														

U23EEP01

**ENGINEERING PRACTICES LABORATORY
(Common to CIVIL, EEE, MECH and MCT)**

L	T	P	C
0	0	4	2

Pre-Requisites : None

Course Objectives:

- To gain the basic knowledge of measuring the components.
- To know about the usage of appropriate tools and equipment used in welding, plumbing and carpentry
- To impart knowledge about different types joints in welding, carpentry and plumbing.
- To understand working methodologies of lathe machine and sheet metal processes.
- To impart knowledge in electrical wiring concepts for house hold and calculations of power and energy.
- To familiarize with various electronic components and equipment.
- To learn the basic skills of soldering electronic components and wires.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply techniques to measure basic dimensions of mechanical components and join metals using arc welding.	K3
CO2	Create models in sheet metal, perform basic machining operations on a lathe, and use proper tools for plumbing and carpentry.	K3
CO3	Apply skills to make joints related to carpentry and plumbing work.	K3
CO4	Understand and carry out basic home electrical works and measure electrical quantities.	K2
CO5	Apply knowledge of various electronic components and equipment.	K3
CO6	Understand and elaborate on soldering practices.	K2

LIST OF EXPERIMENTS

MECHANICAL AND CIVIL ENGINEERING PRACTICES

- 1 Measurement of mechanical components using Vernier Caliper and Vernier Height Gauge.
- 2 Measurement of diameter of mechanical components using Micrometer.
- 3 Sheet Metal Works: Model making – like Rectangular Tray.
- 4 Hands-on-exercise on Lathe machine: Facing, Simple Turning and Step Turning
- 5 Hands-on-exercise on Drilling Machine: Drilling of holes in a component.
- 6 Preparation of butt joint, lap joint and T- joint by metal arc welding.
- 7 Study of plumbing tools and equipment
- 8 Hands-on-exercises in Plumbing: Basic pipe connection using different types of joints and components required for residential and industrial buildings.
- 9 Hands-on-exercises in Carpentry: Wood work joints using conventional and power tools.
- 10 Assembling and dismantling of simple mechanical products.

ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES

1. Basic switch board wiring with switch to connect three pin socket, Two Lights and Indicator Lamp.
2. Staircase wiring.
3. Measurement of Voltage, Current, Power and calibration of Single-phase Energy meter.
4. Fluorescent Lamp wiring with introduction to CFL and LED types.
5. Measurement of AC Signal parameters using CRO and Function Generator.
6. (i) Measurement of DC & AC Voltage, Continuity using Digital Multimeter.
(ii) Measurement of Inductor and Capacitor using LCR Meter.
7. Soldering of Electronic components in PCB.
8. Study of Megger, Circuit Breakers, DC Regulated power supply and DSO.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	2	-	-	3	2	3	-	-	3	-	2	-	-
CO2	-	2	-	-	3	-	2	-	-	-	-	2	-	2
CO3	-	3	3	3	3	2	-	3	3	3	-	2	-	3
CO4	-	2	3	3	3	3	-	2	3	3	-	3	3	-
CO5	-	2	3	3	3	3	-	3	-	2	3	3	-	3
CO6	-	3	2	3	3	-	-	3	2	2	-	3	3	-
Average	-	2.4	2.7	3	3	2.6	-	2.6	2.8	2.6	2.8	2.6	2.8	2.6
3 –High; 2–Medium;1 –Low; - No Correlation														

Semester – II

U23EGT02

**PROFESSIONAL ENGLISH
(Common to ALL branches)**

L	T	P	C
3	0	0	3

Pre-Requisites : None

Course Objectives:

- To enhance learners' English language acquisition skills
- To facilitate learners to acquire effective technical writing skills
- To prepare learners for placement and competitive exams
- To facilitate effective English language skills for academic purposes and real-life situations

Course Outcomes:

Upon completion of the course, students shall have ability to

**BT Level
(highest
level)**

CO1	Cultivate critical thinking skills to analyse and evaluate information effectively.	K4
CO2	Acquire and apply specialized English language skills in professional contexts.	K6
CO3	Develop technical communication competencies to articulate complex ideas with precision and clarity.	K3
CO4	Demonstrate expertise in professional communication, encompassing written, verbal, and interpersonal skills.	K6
CO5	Enhance language proficiency and strategic competencies to excel in competitive examinations and professional pursuits.	K5

Course Contents

Unit I CREATIVE THINKING **9**

Articles – Conjunctions – subject verb agreement - Sentence completions- online worksheets on matching, paragraph writing on Comparison and contrast.

Unit II PROFESSIONAL VOCABULARY **9**

Compound nouns-Process description, product description, Job application and resume writing-Online worksheets for hints development

Unit III TECHNICAL SKILL **9**

Discourse Markers -Gerunds and infinitive- Relative Pronouns – Definitions of Technical Terms – Digital Transcoding – Group discussion (Do's and Don't)-online worksheet on transcoding

Unit IV PROFESSIONAL COMMUNICATIONS **9**

Concord – Clauses – Phrases – Numerical Adjectives – Complaint letter-Filling up forms(Opening bank a/c and ticket booking) – Virtual Communication: E-Mail Writing – Essay Writing: Types of essays Opinion Essay, Discussion Essay, Direct Questions Essay, Advantage/Disadvantage Essay, Problem/Solution Essay.

Unit V ENGLISH FOR COMPETITIVE EXAMS **9**

TOFEL / IELTS- (LSRW) Synonyms; Vocabulary; reading comprehension of IELTS; writing-verbal: Verbal Ability- Commonly misspelt words, travel itinerary.

Total Periods: 45

Text Books:

1. "English for Engineers & Technologists", 202, Department of English, Anna University, OrientBlackswan Private Ltd., Hyderabad.

2. Dr. B. Vinoth & Prof. J. Oormila Heleena, "A workbook of Communicative English", First edition, 2023, Sri Krishna Hitech publishing company pvt Ltd, Coimbatore,
3. Ramalingam N, "Grammar for all", Second edition, 2013, Himalaya Publishing House, Bengaluru.

Reference Books:

1. Norman Whitby, "Business Benchmark Pre-intermediate to intermediate Personal Study Book", BEC and BULATS Edition, 2006, Cambridge University Press India Ltd, New Delhi.
2. Anne Laws, "Writing Skills", 2011, Summertown Publishing Oxford - U.K.
3. Sinha DK, "Specimen of English Prose", 2012, Orient Black Swan., Hyderabad.
4. Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", 2009, Oxford University Press India Ltd, New Delhi.
5. Raymond Murphy. "English Grammar and Use" - 4th edition, 2004, Cambridge University Press, UK.

Web URL(s):

1. <https://www.liveworksheets.com/worksheets/en>
2. <https://www.ets.org/toefl.html> (TOEFL Test Takers (ets.org))
3. <https://englishonline.britishcouncil.org/ielts-coach/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	3	2	-	-	-	-	2	-	3	-	2
CO2	3	-	3	-	2	-	-	-	3	3	-	3	2	-
CO3	3	2	2	2	3	-	-	-	3	3	-	3	-	2
CO4	-	-	-	-	3	3	-	-	3	3	2	2	-	3
CO5	3	2	-	3	2	-	-	-	2	3	-	3	3	-
Average	3	1.5	1.3	3	2.4	0.6	-	-	2.2	2.8	0.4	2.8	1.3	1.4
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MAT02	TRANSFORMS AND BOUNDARY VALUE PROBLEMS (Common to CIVIL, ECE, EEE, MECH and MCT)	L	T	P	C
		3	1	0	4

Pre-Requisites : Linear Algebra and Calculus

Course Objectives:

To make the students

- Introduce the basic concepts of partial differential equations for solving standard types.
- Introduce Fourier series in engineering problems.
- Acquaint with Fourier transform techniques used in wide variety of situations.
- Interpret with Fourier series techniques in solving heat flow problems.
- Introduce the effective mathematical tools for the solutions of partial differential equations to model several physical processes and to develop Z transform techniques for discrete time systems.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 Solve the standard partial differential equations.	K3
CO2 Solve differential equations using Fourier series analysis in engineering applications	K3
CO3 Apply the mathematical principles of transforms and partial differential equations to formulate and solve the physical problems of engineering.	K3
CO4 Apply the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow Problems and one-dimensional wave equations.	K3
CO5 Apply the mathematical tools for the solutions of partial differential equations using the Z transform techniques for discrete time systems	K3

Course Contents

Unit I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Solution of standard types of first order equations- Lagrange's equation- linear partial Differential equation of second and higher order with constant coefficients.

Unit II FOURIER SERIES 9+3

Dirichlet's conditions- General Fourier series- Half Range Sine and Cosine series- Parseval's Identity- Harmonic Analysis.

Unit III FOURIER TRANSFORM 9+3

The infinite Fourier transform pair - sine and cosine transform - properties- Parseval's identity and convolution theorem (statement only)

Unit IV BOUNDARY VALUE PROBLEMS 9+3

Classification of Second order linear partial differential equations- solutions of one-dimensional wave equation-One-dimensional heat equation, steady state solution of two-dimensional heat equation, Fourier series solution in cartesian coordinates

Unit V Z – TRANSFORMS 9+3

Definition and properties- Elementary Problems- Inverse Z transforms (partial fraction method) -convolution theorem (statement only)- Application of Z – Transforms in solving difference equations.

Total Periods: 60

Text Books:

1. Grewal.B.S. and Grewal.J. S, “Higher Engineering Mathematics”, 44th Edition,2018,KhannaPublishers, New Delhi.
2. Kreyszig.E, “AdvancedEngineeringMathematics”, 10thEdition ,2018, JohnWileyand Sons (Asia) Ltd, Delhi.

Reference Books:

1. Bali.N. P and Manish Goyal., “A Textbook of Engineering Mathematics”, 10th Edition ,2015,Laxmi Publications, Pvt Ltd.
2. Ramana. B.V., “Higher Engineering Mathematics”,6th edition, 2018, McGraw Hill Education Pvt Ltd, New Delhi
3. James. G., “Advanced Modern Engineering Mathematics”, 4th Edition, 2016, Pearson Education, New Delhi.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/111/105/111105123/>
2. <https://archive.nptel.ac.in/courses/111/106/111106111/>
3. <https://archive.nptel.ac.in/courses/111/102/111102129/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3 - Apply, K4 - Analyze, K5 - Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	2	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-	2	-	-
CO3	3	3	2	2	1	-	-	-	-	-	-	3	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	3	-	2
CO5	3	3	2	3	1	-	-	-	-	-	-	2	-	2
Average	3	2.8	2	2.4	1	-	-	-	-	-	-	2.6	-	2
3 –High; 2–Medium;1 –Low; - No Correlation														

U23CYT02	APPLIED CHEMISTRY (Common to CIVIL, MECHANICAL and MCT)	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Course Objectives:

- To understand the requirements of Boiler feed water, its problems and water treatment methods
- To learn the principles and generation of energy in solar cells, fuel cells and batteries.
- To familiar with the nature of fuels its combustion.
- To understand the basic concepts of Phase Rule and its application to one component systems and appreciate the purpose of significance of alloys.
- To develop an understanding about engineering materials, synthesis of nanomaterials and its applications.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 Apply knowledge of various water treatment processes to make water suitable for industrial and domestic purposes.	K3
CO2 Examine various sources of energy and their storage in different types of batteries, with applications in societal and engineering fields.	K3
CO3 Apply an understanding of fuel characteristics and combustion to select appropriate fuels for different applications.	K3
CO4 Identify components of a system and select suitable heat treatment processes for alloys.	K3
CO5 Understand methods involved in the synthesis of different materials and infer their properties.	K2

Course Contents

Unit I WATER TECHNOLOGY 9

Hardness of water-types -expression-units-estimation of hardness of water by EDTA-numerical problems-boiler feed water-disadvantages of hard water in boilers-boiler troubles (scale & sludge, boiler corrosion)-water treatment-zeolite process, Ion exchange process-desalination-reverse osmosis-instrumental methods for water analysis-AAS, flame emission spectroscopy and photocalorimetry.

Unit II ENERGY SOURCES AND STORAGE DEVICES 9

Energy sources-types-nuclear energy-nuclear fission-controlled nuclear fission-nuclear fusion-nuclear reactor power generator-breeder reactor-solar energy-solar energy conversion-wind energy-Batteries - primary (alkaline battery) - Secondary (lead storage battery, NICAD battery and lithium ion battery) - Electric vehicles – working principles -Fuel cells (H₂-O₂ , direct methanol and solid oxide)-super capacitors.

Unit III FUELS AND COMBUSTION 9

Fuels: Introduction-Gross Calorific value- Net Calorific value- classification of fuels - coal- analysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (Otto Hoffmann method) - octane number - diesel oil- cetane number - natural gas- compressed natural gas (CNG)- liquefied petroleum gases (LPG)- Power alcohol and bio diesel. flue gas analysis (gas chromatography).

Unit IV PHASE RULE AND ALLOYS 9

Phase Rule: Introduction-definition of terms with examples-one component system-water system-reduced phase rule – thermal analysis and cooling curves-two component system-lead-silver system-Pattinson process. Alloys: Introduction-definition-properties of alloys-significance of alloying, functions



and effect of alloying elements-ferrous alloys (Nichrome and Stainless steel)-Heat treatment of steel-nonferrous alloys (Brass and Bronze).

Unit V CHEMISTRY OF ENGINEERING MATERIALS

9

Abrasives-classification-properties-Mho scale-Applications of Abrasives -Portland Cement-manufacture (wet process)-properties-setting and hardening of cement-special cement-alumina cement and water proof cement. -Nano Chemistry: Basics-distinction between molecules, nano particles and bulk materials-preparation of nano particles by sol-gel-preparation of nano wires by electro spinning-preparation of carbon nano tube by chemical vapour deposition-quantum dots-synthesis by colloidal process-Applications of nano materials.

Total Periods:

Text Books:

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, 17th Edition, 2018,Dhanpat Rai Publishing Company (P) Ltd, New Delhi.
2. Palanna O.G, “Engineering Chemistry”, 2nd edition, 2017, McGraw Hill Education (India) Pvt. Ltd., Chennai.
3. Dara S.S, and Umare S.S, “Engineering Chemistry”, 2013, S. Chand & Company Ltd., New Delhi

Reference Books:

1. Murty B. S, Shankar P, Baldev Raj, Rath B.B and James Murday, “Text book of nanoscience and nanotechnology”, 2018, Universities Press-IIM Series in Metallurgy and Materials Science., Springer Publications, US
2. Sivasankar B, “Engineering Chemistry-Fundamentals and Applications”, 2008, Tata McGraw-Hill Publishing Company, Ltd., New Delhi.
3. Shikha Agarwal, “Engineering Chemistry” Second Edition, 2019, Cambridge University Press, New Delhi.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/118/104/118104008/>
2. <https://archive.nptel.ac.in/courses/118/102/118102003/>
3. <https://archive.nptel.ac.in/courses/105/106/105106206/>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	1	-	-	-	-	-	-	3	-	-
CO2	3	3	3	2	1	-	-	-	-	-	-	2	-	-
CO3	3	3	3	3	2	-	-	-	-	-	-	3	-	-
CO4	3	2	2	2	1	-	-	-	-	-	-	2	-	-
CO5	3	2	2	3	-	-	-	-	-	-	-	3	2	2
Average	3	2.6	2.4	2.4	1	-	-	-	-	-	-	2.6	2	2
3 –High; 2–Medium;1 –Low; - No Correlation														

U23CST02

PYTHON PROGRAMMING

L	T	P	C
3	0	0	3

Pre-requisites : None

Course Objectives:

- To understand and apply fundamental Python programming concepts
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To know the basics of object-oriented programming concepts.
- To do input/output with files in Python.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
C01	Apply knowledge to develop Python programs using appropriate data types.	K3
C02	Utilize and manipulate Python data structures such as lists, tuples, sets, and dictionaries.	K3
C03	Design and implement functions, modules, and packages for structured Python programming.	K3
C04	Articulate and apply object-oriented programming concepts in Python.	K3
C05	Develop Python applications incorporating file handling, command-line programming, and exception handling.	K3

Course Contents

UNIT I	BASICS OF PYTHON PROGRAMMING	9
	Introduction to Python - Python Interpreter – Data types - variables - expressions -statements- Operators and Expressions – Strings – Decision control statements	
UNIT II	PYTHON DATA STRUCTURES	9
	Sequence - Lists - Functional Programming – Tuples – Sets- Dictionaries	
UNIT III	FUNCTIONS, MODULES AND PACKAGES	9
	Functions – Definition – Call - Variable scope and Life time – Return- Lamda Functions- Recursive functions- Modules – Packages	
UNIT IV	OBJECT ORIENTED PROGRAMMING	9
	Object-Oriented Concepts and Terminology - Classes and objects - Attributes and Methods - Inheritance – Method overriding – Data encapsulation – Data hiding	
UNIT V	FILES AND EXCEPTION HANDLING	9
	File Handling - Read - Write – Command Line Programming – Exception Handling	
Total Periods:		45

Text Books:

1. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Second Edition, 2016, Updated for Python 3, Shroff O’Reilly Publishers.
2. ReemaThareja, “Problem solving and Programming with Python”, 2018, Oxford University.
3. Liang Y. Daniel, “Programming Using Python”, 1st Edition, 2017, Pearson Education.
4. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python”, 2011, Revised and updated for Python 3.2, Network Theory Ltd.

Reference Books:

1. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, 2012,CENGAGE Learning.
2. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus”, 2013, Wiley India Edition.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-Disciplinary Approach”, 2016, Pearson India Education Services Pvt. Ltd.

4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, 2019, No Starch Press.

Web URL(s):

1. <https://nptel.ac.in/courses/106106145>
2. https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
4. <https://nptel.ac.in/courses/106106182>
5. <https://www.udemy.com/course/python-for-complete-beginners-1/>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO2	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO3	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO4	3	3	3	2	2	-	-	-	-	-	-	3	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	3	2	2
Average	3	3	3	2	2.2	-	-	-	-	-	-	3	2	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23ECT03	BASICS OF ELECTRICAL, ELECTRONICS AND INFORMATION SCIENCE (Common to MECH, CIVIL and MCT)	L	T	P	C
		3	0	0	3

Pre-Requisites : Mathematics and Physics

Course Objectives:

- To introduce the basics of electric circuits and analysis.
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To know about the various types of communication systems.
- To familiar with the concepts in Emerging fields of Information science.

Course Outcome

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

C01	Analyze and compute electric circuit parameters for simple problems.	K4
C02	Analyze the characteristics of analog electronic devices.	K4
C03	Understand and explain the basic concepts of digital electronics.	K2
C04	Apply the concepts of modulation and demodulation, and utilize amplitude modulation techniques.	K3
C05	Investigate the characteristics of different network technologies.	K3

Course Contents

Unit I ELECTRIC CIRCUITS **9**

Introduction to DC Circuits: Conductor, Resistor, Inductor, Capacitor- Ohm's Law, Kirchhoff's Laws, simple problems. Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.

Unit II ANALOG ELECTRONICS **9**

Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode –Characteristics and Applications – Bipolar Junction Transistor- Types, I-V Characteristics and Applications.

Unit III DIGITAL ELECTRONICS **9**

Basic logic gates, Universal gates, Combinational circuit, Half- Adder, Full-Adder, Decoder, Sequential Circuit, Latches, RS Flip-flop, JK Flip-flop, D Flip-flop, T Flip-flop.

Unit IV COMMUNICATION FUNDAMENTALS **9**

Analog and Digital Communication: Need for Modulation, Amplitude Modulation and Frequency modulation, Basic of Pulse Amplitude Modulation, Pulse Code Modulation, Digital Modulation Techniques.

Unit V COMPUTER AND INFORMATION TECHNOLOGY **9**

Computer Networks: TCP/IP Model- Introduction to Microcontroller (Quantitative treatment only), Introduction to Embedded Technology- Real Time Application- Washing machine controller, Advanced Technologies- Artificial Intelligence.

Total Periods: 45



Text Books

1. Sudhakar A, Shyammohan S Pilla, “Circuits and Networks Analysis and Synthesis”, 2013, Tata McGraw Hill India Pvt Limited, New Delhi.
2. Robert L Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 2013, Pearson Education, New Delhi. .

Reference Books

1. Morris Mano M and Michael D Ciletti, “Digital Design, With an Introduction to the Verilog HDL”, 2013, Pearson Education, New Delhi.
2. Wayne Tomasi, “Electronic Communication Systems”, 2004, Pearson Education, New Delhi.

Web url(s)

1. <https://nptel.ac.in/courses/105103023>
2. <https://www.allaboutcircuits.com/>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	3	2	1	-	-	-	-	-	3	2	2
CO2	3	3	2	3	2	1	-	-	-	-	-	3	2	2
CO3	2	2	3	3	2	1	-	-	-	-	-	2	2	2
CO4	3	2	3	3	2	1	-	-	-	-	-	3	2	2
CO5	3	2	3	3	3	1	-	-	-	-	-	3	2	2
Average	2.8	2.6	2.6	3	2.2	1	-	-	-	-	-	2.8	2	2
3 -High; 2-Medium;1 -Low; - No Correlation														

U23TAT02

TAMILS AND TECHNOLOGY

L	T	P	C
1	0	0	1

Pre-Requisites : None

Course Objectives:

To make the students to:

- Understand the key technologies and techniques in weaving and ceramics during the Sangam Age, including pottery styles and decorations.
- Explore ancient design and construction methods by studying buildings and architectural styles from different historical periods in Tamil Nadu.
- Learn about manufacturing technologies like shipbuilding and metalworking, and their importance in ancient Tamil society through archaeological findings.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|--|-----------|
| CO1 | Understand the significance of weaving and ceramic technology during the Sangam Age, including Black and Red Ware Potteries and graffiti on potteries. | K2 |
| CO2 | Apply knowledge of ancient design and construction techniques to analyze structural elements and materials used during the Sangam Age. | K3 |
| CO3 | Evaluate the technological advancements in manufacturing, such as shipbuilding, metallurgy, and bead making during ancient Tamil periods. | K3 |
| CO4 | Understand agricultural and irrigation practices, including dam and pond construction, and animal husbandry methods used during the Chola period. | K2 |
| CO5 | Assess the development of scientific Tamil and Tamil computing, including digitalization efforts and the establishment of Tamil virtual resources. | K3 |

Course Contents

Unit I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

Unit II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

Unit III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold-Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

Unit IV AGRICULTURE AND IRRIGATION TECHNOLOGY

3

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

Unit V SCIENTIFIC TAMIL & TAMIL COMPUTING

3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Total Periods: 15

Text-cum-Reference Books:

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	2	1	1	-	-	-	-	-	2	2	2
CO2	3	3	2	3	2	1	-	-	-	-	-	3	3	3
CO3	3	3	3	2	3	1	-	-	-	-	-	3	3	3
CO4	2	2	2	3	2	1	-	-	-	-	-	2	2	2
CO5	3	2	3	2	2	1	-	-	-	-	-	3	3	3
Average	2.6	2.4	2.2	2.4	2	1	-	-	-	-	-	2.6	2.6	2.6
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23CYP01

CHEMISTRY LABORATORY
(Common to ALL branches)

L	T	P	C
0	0	2	1

Pre-Requisites : None

Course Objectives:

- To make the student to acquire practical skills in the determination of water quality parameters through Volumetric and instrumental analysis.
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, hardness, DO.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.
- To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | |
|--|-----------|
| CO1 Examine the water quality parameters for domestic and industrial purposes. | K3 |
| CO2 Analyze the amount of metal ions quantitatively using spectroscopic techniques. | K3 |
| CO3 Apply electroanalytical techniques to determine ions in solution. | K3 |

List of Experiments

1. Estimation of Total, Temporary and Permanent Hardness of Water Sample by EDTA method.
2. Determination of DO content in Water by Winkler's method.
3. Determination of strength of acids in a mixture using conductivity meter.
4. Determination of strength of acid in a base using conductivity meter.
5. Determination of strength of an acid using pH meter.
6. Estimation of iron content of the given solution using potentiometer.
7. Determination of molecular weight and degree of polymerisation of a polymer (PVA) by viscometric method
8. Estimation of Iron in a given sample by photo colorimetry

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	2	2	3	-	-	-	-	-	-	2	2	1
CO2	3	3	2	2	3	-	-	-	-	-	-	2	2	2
CO3	3	3	2	3	3	-	-	-	-	-	-	3	3	2
Average	3	3	2	2.3	3	-	-	-	-	-	-	2.3	2.3	1.7

3 –High; 2–Medium; 1 –Low; - No Correlation

U23CSP02

PYTHON PROGRAMMING LABORATORY

L T P C
0 0 2 1

Pre-requisites : None

Course Objectives:

This course helps to develop and implement Python programs using fundamental constructs, data structures, and advanced features like OOP and file handling.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| C01 | Apply Python programming fundamentals to create programs using simple statements, expressions, and control structures. | K3 |
| C02 | Analyze and design complex programs that integrate data structures, modules, and exception handling for technical solutions. | K4 |
| C03 | Create real-time applications using advanced Python features such as functions, object-oriented programming (OOP), and file handling. | K6 |

List of Experiments

1. Python programming using simple statements and expressions
2. Conditionals and Iterative loops
3. Implementing programs using Functions.
4. Implementing programs using Strings
5. Implementing real-time/technical applications using Lists, Tuples, and Dictionaries.
6. Implementing programs using written modules and Python Standard Libraries.
7. Implementing real-time/technical applications using File handling.
8. Implementing real-time/technical applications using Exception handling.
9. Python programming using OOPs concepts.
10. Mini project.

Total Periods: 30

Reference Books

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, 2016, Updated for Python 3, Shroff O'Reilly Publishers.
2. ReemaThareja, "Problem solving and programming with python", 2018, Oxford University.
3. Liang Y. Daniel, "Programming Using Python", 1st Edition, 2017, Pearson Education.
4. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python ", 2011, Revised and updated for Python 3.2, Network Theory Ltd.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", 2012, CENGAGE Learning.
6. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus", 2013, Wiley India Edition.
7. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-Disciplinary Approach", 2016, Pearson India Education Services Pvt. Ltd.
8. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, 2019, No Starch Press.

Web URL(s):

1. <https://python-iitk.vlabs.ac.in/>

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create



Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	3	3	2	3	2	1	-	-	-	-	3	3	2
CO2	3	3	3	3	3	3	2	1	-	-	-	3	3	3
CO3	3	3	3	3	3	3	2	2	1	-	-	3	3	3
Average	3.0	3.0	3.0	2.7	3.0	2.7	1.7	1.0	-	-	-	3.0	3.0	2.7
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MEP01	COMPUTER AIDED DRAFTING LABORATORY (Common to MECH, MCT and CIVIL)	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Course Objectives:

- To draw simple figures with title block using CAD software commands.
- To sketch curves like parabola, spiral and involute of square & circle and draw the orthographic projection of simple solids.
- To prepare orthographic projection of simple machine parts and draw a plan of residential building
- To develop skill in sketching simple steel truss and sectional views of simple solids.
- To develop skill to use software to create 2D and 3D models.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Exhibit proficiency in creating and editing a title block that includes essential text elements and projection symbols using CAD software.	K3
CO2	Construct front, top, and side views of simple objects from a given pictorial view, including basic dimensions and sectional details using cad software.	K3
CO3	Develop a detailed plan of a residential building featuring designated rooms and produce an accurate drawing of a simple steel structures using CAD software.	K3

List of Exercises:

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using B-spline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder and cone including dimensioning.
5. Drawing sectional views of prism, pyramid, cylinder and cone.
6. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
7. Drawing isometric projection of simple objects.
8. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.
9. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
10. Drawing of a simple steel truss.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply , K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	-	-	-	3	-	-	-	1	-	-	2	-	-
CO2	2	1	2	-	3	-	-	-	1	-	-	2	-	1
CO3	2	1	3	-	3	1	-	-	2	1	-	2	-	-
Average	1.7	0.7	1.7	-	3	0.3	-	-	1.3	0.3	-	2.0	-	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

Semester III

U23MAT04	STATISTICS AND NUMERICAL METHODS (Common to CIVIL, MECH, MCT)	L	T	P	C
		3	1	0	4

Pre-Requisites : Basic concepts of Integration, Differentiation, Probability and Standard Distributions

Course Objectives:

To provide the necessary basic concepts and procedures for solving numerically in engineering and technology.

- Acquaint the knowledge in testing the hypothesis for small and large samples in real life problems.
- Provide the necessary basic concepts of a design of experiments in statistics.
- Introduce the basic concepts of solving algebraic and transcendental equations using numerical techniques.
- Introduce the numerical systems of interpolation, differentiation and integration.
- Acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply the concept of testing of hypothesis for small and large samples in real life problems.	K3
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.	K3
CO3	Solve the algebraic and transcendental equations using numerical techniques for engineering applications.	K3
CO4	Apply the numerical techniques of interpolation in various intervals, differentiation and integration for engineering problems.	K3
CO5	Use the knowledge of various techniques and methods for solving first and second order ordinary differential equations.	K3

Course Contents

Unit I TESTING OF HYPOTHESIS **9+3**

Tests for single and difference of means (Large and small samples) – Tests based on t, chi-square and F distribution for testing mean and variance – Contingency table (test for independence)- Goodness of fit.

Unit II DESIGN OF EXPERIMENTS **9+3**

One way and two-way classifications-Completely randomized design – Randomized block design – Latin square design.

Unit III NUMERICAL SOLUTION OF LINEAR EQUATIONS **9+3**

Solution of algebraic and transcendental equations - Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel.

Unit IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION **9+3**

Lagrange’s and Newton’s forward and backward difference interpolation –Approximation of derivatives using interpolation polynomials– Numerical single and double integration using Trapezoidal and Simpson’s 1/3 rules.



Unit V NUMERICAL SOLUTION OF ODE GIVEN INITIAL VALUES

9+3

Single step methods: Taylor’s series method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne’s predictor corrector methods for solving first order differential equations.

Total Periods : 45+15=60

Text Books:

1. Grewal B.S. and Grewal J.S., “Numerical Methods in Engineering and Science”, 11th Edition,2013,KhannaPublishers, New Delhi.
2. Johnson R.A., Miller.I and Freund.J, “Miller and Freund’s Probability and Statistics for Engineers”,8thEdition,2015, Pearson Education, Asia.

Reference Books:

1. Gupta S.C. and Kapoor V. K., “Fundamentals of Mathematical Statistics”, 12th Edition, 2020, Sultan Chand& Sons, New Delhi.
2. Burden R.L. and Faires J.D, “Numerical Analysis”, 9th Edition,2016,Cengage Learning, New Delhi.
3. Devore. J.L, “Probability and Statistics for Engineering and the Sciences”, 8th Edition,2014, Cengage Learning , New Delhi.

Web URL(s):

1. <https://nptel.ac.in/courses/111105041>
2. <https://nptel.ac.in/courses/102106051>
3. <https://nptel.ac.in/courses/111105038>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	3	1	3	2	1	-	-	-	1	1	3	-	2
CO2	1	3	1	3	2	1	-	-	-	1	-	3	1	2
CO3	2	3	-	1	2	-	-	-	-	-	1	2	2	1
CO4	3	3	-	2	3	-	-	-	-	-	-	2	2	1
CO5	3	3	-	3	3	-	-	-	-	-	-	2	2	1
Average	2.2	2.6	1	2.4	2.4	1	-	-	-	1	1	2.4	1.4	1.4
3 –High; 2–Medium; 1 –Low; - No Correlation														

Types of Friction- Coulombs Law of Dry Friction - Impending motion, Angle of repose - Simple contact friction - Ladder friction. Kinematics of rigid bodies – Translation and Rotation of Rigid Bodies – General Plane motion.

Total Periods: 45

Text Books:

1. Vela Murali, “Engineering Mechanics”, 2010, Oxford University Press, India.
2. Ferdinand Beer P, “Russell Johnston E, Vector Mechanics for Engineers: Statics and Dynamics”, 9th Edition, 2010, Tata McGraw-Hill International Edition, India.

Reference Books:

1. Kottiswaran N, “Engineering Mechanics - Statics and Dynamics”, 2013, Sri Balaji Publications, India.
2. Rajasekaran S and Sankara subramanian G., “Engineering Mechanics”, 2005, 3rd Revised Edition, Vikas Publishing House Pvt. Ltd., India.
3. KumarD.S., “Engineering Mechanics”, 2012,S.K.Kataria& Sons Publications, India.
4. Irving H. Shames, “Engineering Mechanics - Statics and Dynamics”, 2011, Pearson Education Asia Pvt. Ltd.,India.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/112/106/112106286/>
2. <https://archive.nptel.ac.in/courses/112/106/112106180/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO2	3	3	2	-	-	-	-	-	-	-	1	3	-	-
CO3	3	2	2	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	2	-	2	-	-	-	-	-	1	3	1	-
CO5	3	3	3	2	-	-	-	-	-	-	1	3	1	-
Average	3	2.4	2.3	2	2	-	-	-	-	-	1	2.8	1.0	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCT01	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

Pre-Requisites : Nil

Course Objectives:

- To understand the properties of fluids and principles of fluid statics.
- To learn the behavior of fluids under rest and motion using fundamental equations.
- To explore the concepts of dimensional and model analysis for real-world applications.
- To study the principles and performance of hydraulic turbines and pumps for engineering applications.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1 Describe fluid properties and explain pressure measurement methods used in static fluid systems.	K3
CO2 Analyze fluid motion using kinematic and dynamic equations and apply Bernoulli's principle in real time pipe flow problems.	K3
CO3 Apply dimensional analysis techniques to derive empirical relationships and develop models using similitude principles.	K3
CO4 Construct velocity triangles and analyze the performance characteristics of hydraulic turbines for power generation.	K3
CO5 Determine discharge, efficiency and work done of pumps and analyze the performance of centrifugal and reciprocating pumps in fluid systems.	K3

Course Contents

Unit I FLUID PROPERTIES AND PRESSURE MEASUREMENT 9

Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, Capillarity, Compressibility and Bulk modulus –Newton's law of viscosity- Pascal's Law – pressure measurements – Buoyancy and meta-centre - Fluid statics - Total pressure and centre of pressure on submerged surfaces

Unit II FLUID KINEMATICS AND DYNAMICS 9

Types of fluid flow and flow lines – concept of continuum and control volume – continuity equation in one-dimension and three dimension – velocity potential and stream function -Energy equation – Euler and Bernoulli's equations – Laminar and Turbulent flow through pipes – Hagen Poiseuille's equation- Major and Minor Energy Losses- Darcy Weisbach formula- applications

Unit III DIMENSIONAL AND MODEL ANALYSIS 8

Need for dimensional analysis – Dimensional Homogeneity – Rayleigh's and Buckingham methods of dimensional analysis –Problems. Model and Prototype- Model study and Similitude – scale effects and distorted model.

Unit IV HYDRAULIC TURBINES 10

Impact of Jets- Euler's equation- Theory of rotodynamic machines- General layout of a hydro electric power plant-Velocity components at the entry and exit of the rotor- Classification of turbines-Axial, Radial and mixed flow turbines- – construction, working principles, Velocity triangles and design of Pelton wheel, Francis and Kaplan Turbines - head, losses, work done and efficiency - specific speed – operating characteristics - Governing of Turbines – Problems.

Unit V PUMPS

Classification of pumps - Centrifugal pump - working principle and Velocity triangle - discharge, work done and efficiencies – Gear oil and Multistage pumps - Reciprocating pumps - work done and efficiencies – Problems- working principle of Gear-oil pump and Vane pump-Applications.

Total Periods: 45

Text Books:

1. Bansal R.K. , “A textbook of Fluid Mechanics and Hydraulic Machines”, Tenth Edition, 2018 Laxmi Publications, New Delhi.2023
2. Rajput.R.K, “A text Book of Fluid Mechanics and Machinery”, 2012,S. Chand and Company, New Delhi,2017

Reference Books:

1. Yunus A Cengel, John M Cimbala,” Fluid Mechanics”, Third Edition, 2014 McGraw Hill Education (India) Pvt Ltd., India.
2. Kumar.K.L, “Engineering Fluid Mechanics”, 2008 Eurasia Publishing House (P) Ltd., New Delhi.
3. Streeter, Victor L , Wylie, E. Benjamin, “Fluid Mechanics”, 2017, Tata McGraw Hill, Delhi.
4. Hibbler R C, “Fluid Mechanics”, First edition, 2017,Pearson, USA

Web URL(s):

1. <https://nptel.ac.in/courses/112105206>
2. <https://nptel.ac.in/courses/112105183>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	1	1	-	-	-	-	-	1	1	-	-
CO3	3	3	2	3	2	-	-	-	-	-	1	1	-	1
CO4	2	1	-	-	1	-	-	-	-	-	1	2	-	-
CO5	2	1	-	-	1	-	-	-	-	-	1	2	-	-
Average	2.4	1.6	2	2	1.25	-	-	-	-	-	1	1.6	-	1
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCT02	DIGITAL SYSTEM DESIGN AND MICROPROCESSOR	L	T	P	C
		3	0	0	3

Pre-Requisites : Basics of Electrical, Electronics and Information Science

Course Objectives:

- To introduce Boolean algebra, digital principles, and applications in digital systems
- To familiarize with the design of various combinational and sequential digital logic circuits
- To present concepts related to programmable logic devices and memory systems
- To introduce the concept of microprocessor architecture and programming
- To demonstrate the peripheral interface techniques and address decoding

Course Outcomes:

At the end of this course students will have the ability to

	BT Level (highest level)
CO1 : Apply Karnaugh map techniques to simplify boolean expressions and implement the corresponding logic circuits using universal gates.	K3
CO2 : Explain the design principles of combinational and sequential logic circuits including adders, subtractors, multiplexers, decoders, flip-flops, counters, and shift registers for specified logic functions.	K2
CO3 : Describe the architecture and working of memory devices and programmable logic components including ROM, RAM, PLA, PAL, and FPGA.	K2
CO4 : Interpret the architecture, instruction set, pin configuration, and addressing modes of the 8085 microprocessor with timing diagrams.	K2
CO5 : Discuss the concepts of memory and peripheral interfacing including address decoding, programmable devices, and actuator control techniques.	K2
Unit I MINIMIZATION TECHNIQUES AND LOGIC GATES	9

Number Systems, 1's and 2's complements, Binary codes, Boolean Algebra-Boolean postulates and laws – De-Morgan's Theorem-Minimization of Boolean expression, Karnaugh map, Don't care conditions, Logic Gates, Digital Logic Families: TTL, CMOS.

Unit II **COMBINATIONAL & SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN** **9**

Half Adder, Full Adder, Half Subtractor, Full Subtractor, Multiplexer, De-multiplexer, Decoder-7 segment display decoder, Flip flops – SR, JK, T, D, Design of Synchronous and asynchronous counters, Shift register, Ring counter and Johnson counter.

Unit III **MEMORY DEVICES** **9**

Basic memory structure – ROM – PROM – EPROM – EEPROM – EAPROM, RAM – Static and dynamic RAM – Programmable Logic Devices – Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL.

Unit IV **8085 MICROPROCESSOR FUNDAMENTALS** **9**

Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes – instruction machine cycles with states and timing diagram.- 8085 assembly language programming examples.

Unit V INTERFACING TECHNIQUES

9

Need for Interfacing – Memory Interfacing, address space partitioning – address map – Address decoding – Designing decoders circuit, Programmable peripheral device(8255), Keyboard and Display Controller (8279), Interfacing A/D and D/A converters, Stepper motor control

Total Periods: 45

Text Books:

1. Morris Mano, Michel D. Ciletti, "Digital Design with an Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Global Edition Pearson Education, New Delhi, 2019.
2. Anand Kumar A, "Fundamentals of Digital Circuits", Fourth Edition, PHI Learning Private Limited, New Delhi, 2016.
3. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", Sixth Edition, Penram International Publishing, India, 2013.

Reference Books:

1. Charles H.Roth, "Fundamentals of Logic Design", 7th edition, Thomson Learning, USA, 2013.
2. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2013.
3. Anil K.Maini, "Digital Electronics", 1st edition, Wiley Publications, USA, 2014.
4. Soumitra Kumar Mandal, "Digital Electronics", McGraw Hill Education Private Limited, India, 2016.

Web URL(s):

1. https://onlinecourses.swayam2.ac.in/cec24_cs09
2. https://onlinecourses.nptel.ac.in/noc24_ee46

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	-	-	-	-	-	-	3	-	-
CO2	3	3	2	-	1	-	-	-	-	-	-	3	2	-
CO3	3	-	2	-	1	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	1	-	-	-	-	-	-	2	2	-
CO5	3	-	-	-	1	-	-	-	-	-	-	2	3	-
Average	3.0	3	2	-	1	-	-	-	-	-	-	2.6	2.3	-
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MCT03	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

Pre-Requisites : Nil

Course Objectives:

- To learn the working principle and performance characteristics of DC Machines.
- To study the working principle of transformers and autotransformer.
- To impart knowledge on working principle and types of induction machines and synchronous machines.
- To impart knowledge on working operation and its applications of special electrical machines.

Course Outcomes:

At the end of this course students will have the ability to

**BT Level
(highest
level)**

- | | |
|--|-----------|
| CO1 : Describe the excitation type and characteristics of DC Machines. | K2 |
| CO2 : Explain the construction, principle of operation, and performance parameters of single-phase and three-phase transformers | K2 |
| CO3 : Summarize the working principles of induction motors and synchronous machines. | K2 |
| CO4 : Interpret the construction, operation, types and applications of stepper motors and BLDC motors. | K2 |
| CO5 : Apply suitable special motors to meet specific industrial application. | K3 |

Unit I DC MACHINES

9

DC generator: Constructional details – Working operation – EMF equation – Methods of excitation – Characteristics of series, shunt and compound generators – D.C. motor: Principle of operation – Back EMF – Characteristics of series, shunt and compound motors – Speed control of D.C. shunt motors.

Unit II TRANSFORMERS

9

Single phase transformers: Constructional details – Principle of operation – EMF equation – phasor diagrams – Equivalent circuit– Regulation and Efficiency – Three phase transformers – Constructional details – Autotransformers.

Unit III INDUCTION AND SYNCHRONOUS MACHINES

9

Single phase induction motor: operation - Double field revolving theory – Types - Applications. Three phase induction motor: Construction - Working operation. Synchronous generator: Constructional details - Types of rotors - Synchronous motor: Principle of operation - Starting methods – Applications.

Unit IV STEPPER MOTORS AND PMLBDC MOTORS

8

Stepper motors: Constructional features –Principle of operation –Types – Characteristics – Applications. BLDC motors: Construction - Principle of operation- Types - EMF and Torque equations- Applications.

Unit V OTHER SPECIAL MACHINES

10

Constructional features – Principle of operation – Hysteresis motor – Synchronous Reluctance Motor – Universal motor – Repulsion motor – Servomotor: Construction – Working principle -Types – Applications.

Text Books:

1. Stephen J Chapman, “Electric Machinery Fundamental”, 5th Edition, McGraw-Hill, USA, 2012.
2. Kothari D P , Nagrath I J, “Electric Machines”, 5th Edition, Tata McGraw Hill Publishing Company Ltd New Delhi, 2017.
3. Fitzgerald A.E, Charles Kingsley, “Electric Machinery”, 6th Edition, McGraw Hill publishing Company Ltd, 2017.
4. Venkataratnam K., “Special Electrical Machines”, Universities Press (India) Private Limited, India, 2021.

Reference Books:

1. Bhimbhra P.S., “Electrical Machinery”, 2nd edition, Khanna Publishers, India, 2021.
2. Theraja.B.L, Theraja.A.K, “A Textbook of Electrical Technology”, Vol.II "AC & DC Machines”, 2015, S.Chand & Company Ltd, New Delhi.
3. Janardanan E.G., “Special electrical machines”, PHI learning Private Limited, Delhi, 2014,

Web URL(s):

1. <https://nptel.ac.in/courses/108102146/>
2. <https://nptel.ac.in/courses/108/102/108102156/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	-	-	-	-	-	-	-	-	1	3	-	-
CO2	3	1	-	-	-	-	-	-	-	-	1	3	-	-
CO3	3	1	-	-	-	-	-	-	-	-	1	1	1	-
CO4	3	1	-	-	-	-	-	-	-	-	1	1	1	-
CO5	3	1	1	-	1	-	-	-	-	-	1	1	1	1
Average	3.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	1.8	1.0	1.0
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MCP01

**FLUID MECHANICS AND MACHINERY
LABORATORY**

L T P C
0 0 2 1

Pre-requisites : NIL

Course Objectives:

- To conduct experiment and determine the coefficient of discharge of flow meters.
- To conduct experiments on various pumps and turbines and evaluate their performance
- To perform experiments to analyze and determine the major and minor energy losses in pipe flow.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| CO1 | Demonstrate the use of various flow meters and determine their coefficients of discharge through experimentation. | K3 |
| CO2 | Experiment to identify and quantify minor energy losses in pipe flow systems. | K3 |
| CO3 | Calculate the efficiency and analyze the performance characteristics of different pumps and turbines. | K3 |

List of Experiments:

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting performance test and drawing the characteristic curves of centrifugal pump/ submersible pump
6. Conducting performance test and drawing the characteristic curves of reciprocating pump.
7. Conducting performance test and drawing the characteristic curves of Gear pump.
8. Conducting performance test and drawing the characteristic curves of Pelton wheel turbine.
9. Conducting performance test and drawing the characteristics curves of Francis turbine.
10. Conducting performance test and drawing the characteristic curves of Kaplan turbine.
11. Study of minor energy losses in a pipe flow.
12. Study of Bernoulli's theorem.
13. Determination of friction in pipes
<https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/>
14. Performance characteristics of Pelton Turbine
<https://fmc-nitk.vlabs.ac.in/exp/pelton-turbine/>

TOTAL PERIODS: 30

References:

1. Lab Manual

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	–	–	–	2	–	–	–	–	–	–	3	–	–



CO2	3	-	-	-	2	-	-	-	-	-	-	3	-	-
CO3	3	-	2	-	3	-	-	-	-	-	-	-	-	3
Average	3.0	-	2.0	-	2.3	-	-	-	-	-	-	3.0	-	3.0
3 -High; 2-Medium; 1 -Low; - No Correlation														

U23MCP02 ELECTRICAL MACHINES LABORATORY

L	T	P	C
0	0	2	1

Pre-requisites : NIL

Course Objectives:

- To provide hands on experience to determine the characteristics, performance parameters of DC machines and transformers by conducting suitable tests.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|--|-----------|
| CO1 | Perform load tests and speed control on DC machines to analyze their performance characteristics. | K3 |
| CO2 | Demonstrate load, no-load, and blocked rotor tests on induction motors | K3 |
| CO3 | Determine the performance characteristics of single-phase, three-phase transformers and stepper motors | K3 |

List of Experiments:

1. Load test on D.C. shunt motor.
2. Load test on D.C. series motor.
3. Speed Control of DC motor by field resistance control
<https://ems-iitr.vlabs.ac.in/exp/dcmotor-field-resistance-control/index.html>
4. Speed control of D.C. shunt motor.
5. To study the Load Characteristics of DC shunt generator
<https://ems-iitr.vlabs.ac.in/exp/load-characteristics-dc-shunt/index.html>
6. Load characteristics of separately excited DC generator.
7. Load test on three phase induction motor.
8. Load test on single phase induction motor.
9. Performance characteristics of single phase and three phase transformers.
10. Performance characteristics of stepper motor.
11. No load and blocked rotor test on single-phase induction motor.

TOTAL PERIODS: 30

References:

1. Lab Manual

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	1	-	1	-	-	-	-	-	-	2	-	-
CO2	2	1	1	-	1	-	-	-	-	-	-	2	1	-
CO3	2	1	1	-	2	-	-	-	-	-	-	2	1	1
Average	2.0	1.0	1.0	-	1.3	-	-	-	-	-	-	2.0	1.0	1.0

3 - High, 2- Medium, 1 - Low, - No Correlation



Semester IV

U23MCT04	THEORY OF MACHINES	L	T	P	C
		3	1	0	4

Pre-Requisites : Engineering Mechanics

Course Objectives:

- To understand basic components and layout of kinematic linkages in machine and find their velocity and acceleration
- To construct the cam profile for various types of follower motion and to understand the effects of friction in motion transmission and in machine components.
- To perform static and dynamic force analysis in machine member.
- To learn the concept of free and forced vibration.
- To understand the basic concepts of governor and to gain knowledge on the balancing of rotating and reciprocating masses.

		BT Level (highest level)
CO1	Illustrate the basic of kinematic linkages based on given application and construct velocity and acceleration in simple mechanisms.	K3
CO2	Construct the cam profile for different follower motion and analyse the various components of forces due to friction.	K3
CO3	Analyze static and dynamic forces in simple machine components, Design and optimize flywheels to manage energy fluctuations and maintain speed stability in machinery.	K3
CO4	Interpret the free and forced vibration on the various machine members.	K3
CO5	Analyze Governor Parameters and estimate balancing mass and its position.	K3

Course Contents

Unit I	KINEMATICS AND ANALYSIS OF MECHANISMS	12
	Mechanisms –Terminology and definitions- Grashoff's law -Kutzback criterion. Kinematic inversions of four-bar, slider crank chain and double slider crank chain-Velocity and acceleration Polygons-Tensegrity Table.	
Unit II	CAM MECHANISMS AND FRICTION	12
	Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, simple harmonic, uniform acceleration and retardation and cycloidal motions – Sliding and Rolling Friction angle- Friction in threads – Friction in drives Belt and rope drives.	
Unit III	FORCE ANALYSIS AND FLYWHEEL	12
	Static Force analysis in simple machine members – Dynamic force analysis – Inertia force and Inertia torque – D Alembert's principle – Dynamic Force Analysis in reciprocating engines - Turning moment diagram - Fluctuations of energy- Fluctuations of speed	
Unit IV	VIBRATION	12
	Types of vibration – Free undamped and damped vibration –Critical speed of shaft – Torsional vibration of single rotor and two rotor system – Forced damped vibration – Disturbance caused by unbalance in	

rotating and reciprocating machines – Transmissibility.

Unit V GOVERNOR AND BALANCING

12

Types of governors - Force analysis of Watt, Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power -Balancing of revolving and reciprocating masses.

Total Periods: 60

Text Books:

1. Rattan SS, "Theory of Machines", 5th Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 5th Edition, 2020.
2. John J.Uicker, Gordon R. Pennock, Joseph E Shigley, "Theory of Machines and Mechanisms", 6th Edition, Oxford University Press, UK, 2023.

Reference Books:

1. Khurmi R. S., "Theory of Machines", S Chand Publications, India, 4th Edition, 2006.
2. Bansal R.K., "Theory of Machines", Lakshmi Publications pvt.ltd, India, 6th Edition, 2016.
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 6th Edition, 2020.
4. Sadhu Singh, "Theory of Machines", Pearson Education India, 3rd Edition, 2011.
5. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, USA, 3rd edition, 2013.
6. Henry T. Brown, "507 Mechanical Movements", Brown & Seward Publisher, USA, 2021.

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1. <https://www.youtube.com/watch?v=I8L6JQGKQc&list=PL5KGB23FFL8eDGFRT7wK4cm6uwYwA7d04>
2. https://www.youtube.com/watch?v=yDEJxYGAoso&list=PLbRMhDVUMngdCkMipemSKP_dCgZLLfOe8
3. https://www.youtube.com/watch?v=Qp1T4oFe_gQ&list=PLW4Rtyezg8yk6WCwOGY1E_JoP62u-qyLI
4. https://www.youtube.com/watch?v=Rv0LbnJYMew&list=PLf-VAO7xqD8edD0A5mkUstkWW_ET4P9LE
<https://www.youtube.com/watch?v=YAjGR67PGYg>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	-	-	-	-	-	-	-	2	1	1
CO2	2	1	-	-	1	-	-	-	-	-	-	2	1	-
CO3	2	1	1	-	-	-	-	-	-	-	-	2	-	-
CO4	2	2	-	1	1	-	-	-	-	-	-	2	1	-
CO5	2	2	1	-	1	-	-	-	-	-	-	2	1	1
Average	2.2	1.6	1.0	1.0	1.0	-	-	-	-	-	-	2.0	1	1
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MGT02	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : None

Course Objectives:

- To introduce the fundamental concepts and principles of management.
- To explore the fundamental roles and functions of management, including planning, organizing, leading, and controlling.
- To develop the ability to apply management principles to organizational scenarios.
- To build decision-making and problem-solving skills in management contexts.
- To understand ethical and social considerations in management practices.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the evolution of management thought and the roles, responsibilities, and ethical dimensions of modern managers in various organizational contexts.	K2
CO2	Discuss the nature, purpose, and process of planning, including goal setting, strategic tools, and decision-making techniques used in effective management.	K2
CO3	Differentiate various organizational structures and analyze how authority, delegation, and communication impact organizational efficiency and culture.	K2
CO4	Interpret leadership styles and motivational theories and summarize the processes of team building, communication, and group dynamics in effective leadership.	K2
CO5	Describe the control process and discuss both financial and non-financial control techniques used to measure and improve organizational performance.	K2

Course Contents

Unit I INTRODUCTION TO MANAGEMENT 9

Definition, Nature, and Importance of Management - Evolution of Management Thought - Classical Approach: Scientific Management, Administrative Theory, Bureaucratic Management -Human Relations and Behavioural Approach - Contemporary Approaches: Systems Theory, Contingency Theory - Roles and Skills of a Manager - Ethical and Social Responsibilities of Management

Unit II PLANNING 9

Nature and Purpose of Planning - Types of Plans: Strategic, Tactical, Operational - Planning Process - Goal Setting: SMART Goals - Decision Making: Types, Process, and Techniques Strategic Management and Planning Tools: SWOT Analysis, PEST Analysis, BCG Matrix

Unit III ORGANIZING 9

Organizational Structure and Design - Functional, Divisional, Matrix Structures - Authority and Responsibility - Delegation: Process, Barriers, and Principles - Decentralization vs. Centralization - Organizational Culture and Change - Coordination and Communication

Unit IV LEADING 9

Leadership vs. Management - Leadership Theories and Styles - Trait Theory, Behavioural Theories, Contingency Theories - Motivation Theories: Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory - Communication: Process, Types, Barriers, and Effective Communication - Team Building and Group Dynamics.

Unit V CONTROLLING

9

Nature and Importance of Control - Control Process - Types of Control: Feedforward, Concurrent, Feedback - Financial Controls: Budgets, Audits, Financial Statements - Non-Financial Controls: Balanced Scorecard, Benchmarking - Performance Measurement: KPIs and Metrics - Managing Information and Technology in Control

Total Periods: 45

Text Books:

1. Tripathy PC and Reddy PN, "Principles of Management", Tata McGraw Hill, New Delhi, 2017.
2. Harold Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, New Delhi, 2020.

Reference Books:

1. Gail Freeman - Bell and Janes Balkwill, "Management in Engineering – Principles and Practice", Prentice Hall of India Pvt. Ltd, India, 2008.
2. Stephen A. Robbins, David A. Decenzo and Mary Coulter, "Fundamentals of Management", 7th Edition, Prentice Hall, India, 2010.
3. Gupta and Meenakshi, "Principles of Management", PHI Learning Pvt. Ltd., India, 2009.

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2. https://onlinecourses.nptel.ac.in/noc20_mg58/preview
3. <https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-mg58/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	–	–	–	–	3	3	–	–	–	–	–	–	–
CO2	3	2	–	–	–	–	–	–	–	–	–	–	–	–
CO3	2	–	–	–	–	–	–	–	3	–	–	–	–	–
CO4	–	–	–	–	–	–	–	3	3	–	–	–	–	–
CO5	2	–	–	–	3	–	–	–	–	–	–	–	–	–
Average	2.5	2	–	–	3	3	3	3	3	–	–	–	–	–

3 –High; 2–Medium; 1 –Low; - No Correlation

U23MCT05	POWER ELECTRONICS AND DRIVES	L	T	P	C
		3	0	0	3

Pre-Requisites : Basic Knowledge in semiconductor devices, Electrical Machines

Course Objectives:

- To familiarize in different types of power electronics devices and their characteristics.
- To impart knowledge on operation and characteristics of various AC-DC converters and DC-DC Converters.
- To learn the different modulation techniques of pulse width modulated inverters and to understand the operation of AC-AC converters.
- To study the operation of Phase control rectifiers and choppers in DC motor Drives.
- To analyze the speed control of AC motor Drives.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 : Describe the characteristics and applications of power electronic devices.	K2
CO2 : Summarize the operation and applications of rectifiers and choppers.	K2
CO3 : Explain the operation and applications of voltage source inverters, PWM techniques, and AC-AC converters.	K2
CO4 : Analyze the performance and control strategies of electric drives including phase-controlled DC motor drives and modern stepper and BLDC motor drives.	K3
CO5 : Apply speed control methods and control strategies for AC drives.	K3

Unit I POWER ELECTRONICS DEVICES 8

Introduction to Power Electronics -Construction, Operation, Static, dynamic and switching characteristics of Power Diode, SCR, TRIAC, Power transistor, MOSFET, IGBT and IGCT.

Unit II AC TO DC CONVERTERS AND DC-DC CONVERTERS 10

Controlled Bridge Rectifiers - single phase and three phase half controlled and fully controlled rectifiers with R, RL Load- Dual converters- Applications -Light dimmer.
Choppers, Control Strategies, Types of Choppers, Buck, Boost, Buck-boost, cuk Converter-Applications- Battery operated vehicles, Solar PV systems.

Unit III DC-AC CONVERTERS AND AC-AC CONVERTERS 9

Single phase and three phase voltage source inverters (both 120° mode and 180° mode) - PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM - Introduction to space vector modulation -Current source inverter. Application-induction heating, UPS. AC voltage controllers- - Power Factor Control - Multistage sequence control -Basic Principle of Cycloconverter -Applications-welding.

Unit IV DC MOTOR DRIVES 9

Basic Elements - Types of Electric Drives- Phase controlled rectifier fed separately excited DC motor drives-Four quadrant operation of chopper fed drives- stepper motor drive- BLDC motor drive.

Unit V AC MOTOR DRIVES 9

Speed control of Induction motor drives - Closed loop control of Induction motor drive - Cycloconverter Fed Drives - Slip power Recovery system - Permanent magnet Synchronous motor Drives - Three phase voltage/current source fed synchronous motor.



Total Periods: 45

Text Books:

1. Muhammad H. Rashid, "Power Electronics: Circuits, Devices & Applications", 4th Edition, Pearson, India, 2023.
2. Dubey. G. K, "Fundamentals of Electrical Drives", 2nd edition, Narosa publishing house, India, 2022.
3. Bimbhra P. S., "Power Electronics", 7th Edition, Khanna Publishers, India, 2022.

Reference Books:

1. Sen P.C., "Power Electronics", 2nd edition, Tata McGraw-Hill, India, 2017.
2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), UK, 2013.
3. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill, India, 2017.

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2. <https://nptel.ac.in/courses/108/108/108108077/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	1	-	-	-	-	-	-	-	-	1	1	1	-
CO4	3	1	-	-	-	-	-	-	-	-	1	1	1	-
CO5	3	1	1	-	1	-	-	-	-	-	1	1	1	1
Average	3.0	1.0	1.0	-	1.0	-	-	-	-	-	1.0	1.4	1.0	1.0
3 - High, 2- Medium, 1 - Low, - No Correlation														

Text Books:

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", 7th Edition, 2018,,S.Chand& company Ltd., New Delhi
2. Rattan S.S., "Strength of Materials", 2017, Tata McGraw Hill Education Pvt .Ltd., New Delhi.

Reference Books:

1. Singh. D.K., "Strength of Materials", 2021, Ane Books Pvt Ltd., New Delhi.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, 2015, PHI Learning Pvt. Ltd., New Delhi.
3. Beer. F.P. & Johnston. E.R. "Mechanics of Materials", 8th Edition, 2019, Tata McGraw Hill, New Delhi.
4. Vazirani. V.N, Ratwani. M.M, Duggal. S.K "Analysis of Structures: Analysis, Design andDetailing of Structures-Vol.1", 2014, Khanna Publishers, New Delhi.

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1. <https://archive.nptel.ac.in/courses/112/102/112102284/>
2. <https://archive.nptel.ac.in/courses/105/104/105104160/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	-	-	-	-	-	-	-	3	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	3	-	1
CO3	3	2	3	-	1	-	-	-	-	-	-	3	2	2
CO4	3	2	2	-	1	-	-	-	-	-	-	2	-	1
CO5	3	3	2	1	-	-	-	-	-	-	-	2	-	2
Average	3.0	2.2	2.0	1.0	1.0	-	-	-	-	-	-	2.6	2.0	1.4
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCT06

SENSORS AND SIGNAL CONDITIONING

L	T	P	C
3	0	0	3

Pre-Requisites :

Course Objectives:

- To comprehend the characteristics, response, and calibration concepts of transducers
- To become familiar with sensors used for displacement and force measurement
- To learn about various sensors used for measuring temperature, acceleration, and range
- To gain knowledge in designing interface electronic circuits
- To understand the fundamentals of signal conditioning, data acquisition, and communication systems used in mechatronics system development

Course Outcomes:

At the end of this course students will have the ability to

**BT Level
(highest)**

- | | | |
|------------|--|-----------|
| CO1 | : Explain the structure of measurement systems and perform calibration using error analysis and sensor characteristics. | K2 |
| CO2 | : Summarize the operation of the sensors for displacement and force measurement including potentiometers, LVDTs, strain gauges, and tactile sensors. | K2 |
| CO3 | : Illustrate the function of thermocouples, MEMS, and Hall effect sensors in automotive and mechatronics applications. | K3 |
| CO4 | : Describe the working and applications of operational amplifiers including inverting, non-inverting, filtering, and instrumentation circuits. | K2 |
| CO5 | : Use bridge circuits and data converters to model and examine data acquisition systems for real-time signal processing. | K3 |

Unit I INTRODUCTION TO MEASUREMENT SYSTEMS

9

Generalized Measurement System, Static and Dynamic Characteristics of transducers, Errors in Measurement- Error analysis, Classification of sensors, Sensor calibration techniques

Unit II SENSORS FOR DISPLACEMENT AND FORCE MEASUREMENT

9

Potentiometer, Capacitive transducer, Inductive transducer: LVDT, RVDT, Strain Gauge, Encoder: Optical, Magnetic, Inductive, Bridge Configuration of Load Cell, Magnetic and Inductive Proximity Sensors, Tactile Sensors

Unit III SENSORS FOR TEMPERATURE, ACCELERATION AND RANGE MEASUREMENT

9

Thermistor, RTD, Thermocouple, Hall Effect sensor, Photo conductive cell, LDR, Fibre optic sensors, Eddy Current Sensors, RADAR, LIDAR, RFID, MEMS Sensors, Automotive sensors, Smart sensors

Unit IV INTERFACE ELECTRONIC CIRCUITS

9

Input Characteristics of Interface Circuits, Operational Amplifier (Op-Amp) – Pin diagram & internal circuit diagrams of IC 741, Ideal characteristics, Op – AMP Applications: Inverting and Non-inverting amplifiers, V-to-I and I-to-V converters, filters, Adder, Subtractor, Integrator, Differentiator, Instrumentation amplifier, Analog to Digital Converters

Unit V SIGNAL CONDITIONING, DATA ACQUISITION AND CASE STUDIES

9

DC bridges– Wheatstone Bridge, AC bridges: Introduction –Sources and Detectors – Maxwell’s inductance bridge, Sample and Hold circuits, Data Acquisition: Single channel and Multi-channel data acquisition, Case study on Home appliances, Smart manufacturing, Healthcare applications

Total Periods: 45

Text Books:

1. Sawhney. A.K, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th Edition, Dhanpat Rai & Company Private Limited, New Delhi, 2015.
2. D Choudhury Roy, “Linear Integrated Circuits”, 5th Edition, New Academic Science, New Delhi, 2018
3. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 3rd edition, Springer, New York, 2015.

Reference Books:

1. John G. Webster, Halit Eren, “Measurement, Instrumentation, and Sensors Handbook”, 2nd edition, CRC Press, USA, 2018.
2. Albert D. Helfrick and William D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, 1st edition, Prentice Hall of India. India, 2016.
3. Ernest O Doebelin and Dhanesh N Manik, “Measurement systems, Application and design”, 6th edition, McGraw-Hill, New Delhi, 2012.

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Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	–	–	–	–	–	–	–	–	–	2	2	–
CO2	3	1	2	–	1	–	–	–	–	–	–	2	2	–
CO3	3	1	2	–	1	–	–	–	–	–	–	2	3	2
CO4	3	1	–	–	1	–	–	–	–	–	–	3	–	–
CO5	3	1	–	–	1	–	–	–	–	–	–	2	2	–
Average	3.0	1	2	–	1	–	–	–	–	–	–	2.2	2.3	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCP03

**SENSORS AND SIGNAL CONDITIONING
LABORATORY**

L	T	P	C
0	0	2	1

Pre-Requisites :

Course Objectives:

- To study various sensors for measuring displacement, force, and temperature
- To understand vibration measurement techniques and the working of optical sensors
- To comprehend the characteristics, response, and calibration concepts of transducers
- To explore signal conditioning circuits using operational amplifiers and data acquisition (DAQ) systems

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| CO1 | Apply contact and non-contact sensing techniques to measure displacement, temperature, vibration, and level in real-time systems. | K3 |
| CO2 | Demonstrate the signal conditioning circuits for addition, subtraction, and analog-to-digital conversion operations. | K3 |
| CO3 | Examine performance data of sensors to select appropriate types for measuring displacement, force, temperature, and speed. | K3 |

List of Experiments

1. Design and testing of Digital Comparator
2. Design of Signal Conditioning circuits using Operational Amplifier (IC 741) -Adder and Subtractor
3. Design and testing of Analog to Digital Converters
4. Displacement measurement using Potentiometer and plotting the characteristic curves
5. Displacement measurement using LVDT and plotting the characteristic curves
6. Measurement and calibration of Strain Gauge and Load Cell
7. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics
8. Temperature measurement using NI DAQ and LabVIEW software
9. Vibration measurement using Accelerometer
10. Measurement of level in a tank using capacitive type level probe
Virtual lab experiment: <https://sil-coep.vlabs.ac.in/exp/tank-using-capacitive/>
11. Speed, Position and Direction Measurement Using Encoders
12. Determine the Characteristics of Various Light Detectors (Optical Sensors)
13. Data acquisition, visualization and analysis of signals
14. Configuration of proximity sensors and its application.
Virtual lab experiment: <https://sil-coep.vlabs.ac.in/exp/proximity-sensors-applications/>

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	2	-	-	-	-	-	-	2	1	1
CO2	3	-	3	-	2	-	-	-	-	-	-	3	2	1
CO3	3	2	-	-	2	-	-	-	-	-	-	2	2	1
Average	3.0	2	3	-	2.0	-	-	-	-	-	-	2.3	1.7	1.0
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCP04 POWER ELECTRONICS AND DRIVES LABORATORY

L	T	P	C
0	0	4	2

Pre-Requisites :

Course Objectives:

- To study the characteristics of SCR, MOSFET and IGBT.
- To analyze the performance of various converters and controllers by experimentation.
- To study the behaviour of voltage waveforms of PWM inverter applying various modulation techniques.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| CO1 | Evaluate the performance of power electronic switches based on their switching characteristics. | K3 |
| CO2 | Demonstrate the working principles of AC-DC, DC-DC converters, inverters, and AC voltage controllers. | K3 |
| CO3 | Determine the speed of electrical drives using appropriate power electronic converters. | K3 |

List of Experiments

1. Static and Dynamic characteristics of SCR.
2. Static and Dynamic characteristics of MOSFET and IGBT.
3. Single Phase Half Wave Silicon Controlled Rectifier with R Load, RL Load & RLE Load
Virtual lab experiment: <https://pe-iitr.vlabs.ac.in/exp/single-half-silicon/>
4. Single phase AC to DC half controlled and fully controlled converter.
5. Step-up Chopper with R Load
Virtual lab experiment: <https://pe-iitr.vlabs.ac.in/exp/step-up-chopper/>
6. Step down and Step-up DC-DC converter.
7. IGBT based single phase PWM inverter.
8. Single phase AC Voltage controller.
9. Speed control of dc motor using three phase rectifiers.
10. Speed control of brushless dc motor.
11. Speed control of 3 phase induction motor using PWM inverter.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	1	-
CO3	2	1	1	-	1	-	-	-	-	-	-	1	1	1
Average	2.0	1.0	1.0	-	1.0	-	-	-	-	-	-	1.3	1.0	1.0
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MEP03	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : None

Course Objectives:

- To understand and apply the principles and standards of machine drawing, concepts of limits, fits, geometric dimensioning, and tolerances while preparing drawings.
- To prepare 2D drawings and 3D modelling of various mechanical components and assemblies using CAD software packages.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply BIS standards and code of practice in preparing machine drawings, including limits, fits, tolerances, and geometric dimensioning.	K3
CO2	Construct 2D part and assembly drawings of simple machine components using cad software.	K3
CO3	Create 3D models of simple machine components and generate orthographic/isometric views with proper sectioning and Bill of Materials	K3

Course Contents

1.	Basics of Machine Drawing Code of practice for Engineering Drawing, BIS specifications, Classification of Machine Drawings	3
2.	Limits, Fits and Tolerances Fundamentals of Limits & Fits, Geometric Dimensioning & Tolerances.	3
3.	Symbols Welding symbols, riveted joints, keys, fasteners. Machining symbols - surface finish indication - Functional and manufacturing datum.	4
4.	Detailed part drawings (2D Drafting) Preparation of detailed parts drawings of the following Flange coupling, Universal and Oldham couplings, Plummer Block, Footstep bearing, etc	16
5.	Creation of machine assembly drawings (2D Drafting) Preparation of part and assembly drawings Safety valve, Knuckle joint, screw jack.	16
6.	Part Modeling of machine components (3D Modeling) Creating standard machine components Shaft, Pulleys for flat and V- rope, Bracket.	8
7.	Detailed Drawing of Assembly Creation of Orthographic, Isometric and Section views. Applying Bill of Material concept. Stuffing box, Steam engine crosshead, machine vice, etc	10

Total Periods: 60

Text Books:

1. Gopalakrishna K.R., "Machine Drawing", 17th Edition, 2003, Subhas Stores Books Corner, Bangalore.

2. Bhatt N. D. and Panchal V.M., “Machine Drawing”, 51st Edition, 2022, Charator Publishers, India.
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, “Machine Drawing”, 2006, published by Tata McGrawHill, India.
4. S. Trymbaka Murthy, “A Text Book of Computer Aided Machine Drawing”, 2007, CBS Publishers, New Delhi.

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	3	-	2	1	1	-	1	-	-	1	-	1
CO2	2	1	3	-	3	1	-	-	1	-	-	2	-	1
Average	2	1	3	-	3	-	-	-	2	-	-	2	-	1
3 –High; 2–Medium; 1 –Low; - No Correlation														

Semester V

U23MCT07	CONTROL SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : Basics Knowledge of Mathematics and Physics

Course Objectives:

- To understand the basic concepts of open loop and closed loop control systems.
- To analyse the given system in time domain.
- To understand the concept of frequency domain analysis and stability of system.
- To design the compensator for different control systems.
- To understand the concept of controllability and observability using state space analysis.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Solve a mathematical model of a physical system and compute the transfer function using block diagram reduction technique and signal flow graph.	K3
CO2	Analyse the performance of first and second order systems and stability using Routh-Hurwitz and root locus techniques.	K3
CO3	Analyse the frequency response of control systems using Bode and polar plot techniques	K3
CO4	Apply Bode plot techniques for compensators and controllers in control systems.	K3
CO5	Determine the controllability and observability of a system using the state space approach.	K3

Course Contents

Unit I MATHEMATICAL MODEL OF PHYSICAL SYSTEMS **9**

Basic elements in control systems Open and closed loop systems with examples-Mathematical representation of systems Transfer function mechanical and electrical systems-Electrical analogy of mechanical systems- Block diagram reduction techniques -Signal flow graphs.

Unit II TIME DOMAIN ANALYSIS **9**

Time response - Time domain specifications -Types of test inputs I and II order system response -Steady state error, error constants - Stability concept and definition Characteristic equation - Location of poles - Routh Hurwitz criterion - Root locus techniques.

Unit III FREQUENCY DOMAIN ANALYSIS **9**

Bode plots - Polar plot - Correlation between frequency domain and time domain specifications - stability analysis using frequency response methods.

Unit IV COMPENSATOR AND CONTROLLER DESIGN **9**

Compensators: Design of Lag compensator -Lead compensator - Lag-lead compensator (using Bode plot) - Introduction to P, PI, PID controllers.

Unit V STATE SPACE ANALYSIS **9**



State equation - Solutions, Realization, Controllability, Observability - State space to transfer function conversion.

Total Periods 45

Text Books:

1. I.J. Nagrath and M. Gopal, "Control System Engineering", New Age International Publisher, 7th edition 2021.
2. M Gopal, "Control Systems Principles and Design", Tata McGraw hill, New Delhi, 2012.

Reference Books:

1. K.Ogatta, "Modern Control Engineering", Pearson Education, New Delhi, 2015.
2. Benjamin C. Kuo, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd., 2014.
3. Norman S. Nise, "Control Systems Engineering", 4th edition, New York, John Wiley, 2003

Web URL(s):

1. <https://www.aalimec.ac.in/wp-content/uploads/2020/01/CONTROL-SYSTEMS.pdf>
2. <https://testbook.com/electrical-engineering/control-system>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	1	-	-	-	-	-	-	2	1	-
CO2	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO3	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO4	3	2	1	-	1	-	-	-	-	-	-	1	1	-
CO5	3	2	1	-	1	-	-	-	-	-	-	1	1	-
Average	3.0	2.0	1.0	-	1.0	-	-	-	-	-	-	1.2	1.0	-
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MCT08	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

Pre-Requisites : Theory of Machines

Course Objectives:

- To provide foundational knowledge on various automobile structures, internal combustion engine components, and the influence of vehicle aerodynamics on performance.
- To understand the construction and operation of engine auxiliary systems and engine cooling.
- To introduce the functional principles and types of vehicle transmission systems, including clutches, gearboxes, final drive, and axle mechanisms.
- To familiarize with the construction and working of steering mechanisms, braking systems, front axles, and suspension systems in modern vehicles.
- To examine emission control standards, and modern safety technologies.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain various automobile structures, the impact of aerodynamics, and the functions of engine components.	K2
CO2	Describe the construction and working of engine auxiliary systems and engine cooling systems.	K2
CO3	Summarize the types and working principles of transmission systems, drive components, and rear axle drives used in vehicles.	K2
CO4	Describe the construction and components of steering systems, front axle, braking systems and suspension system.	K2
CO5	Apply emission control technologies and safety features to meet global and Indian automotive standards in petrol and diesel vehicles.	K3

Course Contents

Unit I VEHICLE STRUCTURE AND ENGINES 8

Types of automobiles - Vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).

Unit II ENGINE AUXILIARY SYSTEMS 9

Carburettor: types and construction – Ignition System: Battery coil, Magneto coil and Electronic ignition system - Fuel Injection systems: Unit injector, common rail direct injection - Electronic fuel injection – GDI - Turbo chargers – Engine Cooling System - Automotive air conditioning - Starting system: Kick starter and Self-starter system.

Unit III TRANSMISSION SYSTEMS 11

Clutch: types and construction - Gear boxes :types and Construction, Manual Transmission(MT)- Automatic Transmission(AT) - Automated Manual Transmission (AMT) - Dual Clutch Transmission (DCT) - Intelligent Manual Transmission (IMT) - Continuously Variable Transmission (CVT)- Torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.



Unit IV STEERING, BRAKES AND SUSPENSION SYSTEMS

9

Steering geometry -Power Steering - Types of Front Axle - Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), Electronic brake force distribution (EBD) - Suspension Systems -Types - Traction Control.

Unit V EMISSION CONTROL AND SAFETY

8

Emission Control: Global Standards - Indian Pollution Norms for Petrol & Diesel Vehicles - Engine emission control by three way catalytic converter - Exhaust gas recirculation system - Safety measures in Automobiles - Seat belt, Air bags, Collision Warning System.

Note: Students should gain experience in assembling and disassembling engine parts and transmission systems.

Total Hours 45

Text Books:

1. William Crouse, Donald Anglin, "Automotive Mechanics", McGraw Hill Education, US, 10th Edition, 2017.
2. S.K. Gupta "Automobile Engineering", S.Chand Publishing, New Delhi. 2nd Edition, 2020.

Reference Books:

1. Kirpal Singh, "Automobile Engineering", Vol I & II, Standard Publishers Distributor, New Delhi, 14th Edition, 2019.
2. Kumar D.S., "Automobile Engineering", S.K. Kataria and Sons, Delhi, 2nd Edition, 2017.
3. Anil Chhikara, "Automobile Engineering", Vol-1 & 2, Tech India Publications, New Delhi, 2017.
4. Rajput R.K., "A Text book of Automobile Engineering", Laxmi Publication, New Delhi, 2nd Edition, 2017.

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1. <https://archive.nptel.ac.in/courses/107/106/107106088/>
2. <https://archive.nptel.ac.in/courses/107/106/107106080/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	1	-	-	-	-	-	-	-	-	3	-	1
CO2	3	1	-	-	1	-	-	-	-	-	-	3	-	-
CO3	2	2	1	-	1	-	-	-	-	-	-	3	-	-
CO4	3	1	-	-	1	-	-	-	-	-	-	3	-	-
CO5	1	-	-	-	-	2	1	1	-	-	-	2	2	-
Average	2.4	1.5	1	-	1	2	1	1	-	-	-	2.8	2.0	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MET06

MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Pre- Requisites :

Course Objectives:

- To illustrate the working principles of various metal casting and metal joining processes.
- To analyse the working principles of bulk deformation and sheet metal forming processes.
- To study the concepts and basic mechanics of metal cutting and the factors affecting machinability.
- To learn working of basic and advanced conventional machine tools.
- To study the basic concepts of CNC machine tools construction and its programming.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest level)**

- | | |
|--|-----------|
| CO1 Explain the principle of metal casting processes and metal joining processes including their defects and remedies. | K2 |
| CO2 Compare the bulk deformation and sheet metal processes based on working conditions and material behaviour. | K2 |
| CO3 Apply the mechanism of metal removal process to identify the factors involved in improving machinability. | K3 |
| CO4 Demonstrate the operations of conventional machine tools and surface finishing processes through suitable applications | K3 |
| CO5 Apply basic CNC programming concepts to generate part programs for simple turning and milling operations using G and M codes. | K3 |

Course Contents

Unit I METAL CASTING AND JOINING PROCESSES 9

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties - Moulding machines – Types and applications - Shell moulding – Investment casting - Pressure die casting – Centrifugal Casting – Defects in Sand casting process-remedies. Fusion welding processes – Arc welding– TIG and MIG Welding- Submerged arc welding – Electro slag welding– Spot welding Process -Laser beam Welding – Thermit Welding - Weld defects and remedies – Brazing - soldering – Adhesive bonding.

Unit II BULK DEFORMATION AND SHEET METAL PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Rolling of metals – Rolling Mill stands– shape rolling operations – Defects in rolled parts – Wire drawing – Hot and Cold extrusion. Sheet metal characteristics – Typical shearing, bending and drawing operations – Formability of sheet metal – Hydro forming – Rubber pad forming – Metal spinning – Explosive forming– Super plastic forming.

Unit III MECHANICS OF METAL CUTTING 9

Mechanics of chip formation - forces in machining - Types of chips - single point cutting tool nomenclature - orthogonal and oblique metal cutting - thermal aspects - cutting tool materials - tool wear - tool life - surface finish - cutting fluids and Machinability.



Unit IV MACHINE TOOL OPERATIONS AND FINISHING PROCESSES

9

Turning Machine operations - Drilling Machine operations - Shaper machine operations – Planar machine operations – Milling Machine operations- Gear cutting operations: Gear shaping and Gear hobbing - Grinding processes: cylindrical grinding, surface grinding, centreless grinding - Grinding wheel specifications – Honing- Lapping – Super Finishing- Polishing - Buffing.

Unit V CNC MACHINE TOOLS AND PROGRAMMING

9

Computer Numerical Control (CNC) machine tools, constructional details, special features – Drives, Recirculating ball screws, tool changers; CNC Control systems – Open/closed, point-to point/continuous - Turning and machining centres. Coordinates: Absolute vs Incremental, Interpolators, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers.

Total Hours 45

Text Books:

1. P. N. Rao Manufacturing Technology Volume 1 & 2, McGraw hill Education 5th edition,2018.
2. Kalpakjian.S,“ManufacturingEngineeringandTechnology”,PearsonEducationIndia Edition,2018.

Reference Books:

1. Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 3rd edition, 2013.
2. HajraChouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai. 2018
3. Sharma,P.C.,ATextbookofproductionTechnology,S.ChandandCo.Ltd.,2006
4. A.B.Chattopadhyay,MachiningandMachineTools,Wiley,2ndedition,2017.

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2. <https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-me05/>

Bloom’s Taxonomy Level

K1- Remember (Re), K2 – understand (Un), K3- Apply (Ap), K4- Analyse (An), K5- Evaluate (Ev), K6 – Create (Cr)

Mapping COs, POs & PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO3	3	-	-	-	3	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	2	-	-	1	-	-	-	3	-	-
CO5	3	-	-	-	3	-	-	1	-	-	1	3	2	-
Average	3	-	-	-	2	-	-	1	-	-	1.0	2.8	2.0	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCT09	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites : Digital System Design and Microprocessor

Course Objectives:

- To understand the architecture, memory structure, and instruction set of the 8051 microcontroller.
- To learn programming and communication techniques for the 8051 using assembly, C, and serial protocols.
- To explore peripheral interfacing methods with sensors, actuators, and displays using 8051 microcontroller.
- To study embedded system architecture and the internal structure and operation of the ARM7 processor.
- To introduce real-time operating systems and analyze embedded system applications through case studies.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the architecture, memory structure, instruction set, and addressing modes of the 8051 microcontroller.	K2
CO2	Describe the programming techniques for 8051 microcontroller using assembly and embedded C with serial communication protocols such as UART, I2C, SPI, CAN, Bluetooth, and Wi-Fi	K2
CO3	Interpret peripheral interfacing techniques involving memory, displays, sensors, actuators, and control using PWM and feedback systems.	K2
CO4	Apply embedded system design concepts using timers and ARM7 processor modes to develop simple control applications.	K3
CO5	Apply real-time operating system concepts to implement multitasking solutions in embedded applications like smart cards, vending machines, and automotive systems.	K3

Course Contents

Unit I INTRODUCTION TO MICROCONTROLLER **9**

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

Unit II PROGRAMMING AND COMMUNICATION **9**

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



Unit III PERIPHERAL INTERFACING

9

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

Unit IV FUNDAMENTALS OF EMBEDDED SYSTEMS AND ARM PROCESSOR

9

Embedded system Architecture - Design Process in Embedded system- Classification of Embedded system Timer and Counting devices - Watchdog Timer - Real Time Clock - Introduction ARM 7 Processor - Internal Architecture – Modes of Operations.

Unit V REAL TIME OPERATING SYSTEM AND CASE STUDIES

9

Introduction to basic concepts of RTOS – Tasks and Data – Threads – Multiprocessing and Multitasking, Case studies: washing machines-Cruise control- antilock braking systems-Automatic chocolate vending machine -smart card-ATM Machines.

Total Periods: 45

Text Books:

1. Muhammad Ali Mazidi, Rolin D. McKinlay and Janice GillispieMazidi, “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, Pearson Education, 2016.
2. Raj Kamal, “Embedded Systems: Architecture, Programming and Design” Tata McGraw-Hill , 2015.

Reference Books:

1. Santanu Chattopadhyay, “Embedded system Design” 2nd Edition, PHI Learning Private Limited, 2013.
2. Frank Vahid and Tony Givagis, “Embedded System Design”, Wiley, 2011.
3. James W. Stewart, “The 8051 Microcontroller Hardware, Software and Interfacing”,Regents Prentice Hall, 2013.
4. K C Wang, “Embedded and Real time Operating systems” Springer, 2017

Web URL(s):

1. <https://embeddedhash.in/embedded-systems-course-syllabus/>
2. <https://www.emertxe.com/embedded-systems/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	-	-	-	-	-	-	2	-	-
CO2	2	-	2	-	1	-	-	-	-	-	-	2	2	-
CO3	2	2	3	-	1	-	-	-	-	-	-	2	3	2
CO4	2	-	2	-	1	-	-	-	-	-	-	2	2	-
CO5	1	-	3	-	1	-	-	-	-	-	-	2	3	2
Average	1.8	2	2.5	-	1	-	-	-	-	-	-	2	2.5	2
3 –High; 2–Medium;1 –Low; - No Correlation														



U23MCT10	APPLIED MACHINE DESIGN	L	T	P	C
		3	0	0	3

Pre-Requisites : Engineering Mechanics, Mechanics of Solids

Course Objectives:

- To impart fundamental knowledge in design principles for mechanical components under various loading conditions.
- To develop skills to design shafts, joints, gears, couplings, and bearings using standard data and selection methods.
- To enable students to apply appropriate design procedures and data books for component selection in machine tool applications.

		BT Level (highest level)
Course Outcomes: Upon completion of the course, students would be able to		
C01	Compute stresses in curved beams, and under eccentric and fluctuating loading conditions using appropriate design principles.	K3
C02	Select suitable belt drives and bearings based on operational requirements using standard selection procedures.	K3
C03	Develop shafts and couplings considering strength, rigidity, and critical speed.	K3
C04	Determine suitable temporary and permanent joints under given load conditions using design concepts.	K3
C05	Construct gear trains and gearbox layouts using speed ratios and progression rules for machine tool applications.	K3

Course Contents

Unit I FUNDAMENTAL CONCEPTS IN DESIGN 10

Introduction to Design - factors influencing machine design, selection of materials based on mechanical properties-Factor of safety – stresses due to bending and torsion moment - calculation of principal stresses for various load combinations, eccentric loading – curved beams – crane hook and ‘C’ frame–Eccentric loading–Design against fluctuating loads– theories of failures.

Unit II DESIGN OF FLEXIBLE ELEMENTS AND BEARINGS 9

Introduction to flexible elements, Design of belt drives – Flat, Vee, and Timing Belts- Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Somerfield Number, Raimondi & Boyd graphs - Selection of Rolling Contact bearings.

Unit III DESIGN OF SHAFT AND COUPLING 9

Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys, keyways and splines - Rigid and flexible couplings.

Unit IV TEMPORARY AND PERMANENT JOINTS 8

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, riveted joints for structures - theory of bonded joints.

Unit V DESIGN OF GEARS AND GEAR BOXES 9

. Design of Gears (Spur, Helical and Bevel) - Geometric progression - Standard step ratio - Ray



diagram, kinematic layout - Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications.

Total Hours 45

Text Books:

1. Bhandari.V.B, “Design of Machine Elements”, 4th edition, McGraw-Hill Education India, 2023.
2. R.S. Khurmi and J.K. Gupta “Machine Design” Edition, S. Chand & Company, 2024.

Reference Books:

1. Joseph Edward Shigley, Charles R. Mischke, “Mechanical Engineering Design”,11th edition, McGraw Hill, 2020.
2. Robert L.Norton, “Machine Design – An Integrated Approach”, 6th edition, Pearson Education, 2020.
3. William C. Orthwein “Machine Component Design”, 3rd Edition, Cengage Learning, 2021.
4. PSG Design Data Handbook – Data Book of Engineers”, Kalaikathir Achchagam, PSGCoimbatore, 2023.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/112/105/112105125/>
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Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-	2	-	2
CO3	3	2	3	-	2	-	-	-	-	-	-	3	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	2	-	2
CO5	3	2	3	-	2	-	-	-	-	-	-	3	2	-
Average	3	2	2.4	-	2	-	-	-	-	-	-	2.6	2	2
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCP05 MANUFACTURING TECHNOLOGY LABORATORY

L	T	P	C
0	0	4	2

Pre-Requisites : None

Course Objectives:

- To familiarize students with various metal cutting and shaping operations using conventional machine tools.
- To provide hands-on experience in manufacturing techniques such as turning, drilling, milling, grinding, welding and gear cutting.
- To develop skills in handling tools and machines safely and efficiently.
- To enable students to fabricate simple components based on engineering drawings.
- To promote understanding of the importance of tolerance, surface finish and process planning in manufacturing.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|--|-----------|
| CO1 | Demonstrate turning, knurling, and threading operations on lathe machines and operate CNC turning centre to perform basic machining tasks. | K3 |
| CO2 | Illustrate appropriate manufacturing processes such as welding, milling, or grinding to fabricate and finish components as per given specifications. | K3 |
| CO3 | Use gear cutting and shaping machines to produce components with fundamental geometric features. | K3 |

LIST OF EXPERIMENTS:

1. Fabricating simple structural shapes using Gas / Metal Arc Welding machine.
2. Preparing green sand moulds with wooden patterns.
3. Plain, Taper and Step Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Dove Tail machining on square parts using shaper machine.
6. Drilling and Reaming using vertical drilling machine.
7. Milling contours on plates using vertical milling machine.
8. Cutting spur gear using milling machine.
9. Generating gears using gear hobbing machine.
10. Grinding components using surface, cylindrical and centreless grinding machines.
11. Machining of a component using CNC Turning Centre.
12. Virtual Experiment1: Study and observation of various stages of casting through demonstration of sand casting process

<https://mp-dei.vlabs.ac.in/exp/study-observe-stages-casting-sand-casting-process/>

13. Virtual Experiment2: Designing and manufacturing a wooden pattern for a given casting

<https://mp-dei.vlabs.ac.in/exp/design-manufacture-wooden-pattern-given-casting/>

Total Periods: 60

References:

1. Lab Manual



Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	3	2	3	-	-	-	-	-	-	3	2	-
CO2	3	-	2	-	2	-	-	-	-	-	-	3	-	-
CO3	3	-	2	-	2	-	-	-	-	-	-	3	-	-
Average	3.0	-	2.3	2.0	2.3	-	-	-	-	-	-	3.0	2.0	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCP06

EMBEDDED SYSTEMS LABORATORY

L	T	P	C
0	0	2	1

Pre-Requisites : Basics of Microprocessor

Course Objectives:

- To develop skills in assembly language programming and simulation using the 8051 microcontroller.
- To apply Arduino IDE for interfacing and controlling basic electronic components such as LEDs, buzzers, displays, sensors, and actuators.
- To design and implement real-time embedded applications involving sensor data acquisition and peripheral control.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | |
|---|-----------|
| CO1 Apply assembly programming techniques to execute arithmetic and logical operations on the 8051 microcontroller. | K3 |
| CO2 Experiment with embedded C code in Arduino IDE to show the functional interfacing of LEDs, buzzers, switches, and display modules in embedded systems. | K3 |
| CO3 Demonstrate data acquisition and control by interfacing Arduino with temperature, moisture, PIR, and pulse sensors in embedded applications. | K3 |

List of Experiments:

1. Develop and simulate basic assembly language programs for the 8051 microcontroller using an appropriate simulator.
2. Implement programs in Arduino IDE to blink LEDs and demonstrate LED fading using delay functions.
3. Develop and execute programs to control a buzzer using a switch interface on the Arduino platform.
4. Interface a 16x2 LCD with Arduino and display a predefined word through programming in Arduino IDE.
5. Interface and program a 7-segment display with Arduino to display numerical values.
6. Interface a relay and a servo motor with Arduino and execute control operations through programmed instructions.
7. Interface temperature and soil moisture sensors with Arduino and display sensor readings.
8. Interface a Passive Infrared (PIR) motion sensor with Arduino and execute motion detection functionality.
9. Interface a pulse sensor with Arduino to measure heart rate and display the results.
10. Programming for I/O Interfacing (LED and Switch Interfacing)
Virtual Lab experiment: <https://esd-coep.vlabs.ac.in/exp/io-interfacing-led-switch/>
11. Control an LED brightness by generating a PWM signal on PIC18 series microcontroller
Virtual Lab experiment: <https://esd-coep.vlabs.ac.in/exp/pwm-generation/>

Total Periods: 30

References:

1. Lab Manual

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	2	-	2	-	-	-	-	-	-	2	-	-
CO2	3	-	3	-	2	-	-	-	-	-	-	2	2	-
CO3	3	-	2	-	2	-	-	-	-	-	-	2	3	1
Average	3.0	-	2.3	-	2.0	-	-	-	-	-	-	2.0	2.5	1
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCO01	INTERNSHIP/IN-PLANT TRAINING	L	T	P	C
		0	0	2	1

Pre-Requisites :

Course Objectives:

- To offer practical exposure through internships in industries related to automation, robotics, and system integration.
- To familiarize students with real-time industrial practices in design, manufacturing, control systems, and embedded technologies.
- To bridge theoretical knowledge with practical applications in solving interdisciplinary engineering problems.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|--|-----------|
| CO1 | Describe theoretical mechatronics concepts in the context of their application in real-world industry practices. | K2 |
| CO2 | Solve practical engineering problems using appropriate mechatronics tools and methodologies. | K3 |
| CO3 | Demonstrate technical and professional competence by performing hands-on tasks in industries, service centers, or project sites. | K3 |

Guidelines for Internship / In-plant Training:

- Students must undergo a minimum of four weeks of practical training in an industry, project site, service center, R&D unit, or design/planning office relevant to Mechatronics Engineering, with prior approval from the Head of the Department (HoD).
- Upon completion, students must submit a comprehensive internship report adhering to the format prescribed by the department.
- Students are required to deliver a presentation summarizing their internship experience before a departmental evaluation committee constituted by the HoD.

Evaluation will be based on:

- Quality, accuracy, and completeness of the Internship Report
- Clarity, coherence, and professionalism in the Presentation
- Depth of understanding in industrial processes, interdisciplinary roles, and application of mechatronics concepts

- This course is conducted in Internal Mode only.
- Successful completion of the internship is mandatory for the award of the degree. Grades and marks will be assigned in accordance with institutional academic regulations.

Assessment Pattern:

Internship Report: 50%

Presentation and Viva Voce: 50%

Total Periods: 30

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	-	-	-	-	2	-	1	2	-	1
CO2	-	3	2	-	2	-	-	-	-	-	-	2	2	2
CO3	-	-	2	-	2	-	2	2	2	-	-	1	1	2
Average	2.0	2.5	2.0	-	2.0	-	2.0	2.0	2.0	-	1.0	1.7	1.0	1.7
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23EGS01	ENGLISH EXPERTISE AND CAREER MOXIE (Common to ALL branches)	L	T	P	C
		0	0	2	1

Pre-Requisites : None

Course Objectives:

- To enable learners to develop their Professional communicative competence
- To enhance the practical understanding of the placement activity with employability skills
- To facilitate learners' soft skills

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Develop speaking skills with clarity and confidence which in turn argument employability skills	K2
CO2	Plan and use of the language appropriately for public speaking, presentation and interviews	K4
CO3	Make use of the learners' cognitive skills in listening and speaking	K2
CO4	Construct sentences with clarity in simple, apt and flawless language with coherence and cohesion	K1
CO5	Utilize reading and listening skills to understand and respond to others in different situations	K4
CO6	Select appropriate language skills/Tools to communicate effectively for personal and professional growth	K3

Course Contents:

1. Listening: Listen to latest corporate meetings
2. Speaking: Excerpts from formal corporate meetings
eg. i. Project status or update meeting,
ii. Innovation meeting
iii. Governance cadence etc
3. Interview Skills
4. Biography of Founder / CEO's
5. Work in pair or groups on Managing Time and Accepting Responsibility
Eg. Undertake small projects
6. Organize and maintain a Portfolio of one's work
7. Create Term Planners and schedules noting Key dates / events
8. Address questions on specific company from the audience
9. Oral presentations using latest audio-visual aids observing time restrictions
10. Travel essential and preparation for domestic / International Business
11. Creative Thinking: Preparing Digital Brochures, Agenda and minutes of meeting
12. Listening and completing technical conversation
13. Filling up Self-assessment Forms – SWOT Analysis
14. History of reputed companies
15. Hands on training in latest AI Tools

Total Periods: 30

Reference Books:

1. On Writing Well, William Zinsser, Harper Resource Book, 2001
2. Study Writing, Liz Hamp-Lyons and Ben Heasley, Cambridge University Press, 2006
3. Communication Skills, Sanjay kumar and pushpalata, Oxford University Press. 2011

Web URL(s):

1. Best Academic Course Programs in Business English 2023 (academiccourses.com)
2. Cambridge English
3. TED Talks
4. Company Websites
5. AI Apps
6. YouTube - Documentaries

Bloom's Taxonomy Level

K1- Remember (Re), K2 – understand (Un), K3- Apply (Ap), K4- Analyse (An),
K5- Evaluate (Ev), K6 – Create (Cr)

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	-	-	2	2	2	-	-	-	-
CO2	-	-	-	-	-	-	-	2	2	2	-	-	-	-
CO3	-	-	-	-	-	-	-	2	2	-	-	-	-	-
CO4	-	-	-	-	-	-	-	2	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	2	2	-	-	-	-	-
CO6	-	-	-	-	-	-	-	2	2	2	2	-	-	-
Average	-	-	-	-	-	-	-	2	2	2	2	-	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

Semester VI

U23MCT11	COMPUTER AIDED DESIGN WITH INTEGRATED MANUFACTURING SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites : Manufacturing Technology

Course Objectives:

- To introduce the fundamentals of computer-aided design and manufacturing systems.
- To develop understanding of geometric modeling, graphics standards, and part representation.
- To introduce computer-aided process planning (CAPP) and group technology (GT) as tools for process optimization and design standardization.
- To introduce flexible manufacturing, robotics and automation systems used in integrated production environments.
- To explore modern developments in digital manufacturing, including PLM, Digital Twin, additive manufacturing, and CAD/CAM data integration.

Course Outcomes:	BT Level (highest level)
Upon completion of the course, students would be able to	
CO1 Discuss the role and benefits of CAD/CAM / CIM in product development and manufacturing systems.	K2
CO2 Describe the principles of geometric modeling, transformations, and part representation.	K2
CO3 Demonstrate the use of computer-aided process planning and group technology to enhance manufacturing efficiency.	K3
CO4 Interpret the principles of geometric modeling, transformations, and part representation.	K2
CO5 Differentiate the components of flexible and automated manufacturing systems and explain their integration.	K3

Course Contents

Unit I INTRODUCTION TO CAD/CAM/CIM SYSTEMS 7

Definition and scope of CAD, CAM and CIM-Advantages and limitations of CAD/CAM/CIM systems-Product cycle and role of CAD/CAM/CIM in design, manufacturing and management -Introduction to computer hardware for CAD/CAM/CIM-Basic structure of a CAD/CAM/CIM system-Overview of digital manufacturing and Industry 4.0 relevance

Unit II GEOMETRIC MODELING AND TRANSFORMATIONS 10

Types of geometric modeling: Wireframe, Surface, and Solid modeling-Representation of points, lines, circles, and conics-B-splines and Bezier curves (basic overview)-2D transformations: translation, rotation, scaling-3D transformations and homogeneous coordinates-Modeling standards: IGES, STEP, DXF

Unit III COMPUTER AIDED PROCESS PLANNING AND GROUP TECHNOLOGY 10

Introduction to Process Planning: manual vs computer-aided-Computer Aided Process Planning (CAPP): Retrieval type and Generative type-Steps in developing CAPP systems-Benefits and limitations of CAPP-Group Technology (GT): concept, advantages and disadvantages-Part family formation and classification-Coding systems: OPITZ, MICLASS (overview only)-GT applications in cellular

manufacturing.

Unit IV FLEXIBLE MANUFACTURING AND AUTOMATION SYSTEMS

9

Flexible Manufacturing System (FMS): Definition, components, layout types, benefits, and limitations- Robotics in Manufacturing:Types of robots used in manufacturing-End-effectors, sensors-Applications in material handling, assembly, and welding-Automated Storage and Retrieval Systems (AS/RS): Types of AS/RS-Integration of Manufacturing Systems:Interfacing CAD, CAM, FMS, and ERP

Unit V DIGITAL MANUFACTURING AND CAD/CAM INTEGRATION

9

CAD/CAM Integration:Flow of design to manufacturing -post-processors and interfacing with CNC machines-Product Lifecycle Management (PLM): Concepts, stages, and benefits-PLM software tools overview-Digital Twin in Manufacturing:Concept, architecture, and applications-Role in predictive maintenance -Additive Manufacturing (3D Printing): Basics of 3D printing processes (FDM, SLA, SLS)- Applications and integration with CAD

Total Hours 45

TEXT BOOKS:

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Pearson, 5th Edition, 2023
2. Ibrahim Zeid, "Mastering CAD CAM, Tata McGraw-Hill, New Delhi, 2009

REFERENCES:

1. Mikell P. Groover and Emory W. Zimmers Jr, "CAD/CAM: Computer-Aided Design and Manufacturing" , Pearson Education, 2nd Edition Reprint 2023
2. John Stark, "Product Lifecycle Management (Volume 1): 21st Century Paradigm for Product Realisation" , Springer, 4th Edition 2023

Web URL(s):

1. https://onlinecourses.swayam2.ac.in/nou25_me04/preview
2. https://onlinecourses.nptel.ac.in/noc25_me11/preview

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	2	-	3	-	-	-	-	-	-	3	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-	2	-	-
CO3	2	-	3	-	2	-	-	-	-	-	-	3	-	-
CO4	3	-	2	-	2	-	-	-	-	-	-	2	-	-
CO5	3	-	2	-	3	-	-	-	-	-	-	2	-	-
Average	2.8	-	2.2	-	2.4	-	-	-	-	-	-	2.4	-	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCT12	FLUID POWER SYSTEMS AND PLC	L	T	P	C
		3	0	0	3

Pre-Requisites : Fluid Mechanics and Machinery

Course Objectives:

- To understand the fundamental principles and components of fluid power systems.
- To develop skills in designing hydraulic and pneumatic circuits for industrial applications.
- To understand the architecture, operation, and components of PLCs.
- To develop ladder logic programming skills for industrial applications.
- To apply PLCs in automation and control systems.

Course Outcomes:		BT Level (highest level)
Upon completion of the course, students would be able to		
C01	Summarizethe working principles ofcompressors, valves, pumps, cylinders, and actuators in hydraulic and pneumatic system.	K2
C02	Apply the principles of fluid power to construct hydraulic and pneumatic circuits including sequential, synchronizing, and accumulator-based systems for industrial applications.	K3
C03	Describe the architecture and functional blocks of programmable logic controllers including input/output modules, CPU, and interfacing methods.	K2
C04	Apply ladder logic programming using relay logic, timer, counter, math, and program control instructions to implement industrial automation tasks.	K3
C05	Demonstrate the application of PLCs in industrial systems such as motor control, elevator automation, traffic control, and material handling processes.	K3

Course Contents

Unit I	HYDRAULIC AND PNEUMATIC ESSENTIALS	9
Fluid power symbols - Properties of air and Hydraulic oil - Compressors: Piston, Screw and Vane compressor. Fluid Conditioners: Air filters, Air pressure regulators, Air lubricators, Pneumatic silencers, Air dryers- Construction and working principle of Gear, Vane and Piston pumps - Cylinders: Construction & Working principle - Single acting, Double acting, Tandem, Double rod and Telescopic cylinder, Cushioning mechanism, Hydraulic motors: Gear, Vane and Piston motors - Directional control valves- Shuttle valve - check valve - Pressure control valves, Flow control valve.		
Unit II	DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS	9
Basic circuits - Meter-in and Meter-out, Sequential circuit - synchronizing circuit - regenerative and fail safe circuits. Design of hydraulic circuits for drilling, planning, shaping and surface grinding- Design of pneumatic circuit for a pick and place application - Accumulators and Intensifier: Application circuits - Cascade method.		
Unit III	PLC FUNDAMENTALS	9
Principles of operation – PLC Architecture and specifications – PLC hardware components Analog& digital I/O modules , CPU & memory module – Programming devices, Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet, Discrete Input Devices: Pushbuttons –Proximity Sensors - Float Switch-Temperature switch – Pressure switch, Discrete Output Devices: Discrete: Relays – Contactors – DOL Starter – Solenoid valves.		
Unit IV	PLC PROGRAMMING	9

Ladder Logic Programming: - Relay Logic Instructions, Timer, Counter, Math and Program Control instructions – Examples.

Unit V APPLICATIONS OF PLC

9

Materials handling applications, Automatic control of warehouse door, Automatic lubrication of Conveyor belt, motor control, Automatic car washing machine, Bottle label detection, Elevators, Pneumatic stamping system, Traffic light control

Total Hours 45

Text Books:

1. Anthony Esposito, Fluid power with applications, Pearson Education, New Delhi, 7th Edition 2024.
2. Frank D Petruzella, Programmable logic controllers, Fourth edition, McGraw Hill higher education , 5th Edition 2019.
3. W.Bolton- Programmable Logic Controllers, Newnes, 6th Edition, 2015.

Reference Books:

1. Majumdar S.R., Oil hydraulics system- principles and maintenance, Tata McGraw Hill, 2021.
2. Srinivasan R, Hydraulic and pneumatic controls, Vijay Nicole imprints, 3rd Edition (2019)
3. Garry A. Dunning-Introduction to Programmable Logic Controllers, Thomson/Delmar Learning Publications, 3rd Edition, 2005.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/112/106/112106300/>
2. <https://nptel.ac.in/courses/108105063>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	2	-	-	-	-	-	-	2	2	-
CO2	2	1	2	-	2	-	-	-	-	-	-	2	2	1
CO3	2	-	-	-	-	-	-	-	-	-	-	2	2	-
CO4	2	-	2	-	2	-	-	-	-	-	-	2	3	-
CO5	2	-	-	-	2	-	-	-	-	-	-	1	3	2
Average	2	1	2	-	2	-	-	-	-	-	-	1.8	2.5	1.5
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCT13	THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	0	0	3

Pre-Requisites : Basics of Engineering Physics

Course Objectives:

- To introduce the fundamental concepts of thermodynamics, including system, boundary, state, process, heat and work transfer.
 - To explain the first and second laws of thermodynamics and their applications to closed and open systems.
 - To impart knowledge on air-standard thermodynamic cycles and the working principles of various types of compressors.
 - To familiarize students with the principles and components of refrigeration and air-conditioning systems.
- To develop the ability to apply basic heat transfer concepts to solve conduction problems in various geometries.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply the first law of thermodynamics to work and heat transfer in open and closed systems.	K3
CO2	Apply the second law of thermodynamics to thermal devices like engines and pumps.	K3
CO3	Apply thermodynamic cycles to evaluate efficiency and performance of air-standard cycles and compressors.	K3
CO4	Illustrate the working principles of refrigeration systems and interpret the properties of refrigerants.	K2
CO5	Apply heat transfer equations to solve conduction problems in various geometries.	K3

Course Contents

Unit I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Thermodynamic systems - Boundary - Control volume - Properties - State-process- Work and heat transfer - Point and path functions - First law of thermodynamics for open and closed systems- Engineering Applications of Steady flow energy equation Heat and work transfer in flow and non-flow processes.

Unit II SECOND LAW OF THERMODYNAMICS 9

Second Law of thermodynamics – statements – equivalents of Kelvin Plank and Clausius statements – Heat engines - Refrigerators and heat pumps - Carnot cycle - Carnot theorem.

Unit III AIR STANDARD CYCLES AND COMPRESSORS 9

Otto, Diesel, Dual combustion and Brayton cycles; Calculation of Airstandard efficiency (simple problems). Mean effective pressure (Definition only). Compressors, Classifications of compressors, Reciprocating compressor- Rotary, Axial and Vane compressors (descriptive).

Unit IV REFRIGERATION AND AIR-CONDITIONING 9

Construction and working principles of refrigeration, Vapour compression system – Vapourabsorption

types, comparison – Definition of Co-efficient of performance (COP), Properties of refrigerants – Psychrometry processes (Definition only).

Unit V INTRODUCTION TO HEAT TRANSFER

9

Modes of heat transfer, Heat conduction in parallel, radial and composite wall – Heat conduction through hollow and composite cylinders, spheres (simple problems). Basics of Convective heat transfer and Fundamentals of Radiative heat transfer (descriptive only)

Total Hours

45

Text Books:

1. Nag, P. K., “Engineering thermodynamics”, 6th edition, McGraw-Hill Education, 2020.
2. Rajput, R. K.,” Textbook of Heat and Mass Transfer” 7th edition,S. Chand Publishing, 2019.

Reference Books:

1. Moran& Shapiro,” Fundamentals of Engineering Thermodynamics”, 9th edition, Wiley, 2020.
2. Yunus, A. Cengel,Afshin, J. Ghajar.,” Heat and mass transfer: Fundamentals and applications” 6th edition, McGraw-Hill Education, 2022.
3. Kothandaraman, C. P.,Subramanyan, S., “Heat and mass transfer data book”, 10th edition, New Age International, 2022.

Web URL(s):

1. https://swayam.gov.in/nd1_noc20_me20/preview
2. https://swayam.gov.in/nd1_noc20_me42/preview
3. https://swayam.gov.in/nd1_noc20_me19/preview

Bloom’s Taxonomy Level

K1- Remember (Re), K2 – understand (Un), K3- Apply (Ap), K4- Analyse (An),
K5- Evaluate (Ev), K6 – Create (Cr)

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	2	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	2	2	-	2	-	-	-	-	-	-	2	-	-
Average	2.8	2.0	2.0	-	2.0	-	-	-	-	-	-	2.0	2.0	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCT14 INTERNET OF THINGS

Pre-Requisites : Basics Programming Skills

Course Objectives:

- To learn the fundamentals of Internet of Things.
- To understand IoT Reference Architecture.
- To learn about the basics of IoT protocols.
- To understand the basics of python with IoT.
- To build a small low cost IoT system and to apply the concept of Internet of Things in the real world scenario.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the architecture, components, communication models, and application domains of Internet of Things systems.	K2
CO2	Differentiate between M2M and IoT communication and summarize the role of system management protocols.	K2
CO3	Interpret the IoT development methodology including requirement analysis, modeling, and service specification.	K2
CO4	Describe the use of Python programming constructs and remote access methods for IoT system design.	K2
CO5	Discuss the implementation of an IoT-based case study using Raspberry Pi and relevant Python libraries for data acquisition and device integration.	K2

Course Contents

Unit I INTRODUCTIONANDAPPLICATIONS 9

Introduction to IoT–Definition, Characteristics, functional requirements, motivation, Physical design-things in IoT, IoT protocols, Logical Design functional blocks, communication models, Communication APIs, Applications–Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry.

Unit II M2M AND SYSTEM MANAGEMENT 9

Introduction–M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management–need, SNMP, NETCONF, YANG.

Unit III DEVELOPING INTERNET OF THINGS 9

IoT Methodology–Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.

Unit IV USAGE OF PYTHON 9

IoT systems logical design using python–python data types & data structures, control flow, functions or modules, remote access enablement using cloud.

Unit V CASE STUDY ON IoT SYSTEM 9

Case study for weather monitoring system–modules & package of python, python packages of interest for IoT–JSON, XML, HTTP & URLLib, SMTPLib -Exemplary device–Raspberry pi, Linux on Raspberry pi.



Text Books:

1. ArshdeepBahga and Vijay Madiseti, Internet of Things A Hand-on Approach, Universities press, 2015.
2. Dr.OvidiuVermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.
3. HonboZhou, "The Internet of Things in the Cloud: A Middleware Perspective" - CRC Press 2012.

Reference Books:

1. Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011
2. Pethuru Raj and AnupamaC.Raman, "The Internet of Things: Enabling Technologies and Use Cases, CRC Press.1st Edition, 2017.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc19_cs65
2. The Internet of Things in the Cloud | A Middleware Perspective | Honbo (taylorfrancis.com)

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	-	3
CO5	3	1	-	-	2	-	-	-	-	-	-	-	-	3
Average	2.6	1.0	-	-	2.0	-	-	-	-	-	-	-	3.0	3.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCP07	COMPUTER AIDED DESIGN AND MANUFACTURING LABORATORY	L	T	P	C
		0	0	4	2

Pre-Requisites : Engineering Graphics & Computer Aided Machine Drawing.

Course Objectives:

- To equip students with hands-on experience in solid modeling, assembly design, and drafting using advanced CAD tools and techniques.
- To develop the ability to simulate real-world mechanical mechanisms and analyze their motion using integrated CAD/CAM software tools.
- To enable students to understand and practice manual CNC part programming and toolpath simulation for both turning and machining operations.

Course Outcomes:	BT Level (highest level)
Upon completion of the course, students would be able to	
CO1 Model part geometries, modify features, and assemble 3D components using 3D modeling software.	K3
CO2 Illustrate standard machine elements and generate detailed drafting models with accurate dimensions and annotations using 3D CAD tools.	K3
CO3 Demonstrate the creation of manual CNC part programs and simulate tool paths for turning, drilling, milling, and threading operations.	K3

Course Contents

Unit I Basic Solid Modeling 9

Introduction & sketcher tools: CAD Tools and Applications: CAD - CAM – CAE Parametric Feature Based Modeling and Parent-Child Relation - Modeling Software - Getting Started & Graphical User Interface - Sketch Entities and Tools - Dimensioning and Adding Relations to define the Sketch. Sketched Features (Boss / Base and Cut) Base Features: Extrude & Revolve - Reference Geometry, Curves & 3D Sketch - Sweep & Loft.

Unit II Advance Features Applied Features 9

Patterns & Mirror - Fillet/Round & Chamfer - Hole & Hole Wizard - Draft, Shell, Rib and Scale - Dome, Flex and Wrap - Indent Tool - Combine Bodies - Boolean Operations - Split, Move/Copy and Delete Bodies - Other Tools & Options - Design Table and Configurations - Adding Equations and Link Values - Tools - Measure and Mass Properties - Appearance - Edit Material, Colour and Texture - Options - System and Document Properties.

Unit III Assembly & Mechanisms Bottom Up Assembly Approach 9

Inserting Components/Sub-Assemblies - Adding Mates - Standard & Advance - Editing Mates, Part and Replacing Components.
Top down Approach & Mechanisms: Inserting New Part to Existing Assembly - Use of Layout Sketching - External References - In-context and Out-of-context, Locked and Broken Assembly Features - Component Patterns & Mirrors - Cuts & Holes - Belt/Chain and Weld Bead. Representations of Assembly Components: Light Weight, Suppressed and Resolved - Hide, Transparency and Isolate - Exploded View - Assembly Check - Interference Detection - Collision Detection and Physical Dynamics Motion Study - Assembly Motion & Physical Simulation - Animation Wizard & Save as AVI file - Mechanism Analysis - Plot Displacement, Velocity and Acceleration Diagram.



Unit IV Detailed Drafting

9

General Procedure for Drafting & Detailing - Inserting Drawing Views, Dimensioning and Adding Annotations - Drawing Templates & Sheet Format - Setting Options - Drawing Views: Model View & Standard 3 View - Projected View & Auxiliary View - Section & Aligned Section View - Detail View, Broken-out Section and Crop View – Dimensioning - Standards, Rules and Guidelines - Dimension Insertion/Creation - Insert Model Items & Dimension tool Annotations - Notes & Holes Callout - Datum & Geometric Tolerances - Surface Finish & Weld Symbols, Centre Mark & Centre line, Bill of Material.

Unit V Manual Part Programming and Simulation

9

CNC Machining Centre: Linear Cutting - Circular cutting - Cutter Radius Compensation - Canned Cycle Operations - CNC Turning Centre: Straight, Taper and Radial Turning - Thread Cutting - Rough and Finish Turning Cycle - Drilling and Tapping Cycle.

List of Experiments

1. Part modelling
2. Feature manipulation
3. Creation of 3D assembly and drafting model of following machine elements using 3D Modeling software:
Flange Coupling - Plummer Block - Screw Jack - Lathe Tailstock - Universal Joint - Stuffing box - Safety Valves - Non-return valves - Connecting rod with Piston.
4. Manual Part programming and tool path simulation of : Step Turning, Taper turning, Circular arc cutting, Drilling, Boring, Grooving, Thread Cutting, Square slot milling, Taper Slot milling and circular arc milling.

Total Periods: 60

Reference Books:

1. CIET-CAD/CAM Lab Manual

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	–	3	–	3	–	–	–	–	–	–	3	2	–
CO2	2	–	2	–	3	–	–	–	–	–	–	2	2	–
CO3	2	–	3	–	3	–	–	–	–	–	–	3	2	–
Average	2.0	–	2.7	–	3.0	–	–	–	–	–	–	2.7	2.0	–
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCP08 FLUID POWER SYSTEMS AND PLC LABORATORY

L	T	P	C
0	0	2	1

Pre-Requisites :

Course Objectives:

- To understand and design hydraulic and pneumatic circuits for pressure, flow, and direction control.
- To develop and implement pneumatic circuits with logic controls, timers, and multi-cylinder sequences.
- To apply PLC programming techniques for industrial applications, including relay testing, traffic control, and motor speed control.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Demonstrate the use of single and double-acting cylinders to test hydraulic and pneumatic circuits for various industrial automation tasks.	K3
CO2	Illustrate the operation of electro-pneumatic systems by modeling control circuits that integrate solenoid valves, sensors, and limit switches.	K3
CO3	Apply PLC programming techniques to implement automation solutions for traffic control, motor speed regulation, and logical operations using timers, counters, and arithmetic instructions.	K3

List of Experiments:

1. Operation of single acting and double a cylinder with speed control.
2. Automatic operation of double acting cylinder in multicycle using limit switches.
3. Electro pneumatic operation of single and double acting cylinder using single and double solenoid valve.
4. Design and simulation of hydraulic operation of single acting and double acting cylinder using simulation software.
5. Development of an application by using PLC timer and counter instructions
6. Testing of Relays using PLC
7. Traffic Light Control System
8. PID based DC motor speed control

9. Implementation Of PLC Arithmetic Instructions
Virtual Lab Experiment: <https://plc-coep.vlabs.ac.in/exp/plc-arithmetic-instructions/>
10. Implementation Of DOL Starter
Virtual Lab Experiment: <https://plc-coep.vlabs.ac.in/exp/dol-starter/>

Total Periods: 30



Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	2	1	1	-	-	-	-	-	1	1	1	1
CO2	2	1	2	-	1	-	-	-	-	-	1	1	1	1
CO3	2	2	2	-	1	-	-	-	-	-	2	1	1	2
Average	2.0	1.7	2.0	1.0	1.0	-	-	-	-	-	1.3	1.0	1.0	1.3
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCO02	REAL-TIME EMBEDDED SYSTEMS	L	T	P	C
		0	0	2	1

Pre-Requisites : Basic knowledge on microcontroller programming

Course Objectives:

- To gain practical experience in working with the ESP32 microcontroller.
- To develop programming skills using Embedded C and MicroPython.
- To learn how to integrate various sensors, actuators, and communication modules.
- To apply knowledge through project-based learning for addressing real-world challenges.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply knowledge of ESP32 architecture to configure GPIOs and peripherals for embedded tasks	K3
CO2	Examine the sensor and actuator interfacing techniques using ESP32 for real-time applications	K3
CO3	Apply embedded programming skills to build task-oriented applications using timers, interrupts, and RTOS	K3

Course Contents:

Module 1 ESP32 Basics and Development Setup 10

- Introduction to ESP32 architecture and features
- Setting up Arduino IDE and/or Platform IO
- GPIO programming: LED, Push button
- Analog and digital I/O
- Timers and interrupts
- Practical: Blinking LED, Button counter

Module 2 Sensor and Actuator Interface 10

- Interfacing sensors: Temperature, IR, Ultrasonic, LDR
- Interfacing actuators: Relay, Motor (DC/Servo/Stepper)
- PWM generation and motor speed control
- ADC, DAC usage in ESP32
- Practical: Sensor-based automation

Module 3 Communication and IoT Applications 10

- Wi-Fi & BLE basics in ESP32
- Connecting to cloud via MQTT
- Data logging to Google Sheets or Thing Speak
- Creating a simple web server on ESP32
- Intro to FreeRTOS and task handling
- Practical: Smart home project or sensor dashboard

Total Periods: 30

Assessment & Evaluation:

1. Students will perform and demonstrate module-specific embedded programming and interfacing tasks using the ESP32 platform.
2. Students will develop and showcase a real-time embedded application integrating ESP32 peripherals, sensors, actuators, and communication features.
3. Individual technical assessment will be conducted after each module to evaluate understanding of core concepts such as GPIOs, interrupts, RTOS, and communication protocols.

Bloom's Taxonomy Level

K1- Remember (Re), K2 – understand (Un), K3- Apply (Ap), K4- Analyse (An),
K5- Evaluate (Ev), K6 – Create (Cr)

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	2	-	2	-	-	-	-	-	-	2	1	1
CO2	1	1	2	-	1	-	-	-	-	-	-	1	1	2
CO3	2	2	1	-	1	-	-	-	-	-	1	2	2	1
Average	1.6	1.6	1.6	-	1.3	-	-	-	-	-	1.0	1.6	1.3	1.3
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCJ01	INNOVATION PROJECT	L	T	P	C
		0	0	4	2

Pre-Requisites :

Course Objectives:

- To develop the ability to apply engineering concepts in the design and fabrication of working models, providing hands-on experience in real-world engineering practices.
- To enhance students' skills in effectively demonstrating and communicating their innovative solutions through technical presentations and reports.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| CO1 | Demonstrate a working model, product, or process by applying multidisciplinary engineering knowledge through design and fabrication. | K3 |
| CO2 | Create a novel working model by developing assembly drawings, part drawings, and process charts, and presenting outcomes effectively. | K6 |

Guidelines for Conduct of the Course:

- Students must form convenient groups, with no more than four members in each group.
- Each group shall select a new product, process, process add-on, or working model for design and fabrication.
- Every project will be supervised by a faculty guide from the department. If necessary, an industry expert may act as a co-guide.
- The project title must clearly indicate that the work involves design and fabrication.
- A minimum of three review meetings shall be organized for internal assessment, coordinated by a Project Coordinator appointed by the Head of the Department.
- Students must design, fabricate, and demonstrate the working model within the college premises, and submit a detailed project report.
- The project report must include:
 - Assembly drawings
 - Part drawings
 - Process charts related to fabrication
- At the end of the semester, the project will be evaluated based on:
 - Oral presentation
 - Quality and content of the project report
 - Demonstration of the working model
- The evaluation will be conducted jointly by internal and external examiners appointed by the Head of the Department.

Total Periods: 60

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	2	1	-	-	-	2	1	1	1	2	2	1
CO2	2	1	2	-	-	-	-	2	1	1	1	1	2	2
Average	2.0	1.0	2.0	1.0	-	-	-	2.0	1.0	1.0	1.0	1.5	2.0	1.5
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCO03 INDUSTRIAL AUTOMATION CONTROLLERS	L	T	P	C
	0	0	4	2

Pre-Requisites : Basic knowledge on PLC

Course Objectives:

- To understand and implement PLC programming for industrial control applications.
- To apply timers, counters, and logical operations in PLC-based automation tasks.
- To develop and configure HMI and SCADA systems for real-time monitoring and control.
- To gain hands-on experience through simulation, demonstration, and industrial project exercises.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest level)**

CO1	Apply fundamental principles of industrial automation to simulate and control simple process automation tasks using PLCs.	K3
CO2	Demonstrate the use of PLC programming for controlling industrial devices such as motors, actuators, and sensors in practical scenarios.	K3
CO3	Solve the basic HMI and SCADA configurations for monitoring and managing industrial automation systems.	K3

Course Contents:

Module I PLC Programming

20

PLC Programming Steps Practice,

- Simple Programming exercises on Logic gates
- PLC Programming - Conveyor control, Forward & Reverse control of Motors,
- Tank Level control
- Practical's - Industrial Applications
- PLC programming and Testing using Motors,
- Pneumatic and Hydraulic actuators

Module II PLC Timers & Counters

20

- PLC Timers & Counters - Introduction, Types, Applications & Programming examples
- PLC Programming to control Induction Motors, Solenoids & Electro Pneumatic/ Hydraulics systems
- Industrial examples for PLC programming and execution

Module III HMI SCADA

20

- HMI & SCADA – Introduction, Basic steps overview
- HMI & SCADA– Establishing connection with PLC
- SCADA – Introduction, Comparison with PLC & SCADA
- Steps to create SCADA application
- Getting started with Elementary graphical displays
- Editing of graphical elementary displays for various applications
- Tag data building and expressions
- Demonstration of SCADA application
- HMI & SCADA – Tag creation, Screen designing, Controlling PLC program
- Alarm generation & warnings view in Screen
- Demo HMI/ VFD/SCADA - Concepts

Total Periods 60

Assessment & Evaluation:

1. Students will perform and demonstrate simulation-based and hardware-integrated PLC control tasks after completing each module.
2. Students will develop and present a functional industrial automation setup involving PLC programming, device control, and basic SCADA/HMI integration.
3. Individual technical assessment will be conducted post-module to assess understanding of industrial automation principles, PLC logic, and interface configuration.

Bloom's Taxonomy Level

K1- Remember (Re), K2 – understand (Un), K3- Apply (Ap), K4- Analyse (An),
K5- Evaluate (Ev), K6 – Create (Cr)

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	2	-	-	-	-	-	1	2	2	1
CO2	2	-	1	-	2	1	-	-	-	-	1	2	2	1
CO3	2	-	1	-	2	2	-	-	-	-	1	2	2	1
Average	2.0	1.0	1.0	-	2.0	1.5	-	-	-	-	1.0	2.0	2.0	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

PROFESSIONAL ELECTIVE COURSES

U23MCV01

METROLOGY AND MEASUREMENTS

L	T	P	C
3	0	0	3

Pre-Requisites : None

Course Objectives:

- To learn basic concepts of the metrology and importance of measurements.
- To teach measurement of linear and angular dimensions assembly and transmission elements.
- To study the tolerance analysis in manufacturing.
- To develop the fundamentals of GD & T and surface metrology.
- To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| CO1 | Explain the need, process, and types of measurement errors along with the estimation of measurement uncertainty and calibration procedures. | K2 |
| CO2 | Describe the principles and applications of linear and angular measuring instruments used for dimensional inspection. | K2 |
| CO3 | Summarise the measurement techniques for screw threads and gears including pitch diameter, lead, tooth profile, and functional testing methods. | K2 |
| CO4 | Describe the principles of geometric dimensioning and tolerancing (GD&T), and the methods used to measure surface finish and geometric deviations. | K2 |
| CO5 | Interpret the principles and applications of advanced metrology systems including laser-based instruments, coordinate measuring machines, and machine vision systems. | K2 |

Course Contents

Unit I BASICS OF METROLOGY

9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Measurement system analysis, Calibration of measuring instruments. ISO standards

Unit II MEASUREMENT OF LINEAR AND ANGULAR DIMENSIONS

9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector – Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Auto collimator, Angle dekkor.

Unit III MEASUREMENT OF TRANSMISSION ELEMENTS

9

Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

Unit IV METROLOGY OF SURFACES AND TOLERANCING

9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations- Measurement of Surface finish – Functionality of surfaces, Comparative, Stylus based and Optical Measurement techniques. Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits.

Unit V ADVANCES IN METROLOGY

9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Computer Aided Metrology - Basic concept of CMM– Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multisensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in process monitoring in production - Computed tomography.

Total Periods: 45

Text Books:

1. Raghavendra N.V. and Krishnamurthy. L., “Engineering Metrology and Measurements”, 2013,Oxford University Press, India.
2. Venkateshan, S. P., “Mechanical Measurements”, Second edition, 2015, John Wiley & Sons, India.

Reference Books:

1. Ammar Grous J, “Applied Metrology for Manufacturing Engineering”, 2011, Wiley-ISTE, USA.
2. Galyer J.F.W., Charles Reginald, Shot bolt, “Metrology for Engineers”, 5th revised edition, 1990,Cengage Learning EMEA, UK.
3. Dotson Connie, “Dimensional Metrology”, First edition, 2012, Cengage Learning, New Delhi.
4. Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Fifth edition, 2013, Industrial Press, US.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/112/104/112104250/>
2. <https://nptel.ac.in/courses/112106179>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	–	2	–	–	–	–	–	–	1	2	–	2
CO2	2	–	–	2	–	–	–	–	–	–	–	2	–	–
CO3	2	2	–	2	–	–	–	–	–	–	–	1	–	1
CO4	2	–	–	2	–	–	–	–	–	–	–	1	–	–
CO5	2	2	1	2	1	–	–	–	–	–	1	1	1	1
Average	2.0	2.0	1.0	2.0	1.0	–	–	–	–	–	1.0	1.4	1.0	1.3
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV02	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites :

Course Objectives:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators to introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the intrinsic characteristics of MEMS, microfabrication processes, and essential electrical and mechanical concepts relevant to the design and operation of MEMS devices.	K2
CO2	Describe the working principles and characteristics of MEMS sensors, including electrostatic and piezoresistive types, with applications to inertia, pressure, tactile, and flow measurements.	K2
CO3	Illustrate the principles and applications of MEMS actuators including magnetic, shape memory alloy, and piezoelectric types used in inertia, acoustic, tactile, and flow-based systems.	K2
CO4	Summarise the micromachining techniques including wet and dry etching, surface micromachining, and LIGA processes used in the fabrication of MEMS devices.	K2
CO5	Discuss the applications of MEMS in inertial, optical, RF, and microfluidic systems including sensors for acceleration, pressure, flow, and tactile measurements.	K2

Course Contents

Unit I INTRODUCTION 9

Intrinsic Characteristics of MEMS- Miniaturization, Microelectronics Integration, Mass Fabrication with Precision, Sensors and Actuators- Energy Domains and Transducers, Sensors, Actuators. Introduction to Micro fabrication: The Microelectronics Fabrication Process, Silicon based MEMS processes, New Materials and Fabrication Processes, Points of Consideration for Processing. Review of Essential Electrical and Mechanical Concepts: Conductivity of Semiconductors, Crystal Planes and Orientation, Stress and Strain, Flexural beam bending analysis under simple loading conditions, Torsional deflections.

Unit II SENSORS 9

Characteristics of sensors – Electrostatic sensors – Parallel plate capacitors – Piezoresistive sensors – Piezoresistive sensor materials – Stress and strain analysis – Flexural beam bending – Torsional deflection- Applications to Inertia, Pressure, Tactile and Flow sensors.

Unit III ACTUATORS 9

Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys. Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors.

Unit IV MICROMACHINING 9



Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching- Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants -Case studies – Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antirestriction methods – LIGA Process -Assembly of 3D MEMS – Foundry process.

Unit V APPLICATIONS OF MEMS INERTIAL SENSORS

9

Application to Acceleration, Inertia, Acoustic, Tactile, Pressure, Flow and Tactile sensors-Optical MEMS -Lenses and Mirrors -Actuators for Active Optical MEMS.- RF MEMS and Microfluidics

Total Periods: 45

Text Books:

1. Julian W.Gardner, Vijay.K.Varadhan, Osama.O.Awadelkarim, “Microsensors, MEMS and Smart Devices”, 2013, John Wiley & Sons, LTD.
2. Tai –Ran Hsu, “MEMS and Microsystem: Design and Manufacture”, First Edition, 2002, Tata McGraw Hill, New Delhi.
3. Anantha Suresh G.K., Vinoy K. J., Gopalakrishnan S, Bhat K.N and Athrae V.K, “Micro and Smart System”,First edition, 2010, Wiley India Pvt Ltd, India.

Reference Books:

1. Chang Liu , “Foundation of MEMS” 2nd Edition, 2012, Pearson education, India.
2. Marc J Madou, “Fundamentals of microfabrication and nanotechnology”, Three volume set 3rd revised Edition, 2011, Taylor and Francis, USA.
3. Gad El Hak , “The MEMS Hand Book”, Three volume set, 2nd revised Edition,2005,CRCpress,New York.

Web URL(s):

- 1 <https://nptel.ac.in/courses/117/105/117105082/>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	1	-	-	-	-	-	-	-	1	2	-	-
CO2	2	1	1	-	-	-	-	-	-	-	1	1	2	-
CO3	1	1	1	1	-	-	-	-	-	-	1	1	2	-
CO4	1	1	1	-	-	-	-	-	-	-	1	-	2	1
CO5	2	1	1	1	-	-	-	-	-	-	1	1	1	2
Average	1.6	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.2	1.7	1.5
3 –High; 2–Medium;1 –Low; - No Correlation														



U23MCV03	PRODUCTION OF AUTOMOTIVE COMPONENTS	L	T	P	C
		3	0	0	3

Pre-Requisites : Manufacturing Technology and Automobile Engineering

Course Objectives:

- To understand the fundamentals of casting processes and their application in manufacturing engine components.
- To explore the machining processes involved in manufacturing automotive engine components such as flywheels, pistons, connecting rods, crankshafts, camshafts, and valve components.
- To learn the various advanced forming technologies used in automotive manufacturing, including forging, extrusion, hydro-forming, and stretch forming.
- To understand the powder metallurgy process, its variables, and its application in the manufacturing of automotive parts.
- To study the latest advancements in automotive parts production using emerging technologies such as powder injection molding and plasma spray coatings.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the casting processes used for manufacturing engine components, including sand casting, centrifugal casting, permanent mould casting, and pressure die casting.	K2
CO2	Describe the machining processes and equipment used for manufacturing engine components such as crankshaft, camshaft, piston, valves, and cylinder bores.	K2
CO3	Summarise modern forming technologies including forging, extrusion, hydroforming, and stretch forming used in the production of automotive components.	K2
CO4	Illustrate the powder metallurgy and plastic molding processes used in manufacturing automotive components, including friction materials, PU foam parts, and tyre production.	K2
CO5	Interpret emerging manufacturing technologies including powder injection molding, squeeze casting, plasma spray coating, and composite part production for automotive components.	K2

Course Contents

Unit I Casting Processes for Engine Components 9

Sand casting of cylinder block and liners - Centrifugal casting of flywheel, piston rings, bearing bushes, and liners, permanent mould casting of piston, pressure die casting of carburetor and other small auto parts. Melting practice of alloys

Unit II Comprehensive Machining of Engine Parts 9

Special consideration of machining of various components such as flywheel, piston rings, bearing bushes, and liners. Machining of connecting rods - crank shaft - cam shaft - piston - piston pin - valve - front and rear axle housing - fly wheel - Honing of cylinder bores - Copy turning and profile grinding machines.

Unit III Modern Forming Technologies 9

Forging materials - process flow chart, forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft, transmission gear blanks, steering column. Extrusions: Basic process steps, extrusion of transmission shaft, housing spindle, steering worm blanks, piston pin and valve tappets. Hydro forming -



Process, hydro forming of manifold and comparison with conventional methods- Hydro forming of tail lamp housing – forming of wheel disc and rims. Stretch forming - Process, stretch forming of auto body panels –Super plastic alloys for auto body panels.

Unit IV Powder Metallurgy and Plastics Molding 9

Powder metallurgy process, process variables, Manufacture of friction lining materials for clutches and brakes – plastics-raw material –automobile components – molding – injection, compression and blow – PU foam molding - Machining of plastics. Tyre manufacturing, Recycling of tyres.

Unit V Emerging Technologies in Automotive Parts Production 9

Powder injection molding - Production of aluminum MMC liners for engine blocks - Plasma spray coated engine blocks and valves - Recent developments in auto body panel forming –Squeeze Casting of pistons - aluminum composite brake rotors. Sinter diffusion bonded idler sprocket – gas injection molding of window channel – cast con process for auto parts.

Total Hours 45

Text Books:

1. Hajra Choudry, Elements of Workshop Technology Vol-I Manufacturing Process edition, 2021.
2. HajraChoudry, Elements of Workshop Technology Vol-II Manufacturing Process edition, 2016.
3. Haslehurst.S.E., " Manufacturing Technology ", ELBS, London, 1990

Reference Books:

1. R.S. Khurmi and J.K. Gupta, "A Textbook of Workshop Technology: Manufacturing Processes", 6th edition, S. Chand & Company Ltd., New Delhi, 1999.
2. Manufacturing Engineering and Technology by Seropekalpakjian, Steven R Schmid Pearson Education-Delhi
3. High Velocity "Forming of Metals ", ASTME, prentice Hall of India (P) Ltd., New Delhi, 1990
4. PSG Design Data Handbook - Data Book of Engineers- 2023.
5. Manufacturing Technology-1By P.C Sharma of S.CHAND Publications.

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Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	-	-	-	-	-	-	-	-	-	-	1	-	1
CO2	1	-	-	-	1	-	-	-	-	-	-	1	-	1
CO3	1	-	1	-	-	-	-	-	-	-	-	1	-	1
CO4	1	-	-	-	-	-	-	-	-	-	-	1	-	1
CO5	1	-	1	-	-	-	-	-	-	-	-	1	-	1
Average	1.0	-	1.0	-	1.0	-	-	-	-	-	-	1.0	-	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV04	DESIGN FOR X	L	T	P	C
		3	0	0	3

Pre-Requisites : U23MET06 – Manufacturing Technology

Course Objectives:

- To introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
- To learn the design consideration principles of forming in the design of extruded, stamped, and forged products
- To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
- To learn design consideration principles of welding in the design of welded products.
- To learn design consideration principles in additive manufacturing

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the general design principles for manufacturability considering strength, tolerance limits, process capability, and sustainability factors.	K2
CO2	Describe the factors influencing form design with respect to working principles, material selection, and manufacturing processes such as welding, forging, and casting.	K2
CO3	Illustrate the design features that facilitate machining and assembly, including considerations for tool access, part simplification, and suitability for manual, automatic, and robotic assembly.	K2
CO4	Criticize the design considerations for cast components with respect to parting lines, core minimization, and the use of computer applications for design for manufacturability and assembly (DFMA).	K2
CO5	Explain the principles and design considerations for additive manufacturing, including part orientation, support removal, interlocking features, and reduction of part count in assemblies.	K2

Course Contents

Unit I	INTRODUCTION	9
General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances – Assembly limits -Datum features - Tolerance stacks. Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.		
Unit II	Factors Influencing Form Design	9
Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings.		
Unit III	Component Design - Machining Consideration	9
Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility – Design for assembly – Product design for manual assembly - Product design for automatic assembly –		

Robotic assembly.

Unit IV Component Design – Casting Consideration 9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

Unit V Design for Additive Manufacturing 9

Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.

Total Hours 45

Text Books:

1. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.

Reference Books:

1. CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2. David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly forFast Production, CIM Press, 2020.
3. Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design:Understanding the Principles of How Things Are Made, Elsevier, 2014.
4. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. ReasonPub., 1996.
5. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994

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2. <https://archive.nptel.ac.in/courses/112/107/112107217/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	1	-	-	-	-	-	-	2	2	1
CO2	2	2	-	-	1	-	-	-	-	-	-	1	-	-
CO3	2	-	1	-	1	-	-	-	-	-	-	1	-	1
CO4	1	-	1	-	1	-	-	-	-	-	-	1	-	1
CO5	1	1	1	-	1	-	-	-	-	-	1	1	-	1
Average	1.6	1.0	1.0	-	1.0	-	-	-	-	-	1.0	1.0	2.0	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV05	ELECTRONICS MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-Requisites : Manufacturing Technology

Course Objectives:

- To introduce the fundamentals and importance of electronics manufacturing processes and their applications in consumer, industrial, and medical products.
- To impart knowledge on materials, components, and handling techniques used in electronics manufacturing.
- To develop an understanding of assembly and soldering techniques essential for manufacturing electronic products.
- To provide insights into testing, quality control, and reliability assessment methods in electronics manufacturing.
- To explore advanced manufacturing technologies and emerging trends for a sustainable and automated electronics industry.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Illustrate the importance, applications, and manufacturing processes of electronic products, including semiconductor fabrication, PCB manufacturing, DFA, and DFT.	K2
CO2	Describe the properties and applications of electronic materials, substrates, components, and the handling techniques used in SMT and THT processes.	K2
CO3	Interpret the surface mount assembly process, soldering techniques, solder paste properties, and inspection methods used in electronics manufacturing.	K2
CO4	Summarize the inspection methods, quality control techniques, and reliability testing procedures used in electronics manufacturing.	K2
CO5	Explain advanced manufacturing technologies, green practices, and emerging trends including automation, flexible electronics, additive manufacturing, and IoT-based production techniques.	K2

Course Contents

Unit I INTRODUCTION TO ELECTRONICS MANUFACTURING 9

Importance and applications-Types of electronic products (Consumer, Industrial, Medical)- Manufacturing Processes: Semiconductor fabrication, Printed Circuit Board (PCB) manufacturing processes - Design for Assembly (DFA) and Design for Testability (DFT).

Unit II MATERIALS AND COMPONENTS IN ELECTRONICS MANUFACTURING 9

Electronic Materials: Conductors, semiconductors, and insulators-Substrates (FR4, ceramics, and flexible materials)- Components: Passive and active components-Surface Mount Technology (SMT) and Through-Hole Technology (THT) components-Material Handling and Storage Techniques

Unit III ASSEMBLY AND SOLDERING TECHNIQUES 9

Surface Mount Technology (SMT): SMT process flow (printing, placement, reflow soldering) - Soldering Techniques: Reflow soldering, wave soldering, and manual soldering - Solder paste selection and properties - Automated Assembly Techniques - PCB Cleaning and Inspection.

Unit IV TESTING, QUALITY CONTROL, AND RELIABILITY 9



Inspection and Testing Methods: Automated Optical Inspection (AOI) - In-Circuit Testing (ICT) and Functional Testing - Quality Control Techniques: Statistical Process Control (SPC) - Failure Analysis - Reliability Testing: Thermal, vibration, and environmental testing

Unit V ADVANCED MANUFACTURING TECHNOLOGIES AND TRENDS

9

Automation in Electronics Manufacturing: Robotics and Machine Vision - Industry 4.0 Applications - Green Manufacturing: Eco-friendly materials and processes - Waste management in electronics manufacturing - Emerging Technologies: Flexible electronics - Additive manufacturing (3D printing) - Internet of Things (IoT) production techniques.

Total Hours 45

Text Books:

1. R. S. Khandpur, Printed Circuit Boards: Design, Fabrication, Assembly, and Testing, McGraw-Hill, 2006.
2. Cheryl Tulkoff, Greg Caswell, Design for Excellence in Electronics Manufacturing, Wiley Publications, 2021.

Reference Books:

1. Benard S. Matisoff Hand book of Electronics Manufacturing Engineering, Van Nostrand Reinhold Company, New York, 2012.
2. Thomas C. Landers, William D Brown, Electronics Manufacturing Processes, Pearson College Division, 1994.
3. P.R. Edwards, Manufacturing Technology in the Electronics Industry: An Introduction, Springer Science and Business media, 1994.

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Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	1	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	1	-	1	-	-	-	-	-	-	2	-	-
CO3	2	1	1	-	1	-	-	-	-	-	-	1	-	-
CO4	1	1	1	1	1	-	-	-	-	-	-	-	1	1
CO5	1	1	1	-	1	1	1	-	-	-	-	-	1	2
Average	1.6	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	-	1.6	1.0	1.5
3 –High; 2–Medium; 1 –Low; - No Correlation														



U23MCV06

PRODUCT DESIGN AND DEVELOPMENT

L	T	P	C
3	0	0	3

Pre-Requisites : Computer Aided Machine Drawing Laboratory

Course Objectives:

- To introduce the fundamental principles of product development, including its characteristics, duration, cost factors, and associated challenges.
- To provide knowledge on the product planning process, including opportunity identification, prioritization, resource allocation, and customer need analysis.
- To impart understanding of concept generation techniques such as TRIZ, brainstorming, and lateral thinking, along with concept selection and testing methodologies
- To explore product architecture, industrial design processes, and design considerations for manufacturing, assembly, and serviceability.
- To familiarize students with prototyping principles, technologies, and economic considerations in product development.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the key characteristics, processes, and organizational aspects of successful product development.	K2
CO2	Describe the product planning process and methods for identifying, organizing, and prioritizing customer needs to support early-stage product development.	K2
CO3	Interpret the concept generation and selection processes using system-level thinking, TRIZ tools, S-curves, concept screening techniques, and concept testing methods including FMEA.	K2
CO4	Describe the implications of product architecture, industrial design process, and design for manufacturing, assembly, service, and quality to support system-level and cost-effective product development.	K2
CO5	Illustrate the principles and planning of prototyping and apply basic economic analysis methods to evaluate product development decisions.	K2

Course Contents

Unit I INTRODUCTION

9

Characteristics of successful product development, design and development of products, duration, and cost of product development, the challenges of product development. Development Processes and Organizations: Generic development process, concept development: the frontend process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization.

Unit II PRODUCT PLANNING

9

Product planning process, identify opportunities, evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process Identifying customer needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process.

Unit III CONCEPT GENERATION

9

Activities of concept generation, need for systems level thinking, TRIZ and its comparison with brainstorming and lateral thinking, TRIZ tools Ideality and IFR, problem formulation and functional



analysis, use of 40 principles to solve contradiction, use of S-curves and technology evolution trends. Concept selection: Overview of methodology, concept screening, and concept scoring, Pugh matrix and its application. Concept testing: Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process, Failure Mode Effect Analysis (DFMEA and PFMEA).

Unit IV PRODUCT ARCHITECTURE

9

Implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues. Industrial design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design. Design for X (DFX): Design for manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors, design for assembly, service and quality

Unit V PROTOTYPING

9

Prototyping basics, principles of prototyping, technologies, planning for prototypes Product development economics: Elements of economic analysis, base case financial mode, sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Total Hours 45

Text Books:

1. A K Chitale and R C Gupta, Product Design and Manufacturing, PHI, New Delhi, 6th Edition, 2003.
2. Karl.T.Ulrich and Steven D Eppinger Irwin, Product Design and Development, McGraw- Hill, 5th Edition, 2011.

Reference Books:

1. George E Deiter, Engineering Design, McGraw-Hill, 5th Edition, 2012.
2. Boothroyd G, Dewhurst P and Knight W, Product Design for Manufacture and Assembly, Marcel Dekker, New York, 2nd Edition, 2002.
3. G Altshuller, H Altov, Lev Shulyak, And Suddenly the Inventor Appeared: TRIZ, The theory of Inventive Problem Solving, Technical Innovation Centre, 2nd Edition, 1996.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	1	-	-	1	1	-	-	-	1	1	-	1
CO2	1	2	1	-	-	-	-	-	-	-	1	1	-	1
CO3	1	1	2	-	1	-	-	-	-	-	1	1	-	1
CO4	1	1	2	-	-	1	1	-	-	-	1	1	-	1
CO5	1	1	1	-	-	-	-	-	-	-	1	1	-	1
Average	1.0	1.2	1.4	-	1.0	1.0	1.0	-	-	-	1.0	1.0	-	1.0
3 –High; 2–Medium; 1 –Low; - No Correlation														



U23MCOV07	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Pre-Requisites : U23MGT02 - Principles of Management

Course Objectives:

- To learn the key concepts of quality, including dimensions of quality, quality planning, quality costs, and analysis techniques, as well as foundational theories of Total Quality Management (TQM)
- To examine the principles of Total Quality Management, emphasizing leadership, customer satisfaction, employee involvement, supplier partnership, and continuous improvement in quality processes
- To gain hands-on experience with statistical tools and concepts, including measures of central tendency, control charts, and process capability, to analyze and improve manufacturing and service processes.
- To learn advanced TQM tools such as benchmarking, Quality Function Deployment (QFD), Taguchi Loss Function, and Total Productive Maintenance (TPM), as well as Failure Mode and Effects Analysis (FMEA) for process improvement.
- To study various quality management systems like ISO 9000, ISO 9001, ISO 14000, and TS 16949, focusing on their requirements, implementation, and benefits to improve organizational quality practices.

Course Outcomes:	BT Level (highest level)
Upon completion of the course, students would be able to	
CO1 Explain the fundamental concepts and philosophies of Total Quality Management, including quality definitions, cost analysis, and continuous improvement tools like PDSA, 5S, and Kaizen.	K2
CO2 Describe the principles of Total Quality Management including leadership roles, customer satisfaction, employee involvement, supplier partnership, and performance measurement.	K2
CO3 Summarisethe basic statistical tools used in quality control, including measures of variation, process capability, Six Sigma, and the seven quality and management tools.	K2
CO4 Illustrate the application of TQM tools including Benchmarking, QFD, Taguchi's loss function, TPM, and FMEA in improving product and process quality.	K2
CO5 Explain the structure, requirements, and implementation procedures of quality management systems including ISO standards.	K2

Course Contents

Unit I INTRODUCTION **9**

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen.

Unit II TQM PRINCIPLES **9**

Principles of TQM, Leadership Concepts, Role of Senior Management, Quality Council, Customer



satisfaction - Employee Involvement - Supplier Partnership - Relationship Development, Performance Measures.

Unit III STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools.

Unit IV TQM TOOLS 9

Benchmarking, Quality Function Deployment (QFD) - House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM), FMEA - Stages of FMEA, Case studies.

Unit V QUALITY SYSTEMS 9

Need for ISO 9000 and Other Quality Systems - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2015, ISO 9001:2015 and ISO 9004:2018, TS 16949, ISO 14000, ISO 50001 - Concept, Requirements and Benefits.

Total Hours 45

Text Books:

1. Dale H. Besterfield, Carol Besterfield, Glen H. Besterfield, Mary Besterfield, HemantUrdhwareshe, RashmiUrdhwareshe, Total Quality Management, Pearson Education, 5th Edition, 2018.
2. D.R. Kiran, Total Quality Management, Butterworth-Heinemann, 1st Edition, 2017.

Reference Books:

1. PankajLochan, Organizational Quality Management, TQM Deployment perspectives from manufacturing & process industry, TQM Publication Book 2, 2021.
2. Sayeda Begum, ChandrasekharanRajendran, Prakash Sai L, K. Ganesh, Sanjay Mohapatra, Total Quality Management In Higher Education: Study Of Engineering Institutions, Routledge India, 1st Edition, 2020.
3. Sunil Luthra, A Dixit Garg, AAshishgarwal, Sachin K Mangla, CRC Press, 1st Edition, 2024.

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Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	-	-	1	-	1	-	-	-	1	-	-	1
CO2	1	1	1	-	-	1	1	-	-	-	1	-	1	1
CO3	1	1	-	1	1	-	-	-	-	-	1	1	1	1
CO4	1	1	1	-	-	-	-	-	-	-	-	1	-	1
CO5	1	1	-	-	-	-	1	-	-	-	1	-	-	2
Average	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-	-	-	1.0	1.0	1.0	1.2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV08

MOBILE ROBOTICS

L	T	P	C
3	0	0	3

Pre-Requisites : Theory of Machines, Sensors and Signal Conditioning

Course Objectives:

- To introduce mobile robotic technology and explore its various types in detail.
- To examine the kinematics of wheeled and legged robots.
- To investigate the role of various sensors in enhancing the intelligence of mobile robots.
- To identify localization strategies and explain mapping techniques used by mobile robots.
- To understand the concept of collaborative mobile robotics for task planning, navigation, and decision-making.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | |
|---|-----------|
| CO1 : Describe mobile robots based on locomotion types, stability, and maneuverability for various application scenarios. | K2 |
| CO2 : Explain the forward kinematics and motion constraints used in constructing kinematic models of wheeled and legged mobile robots. | K2 |
| CO3 : Differentiate types of sensors used in mobile robotics based on perception category, performance measures, and sensing uncertainties. | K2 |
| CO4 : Demonstrate mobile robot localization techniques using probabilistic mapping, landmark navigation, and SLAM approaches for autonomous operation. | K3 |
| CO5 : Illustrate path planning, navigation, and obstacle avoidance strategies in autonomous and collaborative robots through case studies and control architectures. | K3 |

Unit I LOCOMOTION 9

Introduction to Robotics – key issues in robot locomotion – Types of Locomotion -legged robots – wheeled mobile robots – aerial mobile robots – stability - robot maneuverability – controllability

Unit II MOBILE ROBOT KINEMATICS 9

Kinematic Models – Representation of Robot – Forward Kinematics – Wheel and Robot Constraints – Degree of Mobility and Steerability – Manoeuvrability – Workspace –Degrees of Freedom – Path and Trajectory Considerations – Motion Controls – Holonomic Robots

Unit III ROBOT PERCEPTION 9

Proprioceptive/Exteroceptive and passive/active sensors, performance measures of sensors, sensors for mobile robots like global positioning system (GPS), Doppler effect-based sensors, vision-based sensors, uncertainty in sensing, filtering.

Unit IV MOBILE ROBOT LOCALIZATION 9

Localization Based Navigation Versus Programmed Solutions - Map Representation - Continuous Representations - Decomposition Strategies - Probabilistic Map-Based Localization - Landmark-Based Navigation - Globally Unique Localization – Positioning Beacon Systems - Route-Based Localization - Autonomous Map Building – Simultaneous Localization and Mapping (SLAM)

Unit V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS 9

Introduction - Competences for Navigation: Planning and Reacting - Path Planning - Obstacle Avoidance - Navigation Architectures - Control Localization - Techniques for Decomposition - Case Studies –

Text Books:

1. Luc Jaulin, “Mobile Robotics”, 2nd edition, Wiley, United Kingdom, 2019.
2. Roland Siegwart, Illah R. Nourbakhsh, “Introduction to Autonomous Mobile Robots”, 2nd Edition, MIT Press, 2014.
3. Dragomir N. Nenchev, Atsushi Konno, Teppei Tsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018.

Reference Books:

1. Mohanta Jagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.
2. Peter Corke, “Robotics, Vision and Control”, Springer, USA, 2017.
3. Roland Siegwart and Illah R. Nourbakhsh, “Introduction to Autonomous Mobile Robots”, MIT Press, Cambridge, 2004.

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2. https://onlinecourses.nptel.ac.in/noc22_me39

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	-	-	-	-	-	-	2	-	-
CO2	3	2	2	-	2	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	3	2	-
CO4	3	2	2	2	2	-	-	-	-	-	-	2	2	2
CO5	3	-	2	-	3	-	-	-	-	-	-	2	3	2
Average	3.0	2	2	2	2.2	-	-	-	-	-	-	2.4	2.3	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV09	UNDERWATER ROBOTS	L	T	P	C
		3	0	0	3

Pre-Requisites : Basic knowledge sensors and control systems

Course Objectives:

- To learn about the variety of underwater robots that are used for ocean exploration and the technical capabilities that differentiate them from one another.
- To understand the various applications of underwater robots. They are used for ocean exploration, underwater infrastructure maintenance, environmental monitoring, and underwater photography.
- To learn about the different types of underwater robots.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Describe the principles of locomotion and explain the classification of mobile robots including ground, aerial, surface, and underwater systems.	K2
CO2	Interpret the relationship between degrees of freedom and the maneuverability of holonomic and non-holonomic underwater robotic systems.	K2
CO3	Differentiate navigation sensors such as gyroscopes, accelerometers, sonar, and vision systems used in autonomous underwater robots.	K2
CO4	Solve motion path planning and control problems using sensor-based obstacle avoidance, kinematic and dynamic control strategies to ensure stability.	K3
CO5	Apply Lyapunov redesign and back-stepping methods to design robust controllers for mobile robots with matched and unmatched uncertainties.	K3

Course Contents

Unit I	FUNDAMENTALS OF MOBILE ROBOT	9
	Introduction to mobile robots - principle of locomotion - types of mobile robots: ground robot, aerial robot, underwater robot and water-surface robot - principles of underwater vehicle construction.	
Unit II	KINEMATICS OF UNDERWATER VEHICLE	9
	Equations for moving frame - rigid motion in a plane - representation of a rotated frame - holonomic and non-holonomic systems - kinematic modeling with respect to global coordinates.	
Unit III	SENSORS FOR ROBOT NAVIGATION	9
	Types of sensors - magnetic and optical position sensor - gyroscope - accelerometer - magnetic compass inclinometer - tactile and proximity sensor - ultrasound range finder - laser scanner, infrared range finder - visual and motion sensing systems.	
Unit IV	MOTION PATH PLANNING, CONTROL AND STABILITY	9
	Path planning algorithms - collision-free path planning - sensor-based obstacle avoidance - motion control methods: kinematic control, dynamic control, controllability and stability about a point and trajectory.	
Unit V	ROBUST FEEDBACK CONTROL DESIGN	9
	Based on kinematic model: input uncertain control model - robust control by the Lyapunov Redesign method - Based on dynamic model: robust back-stepping; unmatched uncertainty - robust control: matched uncertainty - both matched and unmatched uncertainty.	

Total Periods: 45



Text Books:

1. Sabiha Wadoo, Pushkin Kachroo, “Autonomous Underwater Vehicles”, 1st Edition, CRC Press, India, 2011.
2. Yu Junzhi, “Visual Perception and Control of Underwater Robots”, 1st Edition, CRC Press, India, 2018.

Reference Books:

1. Nikolaus Correll, “Introduction to Autonomous Robots”, 1st edition, Magellan Scientific, USA, 2016.
2. Gerald Cook, Feitian Zhang, “Mobile Robots: Navigation, Control and Sensing, Surface Robots and AUVs”, 2nd Edition, Wiley Publication, New York, 2020.
3. Gianluca Antonelli, “Underwater Robots”, 3rd edition, Springer, Germany, 2014.

Web URL(s):

1. <https://nptel.ac.in/courses/112106298>
2. https://onlinecourses.nptel.ac.in/noc20_me03

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	-	-	-	-	-	-	2	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-	2	-	-
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	-
CO4	3	-	2	2	2	-	-	-	-	-	-	2	2	2
CO5	3	-	2	-	2	-	-	-	-	-	-	2	2	2
Average	3.0	-	2	2	2.0	-	-	-	-	-	-	2.0	2	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV10	MICROROBOTICS	L	T	P	C
		3	0	0	3

Pre-Requisites : Theory of Machines, Sensors and Signal Conditioning

Course Objectives:

- To expose students to the fundamental aspects of the emerging field of micro robotics.
- To expose students to micro scale, technologies for fabricating small devices, bio- inspired design, and applications of the field.
- To expose students to various Mathematical formalism for flexures, Electrostaticactuators, Piezo-electric actuators, Magneto-strictive actuator and other sensors.
- To apply micro robotics to various applications
- To engage students in implementation of microrobotics

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the principles of mass, energy, and momentum balance relevant to microrobotic systems.	K2
CO2	Discuss microsystem fabrication methods used in the conceptualization and realization of microrobotic structures.	K2
CO3	Interpret the influence of scaling laws, flexures, actuators, and sensors in modeling microrobots for various applications.	K2
CO4	Apply size, fabrication technology, and functional definitions to classify micro-robots for various MEMS-based applications.	K3
CO5	Demonstrate the working principles of arrayed actuators and apply them in designing micro-robotic systems including micro-grippers, micro-conveyors, and bio-inspired microrobots.	K3

Course Contents

Unit I INTRODUCTION TO MICROROBOTICS 9

Introduction to Micro robotics -MST (Micro System Technology) - Micromachining – Working principles of Microsystems Applications of Microsystems - Micro-fabrication principles-Design selection criteria for micromachining - Packaging and Integration aspects - Micro-assembly platforms and manipulators

Unit II SCALING LAWS AND MATERIALS FOR MEMS 9

Introduction - Scaling laws - Scaling effect on physical properties scaling effects on Electricalproperties - scaling effect on physical forces - Physics of Adhesion - Silicon –compatiblematerial system - Shape memory alloys - Material properties - Piezo resistivity, Piezoelectricity and Thermoelectricity

Unit III FLEXURES, ACTUATORS AND SENSORS 9

Elemental flexures - Flexure systems - Mathematical formalism for flexures –Electrostaticactuators - Piezo-electric actuators - Magneto-strictive actuators - Electromagnetic sensors -Optical-based displacement sensors - Motion tracking with microscopes

Unit IV MICROROBOTICS 9

Introduction - Task specific definition of micro-robots - Size and Fabrication Technology baseddefinition of micro- robots - Mobility and Functional-based definition of micro-robots -Applications for MEMS based micro-robots.

Unit V APPLICATIONS AND EMERGING TRENDS IN MICROROBOTICS 9

Arrayed actuator principles for micro-robotic applications - Micro-robotic actuators - Design of locomotive micro-robot devices based on arrayed actuators - Micro-robotics devices - Micro-grippers and other micro-tools - Micro-conveyors - Walking MEMS Micro-robots - Multi-robot system: Micro-robot powering, Micro-robot communication, Bio-inspired Microrobots.

Total Periods 45

Text Books:

1. Mohamed Gad-el-Hak , "The MEMS Handbook", 2nd Edition, CRC Press, New York, 2019.
2. Yves Bellouard, "Microrobotics Methods and Applications", CRC Press, Massachusetts, 2019.

Reference Books:

1. Nadim Maluf and Kirt Williams, "An Introduction to Microelectromechanical systems Engineering", 2nd edition, Artech House, 2004.
2. Julian W Gardner, "Microsensors: Principles and Applications", 2nd edition, Wiley, 2007.
3. Metin Sitti, "Mobile Microrobotics", MIT Press, 2017.
4. Nicolas Chaillet, Stephane Rangier "Microrobotics for Micromanipulation", John Wiley & Sons, 2013.

Web URL(s):

1. <https://www.edx.org/learn/engineering/eth-zurich-microrobotics>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	-	-	-	-	-	-	2	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-	3	-	-
CO3	3	2	2	-	2	-	-	-	-	-	-	3	2	-
CO4	3	-	3	-	2	-	-	-	-	-	-	3	2	-
CO5	3	-	-	-	2	-	-	-	-	-	-	2	2	2
Average	3.0	2.0	2.3	-	2.0	-	-	-	-	-	-	2.6	2	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

ZMP Based Walking Pattern Generation, Cart-Table Model, Off-Line Walking Pattern Generation, Stabilizer, Principles of Stabilizing Control, Stabilizing Control of Honda Humanoid Robot, Advanced Stabilizers, Footstep Planning and Modification Algorithms

Total Hours 45

Text Books:

1. Dragomir N. Nenchev, Atsushi Konno, "Humanoid Robots Modeling and Control", Butterworth Heinemann, 2019.
2. Shuuji K, Hirohisa H, Kensuke H, Kazuhito, Springer-Verlag GmbH "Introduction to Humanoid Robotics", Springer, London, 2014.
3. Goswami Ambarish, Vadakkepat Prahlad, "Humanoid Robotics: A Reference", Springer, 2019.
4. A. Goswami, P. Vadakkepat (Eds.), "Humanoid Robotics: A Reference", Springer, Netherlands, Dordrecht, 2018.

Reference Books:

1. J K. Harada, E. Yoshida, K. Yokoi (Eds.), "Motion Planning for Humanoid Robots", Springer, London, 2010.
2. J. Craig, "Introduction to Robotics: Mechanics and Control", Fourth Edition, Pearson, 2022.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc23_me51

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	1	-	-	-	-	-	-	2	-	-
CO2	3	2	2	-	1	-	-	-	-	-	-	3	-	-
CO3	3	-	-	-	1	-	-	-	-	-	-	2	2	-
CO4	3	-	3	-	1	-	-	-	-	-	-	3	2	2
CO5	3	-	2	-	1	-	-	-	-	-	-	2	3	2
Average	3.0	2	2.3	-	1.0	-	-	-	-	-	-	2.4	2.3	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV12

AGRICULTURAL ROBOTICS AND AUTOMATION

L	T	P	C
3	0	0	3

Pre-Requisites : Theory of Machines, Sensors and Signal Conditioning, Manufacturing Technology

Course Objectives:

- To provide a comprehensive understanding of the history and evolution of mechanized agriculture and agricultural robotics.
- To familiarize students with precision agriculture techniques, including sensors, GPS systems, and variable rate applications.
- To impart knowledge about traction systems, hitching principles, soil compaction, and tractor testing in agricultural robotics.
- To introduce soil tillage methods, mechanics of tillage tools, and weed management strategies for effective crop production.
- To equip students with the skills to select appropriate agricultural machinery based on efficiency, cost, and operational requirements.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|---|-----------|
| CO1 | Explain the evolution and classification of agricultural robots and their applications in mechanized farming operations. | K2 |
| CO2 | Describe the use of sensors, GPS systems, and remote sensing in precision agriculture and smart farming. | K2 |
| CO3 | Explain the principles of hitching, soil compaction, and traction aids in agricultural vehicle automation. | K2 |
| CO4 | Apply tillage tool mechanics and weed management techniques to improve soil preparation and control in conventional cropping systems. | K3 |
| CO5 | Determine suitable agricultural machinery based on field capacity, draft requirements, power needs, and operational cost parameters. | K3 |

Course Contents

Unit I INTRODUCTION TO AGRICULTURAL ROBOTICS AND MECHANIZATION 9

History of Mechanized Agriculture - Farming Operations and Related Machines - Tillage, Planting Cultivation, and Harvesting, Agricultural Automation - Agricultural Vehicle Robot, Types and Classifications of Agricultural Robots.

Unit II SENSORS, POSITIONING, AND SMART FARMING SYSTEMS 9

Sensors – types and agricultural applications, Global Positioning System (GPS) - GPS for civilian use, Differential GPS, Carrier-phase GPS, Real-time kinematic GPS, Military GPS, Geographic Information System, Variable Rate Applications and Controller Area Networks, Remote Sensing and Aerial Imaging for Precision Agriculture.

Unit III TRACTION AND TESTING 9

Hitching- Principles of hitching, Types of hitches, Hitching and weight transfer, Control of hitches, Tires and Traction models, Traction predictor spread sheet, Soil Compaction, Traction Aids, Tractor Testing.

Unit IV SOIL TILLAGE AND WEED MANAGEMENT 9

Tillage Methods and Equipment, Mechanics of Tillage Tools, Performance of Tillage Implements, Hitching of

Tillage Implements, Weed Management - Conventional Cropping Systems, Tools, Crop Rotation, Mechanical Cultivation

Unit V MACHINERY SELECTION

9

Screw Conveyors, Pneumatic Conveyors, Bucket Elevators, Forage Blowers and Miscellaneous Conveyors, Machinery Selection - Field Capacity and Efficiency, Draft and Power Requirements, Machinery Costs

Total Hours 45

Text Books:

1. Myer Kutz , "Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2019.
2. Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buckmaster, "Engineering Principles of Agricultural Machines", ASABE Publication, 2012.

Reference Books:

1. Qin Zhang, Francis J. Pierce, "Agricultural Automation Fundamentals and Practices", CRC Press, 2016.
2. Stephen L Young, Francis J. Pierce, "Automation: The Future of Weed Control in Cropping Systems", Springer, Dordrecht Heidelberg New York London, 2014.
3. R.A. Kepner, Roy Bainer, E.L. Barger, "Principles of Farm Machinery", 3rd Edition, CBS Publishers, New Delhi, 2005.
4. Guangnan Chen, "Advances in Agricultural Machinery and Technologies", 1st Edition, CRC Press, 2021.

Web URL(s):

1. <https://ieeagra.com>
2. <https://archive.nptel.ac.in/courses/112/105/112105249>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	2	-	-	-	-	-	2	-	-
CO2	3	-	2	-	2	2	-	-	-	-	-	2	2	-
CO3	3	-	2	-	2	-	-	-	-	-	-	3	-	-
CO4	3	-	2	-	2	-	-	-	-	-	-	2	-	2
CO5	3	-	2	-	2	-	-	-	-	2	-	2	-	2
Average	3.0	-	2	-	2.0	2	-	-	-	2	-	2.2	2	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV13

MEDICAL ROBOTICS

L	T	P	C
3	0	0	3

Pre-Requisites : Theory of Machines, Sensors and Signal Conditioning, Manufacturing Technology

Course Objectives:

- To identify and describe different types of medical robots and their potential applications.
- To know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
- To develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image guided interventions.
- To be familiar with the state of the art in applied medical robotics and medical robotics research.
- To understand the various roles that robotics can play in healthcare.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Describe the types and clinical applications of medical robots in navigation, imaging, and rehabilitation.	K2
CO2	Explain advanced localization and tracking techniques using mechanical, optical, electromagnetic, and hybrid systems in surgical environments.	K2
CO3	Summarize the procedures of minimally invasive surgeries and the current advancements in surgical and oncology robotics.	K2
CO4	Apply surgical robotic subsystems and control strategies to analyze their roles in minimally invasive and specialty surgeries through case studies.	K3
CO5	Implement robotic solutions in rehabilitation, physiotherapy, and assistive care using soft robotics and brain-machine interfaces with reference to biomedical applications.	K3

Course Contents

Unit I INTRODUCTION TO MEDICAL ROBOTICS AND HEALTHCARE TECHNOLOGIES 9

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare, Robotic Platforms Used in Clinical Settings (Da Vinci, MAKO)

Unit II ADVANCED LOCALIZATION AND TRACKING TECHNIQUES 9

Position sensors requirements - Tracking - Mechanical linkages - Optical – Sound based - Electromagnetic - Impedance-based - In-bore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid systems, Sensor Calibration and Accuracy in Surgical Environments

Unit III DESIGN OF MEDICAL ROBOTS 9

Characterization of gestures to the design of robots - Design methodologies –Technological choices – Security, Human-Robot Interaction (HRI) Design Considerations

Unit IV SURGICAL ROBOTICS 9

Minimally invasive surgery and robotic integration - surgical robotic sub systems –synergistic control - Control Modes – Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery – Neurosurgery - case studies

Unit V ROBOTS IN REHABILITATION AND MEDICAL CARE 9

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - Assistive robots -Robots in Physiotherapy - soft robotics for biomedical applications, case studies

Total Periods 45

Text Books:

1. Achim Ernst FlorisSchweikard, "Medical Robotics", Springer, 2016.
2. Jaydev P Desai, Rajni V Patel, Antoine Ferreira; Sunil Kumar Agrawal, "The Encyclopedia of Medical Robotics", World Scientific Publishing Co. Pvt. Ltd, 2019.

Reference Books:

1. Paula Gomes, "Medical robotics Minimally invasive surgery", Woodhead, 2013
2. Jocelyne Troccaz , "Medical Robotics", John Wiley & Sons Incorporated, 2013.
3. VanjaBonzovic , "Medical Robotics", I-tech Education publishing, Austria, 2008.

Web URL(s):

1. <https://www.udemy.com/course/mastering-in-medical-robotics>
2. https://onlinecourses.nptel.ac.in/noc23_de12

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	2	-	-	-	-	-	2	-	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	-	-
CO3	3	-	2	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	2	-	2	-	-	-	-	-	-	2	2	2
CO5	3	-	3	-	2	-	-	-	-	-	-	3	2	3
Average	3.0	-	2.3	-	2.0	2	-	-	-	-	-	2.2	2	2.2
3 –High; 2–Medium;1 –Low; - No Correlation														

Unit III SIMULATION ROBOTS IN ROS WITH GAZEBO

9

Robot simulation - Gazebo –create simulation model at Gazebo- Adding colors, textures,transmission tags, 3D vision sensor to Gazebo- Moving robot joints using ROS controllers-ROS controller interacts with Gazebo, interfacing state controller, simulation of moving therobot joints – simulation of differential wheeled robot in Gazebo.

Unit IV ROS WITH VREP

9

V-REP is a multi-platform robotic simulator - Simulating the robotic arm using V-REP – Addingthe ROS interface to V-REP joint - Simulating a differential wheeled robot, Adding a lasersensor , 3D vision sensor

Unit V MOTION PLANNING, MAPPING, AND REAL-WORLD INTEGRATION

9

Movelt Installation - Generating the Self-Collision matrix .virtual joints, planning groups, robot poses, robot end effector - Movelt Architecture Diagram - Trajectory from RViz GUI executingin Gazebo - Planning scene overview diagram- Collision Checking - Motion Planning, Pick andPlace Behaviors using Industrial Robots with ROS Moveit – ROS with MATLAB, Simultaneous Localization and Mapping (SLAM) with ROS

Total Hours 45

Text Books:

1. Lentin Joseph, Aleena Johny, “Robot Operating System (ROS) for Absolute BeginnersRobotics Programming Made Easy”, Second Edition, Apress, 2022.
2. Lentin Joseph, Jonathan Cacace, “Mastering ROS for Robotics Programming”, Second Edition, Packt Publishing, 2018.

Reference Books:

1. Morgan Quigley, Brian Gerkey, William D Smart, “Programming Robots with ROS”, SPD Shroff Publishers and distributors Pvt. Ltd., 2016.
2. Lentin Joseph, “ROS Robotics Projects”, Packt publishing, 2017
3. AnisKoubaa, “Robot Operating System”, Springer link, 2016.
4. Anil Mahtani, “Effective Robotics Programming with ROS”, Packt Publishing, 2016.
5. RamkumarGandhinathan, LentinJoseph ,“ ROS Robotics Projects: Build and controlrobots powered by the Robot Operating System, machine learning, and virtual reality”,Packt Publishing Limited, December 2019.

Web URL(s):

1. <https://www.udemy.com/topic/robot-operating-system/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	2	-	-	-	-	-	-	3	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-	3	-	-
CO3	3	-	2	-	2	-	-	-	-	-	-	3	2	-
CO4	3	-	2	-	2	-	-	-	-	-	-	2	2	2
CO5	3	-	3	-	2	-	-	-	-	-	-	2	3	2
Average	3.0	-	2.2	-	2.0	-	-	-	-	-	-	2.6	2.3	2
3 –High; 2–Medium;1 –Low; - No Correlation														



U23MCV15

DRONE TECHNOLOGIES

L	T	P	C
3	0	0	3

Pre-Requisites :

Course Objectives:

- To understand the basics of drone concepts.
- To learn and understand the fundamentals of design, fabrication and programming of Drone.
- To impart the knowledge of a flying and operation of drone
- To know about the various applications of drone
- To understand the safety risks and guidelines of fly safely

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the evolution, types, and business impacts of drone technology, and discuss its entrepreneurial and employability opportunities.	K2
CO2	Describe the classifications, component functions, and programming methods involved in drone design and fabrication.	K2
CO3	Interpret the operational procedures, control mechanisms, and flight management tools used for drone flying in a controlled environment.	K2
CO4	Summarize the role of drones in various commercial sectors including logistics, agriculture, inspection, and media.	K2
CO5	Discuss future trends in drone miniaturization, autonomy, and swarm usage while explaining safety regulations and licensing standards.	K2

Course Contents

Unit I INTRODUCTION TO DRONE TECHNOLOGY 9

Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses-Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability.

Unit II DRONE DESIGN, FABRICATION AND PROGRAMMING 9

Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts - Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program -Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

Unit III DRONE FLYING AND OPERATION 9

Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations management tool Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

Unit IV DRONE COMMERCIAL APPLICATIONS 9

Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

Unit V FUTURE DRONES AND SAFETY 9

The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

Total Periods: 45

Text Books:

1. Daniel Tal and John Altschuld, "Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and implementation", 1st edition, 2021. John Wiley & Sons, UK.
2. Terry Kilby and Belinda Kilby, "Make: Getting started with Drones", 1st edition, 2016, Shroff/Maker Media, India.

Reference Books:

1. John Baichtal, "Building your Own Drones: A beginners guide to Drones, UAVs and ROVs", 1st edition, 2016, Que Publishing, UK.
2. Završnik, "Drones and Unmanned Aerial Systems: Legal and social Implications for Security and Surveillance", 1st edition ,2018, Springer, UK.

Web URL(s):

1. <https://nptel.ac.in/courses/101104073>
2. <https://nptel.ac.in/courses/101104083>

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO3	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	-	-	-	-	2	2	1	-	-	-	2	1	-
CO5	2	-	-	-	-	2	2	2	-	-	-	2	1	-
Average	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	1.6	1.6	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV16	FLIGHT GUIDANCE AND CONTROL	L	T	P	C
		3	0	0	3

Pre-Requisites : Nil

Course Objectives:

- To learn about the aircraft equations of motion and method of linearization.
- To learn about the operating principle of guidance law.
- To study about the augmentation systems.
- To study longitudinal stability and to design the longitudinal autopilot.
- To study lateral stability and to design the lateral autopilot.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Describe the fundamentals of guidance and control systems by interpreting equations of motion and coordinate frame transformations.	K2
CO2	Explain the design principles of automatic flight control systems including stability and control augmentation strategies.	K2
CO3	Interpret the working of longitudinal autopilot systems and develop control laws using back stepping algorithm.	K2
CO4	Explain lateral autopilot functionalities and assess fly-by-wire control mechanisms using back stepping design.	K2
CO5	Differentiate guidance laws for missiles and launch vehicles, and analyze mission-specific design strategies.	K2

Course Contents

Unit I INTRODUCTION 9

Introduction to Guidance and control - Definition, Historical background Coordinate Frame - Equations of motion Linearization.

Unit II AUGMENTATION SYSTEMS 9

Need for automatic flight control systems, Stability augmentation systems, control augmentation systems, Design of Limited authority and Full Authority Augmentation systems - Gain scheduling concepts.

Unit III LONGITUDINAL AUTOPILOT 9

Displacement Autopilot -Pitch Orientation Control system, Acceleration Control System, Glide Slope Coupler and Automatic Flare Control and Flight path stabilization, Longitudinal control law design using back stepping algorithm.

Unit IV LATERAL AUTOPILOT 9

Damping of the Dutch Roll, Methods of Obtaining Coordination, Yaw Orientation Control system, turn compensation, Automatic lateral Beam Guidance. Introduction to Fly-by-wire flight control systems, Lateral control law design using back stepping algorithm.

Unit V MISSILE AND LAUNCH VEHICLE GUIDANCE 9

Operating principles and design of guidance laws, homing guidance laws- short range, Medium range and BVR missiles, Launch Vehicle- Introduction, Mission requirements, Implicit guidance schemes, Explicit guidance, Q guidance schemes

Total Periods: 45

Text Books:

1. Blakelock.J.H, "Automatic control of Aircraft and Missiles", 2nd Edition, 1990, John Wiley & Sons, New York.
2. Collinson R.P.G, "Introduction to Avionics", 3rd Edition, 1996, Chapman and Hall,UK.
3. George M. Siouris, "Missile Guidance and Control Systems" 2013, Springer New York, New York.

Reference Books:

1. Michael V.Cook, "Flight Dynamics Principles: A linear Systems Approach to Aircraft Stability and Control",2010, Elsevier, India.
2. Nelson R.C, "Flight Stability and Automatic Control", 1989, McGraw Hill, USA.
3. Pierre.T Kabamba, Anouck R Girard, "Fundamentals of Aerospace Navigation and Guidance",2014, Cambridge University Press, USA.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc24_ae05/

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	2	-	-	-	-	-	-	-	-	2	2	-
CO2	3	-	3	2	-	-	-	-	-	-	-	3	3	-
CO3	3	-	3	2	-	-	-	-	-	-	-	3	3	-
CO4	3	-	3	2	-	-	-	-	-	-	-	3	3	-
CO5	3	-	3	2	-	-	-	-	-	-	-	3	3	-
Average	3.0	-	2.8	2.0	-	-	-	-	-	-	-	2.8	2.8	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV17

AVIONICS

L	T	P	C
3	0	0	3

Pre-Requisites : Basic Electrical and Electronics Engineering

Course Objectives:

- To attribute the fundamentals applications of Avionics components implemented in flight vehicles.
- To impart knowledge about the avionic architecture and various avionics data buses
- To introduce the layout and the structure of Modern Glass cockpit section.
- To familiarize the knowledge on advanced systems integrated in the cockpit units
- To familiarize the knowledge on auto pilot system.

Course Outcomes:

At the end of this course students should be able to

		BT Level (highest level)
CO1	Explain the necessity of avionics in various aerospace applications and describe standard avionics system design approaches and regulatory guidelines (DO-178B and DO-254).	K2
CO2	Interpret digital avionics architectures and compare the functionalities of data buses such as MIL-STD-1553B and ARINC protocols.	K2
CO3	Describe the layout and functionalities of glass cockpit systems, including primary and multi-function displays, and identify cockpit design standards.	K2
CO4	Explain the working principles of advanced avionics systems including GPWS, TCAS, and Flight Management Systems with path optimization.	K2
CO5	Identify critical air data quantities and explain the principles of autopilot systems in longitudinal and lateral flight control.	K2

Course Contents

Unit I AIRCRAFT AVIONICS 9

Introduction to Avionics: Need for avionics in civil, military and spacecraft - Evolution of Avionics Architectures - Avionics system Design approaches and Factors - DO-178B and DO254 Avionics standards.

Unit II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

Unit III MODERN COCKPIT 9

Layout of Glass cockpit - Electronic Flight Instrument System -Primary Flight Display - Multi-Function Display - Engine Indicating and Crew Alerting system - Head Up Display - Helmet Mounted Display - Next Generation cockpit System and Aircraft Operations - Cockpit Design Standards

Unit IV ADVANCED AVIONICS SYSTEMS 9

Ground proximity warning system - Traffic Collision Avoidance System - Air Data Computer System - Concept of Auto landing - Flight Management System: Flight Planning and Path Optimization Techniques.

Unit V AIR DATA SYSTEMS AND AUTO PILOT

9

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

Total Hours 45

Text Books:

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc.,5th edition, 2010
2. Dale R. Cundy and Rick S. Brown, "Introduction to Avionics", Pearson Education, 2010.

Reference Books:

1. Spitzer, C.R., "Digital Avionic Systems", The Blackburn Press; Second, Edition, 2007.
2. Brain Kendal, "Manual of Avionics", 3rd Edition, the English Book House, New Delhi, 1993.
3. Middleton, D.H., Ed., "Avionics Systems", New edition, Longman Scientific and Technical,Longman Group UK,2005.
4. Ian Moir and Allan Seabridge, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", Wiley India Pvt Ltd; Third edition, 2012.

Web URL(s):

1. https://www.youtube.com/results?search_query=aircraft+avionics+system
2. https://www.youtube.com/results?search_query=advanced+applications+of+avionics
3. https://www.youtube.com/results?search_query=modern+aircraft+cockpit

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO5	2	-	2	-	-	-	-	-	-	-	-	2	-	-
Average	2.0	-	2.0	-	-	-	-	-	-	-	-	2.0	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV18

AIRCRAFT MECHATRONICS

L	T	P	C
3	0	0	3

Pre-Requisites : Basic Electrical and Electronics Engineering, Engineering Mechanics

Course Objectives:

- To introduce the fundamentals of mechatronic systems in aviation applications.
- To impart knowledge on aircraft sensors, actuators, and embedded systems.
- To explain flight control mechanisms using mechatronic concepts.
- To familiarize students with avionics integration using mechatronics.
- To apply mechatronic principles to automation and fault diagnosis in aircraft systems.

Course Outcomes:

At the end of this course students should be able to

**BT Level
(highest
level)**

CO1	Demonstrate the significance and integration of mechatronic components in modern aircraft systems including control surfaces, landing gear, and avionics subsystems.	K2
CO2	Implement appropriate sensors, actuators, and embedded systems used in aircraft, considering reliability and redundancy requirements.	K2
CO3	Apply flight control principles and mechatronic systems such as fly-by-wire, flight envelope protection, and automatic flight control to enhance aircraft stability and control.	K3
CO4	Demonstrate avionic system integration using mechatronic principles, communication protocols, and digital fly-by-wire architecture in modern aircraft applications.	K3
CO5	Apply aircraft automation and health monitoring techniques, including smart diagnostics and machine learning-based fault diagnosis, to evaluate safety and reliability in aviation systems.	K3

Course Contents

Unit I INTRODUCTION TO AIRCRAFT MECHATRONICS 9

Definition and Evolution of Mechatronics-Importance of Mechatronics in Aerospace Systems-Components of Mechatronic Systems: Sensors, Actuators, Controllers-Applications of Mechatronics in Aircraft: Control Surfaces, Landing Gear Systems-Benefits and Challenges of Aircraft Mechatronics-Overview of Aircraft Mechatronic Subsystems (Flight Control, Engine Systems, Avionics)-Introduction to Cyber-Physical Systems in Aircraft

Unit II SENSORS AND ACTUATORS IN AIRCRAFT SYSTEMS 9

Types of Sensors: Pressure, Temperature, Acceleration, Position, Strain-Smart Sensors and Sensor Networks in Aircraft-Actuators: Electrical, Hydraulic, Pneumatic, and Electro-Mechanical Actuators-Piezoelectric and Shape Memory Alloy Actuators-Principles of Data Acquisition Systems-Basics of Embedded Systems in Aircraft: Microcontrollers, FPGAs, DSPs-Redundancy and Reliability in Sensor-Actuator Networks

Unit III FLIGHT CONTROL SYSTEMS 9

Primary and Secondary Flight Control Surfaces-Fly-by-Wire and Fly-by-Light Systems-Flight Envelope Protection Concepts-Stability Augmentation and Control Laws-Mechatronic Implementation of Flight Control Laws-Electrohydraulic and Electromechanical Actuation



Systems-Automatic Flight Control Systems (AFCS): Autopilot, Auto-throttle, Flight Director Systems

Unit IV AVIONIC INTEGRATION AND MECHATRONICS 9

Integration of Avionics Systems Using Mechatronic Principles-Data Communication Protocols in Avionics: ARINC 429, MIL-STD-1553, AFDX-Digital Fly-by-Wire Architecture and its Advantages-Signal Conditioning and Processing for Aircraft Systems-Human-Machine Interface (HMI) in Cockpits-Fault Tolerant Systems and Redundancy Management-Emerging Technologies: More-Electric Aircraft (MEA) and All-Electric Aircraft (AEA) Concepts

Unit V AIRCRAFT AUTOMATION, HEALTH MONITORING, AND FAULT DIAGNOSIS 9

Aircraft Automation Systems: Auto Landing, Flight Management Systems (FMS)-Condition-Based Maintenance and Prognostic Health Monitoring (PHM)-Smart Diagnostics Tools: Vibration Monitoring, Thermal Imaging-Intelligent Fault Diagnosis Systems Using Machine Learning-Case Studies: Failure Analysis of Mechatronic Subsystems-Safety Protocols in Automated Systems-Future Trends: AI-Driven Automation and Self-Healing Systems in Aviation

Total Hours 45

Text Books:

1. Dr.O.P.Sharma and Lalit Gupta, "Fundamentals of flight-aircraft systems", Reprint; Jain Book Agency, 2015
2. Albert Helfrick.D, Principles of Avionics, 3rd Edition, Airline Avionics, 2007

Reference Books:

1. Spitzer, C.R., "Digital Avionic Systems", The Blackburn Press; Second, Edition, 2007.
2. Pallet E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian Edition, 2011

Web URL(s):

1. https://www.youtube.com/results?search_query=advanced+applications+of+avionics
2. https://www.youtube.com/results?search_query=modern+aircraft+cockpit

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	1	-	-	1	-	-	-	-	-	2	2	-
CO2	2	2	2	-	-	-	1	-	-	-	-	2	-	-
CO3	2	-	2	-	-	2	-	-	-	-	-	2	1	-
CO4	2	-	1	1	-	-	-	-	-	-	-	2	2	-
CO5	2	-	2	1	-	1	-	-	-	-	-	2	2	-
Average	2.0	2.0	1.6	1.0	-	1.3	1.0	-	-	-	-	2.0	1.4	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV19	DESIGN OF UAV SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites : Basics of Engineering Mechanics, Sensors and Signal Conditioning

Course Objectives:

- To introduce the fundamentals of Unmanned Aerial Vehicles (UAVs) and their classifications.
- To provide understanding of aerodynamic design aspects specific to UAVs.
- To explore structural and propulsion system requirements for UAVs.
- To impart knowledge of avionics, control, and communication systems used in UAVs.
- To apply system integration and mission planning techniques for UAV development.

Course Outcomes:

At the end of this course students should be able to

**BT Level
(highest
level)**

CO1	Describe the classification, evolution, components, and applications of UAV systems, along with relevant regulations and safety considerations.	K2
CO2	Explain the fundamental aerodynamic principles and flight mechanics specific to UAVs, including lift, drag, stability, and performance metrics.	K2
CO3	Discuss UAV structural materials, weight estimation, load paths, and various propulsion systems including electric, IC engine, and hybrid types.	K2
CO4	Demonstrate the working of onboard avionics, sensor systems, and UAV communication interfaces including IMU, GPS, and ground control systems.	K3
CO5	Apply system integration principles and mission planning techniques to design, simulate, and evaluate UAV performance for specific applications.	K3

Course Contents

Unit I	INTRODUCTION TO UAV SYSTEMS	9
	Definition and evolution of UAVs; Classifications (fixed-wing, rotary-wing, hybrid); UAV components overview; Civil and military applications; UAV regulations and safety	
Unit II	AERODYNAMICS AND FLIGHT MECHANICS	9
	Fundamentals of UAV aerodynamics; Lift, drag, and moment; Wing and tail design; Stability and control; UAV-specific performance metrics	
Unit III	STRUCTURES AND PROPULSION SYSTEMS	9
	UAV structural materials; Weight estimation and load paths; Propulsion types (electric, IC engines, hybrid); Propeller selection; Power systems	
Unit IV	AVIONICS, SENSORS, AND COMMUNICATION	9
	UAV onboard systems; IMU, GPS, barometers, cameras, LIDAR; Communication links; Ground control systems; Autopilot basics.	
Unit V	UAV DESIGN INTEGRATION AND MISSION PLANNING	9
	Subsystem integration; Payload selection; Path planning and navigation; Simulation and testing; Case studies and emerging trends	
Total Hours		45



Text Books:

1. Paul G. Fahlstrom, Thomas J. Gleason, "Introduction to UAV Systems", Wiley, 5th Edition, 2022
2. Reg Austin, "Unmanned Aircraft Systems: UAVS Design, Development and Deployment", Wiley, 2nd Edition, 2021

Reference Books:

1. Randy Beard, Timothy McLain, "Small Unmanned Aircraft: Theory and Practice", Princeton University Press, 1st Edition, 2012
2. Mohammad H. Sadraey, "Design of Unmanned Aerial Systems", Wiley, 1st Edition, 2020

Web URL(s):

1. <https://nptel.ac.in/courses/101101082>
2. <https://www.uavsystemsinternational.com/>
3. <https://www.grc.nasa.gov/www/k-12/airplane/uav.html>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO3	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	-	-	-	-	2	2	1	-	-	-	2	1	-
CO5	2	-	-	-	-	2	2	2	-	-	-	2	1	-
Average	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	2.0	1.6	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV20	NAVIGATION AND COMMUNICATION SYSTEM	L	T	P	C
		3	0	0	3

Pre-Requisites : Basics of Engineering Mechanics, Sensors and Signal Conditioning

Course Objectives:

- To enable students to grasp the fundamental principles of navigation systems employed in air, land, and marine vehicles.
- To impart knowledge on the functionality and applications of terrestrial and satellite-based navigation aids.
- To educate students on the design and operational aspects of communication systems used in contemporary vehicles.
- To familiarize students with integrated avionics architectures and real-time communication protocols.
- To equip students with the ability to apply sensor technologies and signal processing techniques in navigation and communication systems.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the fundamental principles of navigation systems including reference frames, dead reckoning, and inertial navigation techniques.	K2
CO2	Differentiate global satellite navigation systems and terrestrial navigation aids, and summarize GPS error correction and integration with INS.	K2
CO3	Describe the communication systems used in aerial and vehicular platforms including modulation techniques and aviation-specific data link systems.	K2
CO4	Apply avionics communication protocols such as ARINC 429, MIL-STD-1553, and CAN bus for integrating navigation and communication systems with display interfaces.	K3
CO5	Demonstrate sensor data processing and fusion techniques, including Kalman filtering, to enhance navigation and communication system performance.	K3

Course Contents

Unit I INTRODUCTION TO NAVIGATION SYSTEMS 9

Basics of navigation- Reference systems- Dead reckoning- Inertial Navigation Systems (INS)- Doppler navigation-Overview of global and regional systems.

Unit II SATELLITE AND TERRESTRIAL NAVIGATION 9

GPS, GLONASS, Galileo, BeiDou systems- GPS errors and corrections- Differential GPS- LORAN, VOR, DME, TACAN- Integration with inertial systems

Unit III COMMUNICATION SYSTEMS IN VEHICLES 9

AM/FM, VHF, HF, UHF systems- Satellite communication basics-ADS-B, CPDLC, ACARS-Modulation schemes- Communication architecture in UAVs and aircraft.

Unit IV AVIONICS INTEGRATION AND PROTOCOLS 9

Avionics system design- ARINC 429, MIL-STD-1553, CAN bus, RS232/485- Integration of navigation-



communication systems- Display systems and human-machine interface.

Unit V SENSORS AND SIGNAL PROCESSING TECHNIQUES

9

Role of sensors in navigation-communication- IMU, magnetometers, barometers, GPS antennas-Kalman filtering- Sensor fusion- Error mitigation techniques

Total Hours 45

Text Books:

1. Myron Kayton, Walter R. Fried, "Avionics Navigation Systems", Wiley, 2nd Edition, Updated 2021
2. James Powell, "Aircraft Radio System", Sterling Book House, Mumbai, Indian Edition 2006

Reference Books:

1. Thomas K Eismin, "Aircraft Electricity and Electronics", 5th Edition, McGraw- Hill Book Co, 1994

Web URL(s):

1. <https://nptel.ac.in/courses/101108081>
2. <https://www.gps.gov/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	2	2	-	-	-	-	-	2	-
CO2	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO3	2	-	2	-	-	-	-	-	-	-	-	2	2	-
CO4	2	-	-	-	-	2	2	1	-	-	-	2	1	-
CO5	2	-	-	-	-	2	2	2	-	-	-	2	1	-
Average	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	2.0	1.6	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV21	AERODYNAMICS OF DRONES	L	T	P	C
		3	0	0	3

Pre-Requisites : Basics of Engineering Mechanics and Fluid Mechanics

Course Objectives:

- To explain the fundamental aerodynamic principles governing drone flight.
- To analyze airflow behavior, pressure distribution, and lift/drag forces acting on drone airframes.
- To examine the performance characteristics of fixed-wing and rotary-wing drones.
- To explore the stability, control, and maneuvering aspects of various drone configurations.
- To apply aerodynamic principles to optimize drone design and performance across mission profiles.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain fundamental aerodynamic concepts including Bernoulli's principle, Reynolds number, and Mach number relevant to airfoil behavior.	K2
CO2	Interpret lift, drag, and pressure distribution characteristics of various airfoil and finite wing configurations using aerodynamic theory.	K2
CO3	Apply momentum theory and blade element theory to estimate rotorcraft and multirotor thrust, disk loading, and propeller performance.	K2
CO4	Differentiate between static and dynamic stability modes and describe the aerodynamic role of control surfaces in flight stability.	K2
CO5	Apply aerodynamic principles to analyze trade-offs between payload, endurance, drag, and efficiency for optimized drone design based on mission requirements.	K3

Course Contents

Unit I	FUNDAMENTALS OF AERODYNAMICS	9
	Fluid properties- basic flow equations- Bernoulli's principle- airfoil terminology- angle of attack- Reynolds number, Mach number	
Unit II	AIRFOIL AND WING THEORY	9
	Types of airfoils- pressure distribution- lift and drag curves- finite wing theory- aspect ratio- induced drag- vortex generation	
Unit III	ROTORCRAFT AND MULTIROTOR AERODYNAMICS	9
	Helicopter rotor aerodynamics- momentum theory- blade element theory- multirotor thrust models- disk loading- propeller efficiency	
Unit IV	STABILITY AND CONTROL	9
	Longitudinal, lateral, and directional stability- control surfaces, static and dynamic stability- response to control inputs	
Unit V	DRONE DESIGN CONSIDERATIONS	9
	Aerodynamic considerations in drone design- mission-based trade-offs, drag reduction, efficiency optimization- payload Vs endurance trade-offs	
	Total Hours	45

Text Books:

1. John D. Anderson Jr., "Introduction to Flight", McGraw-Hill Education, 9th Edition, 2022
2. John J. Bertin, Russell M. Cummings, "Aerodynamics for Engineers", Pearson, 6th Edition, 2021

Reference Books:

1. M. H. Sadraey, "Theory of Flight for Unmanned Aerial Vehicles", Wiley, 1st Edition, 2017
2. John D. Anderson Jr., "Fundamentals of Aerodynamics", McGraw-Hill Education, 6th Edition, 2017

Web URL(s):

1. <https://nptel.ac.in/courses/101101080>
2. <https://www1.grc.nasa.gov/beginners-guide-to-aeronautics/learn-about-aerodynamics/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
C01	2	-	-	-	-	2	2	-	-	-	-	-	2	-
C02	2	-	2	-	-	-	-	-	-	-	-	2	2	-
C03	2	-	2	-	-	-	-	-	-	-	-	2	2	-
C04	2	-	-	-	-	2	2	1	-	-	-	2	1	-
C05	2	-	-	-	-	2	2	2	-	-	-	2	1	-
Average	2.0	-	2.0	-	-	2.0	2.0	1.5	-	-	-	2.0	1.6	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV22

BATTERY MANAGEMENT SYSTEM

L	T	P	C
3	0	0	3

Pre-Requisites :

Course Objectives:

- To make the students to understand the working and characteristics of different types of batteries and their management.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Discuss the chemistry, performance parameters, and safety considerations of Li-ion and other advanced battery systems.	K2
CO2	Explain battery pack design, sizing, peak power characteristics, and smart charging methods including real, simulation, and cloud-based models.	K2
CO3	Apply state-space and equivalent circuit modelling techniques to analyze and predict battery behavior in various operating conditions.	K3
CO4	Calculate the State-of-Charges in a Battery Pack	K3
CO5	Apply different Battery Management System (BMS) architectures in real-world usage.	K3

Course Contents

Unit I ADVANCED BATTERIES 9

Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC, DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries.

Unit II BATTERY PACK 9

Battery Pack- design, sizing, calculations, flow chart, real and simulation Model. Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

Unit III BATTERY MODELLING 9

Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models- Introduction. Battery Modelling software/simulation frameworks.

Unit IV BATTERY STATE ESTIMATION 9

SOC Estimation- Definition, importance, single cell Vs series batteries SOC. Estimation Methods- Load voltage, Electromotive force, AC impedance, Ah counting, Neural networks, Neuro-fuzzy forecast method, Kalman filter. Estimation Algorithms.

Unit V MS ARCHITECTURE AND REAL TIME COMPONENTS 9

Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package. ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

Total Periods: 45

Text Books:

1. Battery Management Systems, Volume I: Battery Modeling by Gregory L. Plett, Publisher: Artech House Publishers; Unabridged edition (2015).
2. Battery Management Systems, Volume II: Equivalent-Circuit Methods Gregory L.Plett, Publisher:

Artech House Publishers; Unabridged edition (2016).

3. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteries in Electric Drive Vehicles”, Wiley, 2015.

Reference Books:

1. Ibrahim Dincer, Halil S. Hamut and Nader Javani, “Thermal Management of Electric Vehicle Battery Systems” , 2017, John Wiley & Sons, India.
2. Rui Xion ,”Battery Management Algorithm for Electric Vehicle”,2019, Springer Nature, UK
3. Davide Andrea ,“Battery Management Systems for Large Lithium-Ion Battery Packs”, 2010, ARTECH House, London.
4. <https://www.batteryspace.com/prod-specs/ncr18650b.pdf>
5. <https://www.ti.com/product/BQ76PL536A-Q1>

Web URL(s):

1. <https://www.youtube.com/watch?v=7WNIDLFX7Xk>
2. <https://www.youtube.com/watch?v=cS5tkvbC4ts>
3. <https://www.youtube.com/watch?v=DSoHQupqC30>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	1	1	-
CO2	2	1	-	1	-	-	-	-	-	-	-	1	-	1
CO3	1	1	2	1	1	-	-	-	-	-	-	1	1	1
CO4	2	1	2	1	1	1	-	-	-	-	-	1	-	1
CO5	2	1	2	1	1	-	-	-	1	1	1	1	-	-
Average	1.8	1.0	2.0	1.0	1.0	1.0	-	-	1.0	1.0	1.0	1.0	1.0	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV23

AUTOMOTIVE ELECTRONICS

L	T	P	C
3	0	0	3

Pre-Requisites :

Course Objectives:

- To understand the importance and applications of automotive electronics and electrical systems.
- To analyze the working principles and applications of sensors in automotive systems.
- To explore the functions of various fuel injection and ignition systems
- To study the operation of control systems and networking techniques used in automobiles
- To identify the roles and significance of safety systems, fault diagnostics, and chassis components.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

- | | | |
|------------|--|-----------|
| CO1 | : Describe the functions of electronic control units, starter and charging systems, and hybrid drive components in vehicle electrical architecture. | K2 |
| CO2 | : Explain the construction, working principles, and applications of various automotive sensors and actuators used in vehicle systems. | K2 |
| CO3 | : Discuss the principles, components, and performance effects of electronic engine control, ignition systems, and common rail fuel injection systems. | K2 |
| CO4 | : Apply engine management and automotive networking concepts to explain the integration of ignition, fuel, emission control, and in-vehicle communication systems. | K3 |
| CO5 | : Explain the functions of chassis electronic systems, safety devices, and on-board diagnostic tools used in passenger cars. | K2 |

Course Contents

Unit I Automotive Fundamentals **9**

Vehicle system architecture, Electrical and electronic systems in the vehicle, Electronic Control Unit, Digital Modules in the control unit, Starting System: requirements, starter circuits and starter motors, charging systems: requirements, alternators and charging circuits, Starter batteries: function and requirements, Hybrid drives

Unit II Sensor and Actuators in Automotives **9**

Engine speed sensor, Hall phase sensor, Variable capacitance sensor, Lambda sensor, Hot wire air flow sensor, Methanol sensor, Rain sensor, Piezoelectric knock sensors, Piezoelectric acceleration sensors, Torque sensor, exhaust gas recirculation actuators, stepper motor actuator

Unit III Engine Control System **9**

Electronic Engine Control System - Engine Functions and Control - Electronic Fuel Control System-Engine Mapping- Effect of Air/Fuel Ratio, Spark Timing on Performance Ignition systems: Ignition fundamentals - Electronic ignition systems-Direct ignition - Spark Plug, Common Rail Fuel Injection System: Control and regulation

Unit IV Engine Management and Automotive Networking **9**

Combined ignition and fuel management, Exhaust emission control: Closed loop lambda control, Complete vehicle control systems, Automotive Networking: Requirements, Classifications, Networking, In vehicle networks: CAN, LIN, TTP/C, FlexRay.



Unit V Chassis, Safety System and Fault diagnostics

9

Electronic transmission control-Traction control system – Adaptive cruise control – Antilock braking system - Electronic Stability Program – Electronic suspension system – airbag systems and belt tensioners –Automatic Air Conditioner, On-Board Diagnosis: passenger cars

Total Periods: 45

Text Books:

1. Konrad Reif, “Automotive Mechatronics”, 2016, Springer, USA.
2. Robert Bosch GmbH, “Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive”, 5th edition, 2016, Springer Nature, India.
3. Tom Denton, “Automobile Electrical and Electronics Systems”, 5th Edition, 2018, Routledge Taylor and Francis Publishers, London.

Reference Books:

1. Ribbens William B, “Understanding Automotive Electronics”, 8th Edition, 2017, Butterworth-Heinemann, Burlington
2. James D Halderman, “Automotive Electricity and Electronics”, 5th edition, 2016, Pearson Education, India.
3. Babu A.K., “Automotive Electricals and Electronics”, 2016, Khanna Publishing House, India.
4. David Crolla, “Encyclopedia of Automotive Engineering”, 6th Edition, 2015, Wiley Publications, West Sussex.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO3	2	-	-	-	-	-	-	-	-	-	1	1	-	1
CO4	2	1	-	-	-	-	-	-	-	-	1	1	-	1
CO5	2	-	-	-	-	1	-	-	-	-	1	1	-	1
Average	2.0	1.0	-	-	-	1.0	-	-	-	-	1.0	1.0	-	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV24

ELECTRIC AND HYBRID VEHICLES

L	T	P	C
3	0	0	3

Pre-Requisites : Theory of Machines, Automobile, Engineering, Electrical Machines. Control Systems Engineering

Course Objectives:

- To the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing and sub system design and hybrid vehicle control.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the design requirements and performance characteristics of electric vehicles.	K2
CO2	Summarize the charging methods and quick charging technologies for electric vehicle batteries.	K2
CO3	Explain the working principles, construction, and characteristics of various electric motors used in electrical vehicles.	K3
CO4	Explain the role of power electronics in hybrid and electric vehicles	K3
CO5	Analyze the energy and design requirement for hybrid and electric vehicles.	K3

Course Contents

Unit I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems

Unit II ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modelling - Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

Unit III MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

Unit IV POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

Unit V HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles – Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

Total Periods 45

Text Books:

1. Iqbal Husain, “Electric and Hybrid Vehicles-Design Fundamentals”, CRC Press, 2017.
2. MehrdadEhsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRCPress,2018.

Reference Books:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained” John Wiley & Sons, 2012
2. LinoGuzzella, “Vehicle Propulsion System” ,Springer Publications, 2012
3. Ron HodKinson, “Light Weight Electric/ Hybrid Vehicle Design”,Butterworth Heinemann Publication, 2005

Web URL(s):

1. <https://archive.nptel.ac.in/courses/108/103/108103009/>
2. <https://archive.nptel.ac.in/courses/108/106/108106182/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	1	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	1	-	1	-	-	-	-	-	-	1	2	1
CO3	1	1	1	-	1	-	-	-	-	-	-	1	1	-
CO4	1	1	1	-	1	-	-	-	-	-	-	1	2	-
CO5	2	1	1	-	1	-	-	-	-	-	-	1	1	-
AVG	1.6	1.0	1.0	-	1.0	-	-	-	-	-	-	1.2	1.4	1.0
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MCV25	VEHICLE DYNAMICS AND CONTROL	L	T	P	C
		3	0	0	3

Pre-Requisites : Theory of Machines, Automobile Engineering, Electrical Machines, Control Systems Engineering

Course Objectives:

- To acquire knowledge on road vehicle dynamics, stability and handling
- To develop an understanding of the relationships between vehicle design variables and vehicle dynamic behaviour
- To apply modelling techniques to predict the dynamic behavior of road vehicles
- To Calculate and refer the loads and forces associated to the vehicles
- To Analyse the behavior of the vehicles under acceleration, ride and braking

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Analyze vehicle dynamics during acceleration and deceleration, including braking systems and traction control.	K3
CO2	Illustrate grade ability, tractive force, braking force and stopping distance of a vehicle.	K3
CO3	Model the suspension system of a passenger vehicle using quarter, half, and full car approaches	K3
CO4	Solve the cornering and braking effort of a tire.	K3
CO5	Apply steady state cornering model to design the steering system of a vehicle.	K3

Course Contents

Unit I INTRODUCTION 9

Vehicle and Earth fixed coordinate system, Euler angles, Dynamic axle loads - static loads on level ground - low speed acceleration, Loads on Grades. Road loads - rolling resistance - grade resistance. Equation of motion for Forced Undamped and forced Damped Vibration, Single DOF, Two DOF and Multi DOF systems

Unit II PERFORMANCE MODE 9

Acceleration - free body diagram of accelerating vehicle, maximum transferable tractive force and gradability. Deceleration - free body diagram of decelerating vehicle, maximum decelerating rates, stopping distance and maximum braking force. Prediction of Vehicle performance. Antilock Brake Systems, Traction control

Unit III RIDE MODE 9

Human response to vibration, Sources of Vibration. Design and analysis of passive, semi-active and active suspension using quarter car, half car and full car model. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-infinite and skyhook damping. Air suspension system and their properties

Unit IV TIRE DYNAMICS 9

Tire forces and moments, tire structure, longitudinal and lateral force at various slip angles, rolling resistance, tractive and cornering property of tire. Performance of tire on wet surface. Ride property of tires. Magic formulae tire model, Estimation of tire road friction. Test on various road surfaces. Tire vibration.



Unit V HANDLING MODE

9

Vehicle control - low speed cornering and static steering - Steady-state cornering - steering factors, vehicle control parameters (under steer, neutral steer and over steer), roll steer, compliance steer, ride steer, slip angle steer. Steady state handling - lateral acceleration gain, characteristic speed, yaw velocity gain and critical speed. Effect of braking on vehicle handling

Total Periods 45

Text Books:

1. H.Pacejka, "Tire and Vehicle Dynamics", Oxford: Butterworth-Heinemann Elsevier Ltd, 2012.
2. R.N. Jazar, "Vehicle Dynamics: Theory and Application", NY: Springer, 2025.

Reference Books:

1. T.D. Gillespie, "Fundamentals of Vehicle Dynamics", Michigan: SAE International, 2021.
2. J.Y. Wong, "Theory of Ground Vehicles", 5th edition John Wiley & Sons, 2022.
3. D. Karnopp, "Vehicle Dynamics, Stability and Control", Boca Raton: CRC Press, 2013.

Web URL(s):

1. <https://nptel.ac.in/courses/107106080/>
2. <https://www.youtube.com/watch?v=LZ82iANWBLO>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	-	-	-	-	-	-	-	-	1	2	1	-
CO2	1	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	1	1	1	-	-	-	-	-	-	-	-	2	1	-
CO4	1	1	-	-	-	-	-	-	-	-	-	1	1	-
CO5	1	1	1	-	-	-	-	-	-	-	-	2	1	-
AVG	1.0	1.0	1.0	-	-	-	-	-	-	-	1.0	1.8	1.0	-
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MCV26

SMART MOBILITY AND INTELLIGENT VEHICLES

L T P C
3 0 0 3

Pre-Requisites : Theory of Machines Automobile Engineering, Control Systems Engineering

Course Objectives:

- To understand various technologies and systems used to implement smart mobility and intelligent vehicles
- To understand basic control system theory as applied to autonomous automobiles and the overall impact of automating various driving functions
- To study autonomous intelligent decision-making concerning future reactions of the vehicle that may impact the safety of the occupants

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest level)**

CO1	Explain the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles.	K2
CO2	Describe the types of sensor technology, concept of remote sensing needed to implement remote sensing.	K2
CO3	Apply the concept of fully autonomous vehicles.	K3
CO4	Apply wireless system fundamentals and IoT concepts to integrate vehicle networks for autonomous driving systems.	K3
CO5	Analyse the concept of the connected vehicle and its role in automated vehicles.	K3

Course Contents

Unit I	INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES	9
	Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles	
Unit II	SENSOR TECHNOLOGY FOR SMART MOBILITY	9
	Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.	
Unit III	CONNECTED AUTONOMOUS VEHICLE	9
	Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy	
Unit IV	VEHICLE WIRELESS TECHNOLOGY & NETWORKING	9
	Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts – Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks.	



Unit V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY

9

Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues.

Total Periods

45

Text Books:

1. "Intelligent Transportation Systems and Connected and Automated Vehicles", Transportation Research Board, 2017.
2. Radovan Miucic, "Connected Vehicles: Intelligent Transportation Systems", Springer, 2019.

Reference Books:

1. Tom Denton, "Automobile Electrical and Electronic systems, Routledge", Taylor & Francis Group, 5th Edition, 2018.
2. C. Jotin Khisty, "Transportation Engineering an Introduction", Pearson India, 2016.
3. Paul H. Wright, "Transportation Engineering: Planning and Design", McGraw-Hill 4th edition, 1998.
4. C.S. Papacostas, "Transportation Engineering and Planning", 3rd ed, Pearson, 2015.

Web URL(s):

1. <https://elearn.nptel.ac.in/shop/iit-workshops/completed/e-mobility-and-electric-vehicle-engineering/>
2. <https://avcce.digimat.in/nptel/courses/video/108106182/L80.html>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	1	-	-	-	-	-	-	-	1	1	2	-
CO2	2	1	-	-	-	-	-	-	-	-	1	-	1	-
CO3	1	1	1	-	-	-	-	-	-	-	1	-	1	-
CO4	1	1	1	1	-	-	-	-	-	-	1	1	-	-
CO5	2	1	1	1	-	-	-	-	-	-	1	-	1	1
Average	1.4	1.0	1.0	1.0	-	-	-	-	-	-	1.0	1.0	1.2	1.0
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV27 AUTOMOTIVE SYSTEM MODELLING AND SIMULATION

L	T	P	C
3	0	0	3

Pre-Requisites : Thermodynamics and Heat Transfer

Course Objectives:

- To introduce the fundamentals of automotive system modelling.
- To impart knowledge on simulation tools and techniques.
- To model vehicle subsystems like power train, thermal, and electrical components.
- To understand integration of control systems into automotive models.
- To expose students to real-world case studies and advanced simulation techniques.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the basic principles and techniques of physical, mathematical, and empirical modelling in automotive systems.	K2
CO2	Describe the modelling approaches for engine, transmission, and vehicle dynamics used in performance analysis of conventional and electric drivetrains.	K2
CO3	Explain the modelling concepts of thermal and electrical systems in electric and hybrid electric vehicles.	K2
CO4	Describe the integration of automotive control systems with sensors, actuators, and real-time simulation platforms.	K2
CO5	Apply simulation techniques to analyze system behavior, fault diagnosis, and energy management in electric and autonomous vehicles.	K3

Course Contents

Unit I FUNDAMENTALS OF SYSTEM MODELLING 9

Introduction to systems and subsystems in automotive engineering - Basic principles of modelling – physical, mathematical, and empirical models - Lumped parameter modelling techniques - Overview of simulation tools: MATLAB/Simulink, AMESim, Modelica - Model verification and validation basics.

Unit II POWERTRAIN AND VEHICLE DYNAMICS MODELLING 9

Modelling of engine systems (SI & CI) - Transmission modelling (manual, automatic, CVT) -Longitudinal and lateral vehicle dynamics - Drive cycle analysis and vehicle performance prediction - Hybrid and electric vehicle drive train overview.

Unit III MODELLING OF THERMAL AND ELECTRICAL SYSTEMS 9

Engine cooling and HVAC system modeling - Battery electrical and thermal behaviour in EV/HEV - Heat exchangers and thermal management systems - Regenerative braking system overview - Use of simulation tools for thermal-electrical systems.

Unit IV CONTROL SYSTEM INTEGRATION AND SIMULATION 9

Automotive control systems: ABS, cruise control, traction control - PID and model-based controllers - Sensor and actuator dynamics in vehicles - Real-time system simulation and HIL (Hardware-in-the-Loop) testing - Introduction to AUTOSAR and control integration platforms.

Unit V ADVANCED SIMULATION AND CASE STUDIES 9



Multi-domain co-simulation approaches - Optimization and parameter sensitivity analysis - Fault diagnosis using simulation - Simulation of autonomous vehicle systems (ADAS overview) - Case studies: Electric vehicle modelling, regenerative braking, energy management

Total Periods 45

Text Books:

1. Thomas D. Gillespie, Fundamentals of Vehicle Dynamics, SAE International, 1992.
2. Rajesh Rajamani, Vehicle Dynamics and Control, Springer, 2012.

Reference Books:

1. Lino Guzzella and Antonio Sciarretta, Vehicle Propulsion Systems: Introduction to Modeling and Optimization, Springer, 2013.
2. Dean C. Karnopp et al., System Dynamics: Modeling, Simulation, and Control of Mechatronic Systems, Wiley, 2012.
3. Hans B. Pacejka, Tire and Vehicle Dynamics, Butterworth-Heinemann, 2012.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/112/107/112107214/>
2. <https://www.youtube.com/watch?v=-gYcZt5iKPA>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	1	-	1	-	-	-	-	-	1	1	1	-
CO2	2	1	1	-	1	-	-	-	-	-	1	1	1	-
CO3	1	1	1	-	1	-	-	-	-	-	1	1	1	-
CO4	1	1	1	1	-	-	-	-	-	-	1	1	2	-
CO5	2	1	1	1	-	-	-	-	-	-	1	1	2	-
AVG	1.6	1.0	1.0	1.0	1.0	-	-	-	-	-	1.0	1.0	1.4	-
3 –High; 2–Medium; 1 –Low; - No Correlation														



U23MCV28	ADVANCED DRIVER ASSISTANCE SYSTEMS	L	T	P	C
		3	0	0	3

Pre-Requisites : Theory of Machines, Automobile Engineering, Control Systems Engineering

Course Objectives:

The objectives of the course are:

- To introduce students with various fundamentals related to advanced driver assistance technologies
- To impart knowledge on sensors, control and actuation methodologies and create impact of automating vehicles
- To acquire skills on vehicle prognostics and impaired driver technology
- To learn about various commonly available Advanced Driver Assistance Systems.
- To study about Center Console Technology and other display technology

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Describe the basic components and functions of automotive power, running, and comfort systems.	K2
CO2	Explain the types, operation, and applications of automotive sensors and advanced sensing technologies.	K2
CO3	Apply driver assistance concepts to integrate ADAS technologies using sensor data fusion and vehicle prognostics.	K3
CO4	Describe the functions and applications of advanced driver assistance systems used in modern vehicles.	K2
CO5	Illustrate display and sensor technologies to detect driver impairment and enhance vehicle-driver interaction in ADAS systems.	K3

Course Contents

Unit I	AUTOMOTIVE FUNDAMENTALS	9
	Power System-Running System-Comfort System- Engine Components – Drive train – suspension system, ABS, Steering System	
Unit II	AUTOMOTIVE SENSORS	9
	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 sensors – operation, types, characteristics, advantage and their applications. Radar, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera	
Unit III	OVERVIEW OF DRIVER ASSISTANCE TECHNOLOGY	9
	Basics of Theory of Operation, Applications, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion. Vehicle Prognostics Technology	
Unit IV	ADVANCED DRIVER ASSISTANCE SYSTEMS	9
	Advanced Driver Assistance Systems - Lane Departure (LDW), Active Cruise Control (ACC), Blind Spot Detection, Parking Assist, Autonomous Emergency Braking (AEB), Night Vision, Traffic Sign Recognition (TSR), Intelligent High beam Assistant (IHC), Tire Pressure Monitoring (TPMS), Front Collision Warning System (FCWS), Front Vehicle Departure Warning (FVDW), Adaptive Lighting, Driver Drowsiness Detection, Hill Decent Control, Rear Cross Traffic.	

Unit V ADAS DISPLAY & IMPAIRED DRIVER TECHNOLOGY

9

Center Console Technology, Gauge Cluster Technology, Heads-Up Display Technology, and Warning Technology – Driver Notification. Impaired Driver Technology -Driver Impairment Sensor Technology, Sensor Technology for Driver Impairment Detection, Transfer of Control Technology

Total Periods 45

Text Books:

1. Tom Denton, “Automobile Electrical and Electronic systems, Roulledge”, Taylor & Francis Group, 5th Edition,2018.
2. William B Ribbens, “Understanding Automotive Electronic: An Engineering Perspective”, Elsevier Science,8th Edition,2017.

Reference Books:

1. “Intelligent Transportation Systems and Connected and Automated Vehicles”, Transportation Research Board, 2016.
2. Radovan Miucic, “Connected Vehicles: Intelligent Transportation Systems”, Springer, 2019.

Web URL(s):

1. <https://www.youtube.com/watch?v=EiWl5PATfYA>
2. <https://nptel.ac.in/courses/107106088>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	-	-	1	-	-	-	-	-	1	1	-	-
CO2	2	1	-	-	1	-	-	-	-	-	-	1	-	-
CO3	1	1	-	-	1	-	-	-	-	-	1	1	1	-
CO4	2	1	-	-	1	-	-	-	-	-	1	1	1	1
CO5	2	1	-	-	1	-	-	-	-	-	1	1	-	1
AVG	1.6	1.0	-	-	1.0	-	-	-	-	-	1.0	1.0	1.0	1.0
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV29	IMMERSIVE TECHNOLOGIES AND HAPTICS	L	T	P	C
		3	0	0	3

Pre-Requisites :

Course Objectives:

- To introduce the principles and applications of haptic technology in human-machine interaction.
- To explore the architecture, control, and stability aspects of kinesthetic haptic devices and tele-operation.
- To understand human haptic perception, psychophysics, and virtual modeling tools.
- To develop the ability to design and evaluate virtual and augmented reality systems.
- To provide insight into mixed reality system architecture and immersive interaction techniques.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 : Recognize the haptic technology and its concepts in various haptic systems.	K2
CO2 : Classify the elements of haptics system and tele-operation in detail.	K2
CO3 : Demonstrate understanding of human haptic sensing, psychophysics, and virtual environment platforms.	K3
CO4 : Combine and build the virtual and augmented reality based models.	K2
CO5 : Apply mixed reality interaction techniques and system architectures in designing user-centered MR environments.	K3

Course Contents

UNIT I INTRODUCTION TO HAPTICS

8

Definition - Importance of Touch - Tactile Proprioception - Tactual Stereo Genesis – Kinesthetic Interfaces - Tactile Interfaces - Human Haptics - Overview of Existing applications - Basics of Force Feedback Devices - Kinesthetic Vs. Tactile Haptic Devices - Configurations of Kinesthetic Devices -Types of Kinesthetic Devices

UNIT II KINESTHETIC HAPTIC DEVICES AND TELEOPERATION

10

Mechatronics in Haptics System - Haptic Kinematics - Haptic Dynamics - Existing Kinesthetic Devices - Haptic Device Static Rendering - Haptic Device Dynamic Rendering - Control of Haptic Devices - Stability Analysis of Haptic Devices - Types of Sensors - -Types of Actuators - Types of Transmission - Genesis of Tele-Operation- Tele-Operation Controllers -Tele-Operator Transparency - Stability Analysis of Tele-operator -Tracking and Transparency - Surface Haptic - Exogenous Force Inputs.

UNIT III HUMAN HAPTICS ITS PLATFORM

9

Introduction - Types of Haptic Sensing - Active vs. Passive Touch – Mechanoreception-Mechano receptive Afferents - Kinesthetic Sensing - Force Sensing and Proprioception Introduction To Psychophysics - Laws of Psychophysics - Weber's Law - Fechner's Law - Fitt's Law - Introduction to Virtual Reality Modelling Language (VRML) – Open Haptic Platform - OpenGL- Virtual Environment Manager - Modelling of Simple Haptic System.

UNIT IV VIRTUAL AND AUGMENTED REALITY

9

The Reality – Virtuality Continuum - Virtual Reality Definitions - Software, Hardware, Sensation and Perception - Multi-Modal Interaction Challenges - System Architecture of Virtual Reality.Aspects of Geometrical Modelling and Environmental Modelling General Solution forCalculating Geometric & Illumination. Usability Guidelines - Design and Implementation of an Immersive User Experience - Case Study for VRand AR.

UNIT V MIXED REALITY

System Architecture of a Mixed Reality System - Common Interaction Techniques for Mixed Reality Environments - Common Navigation Techniques - Common Interface for MR -- Haptic Control Panel - Performance of an Interaction Techniques, Advanced Interaction Techniques, Design and Implementation of an Immersive User Experience - Case Study for MR.

TOTAL: 45 PERIODS

Text Books:

1. Burdea, G. C. and Coffet P, "Virtual Reality Technology", 3rd edition, Wiley-Interscience, Hoboken New Jersey 2012.
2. Sherman, William R. and Alan B. Craig, "Understanding Virtual Reality – Interface, Application, and Design" 2nd edition, Morgan Kaufmann, Cambridge U.S, 2019.
3. Hannaford B and Okamura A. M "Haptics: Handbook of Robotics", Springer, UK, 2008.

Reference Books:

1. Weir D. W and Colgate J. E "Stability of Haptic Display: Haptic Rendering: Foundations, Algorithms, and Applications", AKPeters, UK, 2008.
2. Yuichi Ohta, Hideyuki Tamura, "Mixed Reality: Merging Real and Virtual Worlds", Springer Verlag, Berlin, 2014.
3. Kenneth Salisbury, Francois Conti and Federico Barbagli, "Haptic Rendering: IEEE Computer Graphics and Applications", 2004.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/121/106/121106013/>
2. <https://www.youtube.com/watch?v=ZU1iDunSYLE>
3. <https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/?v=c86ee0d9d7ed>

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	–	2	–	–	–	–	–	–	3	2	–
CO2	2	2	2	1	2	–	–	–	–	–	–	3	2	2
CO3	2	2	2	–	2	–	–	–	–	–	–	2	2	–
CO4	2	2	2	1	2	–	–	–	–	–	–	2	2	2
CO5	3	2	2	1	2	–	–	–	–	–	–	2	2	2
Average	2.4	2	2	1	2	–	–	–	–	–	–	2.4	2	2
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV30	COMPUTER NETWORKS AND SECURITY	L	T	P	C
		3	0	0	3

Pre-Requisites :

Course Objectives:

- To study the basic concepts of networks and functions of different layers of ISO/OSI Reference model
- To understand the Error detection and correction techniques and types of LANs.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the transport layer.
- To study the working of various Application layer protocol.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain network models, addressing, and data link layer protocols.	K2
CO2	Apply IPv4/IPv6 addressing and routing protocols in network communication.	K3
CO3	Compare transport and application layer protocols and their functionalities.	K3
CO4	Implement cryptographic methods and web security protocols.	K3
CO5	Analyze hardware/software security techniques including blockchain and firewalls.	K3

Course Contents

Unit I NETWORK MODELS AND DATA LINK LAYER 9

Overview of Networks and its Attributes-Network Models-OSI,TCP/IP, Addressing-Introduction to Data link layer-Error Detection and Correction-Ethernet(802.3)-Wireless LAN-IEEE 802.11, Bluetooth-Flow and Error Control Protocols-HDLC-PPP.

Unit II NETWORK LAYER PROTOCOLS 9

Network Layer-IPv4 Addressing-Network Layer Protocols (IP,ICMP and Mobile IP) Unicast and Multicast Routing-Indradomain and Interdomain Routing Protocols-IPV6 Addresses-IPv6-Datagram Format-Transition from IPv4 to IPv6.

Unit III TRANSPORT AND APPLICATION LAYER 9

Transport Layer Protocols-UDP and TCP Connection and State Transition Diagram-Congestion Control and Avoidance (DEC bit, RED)-Qos-Application Layer Paradigms-Client-Server Programming-Domain Name System-World Wide Web, HTTP, Electronic Mail.

Unit IV NETWORK SECURITY AND WEB SECURITY 9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption – Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm – Digital Signature Algorithm-Web Security threads-Web traffic security approaches-Introduction to Secure Socket Layer (SSL)- Transport Layer Security(TLS)-Concepts of secure electronic transaction.

Unit V HARDWARE AND SOFTWARE SECURITY 9

Introduction to hardware security, -Hardware Trojans- Side-channel attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Block chain Technology-Firewalls-Working design principles, trusted systems, Kerberos.

Text Books:

1. Behrouz.A.Forouzan, “Data Communication and Networking”, Fifth Edition, 2017, TMH, India.
2. William Stallings, “Cryptography and Network Security”, Seventh Edition, 2017, Pearson Education, India.
3. Bhunia Swarup, “Hardware Security –A Hands-On Approach”, First edition, 2018, Morgan Kaufmann, UK.

Reference Books:

1. James. F. Kurose and Keith. Ross W, “Computer Networking – A Top-down Approach”, Sixth Edition, 2017, Pearson, India.
2. Douglas .E.Comer, “Computer Networks and Internets with Internet Applications”, Fourth Edition, 2008, Pearson Education, India.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc20_cs23

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	2	-	2	-	-	-	-	-	-	3	2	-
CO2	3	3	2	-	2	-	-	-	-	-	-	3	2	1
CO3	2	2	2	1	2	-	-	-	-	-	-	2	2	2
CO4	2	2	2	1	2	1	-	-	-	-	-	2	2	1
CO5	2	2	2	-	2	1	-	-	-	-	-	2	2	2
Average	2.4	2.2	2	1	2	1						2.4	2	1.5
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV31

APPLIED SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Pre-Requisites :

Course Objectives:

- To understand the characteristics of various types of signals.
- To carry out the preprocessing of continuous time signals and systems
- To learn DTFT, FFT and Z-Transform methods in signals processing.
- To design digital IIR, FIR filters for signal processing
- To learn about various signal processors and its applications of signals.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Describe the elementary signals and operations in continuous and discrete time domains	K2
CO2	Apply Fourier and Laplace transform techniques to analyze continuous time systems and their frequency responses.	K3
CO3	Interpret the response and stability of discrete time systems from their difference equation models	K2
CO4	Design IIR and FIR digital filters using appropriate transformation and windowing techniques.	K3
CO5	Apply digital signal processors for implementing signal processing applications such as compression, generation, and enhancement.	K3

Course Contents

Unit I INTRODUCTION TO SIGNALS AND SYSTEMS 9

Elementary signals in continuous and discrete time - graphical and mathematical representation - Elementary operations and classification of continuous and discrete time signals – CT systems and DT systems - Properties of CT systems and DT systems Classification of systems

Unit II ANALYSIS OF CONTINUOUS TIME SIGNALS AND SYSTEMS 9

The continuous time Fourier series - Fourier Transform properties - Laplace transform and properties - Impulse response - convolution integrals - Fourier and Laplace transforms in Analysis of CT systems - Frequency response of systems characterized by differential Equations

Unit III ANALYSIS OF DISCRETE TIME SIGNALS AND SYSTEMS 9

Fourier Transform of discrete time signals (DTFT) Properties of DTFT - Discrete Fourier Transform - Fast Fourier Transform (FFT) - Z Transform and Properties – Impulse response - Convolution sum - System analysis from difference equation model - Stability of systems

Unit IV DESIGN OF DIGITAL FILTERS 9

Review of design techniques for analog low pass filters - Frequency transformation – IIR filters - Properties - Design of IIR digital filters using bilinear transformation - FIR filters - Characteristics of FIR filters with linear phase - Design of FIR filters using Window functions.

Unit V DIGITAL SIGNAL PROCESSORS AND APPLCATIONS 9

Architecture of TMS320C54xx DSP - Addressing Modes - Instructions and Programming - Applications: Signal Compression - Sine wave generators - Noise generators – DTMF Tone Detection - Echo cancellation - Speech enhancement and recognition

Total Periods 45

Text Books:

1. Alan V Oppenheim, Alan S Willsky, Hamid Nawab S, "Signals and Systems", 2nd edition, Learning, New Delhi, 2015.
2. John G. Proakis, Dimitris K Manolakis, "Digital Signal Processing, 5th edition, Hoboken,NJ : Pearson Education, New Delhi, 2021

Reference Books:

1. Lonnie C Ludeman, "Fundamentals of Digital Signal Processing", Wiley & Sons, New Delhi, 2014.
2. Emmanuel C Ifeachor, Barrie W Jervis, "Digital Signal Processing", Pearson Education, New Delhi, 2013.
3. Haykin S, Barry Van Veen, "Signals and Systems", John Wiley and sons, New Delhi, 2016.
4. Vinay K Ingle, John G Proakis, "Digital Signal Processing using MATLAB", Cengage Learning, New Delhi, 4th edition, 2017

Web URL(s):

1. <https://archive.nptel.ac.in/courses/117/105/117105149/>
2. <https://archive.nptel.ac.in/courses/108/101/108101174/>
3. https://onlinecourses.nptel.ac.in/noc21_ee33/preview
4. <https://archive.nptel.ac.in/courses/108/108/108108185/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	1	1	-	-	1	-	-	-	-	-	1	1	-	-
CO2	2	1	-	-	1	-	-	-	-	-	1	1	-	-
CO3	1	1	-	-	1	-	-	-	-	-	1	1	1	-
CO4	1	1	1	-	1	-	-	-	-	-	1	2	1	1
CO5	1	1	-	-	1	-	-	-	-	-	1	1	-	1
AVG	1.2	1.0	1	-	1.0	-	-	-	-	-	1.0	1.2	1.0	1.0
3 - High, 2- Medium, 1 - Low, - No Correlation														

U23MCV32

APPLIED IMAGE PROCESSING

L	T	P	C
3	0	0	3

Pre-Requisites :

Course Objectives:

- To introduce various image processing and preprocessing techniques.
- To learn about feature detection and matching using Image processing
- To learn about segmentation using Image processing techniques.
- To learn about computational photography.
- To learn about image recognition using Image processing techniques.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the fundamentals of image formation, photometric processes, and geometric transformations used in digital imaging systems	K2
CO2	Describe feature detection and matching techniques, including key algorithms like SIFT and PCA-SIFT	K2
CO3	Summarize various segmentation methods such as active contours, graph-based methods, and region-based techniques	K2
CO4	Interpret computational photography techniques including photometric calibration, super-resolution, and blur removal	K2
CO5	Differentiate methods for object recognition, face recognition, and image categorization used in image search and retrieval applications.	K2

Course Contents

Unit I	IMAGE FORMATION AND PROCESSING	9
Introduction - Geometric primitives and Transformations - Photometric Image formation - The digital camera. Introduction to image processing - point - spatial - Fourier Transform - Pyramids and wavelets - Geometric transformations - global optimization		
Unit II	FEATURE DETECTION AND MATCHING	9
Introduction - Points and patches - Feature detectors - Feature Descriptors - SIFT - PCA SIFT - Gradient location orientation histogram		
Unit III	SEGMENTATION	9
Introduction - Active contours - Snakes - Scissors - Level sets - Split and merge - Watershed – Region splitting - region merging - and graph-based segmentation - mean shift and mode finding - Normalized cuts – graph cuts and energy-based methods – application		
Unit IV	COMPUTATIONAL PHOTOGRAPHY	9
Photometric calibration - Radiometric response function - Noise level estimation - Vignetting - Optical blur - High dynamic range imaging - Super resolution and blur removal - Color image demosaicing – application		
Unit V	IMAGE RECOGNITION	9
Object detection - Face recognition - Instance recognition - category recognition - Bag of words - Part based models - context and scene understanding- Application: Image search		
Total Periods:		45



Text Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
2. Hartley R, Zisserman A, "Multiple View Geometry in Computer Vision", Cambridge University Press, 2004.

Reference Books:

1. Forsyth D A, Ponce J, "Computer Vision: A Modern Approach", 2nd Edition Boston Pearson, 2015
2. Richard Sc "Computer Vision: Algorithms and Applications", Springer, 2010.
3. Simon J.D.Prince "Computer Vision: Models, Learning and Inference", Cambridge University Press, New York, 2014.

Web URL(s):

1. <https://archive.nptel.ac.in/courses/117/105/117105135/>

Bloom's Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	2	-	2	-	3	-	-	-	-	-	-	-	-	3
CO5	2	-	2	-	3	-	-	-	-	-	-	-	-	3
Average	2.4	-	2	-	3	-	-	-	-	-	-	3	3	3
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV33

COMPUTER VISION

L	T	P	C
3	0	0	3

Pre-Requisites : Fundamental knowledge of image processing, Data structures, Linear Algebra and calculus

Course Objectives:

- To review image processing techniques for computer vision.
- To understand various features and recognition techniques.
- To learn about histogram and binary vision.
- Apply three-dimensional image analysis techniques
- Study real world applications of computer vision algorithms.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest level)**

CO1	Demonstrate image processing techniques including geometric transformations, filtering, and enhancement on visual datasets.	K3
CO2	Apply feature extraction and segmentation algorithms using classical and modern descriptors for visual information analysis.	K3
CO3	Determine geometric features such as lines, ellipses, and objects by applying histogram-based transform techniques.	K3
CO4	Model 3D vision and motion using techniques like stereo vision, optical flow, and triangulation.	K3
CO5	Illustrate real-time application of vision techniques in domains such as surveillance, robotics, and automation.	K3

Course Contents

Unit I INTRODUCTION

9

Image Processing, Computer Vision- Low-level, Mid-level, High-level, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

Unit II FEATURE EXTRACTION AND FEATURE SEGMENTATION

9

Feature Extraction -Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners -Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT, Image Segmentation -Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation.

Unit III IMAGES, HISTOGRAMS, BINARY VISION

9

Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms - Histogram/Image Equalisation - Histogram Comparison - Back-projection -k-means Clustering – Thresholding - Threshold Detection Methods - Variations on Thresholding -Mathematical Morphology – Connectivity.

Unit IV 3D VISION AND MOTION

9

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion –



triangulation – bundle adjustment – translational alignment – parametric motion–spline-based motion-optical flow – layered motion.

Unit V APPLICATIONS

9

Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Virtual Reality and Augmented Reality.

Total Periods 45

Text Books:

1. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2nd edition, 2015
2. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2022.

Reference Books:

1. E. R. Davies, “Computer and Machine Vision: Principles, Algorithms, Applications, Learning”, 5th Edition, Academic Press (Elsevier), 2021.
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
3. Concise Computer Vision: An Introduction into Theory and Algorithms, by Reinhard Klette, 2014.

Web URL(s):

1. docs.opencv.org
2. <https://opencv.org/opencv-free-course/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	–	–	–	2	–	–	–	–	–	–	3	–	–
CO2	3	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3	3	–	–	–	–	–	–	–	–	–	–	–	3	–
CO4	3	–	2	–	3	–	–	–	–	–	–	–	–	3
CO5	3	–	2	–	3	–	–	–	–	–	–	–	–	3
AVG	3.0	–	2	–	3	–	–	–	–	–	–	3	3	3
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV34	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

Pre-Requisites : Basic knowledge of robotics, linear algebra and programming (Python preferred)

Course Objectives:

- To introduce the fundamentals of artificial intelligence (AI) and its application in robotics.
- To equip students with the ability to model, design, and analyze intelligent robotic systems.
- To develop problem-solving skills for decision-making, perception, and learning in robotic environments.
- To foster hands-on skills in AI algorithms using simulation tools and platforms.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

C01	Classify types of AI and apply search algorithms for intelligent agent-based systems.	K2
C02	Represent knowledge using logical models and apply planning strategies for robotic systems.	K3
C03	Demonstrate supervised and unsupervised learning techniques in robotics contexts.	K3
C04	Analyze perception methods using image processing and feature detection techniques.	K3
C05	Apply AI approaches in real-world robotic applications considering safety and ethical standards.	K3

Course Contents

Unit I FUNDAMENTALS OF AI AND ROBOTICS 9

Definition and history of AI - Types of AI: Narrow, General, and Super AI - Robotics and its integration with AI - Intelligent agents and environments - Search strategies: BFS, DFS, A*, Dijkstra

Unit II LOGICAL REASONING AND PLANNING 9

Knowledge representation: Propositional and predicate logic - Semantic networks, frames - Rule-based inference systems - Planning algorithms: STRIPS, forward/backward chaining - State-space and task-level planning

Unit III MACHINE LEARNING IN ROBOTICS 9

Supervised and unsupervised learning basics - Classification algorithms: k-NN, Decision Trees - Clustering methods: K-means - Introduction to reinforcement learning - Applications in navigation and object recognition

Unit IV PERCEPTION AND VISION FOR ROBOTICS 9

Image formation, filtering, and edge detection - Feature detection: SIFT, HOG - Object recognition: template matching, CNN basics - Introduction to SLAM - Sensor fusion (IMU + camera)

Unit V PRACTICAL AI APPLICATIONS IN ROBOTICS 9

AI in mobile, humanoid, and service robots - HRI and collaborative robots - multi-robot systems and swarm intelligence - Use cases in manufacturing, healthcare, logistics - Ethical considerations and safety in AI systems.

Total Hours 45



Text Books:

- 1 Russell, S., &Norvig, P, Artificial Intelligence: A Modern Approach, 4th edition, Pearson Education,2020
- 2 Siegwart, R., Nourbakhsh, I. R., &Scaramuzza, D, Introduction to Autonomous Mobile Robots, 2nd edition, MIT Press,2011.

Reference Books:

- 1 Murphy, R. R, Introduction to AI Robotics,2nd edition, MIT Press, 2019.
- 2 Szeliski, R, Computer Vision: Algorithms and Applications, 2nd edition, Springer, 2022.
- 3 Sutton, R. S., &Barto, A. G, Reinforcement Learning: An Introduction 2nd edition, MIT Press, 2018.

Web URL(s):

- 1 <https://www.redblobgames.com/pathfinding/>
- 2 <https://scikit-learn.org/stable/tutorial/index.html>
- 3 <https://www.tensorflow.org/>
- 4 <https://github.com/ros-planning/navigation>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	3	-	2	-	-	-	-	-	-	3	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	3	2	2	-	-	-	-	-	-	2	3	-
CO4	2	3	2	2	3	-	-	-	-	-	-	2	3	-
CO5	2	2	3	-	2	-	-	-	-	-	-	2	2	3
AVERAGE	2.6	2.4	2.6	2	1.7	-	-	-	-	-	-	2.2	2.5	3
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV35

INTELLIGENT CONTROL SYSTEMS

L	T	P	C
3	0	0	3

Pre-Requisites : Control Systems and Artificial Intelligence for Robotics

Course Objectives:

- To gain knowledge in artificial neural network
 - To gain knowledge in various learning processes.
 - To know about the basic in fuzzy control systems.
 - To gain knowledge in genetic algorithm.
- To know about the advanced algorithm in automation industries.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the architecture and types of Artificial Neural Network (ANN) models including multilayer and recurrent networks used in intelligent systems.	K3
CO2	Apply supervised and unsupervised learning algorithms such as LMS and back-propagation for engineering tasks like forecasting and pattern recognition.	K3
CO3	Design fuzzy logic controllers using fuzzification, inference, and defuzzification techniques to solve real-time engineering control problems.	K3
CO4	Implement intelligent optimization algorithms such as Genetic Algorithm, Particle Swarm Optimization, and Simulated Annealing for control applications.	K3
CO5	Analyze the stability and performance of intelligent control systems using ANN and fuzzy logic in nonlinear and dynamic system identification.	K3

Course Contents

Unit I	ANN MODELS & ARCHITECTURE	9
Biological foundations, Artificial Neural Network (ANN) models, Types of activation function, introduction to network architecture, multilayer feed forward network (MLFFN), Kohonen self-organizing map, radial basis Function network(RBFN), recurring neural network.		
Unit II	LEARNING PROCESSES	9
Supervised and unsupervised learning, error-correction learning, Hebbian learning, Boltzman learning, single layer and multilayer perception model, least mean square algorithm, back propagation algorithm, Application in forecasting and pattern recognition and other engineering problems.		
Unit III	FUZZY LOGIC CONTROL SYSTEM	9
Fuzzy sets, fuzzy set operations, properties, membership functions, fuzzy to crisp conversion, measures of fuzziness, fuzzification and defuzzification methods, application in engineering problems. Simple fuzzy logic controllers with examples, special forms of fuzzy logic models, classical fuzzy control problems.		
Unit IV	GENETIC AND PSO ALGORITHM	9
Genetic Algorithm: Types of reproduction operators, crossover & mutation Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP, Simulated Annealing Algorithm, Particle Swarm Optimization (PSO) - Graph Grammar Approach –Example Problems.		
Unit V	APPLICATIONS	9



Identification and control of linear and nonlinear dynamic systems using Neural Network. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller in standard software. Stability analysis of fuzzy control system.

Total Hours 45

Text Books:

1. Padhy.N.P, "Artificial Intelligence and Intelligent System", Oxford University Press, 2005.
2. Thrishantha Nanayakkara, Ferat Sahin, and Mo M. Jamshidi, "Intelligent Control Systems with an Introduction to System of Systems Engineering", 1st Edition, Taylor & Francis/CRC Press, September 3, 2018.

Reference Books:

1. K. M. Hangos, J. M. Horváth, and M. Gerzson, "Intelligent Control Systems: Concepts and Applications", IEEE Press, 2001
2. Petros A. Ioannou and Bary W. Fidan, "Adaptive Control Tutorial", SIAM, 2006.

Web URL(s):

1. <https://www.anylogic.com/resources/case-studies/modeling-intelligent-control-systems-based-on-a-digital-platform/>
2. <https://www.worldscientific.com/worldscibooks/10.1142/3028?srsltid=AfmBOoqUw2eE-ksm4hDnqGkyQParnNrkpPOHB-61n9h0w0FZjGNG4AmM#t=aboutBook>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	2	-	-	-	-	-	-	2	1	-
CO2	2	2	-	-	2	-	-	-	-	-	-	2	2	1
CO3	2	1	2	-	2	-	-	-	-	-	-	2	2	2
CO4	2	2	2	-	2	-	-	-	-	-	-	2	2	2
CO5	2	1	-	-	2	-	-	-	-	-	-	2	2	2
Average	2	1.4	2	-	2	-	-	-	-	-	-	2	1.8	1.4
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV36	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Pre-Requisites : Nil

Course Objectives:

- To introduce virtual instrumentation concepts and applications.
- To train to program virtual instrumentation software for biomedical applications
- To understand the data acquisition and control in VI
- To obtain the knowledge in instrument interfaces
- To analyze the applications of VI in Bio Medical Engineering

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Explain the architecture, components, and advantages of virtual instrumentation with reference to LabVIEW programming paradigms.	K2
CO2	Describe the process of developing and customizing virtual instruments using loops, structures, and sub-VIs in LabVIEW.	K2
CO3	Interpret the procedure for acquiring and controlling analog and digital signals using DAQ systems in LabVIEW.	K2
CO4	Demonstrate instrument interfacing techniques using RS232, GPIB, USB, and networking protocols for virtual instrumentation systems.	K3
CO5	Illustrate the design of virtual biomedical instrumentation systems such as ECG, EMG, heart rate variability, and biofeedback using LabVIEW.	K3

Course Contents

Unit I INTRODUCTION 9

History of Virtual Instrumentation (VI), advantages, block diagram and architecture of a virtual instrument, Programming paradigms – Virtual Instrumentation – Lab VIEW software – Lab VIEW basics – Lab VIEW environment.

Unit II VI USING LABVIEW 9

Creating, Editing and debugging a VI in Lab VIEW – Creating a sub VI – Loops and charts –Case and sequence structures – File I/O – VI customization.

Unit III DATA ACQUISITION AND CONTROL IN VI 9

Plug-in DAQ boards – Organization of the DAQ VI System – Performing analog input and analog output – Scanning multiple analog channels – Driving the digital I/O's – Buffered data acquisition – Simple problems

Unit IV INSTRUMENT INTERFACES 9

Current loop, RS 232C/RS 485, GPIB, System basics, Interface basics: USB, PCMCIA, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control. ADC, DAC, DIO, DMM, waveform generator.

Unit V APPLICATION OF VI IN BIOMEDICAL ENGINEERING 9

Design of virtual applications for Electrocardiography (ECG), Electromyography (EMG), AirFlow and Lung Volume, Heart Rate variability analysis, Non-invasive Blood Pressure Measurement, Biofeedback,

Virtual Reality & 3D graphical modelling, Virtual Prototyping.

Total Periods: 45

Text Books:

1. Sanjay Gupta and Joseph John, “Virtual Instrumentation using Lab VIEW”, 1st Edition, 2010, Tata Mc Graw –Hill Publishing Company Limited, New Delhi.
2. Jerome, Jovitha, “Virtual Instrumentation and LABVIEW”, 1st Edition, 2010, PHI Learning, New Delhi.

Reference Books:

1. Kevin James, “PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control”, 2003, Newnes, India.
2. Jon B. Olansen, Eric Rosow, “Virtual Bio-Instrumentation: Biomedical, Clinical, and Healthcare Applications in Lab VIEW” ,2001,Pearson Education, India.
3. “LabVIEW User Manual”-
https://engineering.purdue.edu/~aae520/Labview_manuals/LVUser.pdf

Web URL(s):

1. <https://www.ni.com/en.html>

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO4	1	-	2	1	-	-	-	-	-	-	-	2	-	-
CO5	1	-	1	-	-	-	-	-	-	-	-	2	-	-
Average	1.6	1.0	1.7	1.0	-	-	-	-	-	-	-	1.8	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV37	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Pre-Requisites :

Course Objectives:

- To impart the fundamentals and essentials of Cloud Computing.
- To study about virtualization and cloud resource management.
- To provide a sound foundation of the Cloud Computing Services and tools
- To be aware of different cloud platforms.
- To study the core issues of cloud security and to understand various cloud applications.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.	K2
CO2	Explain the concept of cloud resource virtualization.	K2
CO3	Apply the fundamental concepts in data centers to understand the tradeoffs in power, efficiency and cost.	K2
CO4	Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud computing.	K2
CO5	Create and deploy cloud applications.	K2

Course Contents

Unit I INTRODUCTION 9

Introduction-Overview of Computing Paradigms- The Cloud Computing reference model-Benefits and Characteristics of Cloud- Challenges - Cloud Computing Architecture - Cloud computing stack Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service- Deployment Models: Public cloud, Private cloud

Unit II CLOUD RESOURCE VIRTUALIZATION 9

Introduction to virtualization - Characteristics of virtualized environments- Taxonomy of virtualization techniques-Virtualization and cloud computing- Pros and cons of -Management of VM: Anatomy of cloud infrastructures-Scheduling techniques.

Unit III CLOUD PLATFORM ARCHITECTURES OVER VIRTUALIZED DATACENTERS 9

Data-Center design and Interconnection networks-Architectural Design of Compute and Storage Clouds-Public Cloud Platforms, GAE, Azure-Inter-cloud Resource Management-Cloud Security and Trust Management.

Unit IV CLOUD PROGRAMMING AND SOFTWARE ENVIRONMENTS 9

Features of Cloud and Grid Platforms - Parallel and Distributed Programming Paradigms - Programming Support of GoogleApp Engine-Programming on AmazonAWS and Microsoft Azure-Emerging Cloud Software Environments. Case Studies: Openstack, and Docker Containers - AmazonEC2, Google Compute Engine.

Unit V CLOUD SECURITY & APPLICATIONS 9

Cloud Security Risks, Trust, Operating System Security, VM Security, Security of Virtualization, Security Risks Posted by Shared Images, Security Risks Posted by Management OS, Data privacy and security issues, Identity and Access Management , Access Control , Authentication in cloud computing

Text Books:

1. Rajkumar Buyya Christian, Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, 2013, TataMcGrawHill, India.
2. Kai Hwang,GeoffreyC.Fox Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, 2012, Elsevier,UK.
3. Rajkumar Buyya,James, Broberg, Andrzej Goscinski, “Cloud computing: Principles and Paradigms”, 2011,Wiley, India.

Reference Books:

1. Dan C, Marinescu, “Cloud Computing Theory and Practice” , 2013, Elsevier, London.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing-A Practical Approach”, 2009,TMH, India.
George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)” 2009, O'Reilly, UK.
3. JohnW.Ritting house, James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, 2009, CRCPress, India.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc21_cs14

Bloom’s Taxonomy Level

K1- Remember, K2 – understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	-	-	-	1	-	-	2	-	-
CO2	2	2	-	-	1	-	-	-	1	-	-	2	-	-
CO3	2	2	1	-	1	-	-	-	1	-	-	3	1	-
CO4	2	2	1	1	2	-	-	-	1	-	-	3	2	1
CO5	2	2	1	-	2	-	-	-	1	-	-	3	2	2
Average	2.0	1.8	1	1	1.2	-	-	-	1.0	-	-	2.6	1.6	1.5
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MCV38	INDUSTRIAL CONTROL OF MOTION DRIVES	L	T	P	C
		3	0	0	3

Pre-Requisites : Power Electronics and Drives

Course Objectives:

- To define Automation and Control and explain the differences in the sense of the terms.
- To explain the relation between drives and control.
- To underline the basic objectives of a manufacturing industry and explain how automation and control technologies.
- To introduce the concept of interface of real time application.
- To classify Manufacturing plants and categories the different classes of Automation systems.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 Describe the key elements, design process, and hardware components of mechatronic systems used in industrial motion control.	K3
CO2 Select appropriate electrical drives and model process flows for various industrial applications such as paper mills, cranes, and solar pumps.	K3
CO3 Develop control circuits using ladder logic for motor operations including DOL, star-delta, and multi-speed controls in automation systems.	K3
CO4 Interface real-time systems with DAQ and microcontrollers for process automation using communication standards and fuzzy logic control.	K3
CO5 Analyze and integrate mechatronic components in real-world case studies such as robotics, embedded control, and automated manufacturing systems.	K3

Course Contents

Unit I INTRODUCTION TO ELEMENTS OF MECHATRONICS SYSTEMS 9

Introduction to Mechatronics system - Key elements, Mechatronics system design process - Types of design- Comparison between Traditional and Mechatronics approach - Hardware Components in Mechatronics systems- Sensors, Actuators, Controllers, Power and Data transfer, signal conditioning and processing - Issues with interfacing and Troubleshooting.

Unit II INDUSTRIAL PROCESS AND DRIVES 9

Concepts of Electric drives – power modulators- motor used in drives-types of load choice of drives - classification of drives multi quadrant operation of drives-process flow diagram of paper mill, cement mill, sugar mill, steel mill, Hoists and cranes-centrifugal pumps and compressor-solar powered pump drives - selection of drive for above processes.

Unit III DEVELOPMENT OF CONTROL CIRCUIT 9

Open and Closed loop systems with examples – temperature control-water control - Automatic control-Speed Control of Induction Motor-Develop ladder diagram of control from one place, remote place, Interlocking – DOL starter- Forward and reverse motoring- Automatic Star delta starter- Three speed motor Control.

Unit IV REALTIME SYSTEM INTERFACING 9

Introduction to data acquisition- Interface and communication standards, User interfaces in automation, Real time interfacing, Human Machine Interfaces, Fundamentals of graphical programming, DAQ

Interfacing and Control systems design- Microcontroller based DC motor speed control -Fuzzy Logic- Process control in thermal and cement plant.

Unit V CASE STUDIES

9

Case studies in design and integration of components in mechatronics systems such as industrial robot, motion control systems, Embedded vehicle control system, 3D printers, micro-robot, mechatronic control in automated manufacturing, machine tool control systems, automated dispensing systems.

Total Periods 45

Text Books:

1. Austin Hughes & Bill Drury, Electric Motors and Drives: Fundamentals, Types and Applications, Newnes (Elsevier),2019.
2. W. Bolton, Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering, 7th Edition, Pearson Education, 2018.

Reference Books:

1. Kristof Richmond, Mechatronic Systems Design, Springer, 2012.
2. NitaigourPremchand Mahalik, Mechatronics Principles, Concepts and Applications,McGraw Hill Education, New Delhi, 2015,.
3. Peter Hehenberger, David Bradley, Mechatronic Futures: Challenges and Solutions for Mechatronic Systems and their Designers, Springer International, 2016.

Web URL(s):

1. <https://www.ti.com/document-viewer/lit/html/SSZT040>
2. <https://www.deltaww.com/en-US/Drive-System/ALL/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	2	-	2	-	-	-	-	-	-	2	-	-
CO4	2	1	1	-	2	-	-	-	-	-	-	1	1	-
CO5	2	2	-	-	2	-	-	-	-	-	-	2	1	-
Average	2	1.2	1.2	-	2	-	-	-	-	-	-	1.8	1	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV39	MEDICAL MECHATRONICS	L	T	P	C
		3	0	0	3

Pre-Requisites : Sensors and Signal Conditioning

Course Objectives:

- To recall the human physiological system associated with biological signal acquisition using ECG, EEG, EMG and EOG machines.
- To represent the principle function and working of different sensor, transducers and electronics interfaces such as signal conditioning, recording system related to biomedical field.
- To illustrate the functional blocks and operation of some advanced patient monitoring and diagnostic instruments.
- To understand the concept of medical measurement and assist systems.
- To understand the working of biomedical recording systems.

Course Outcomes:

Upon completion of the course, students would be able to

	BT Level (highest level)
CO1 Explain the structure of cells, electrode–electrolyte interface, and the principles behind the measurement of physiological signals such as ECG, EEG, EMG, and EOG.	K2
CO2 Apply the working principles of biomedical transducers and smart sensors for acquiring physiological parameters in healthcare applications.	K3
CO3 Represent the various monitoring systems and signal conditioning systems associated with biomedical devices.	K3
CO4 Justify the construction and working of different biomedical patient measurement and monitoring systems.	K3
CO5 Apply advanced biomedical systems including oscillographs, biotelemetry, and dialyzers to support clinical diagnostics and therapeutic procedures.	K3

Course Contents

Unit I INTRODUCTION **9**

Cell structure - electrode - electrolyte interface, electrode potential, resting and action potential - electrodes for their measurement, ECG, EEG, EMG and EOG - Machine description methods of measurement, failures and troubleshooting, Stem cells

Unit II BIO MEDICAL SENSORS AND TRANSDUCERS **9**

Basic transducer principles, Introduction - resistive, inductive, capacitive related to health care, fiberoptic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation, Bio, Nano sensors and application, smart sensors.

Unit III MONITORING SYSTEMS AND SIGNAL CONDITIONING **9**

Instrument power supply, Input isolation, introduction amplifiers, Arrhythmia and Ambulatory

Monitoring Instruments, Foetal Monitoring Instruments, Oximeters, Pulmonary Function Analysers, Clinical Laboratory Instruments, basis of signal conversion and digital filtering, data reduction technique time and frequency domain technique.

Unit IV MEDICAL MEASUREMENT AND HEALTH ASSIST SYSTEMS

9

Blood pressure measurement: by ultrasonic method plethysmography - blood flow measurement by electromagnetic flow meter, cardiac output measurement by dilution method phonocardiography - vector cardiography. Heart lung machine artificial ventilator - Anesthetic machine - Basic ideas of CT scanner - MRI and ultrasonic scanner -cardiac pacemaker defibrillator patient safety - electrical shock hazards Centralized patient monitoring system

Unit V RECORDERS AND ADVANCED SYSTEMS

9

Oscillography - galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope. Biotelemetry, Diathermy, Audiometers, Dialyzers, Lithotripsy.

Total Periods 45

Text Books:

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Company Limited, 3rd edition, New Delhi, 2014.
2. Kolla Bhanu Prakash, Satish K. Peddapelli, Ivan C. K. Tam, Wai Lok Woo & Vishal Jain, “Computational Intelligent Techniques in Mechatronics”, 1st Edition, Wiley-Scrivener, October 2024,

Reference Books:

1. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India Learning. Ltd.,New Delhi, 2006.
2. Siamak Najarian, Javad Dargahi, Goldis Darbemamieh& Siamak Hajizadeh Farkoush, “Mechatronics in Medicine: A Biomedical Engineering Approach”, 1st Edition, McGraw-Hill, 2011.

Web URL(s):

1. <https://www.ultralibrarian.com/2023/11/30/application-of-mechatronics-in-medical-field-ulc>
2. <https://www.accessengineeringlibrary.com/content/book/9780071768962>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	–	–	1	–	1	–	–	–	1	1	–	2
CO2	2	2	–	–	2	–	–	–	–	–	1	2	1	2
CO3	2	1	–	–	2	–	–	–	–	–	1	2	2	2
CO4	2	2	2	–	2	–	–	–	–	–	1	2	2	2
CO5	2	1	–	–	2	–	–	–	–	–	1	1	2	2
AVG	2.0	1.6	2.0	–	1.8	–	1.0	–	–	–	1.0	1.6	1.8	2.0
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV40	TOTAL INTEGRATED AUTOMATION	L	T	P	C
		3	0	0	3

Pre-Requisites : Fluid Power Systems and PLC

Course Objectives:

- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and their applications.
- To know about the basic in SCADA and DCS systems.
- To gain knowledge in communication protocols in an integrated system.
- To know about the advanced in automation industries.

Course Outcomes:

Upon completion of the course, students would be able to

		BT Level (highest level)
CO1	Develop an understanding of Totally Integrated Automation (TIA) architecture and analyze its components to select appropriate elements for industrial automation systems.	K3
CO2	Design SCADA systems using runtime and developer tools by implementing tag creation, alarm logging, and report generation for process automation.	K3
CO3	Demonstrate integration of SCADA with field devices by evaluating proprietary and open communication protocols such as OPC, DDE, and messaging systems.	K3
CO4	Analyze the architecture and components of DCS and develop simple control applications using DCS programming languages and engineering interfaces.	K3
CO5	Create automation-oriented plant designs by applying process sequencing, plant layout modeling, and selection of suitable power and automation cables using simulation tools.	K3

Course Contents

Unit I	TOTALLY INTEGRATED AUTOMATION	9
	Need for TIA - TIA Architecture - Components of TIA systems - Selection of TIA Components - Programmable Automation Controllers (PAC) – Vertical Integration structure.	
Unit II	SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)	9
	Overview – Developer and runtime packages – Architecture – Tools – Tags – Graphics - Alarm logging – Tagging – Trends – History – Report generation, VB & C Scripts for SCADA application.	
Unit III	COMMUNICATION PROTOCOLS OF SCADA	9
	Proprietary and open Protocols – OLE/OPC – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and another field device.	
Unit IV	DISTRIBUTED CONTROL SYSTEMS (DCS)	9
	DCS – architecture – local control unit- programming language – communication facilities – operator interface –engineering interfaces.	
Unit V	INDUSTRIAL PLANT DESIGN	9

Design criteria – Process sequencing - Plant layout modelling – Selection of industrial power and automation cables, Overview of plant simulation software. Case Studies: Case studies of Machine automation, Process automation.

Total Periods 45

Text Books:

1. David Bailey, Edwin Wright, –Practical SCADA for industry, Newnes, Burlington, 2003.
2. Gordon Clarke, Deon Reynders, Edwin Wright, -Practical Modern SCADA Protocols: DNP3,60870.5 and Related systems, Newnes Publishing, 2004.

Reference Books:

1. Himanshu Kumar, “Advanced Industrial Automation: PLC programming in simplest way with 110 solved examples”, Laxmi Publications, January 2021.
2. Richard Zurawski, Integration Technologies for Industrial Automated Systems, CRC Press, 2006.

Web URL(s):

1. <https://www.aalimec.ac.in/wp-content/uploads/2020/01/Control-Systems.pdf>
2. <https://testbook.com/electrical-engineering/control-system>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	2	-	-	2	-	-	-	-	-	-	-	2	-
CO2	2	-	2	-	3	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	-	1
CO4	2	3	3	-	3	-	-	-	-	-	-	1	2	-
CO5	2	-	-	-	2	-	-	-	-	-	-	2	2	1
Average	2.4	2.6	2.5	-	2.4	-	-	-	-	-	-	1.5	2	1
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MCV41	INDUSTRIAL NETWORK PROTOCOLS	L	T	P	C
		3	0	0	3

Pre-Requisites : Industrial Network Protocols

Course Objectives:

- To know the basic knowledge about networking in industries.
- To understand the evolution of computer networks using the layered network architecture.
- To understand the concepts of data communications.
- To be familiar with the Transmission media and Tools.
- To design computer networks using sub-netting and routing concepts.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the structure and function of industrial communication standards and interfaces such as EIA-232, EIA-485, and fiber optics to assess their suitability for noise-resilient automation systems.	K3
CO2	Compare various industrial bus protocols like Modbus, Profibus, Device Net, and CAN to determine their effectiveness for real-time industrial applications.	K3
CO3	Design Ethernet-based industrial communication systems by applying IEEE 802.3 standards, TCP/IP, and ProfiNet protocols to support high-speed data transfer.	K3
CO4	Evaluate wireless technologies such as RFID, Wireless HART, and radio modem systems for integration in modern industrial communication networks.	K3
CO5	Develop protocol-based industrial communication solutions for automotive and transportation applications using standards like LIN and IEC/IEEE TCN.	K3

Course Contents

Unit I INTRODUCTION 9

Modern instrumentation and control systems – Terminology – Topology – Mechanisms - Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters - Fibre optic cable components and parameters – Basic cable types – Connection fibers – Troubleshooting.

Unit II COMMUNICATION BUS PROTOCOLS 9

Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i) – Device Net: Physical layer – Topology – Device taps – Profibus PA/DP/FMS: Protocol stack – System operation. CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties– Detection – processing – Introduction to CAN 2.0B.

Unit III ETHERNET SYSTEMS 9

IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigabit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet.



Unit IV WIRELESS COMMUNICATIONS

9

Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link–RFID: Basic principles of radio frequency identification – Transponders – Interrogators, WirelessHART.

Unit V APPLICATIONS

9

Automotive communication technologies – Design of automotive X-by-Wire systems, - The LINstandard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.

Total Periods 45

Text Books:

1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, Practical Industrial Data Networks: Design, Installation and Troubleshooting, Newnes (Elsevier), 2004.
2. Eric D. Knapp (and Joel T. Langill), “Industrial Network Security: Securing Critical Infrastructure Networks for Smart Grid, SCADA, and Other Industrial Control Systems”, 3rd Edition, Syngress (Elsevier), April 11, 2024.

Reference Books:

1. James Powell, Henry Vandelinde, –Catching the Process Fieldbus an Introduction to PROFIBUS for Process Automation", Momentum Press, 2013.
2. Richard Zurawski (Ed.), “Industrial Communication Technology Handbook”, 2nd Edition, CRC Press, 2017,

Web URL(s):

1. https://www.siemens.com/global/en/products/automation/industrial-communication.html?gclid=Cj0KCQiAqL28BhCrARIsACYJvkqqrdoPgDHHKiXcZEyynmG7Mq7xMpGesfcXDf2GQeJpjJCn9aIxnawaAkoaEALw_wcB&ac=z=1&gad_source=1
2. <https://pdhonline.com/courses/e497/e497content.pdf>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	2	-	-	-	-	-	-	2	2	-
CO2	2	1	-	-	2	-	-	-	-	-	-	1	2	-
CO3	2	1	-	-	2	-	-	-	-	-	-	2	1	-
CO4	2	2	-	1	2	-	-	-	-	-	-	1	2	1
CO5	1	1	-	-	2	-	-	-	-	-	-	1	2	1
AVG	1.8	1.4	-	1	2.0	-	-	-	-	-	-	1.4	1.8	1
3 –High; 2–Medium; 1 –Low; - No Correlation														

Emerging Approaches to Industrial Automation Security-Internet of Things, Open platformcommunications unified architecture, Security and privacy, Big data analytics and the industrial Internet of Things, The National Institute of Standards Technology (NIST) Cyber-Physical Systems (CPS) Framework, CPS and Cybersecurity, Critical Infrastructure security, Software-defined elements.

Unit V INDUSTRY 5.0

9

Introduction of Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes.

Total Periods 45

Text Books:

1. Digital Twins in Industrial Production and Smart Manufacturing”, 1st Edition, John Wiley & Sons, September 2024, ISBN 978-1-394-19530-5
2. M. Grieves, “Digital Twins: Past, Present, and Future,” The Digital Twin. Springer International Publishing, Cham, pp. 97–121, 2023. doi: 10.1007/978-3-031-21343-4_4.

Reference Books:

1. Digital Twins and Cybersecurity”, Scrivener Publishing, 2025, ISBN 978-1-394-27247-1.
2. Charles J. Brooks, Philip A. Craig Jr., “Practical Industrial Cybersecurity”, John Wiley & Sons, Inc., Hoboken, New Jersey, 2022, ISBN: 978-1-119-88302-9.

Web URL(s):

1. <https://www.cscem.in/courses/introduction-to-digital-twins>
2. <https://books.google.com/books?id=5AxIEAAAQBAJ>
3. <https://www.digitaltwinconsortium.org/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	2	-	-	-	-	-	1	2	-	-
CO2	2	2	-	-	2	-	-	-	-	-	1	2	2	2
CO3	2	2	-	-	3	-	-	-	-	-	1	2	-	2
CO4	2	2	-	-	2	-	-	-	-	-	2	2	3	2
CO5	2	2	-	-	2	-	-	-	-	-	2	2	-	3
AVGERAGE	2	2	-	-	2.2	-	-	-	-	-	1.4	2	2.5	2.2
3 –High; 2–Medium; 1 –Low; - No Correlation														

MANDATORY COURSES

U23MTA02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objective:

- To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Explain the scope and characteristics of traditional knowledge and differentiate it from indigenous and Western knowledge.	K2
CO2	Assess the importance of protecting traditional knowledge and analyze the role of governments in this process.	K3
CO3	Summarize key laws related to traditional knowledge and evaluate their impact on its protection.	K3
CO4	Describe protection systems for traditional knowledge and evaluate patents and non-IPR mechanisms.	K3
CO5	Examine the role of traditional knowledge in various sectors and discuss its significance for sustainability and food security.	K3

Course Contents

Unit I INTRODUCTION TO TRADITIONAL KNOWLEDGE 8

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge

Unit II PROTECTION OF TRADITIONAL KNOWLEDGE 4

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Unit III LEGAL FRAMEWORK AND TRADITIONAL KNOWLEDGE 7

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Unit IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 5

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge.

Unit V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 6

Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Food security of the country and protection of TK.

Total Hours 30

Text Books:

1. Jha, Amit, "Traditional Knowledge System in India", 2009.
2. Mohanta, Basanta Kumar and Singh, Vipin Kumar, "Traditional Knowledge System and Technology in India", 2012, Pratibha Prakashan.

Reference Books:

1. Jha, Amit, "Traditional Knowledge System in India", 2002, Atlantic Publishers.
2. Kapoor, Kapil and Danino, Michel, "Knowledge Traditions and Practices of India".
3. Tempelman, Erik, Shercliff, Hugh, and Ninaber van Eyben, Bruno, "Manufacturing and Design: Understanding the Principles of How Things Are Made", 2014, Elsevier.

Web URL(s):

1. <https://www.youtube.com/watch?v=LZP1StpYEPM>
2. <http://nptel.ac.in/courses/121106003/>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	-	2	1	1	-	2	-	1	-	-
CO2	1	2	-	1	-	2	1	1	-	1	-	1	-	-
CO3	1	2	-	1	-	2	1	1	-	1	-	1	-	-
CO4	1	2	-	1	-	2	1	1	-	1	-	1	-	-
CO5	1	1	-	1	-	2	1	1	-	1	-	1	-	-
Average	1.2	1.8	-	0.8	-	2	1	1	-	1.2	-	1.0	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MTA03	WELLNESS THROUGH YOGA AND AYURVEDA	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To enjoy life happily with fun filled new style activities that help to maintain health
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Define health and describe its various dimensions, emphasizing the importance of maintaining overall health.	K2
CO2	Explain the role of diet in health maintenance, including the components of a balanced diet and their benefits.	K2
CO3	Summarize the preventive aspects of AYUSH systems and evaluate their role in maintaining health through different prevention levels.	K3
CO4	Describe the importance of emotional health, analyze stress management techniques, and explain the impact of sleep and immunity on mental wellness.	K3
CO5	Analyze the benefits of different types of yoga and evaluate how to choose appropriate yogasanas based on individual needs and health conditions.	K3

Course Contents

Unit I HEALTH AND ITS IMPORTANCE 6

Health: Definition - Importance of maintaining health - More importance on prevention than treatment
Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health,

Unit II DIET 6

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight,
Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Unit III ROLE OF AYURVEDA IN MAINTAINING HEALTH 6

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Prevention of illness with our traditional system of medicine-Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

Unit IV MENTAL WELLNESS

8

Emotional health - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life - Short term and long term effects of emotional disturbances.

Stress management - Stress definition - Stress in daily life - How stress affects one's life - Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity.

Unit V YOGA

4

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders.

Total Hours 30

Text Books:

1. Martin, Ashley, "Nutrition and Dietetics", White Word Publications, New York, NY 10001, USA.
2. Elliott, Jennifer, "An Introduction to Sustainable Development", 4th Ed., 2012, Routledge, London.

Reference Books:

- 1 Zeidner, Moshe, Matthews, Gerald, and Roberts, Richard D., "What We Know About Emotional Intelligence: How It Affects Learning, Work, Relationships, and Our Mental Health".
- 2 Neff, Kristin., and Germer, Christopher, "The Mindful Self-Compassion Workbook", The Guilford Press, A Division of Guilford Publications, New York.

Web URL(s):

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/>
2. <https://www.legit.ng/1163909-classes-food-examples-functions.html>
3. <https://www.cdc.gov/nutrition/php/resources/healthy-eating-benefits-for-adults.html>
4. <https://yogamedicine.com/guide-types-yoga-styles/>
5. <https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives>
6. <https://nutritionsource.hsph.harvard.edu/healthy-weight/>
7. <https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	2	2	1	-	1	-	1	-	-
CO2	1	-	-	-	-	2	2	1	-	1	-	1	-	-
CO3	2	2	-	1	-	2	2	1	-	1	-	1	-	-
CO4	2	1	-	-	-	2	2	2	-	1	-	1	-	-
CO5	2	-	-	-	-	2	2	1	-	1	-	1	-	-
Average	1.8	0.6	-	0.2	-	2	2	1.2	-	1	-	1.0	-	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MTA04	UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
- To help students initiate a process of dialog within themselves to know what they ‘really want to be’ in their life and profession
- To help students understand the meaning of happiness and prosperity for a human being.
- To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

Course Outcomes:	BT Level (highest level)
Upon completion of the course, students would be able to	
CO1 Define value education and describe its importance and basic guidelines, including self-exploration as a method for value development.	K2
CO2 Explain the concept of harmony between the Self and the Body, and analyze the needs of both to achieve personal balance.	K3
CO3 Analyze the role of family in human values and relationships, and evaluate the principles for achieving harmony in family, society, and nature.	K3
CO4 Explain the basics of ethical human conduct, analyze defects in ethical behavior, and evaluate holistic and universal approaches to ethical conduct.	K3
CO5 Apply ethical frameworks and principles to create sustainable and ethically sound engineering practices and solutions.	K3

Course Contents

Unit I INTRODUCTION TO VALUE EDUCATION 6

Value Education- Definition, Concept and Need, The Content and Process of Value Education, Basic Guidelines for Value Education. Self exploration as a means of Value Education.

Unit II HARMONY IN THE HUMAN BEING 6

Human Being is more than just the Body. Harmony of the Self ('I') with the Body. Understanding Myself as Co-existence of the Self and the Body. Understanding Needs of the Self and the needs of the Body.

Unit III HARMONY IN THE FAMILY AND SOCIETY AND HARMONY IN THE NATURE 7

Family as a basic unit of Human Interaction and Values in Relationships. The Basics for Respect and today's Crisis: Affection, Guidance, Reverence, Glory, Gratitude and Love. Comprehensive Human Goal: The Five Dimensions of Human Endeavour.

Unit IV SOCIAL ETHICS 5

The Basics for Ethical Human Conduct. Defects in Ethical Human Conduct. Holistic Alternative

and Universal Order. Universal Human Order and Ethical Conduct.

Unit V PROFESSIONAL ETHICS

6

Value based Life and Profession. Professional Ethics and Right Understanding. Competence in Professional Ethics. Issues in Professional Ethics – The Current Scenario.

Total Hours 30

Text Books:

1. Tripathi, A.N., "Human Values", 2004, New Age Intl. Publishers, New Delhi.
2. Bajpai, B. L., "Indian Ethos and Modern Management", 2004, New Royal Book Co., Lucknow. Reprinted 2008
3. Gaur, R.R., Sangal, R., and Bagaria, G.P., "A Foundation Course in Value Education", 2009, Excel Books, New Delhi.

Reference Books:

- 1 Gaur, R.R., Sangal, R., and Bagaria, G.P., "Teachers Manual", 2009, Excel Books.
- 2 Sharma, I.C., "Ethical Philosophy of India", Nagin & Co., Julundhar.
- 3 Govindrajran, M., Natrajan, S., and Senthil Kumar, V.S., "Engineering Ethics (including Human Values)", Eastern Economy Edition, Prentice Hall of India Ltd.

Web URL(s):

1. <https://www.uhv.org.in/uhv-ii>
2. https://fdp-si.aicte-india.org/8dayUHV_download.php
3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEKQw

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	2	2	3	-	2	-	-	-	-
CO2	2	1	-	-	-	3	2	2	-	2	-	-	-	-
CO3	1	2	-	-	-	3	3	3	-	2	-	-	-	-
CO4	1	2	-	-	-	3	3	3	-	2	-	-	-	-
CO5	2	2	2	-	2	3	3	3	-	3	2	-	-	-
Average	1.6	1.4	0.4	-	0.4	2.8	2.6	2.8	-	2.2	0.4	-	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MTA05	GENDER, CULTURE AND DEVELOPMENT	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination
- To analyze current events aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Apply core concepts, historical evolution, and key theories of gender studies to analyze societal structures and practices.	K3
CO2	Apply principles of gender equality and employment laws to address gender dynamics, issues, and violence in the workplace.	K3
CO3	Understand basic concepts and approaches to studying culture from gender perspectives, including the role of media and performance.	K2
CO4	Understand the relationship of gender with development, including key indices and measures such as the Gender Development Index and Gender Empowerment Measure.	K2
CO5	Apply government policies, initiatives, and emerging strategies to enhance gender equality and reduce disparities in economic opportunities in India.	K3

Course Contents

Unit I FOUNDATIONS OF GENDER STUDIES 8

Gender : Core Concepts of Gender/Evolution in Gender Studies, Patriarchy: Power, Structure and Practices, Masculinity/Femininity: An Overview, Understanding Sexuality: Conceptual Underpinnings, Inclusion, Exclusion, Discrimination: Caste, Class, Ethnicity, Waves of Feminism and Gender Theories.

Unit II GENDER DYNAMICS IN THE WORKPLACE 5

Gendering Work, Gender and Employment, Gender Issues in Work and Labour Market, Gender- Based Violence, Gender Equality and Women’s Protection: Law and Legislation in India

Unit III GENDER AND CULTURAL PERSPECTIVES 5

Culture: Gender Perspectives, Basic concepts and approaches to the study of culture: Gender perspectives, Interrogating Culture: Gender, caste and class.

Unit IV GENDER AND DEVELOPMENT 6

Introduction, Relationship of Gender with Development, Role of Gender in Development, Gender Empowerment and Development, Gender Development Index, Gender Empowerment Measure.

Unit V GENDER AND DEVELOPMENT IN INDIA 6

Government Policies and Initiatives for promoting gender equality, Role of women in the Indian economy, Gender disparities in economic opportunities, Women in Indian politics.

Total Hours 30

Text Books:

1. Seth, M., "Women and Development: The Indian Experience", 2001, Sage Publications, New Delhi.
2. Uberoi, P., "Freedom and Destiny: Gender, Family, and Popular Culture in India", 2006, Oxford University Press, New Delhi.
3. Nathan, Hippu Salk Kristle, "Gender-Based Indicators in Human Development: Correcting for 'Missing Women'", 2008, Indira Gandhi Institute of Development Research, Mumbai.

Reference Books:

- 1 Seth, Mira, "Women and Development: The Indian Experience", 2001, Sage Publications, New Delhi.
- 2 Mathu, A., "Gender and Development in India: The Indian Scenario", 2008, Gyan Publishing House.
- 3 Spary, C., "Gender, Development, and the State in India", 2019, Routledge.

Web URL(s):

1. <https://nptel.ac.in/courses/109103122>
2. <https://archive.nptel.ac.in/courses/109/107/109107139/>
3. https://onlinecourses.swayam2.ac.in/arp19_ap54/preview

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	-	3	2	3	-	2	1	-	-	-
CO2	2	3	2	-	-	3	2	3	-	2	1	-	-	-
CO3	1	2	-	-	-	2	3	3	-	2	1	-	-	-
CO4	1	2	-	-	-	3	3	3	-	2	1	-	-	-
CO5	2	2	2	-	-	3	3	3	-	3	2	-	-	-
Average	1.6	2.2	0.8	-	-	2.8	2.6	3	-	2.2	1.2	-	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MTA06	ENVIRONMENTAL SCIENCE	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Study the Environment, Ecosystem and Biodiversity by learning the structures and functions.	K2
CO2	Apply the case studies with present scenario on the effects of resource use on forests, water, minerals, and food by preparing a report that identifies the specific impacts and proposes practical solutions.	K3
CO3	Measure water and air quality parameters and assess pollution levels by conducting field tests and interpreting the results in a written analysis.	K2
CO4	Evaluate the role of NGOs and community initiatives in solving environmental issues by participating in a local environmental project and documenting the process and outcomes in a presentation.	K5
CO5	Identify and describe the different types and limitations of EIA by reviewing and summarizing an actual EIA report for a local development project, highlighting its strengths and weaknesses.	K3

Course Contents

Unit I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 6

Definition – scope of environment – concept of an ecosystem - structure and function of an ecosystem – ecological succession processes – Types. Biodiversity – definition: genetic, species and ecosystem diversity – threats to biodiversity – endangered and endemic species of India – conservation of biodiversity.

Unit II NATURAL RESOURCES 6

Forest resources: Use and benefits – Causes and effects. Water resources: Purpose and benefits, Socio economic impacts – Case studies. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: Food security, effects of modern agriculture on soil and water resources, Problems with Fertilizers and pesticides. Energy resources - Case studies.

Unit III ENVIRONMENTAL POLLUTION 6

Water pollution: Forms and sources of water pollution – water quality parameters – physical, chemical and biological parameters. Air pollution: Sources and classification, effects of air pollution – case study. Marine pollution: Causes and effects - Thermal pollution: Nuclear hazards – Case study.

Unit IV SOCIAL ISSUES AND THE ENVIRONMENTAL LEGISLATION 6

Sustainability – Ecological foot print – Urban energy crisis – Renewable energy. Water conservation – Rainwater harvesting. Role of non-governmental organization. Greenhouse effect - Global warming and climate change. Pollution control boards and acts in India.

Unit V ENVIRONMENT IMPACT ASSESSMENT

6

Environmental impact analysis (EIA) – Legal and Regulatory aspects in India – Types and limitations of EIA – Issues in EIA – Case studies of EIA of developmental projects.

Total Hours 30

Text Books:

1. Joseph, Benny, "Environmental Science and Engineering", 2006, Tata McGraw Hill Publishing Company, New Delhi.
2. Masters, Gilbert M. and Ela, Wendell P., "Introduction to Environmental Engineering and Science", 3rd Ed., 2015, Pearson Education India, Noida, Uttar Pradesh.
3. Peavy, Howard S., Rowe, Donald R., and Tchobanoglous, George, "Environmental Engineering", 2017, McGraw Hill Education, New Delhi.
4. Cunningham, W.P., Cooper, T.H., Gorhani, E., and Hepworth, M.T., "Environmental Encyclopedia", 2001, Jaico Publishing House, Mumbai.

Reference Books:

1. Kaul, S.N. and Ashutosh Gautam, "Principles of Environmental Studies", 2002, Daya Publishing house, New Delhi.
2. Anjaneyalu. Y, "Introduction to Environmental Science", 2004, BS Publications, Hyderabad, Andhra Pradesh.
3. Swarajya Lakshmi, G, Prabhu Prasadini, P, Ramesh Thatikunta and VNLV Tayar, "Environmental Science a Practical Manual", 2010, BS publications, Hyderabad.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc23_ge17/preview
2. https://onlinecourses.nptel.ac.in/noc23_hs155/preview
3. <https://nptel.ac.in/courses/103107084>

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	-	3	3	-	-	2	2	-	-	-
CO2	2	3	2	-	-	3	3	2	-	2	2	-	-	-
CO3	2	2	-	3	2	3	3	-	-	2	2	-	-	-
CO4	2	2	-	2	-	3	3	2	2	2	2	-	1	-
CO5	2	2	-	3	-	3	3	2	-	2	2	-	1	-
Average	2	2.2	0.4	1.6	0.4	3	3	1.2	0.4	2	2	-	0.4	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MTA07	SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To introduce students to the concept and principles of sustainable development.
- To analyze the environmental, social, and economic challenges facing sustainable development.
- To explore strategies for promoting sustainability in various sectors.
- To encourage critical thinking and problem-solving skills in addressing sustainability issues.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Define sustainable development and describe the differences between economic growth and sustainable development, including the transition from MDGs to SDGs.	K2
CO2	Explain the economic, socio-political, and ecological aspects of sustainability and analyze strategies for achieving sustainability in each aspect	K2
CO3	Analyze the roles of society, environment, culture, and economy in sustainable development and evaluate various initiatives and policies.	K3
CO4	Explain major challenges like climate change and resource management, and analyze adaptation and mitigation strategies.	K3
CO5	Describe the SDGs, analyze implementation challenges, and evaluate strategies for development, financing, and governance.	K3

Course Contents

Unit I INTRODUCTION TO SUSTAINABLE DEVELOPMENT 6

Introduction to Sustainable Development - Economic Growth and Progress - Environmental Threats. Business as Usual Versus Sustainable Development, From the MDGs to the SDGs: Agenda 2030.

Unit II ASPECTS OF SUSTAINABILITY DEVELOPMENT 6

Introduction to Sustainability Development, Economic Aspects- Meaning, Ways of Achieving Economic Sustainability. Socio Political Aspects – Meaning, Ways of Achieving Socio Political Sustainability. Ecological (Environmental) Aspects – Meaning, Ways of Achieving Ecological Sustainability.

Unit III DIMENSIONS TO SUSTAINABLE DEVELOPMENT 6

Society, environment, culture and economy; current challenges – natural, political, socio-economic imbalance. Sustainable development initiatives and policies of various countries: global, regional, national, local; needs of present and future generation – political, economic, environmental.

Unit IV CHALLENGES TO SUSTAINABLE DEVELOPMENT 6

Agriculture, Population & Food Security, Public Health and Nutrition, Education, Natural Resources (Forests, Energy, Water), Climate Change, Introduction to the science of climate change, Climate change and natural resources system, Human dimensions of climate change, Adaptation and Mitigation

Unit V PROPOSAL FOR SUSTAINABLE DEVELOPMENT GOALS 6

The Sustainable Development Goals, Structure and Content of the SDGs, Challenges in Implementing the SDGs, Goal-Based Development, Financing for Sustainable Development, Principles of Good Governance – Green Technology.

Total Hours 30

Text Books:

1. Franco, I.B. and Tracey, J., "Community capacity-building for sustainable development: Effectively striving towards achieving local community sustainability targets", 2019, International Journal of Sustainability in Higher Education.
2. Elliott, Jennifer, "An Introduction to Sustainable Development", 4th Edition, 2012, Routledge, London.
3. Rogers, Peter P., Kazi F. Jalal, and John A. Boyd. "An introduction to sustainable development", 2012.
4. Sachs, J. D, "The Age of Sustainable Development", 2015, Columbia University Press, New York.

Reference Books:

- 1 Soubbotina, Tatyana P., "Beyond Economic Growth: An Introduction to Sustainable Development", 2004, WBI Learning Resources Series, Washington DC, World Bank.
- 2 Kerr, Julie, "Introduction to Energy and Climate: Developing a Sustainable Environment", 2017, CRC Press.
- 3 Nhamo, Godwell, and Mjimba, Vuyo, "Sustainable Development Goals and Institutions of Higher Education", 2020, Springer.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc21_mg94/preview
2. https://onlinecourses.nptel.ac.in/noc22_hs61/preview

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	-	2	3	-	-	2	2	-	-	-
CO2	2	2	2	-	-	3	3	-	-	2	2	-	-	-
CO3	2	2	2	2	-	3	3	-	-	2	2	-	-	-
CO4	2	2	2	2	-	3	3	-	-	2	2	-	-	-
CO5	2	2	2	2	-	3	3	-	-	2	2	-	-	-
Average	2	2	1.6	1.2	-	2.8	3	-	-	2	2	-	-	-
3 –High; 2–Medium;1 –Low; - No Correlation														

U23MTA08	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

Course Outcomes:	BT Level (highest level)
Upon completion of the course, students would be able to	
CO1 Explain the concepts of Disaster, Vulnerability and Disaster Risk reduction.	K2
CO2 Identify the Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction.	K3
CO3 Develop disaster response skills by adopting relevant tools and technology	K3
CO4 Build awareness of institutional processes for Disaster response in the country.	K3
CO5 Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity.	K3

Course Contents

Unit I HAZARDS, VULNERABILITY AND DISASTER RISKS 6

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks. Natural, Human induced, Climate change induced. Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters – Structural collapse, Industrial accidents, oil spills – Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.

Unit II DISASTER RISK REDUCTION (DRR) 6

Sendai Framework for Disaster Risk Reduction, Disaster cycle – Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR. Structural – non-structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders.

Unit III DISASTER MANAGEMENT 6

Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction – Disaster Risk Management and post disaster management – Compensation and Insurance. Disaster Management Act (2005) and Policy.

Unit IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 6

Early warning systems - Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness – Role of GIS and Information Technology Components in Preparedness.

Unit V DISASTER MANAGEMENT: CASE STUDIES 6

Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters – Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies. Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies



Text Books:

1. Taimpo, “Disaster Management and Preparedness”, 2016, CRC Publications, Florida, USA.
2. Singh R, “Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami”, 2017, Horizon Press Publications, Norfolk, United Kingdom.
3. Singhal J.P. “Disaster Management”, 2010, Laxmi Publications, Chennai.
4. Tushar Bhattacharya, “Disaster Science and Management”, 2012, McGraw Hill India Education Pvt. Ltd, New Delhi.

Reference Books:

- 1 Govt. of India: Disaster Management Act, 2005, Government of India, New Delhi.
- 2 Government of India, “National Disaster Management Policy”, 2009.
- 3 Shaw R, “Community based Disaster risk reduction”, 2016, Oxford University Press, England, United Kingdom.

Web URL(s):

1. https://onlinecourses.swayam2.ac.in/cec19_hs20/preview
2. <https://ssp.nidm.gov.in/enrol/index.php?id=147>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	-	-	-	2	3	-	-	2	-	-	-	-
CO2	2	3	-	2	-	3	3	-	-	2	-	-	-	-
CO3	2	2	3	2	3	3	3	-	2	2	-	-	-	-
CO4	2	2	2	2	-	3	3	-	-	2	-	-	-	-
CO5	2	2	2	2	-	3	3	-	-	2	-	-	-	-
Average	2	2.2	1.6	1.6	0.6	2.8	3	-	0.4	2.0	-	-	-	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

U23MTA09	VISION FOR HUMANE SOCIETY	L	T	P	C
		2	0	0	0

Pre-Requisites : None

Course Objectives:

- To help the students to understand the importance and types of relationship with expressions.
- To develop the competence to think about the conceptual framework of undivided society as well as universal human order.
- To help the students to develop the exposure for transition from current state to the undivided society and universal human order.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Analyze the significance of feelings in ensuring justice in human-human relationships	K3
CO2	Formulate a conceptual framework of humane society based on relationship and harmony	K2
CO3	Evaluate the fulfillment in relationships in their personal and professional life with the understanding of established and expressed values.	K3
CO4	Develop the competence to work as a team based on relationship in different dimensions of life and society.	K3
CO5	Formulate the steps of transition from current state to humane society (the undivided society and universal human order).	K4

Course Contents

Unit I INTRODUCTION TO THE COURSE 7

Basic aspiration of a Human Being and program for its fulfilment, Need for family and relationship for a Human Being, Human-Human relationship and role of work in its fulfilment, Comprehensive Human Goal, Need for Undivided Society, Need for Universal Human Order.

Unit II UNDERSTANDING HUMAN-HUMAN RELATIONSHIP & ITS FULFILMENT 6

Recognition of Human-Human Relationship, Recognition of feelings in relationship, Established Values and Expressed Values in Relationship, interrelatedness of feelings and their fulfilment, Expression of feelings.

Unit III JUSTICE FROM FAMILY TO WORLD FAMILY ORDER 6

Undivided Society as continuity and expanse of Justice in behaviour – family to world family order, continuity of culture and civilization, Universal Order on the basis of Undivided Society, Conceptual Framework for Universal human order.

Unit IV PROGRAM FOR ENSURING UNDIVIDED SOCIETY AND UNIVERSAL HUMAN ORDER 4

Education –Sanskar, Health –Sanyam, Production-work, Exchange – storage, Justice-preservation.

Unit V HUMAN TRADITION 7

Scope and Steps of Universal Human Order, Human Tradition (Ex. Family order to world family order),

Steps for transition from the current state, Possibilities of participation of students in this direction, Present efforts in this direction, Sum up.

Total Hours 30

Text Books:

1. Gaur, R. R., Sangal, R., and Bagaria, G. P., "A Foundation Course in Human Values and Professional Ethics", 2010, Excel Books, New Delhi.
2. Gandhi, M. K., "Hind Swaraj: Indian Home Rule", 2014, Sarva Seva Sangh Prakashan.
3. Holborn, Martin, and Langley, Peter, "Sociology: Themes and Perspectives", 8th Ed., 2014, HarperCollins; originally published 1980.

Reference Books:

- 1 Dhar, P. L., and Gaur, R. R., "Science & Humanism – Towards a Unified Worldview", 1990, Commonwealth Publishers, New Delhi.
- 2 Nagraj, A., "Manav Vyavahar Darshan", Divya Path Sansthan, Amarkantak, India.
- 3 Kumarappa, J. C., "Economy of Permanence – A Quest for Social Order Based on Non-Violence", 2010, Sarva-Seva-Sangh-Prakashan, Varanasi, India.

Web URL(s):

1. <https://www.nec.com/en/global/about/vision/overview.html>
2. <https://www.who.int/publications/i/item/9789241516570>
3. https://www.youtube.com/watch?v=AK3mTb_-1BQ
4. https://www.youtube.com/playlist?list=PLBvTTYUOHEmc2jUJh4gPaoqm_kKup1aqX

Bloom's Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6 – Create

Mapping COs, POs & PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	-	-	-	-	-	2	2	3	-	2	2	-	-	-
CO2	-	-	2	-	-	3	3	3	2	2	2	-	-	-
CO3	-	-	2	-	-	3	3	3	2	2	2	-	-	-
CO4	-	-	2	-	-	2	-	2	3	3	2	-	-	-
CO5	-	-	2	-	-	3	3	3	2	2	2	-	-	-
Average	-	-	1.6	-	-	2.6	2.2	2.8	1.8	2.2	2.0	-	-	-
3 –High; 2–Medium; 1 –Low; - No Correlation														

OPEN ELECTIVE COURSES OFFERED TO OTHER DEPARTMENT

U23OE251	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	0	0	3

Pre-Requisites :

Course Objectives:

- To understand the fundamentals of industrial automation and system architecture.
- To explore automation components such as sensors, actuators, and power electronic devices.
- To learn computer-aided measurement and control systems, including IoT applications in automation.
- To develop skills in PLC programming, installation, and application in process industries.
- To understand distributed control systems (DCS) and their integration with PLCs and computers.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Describe industrial automation systems with emphasis on PLC, SCADA, and communication protocols like Modbus and Profibus.	K2
CO2	Illustrate the roles of sensors, actuators, power electronic devices, and servo drives in industrial automation systems.	K2
CO3	Demonstrate the application of computer-based systems and IoT in process control and industrial automation.	K3
CO4	Develop basic PLC programs using ladder diagrams for the industrial process control applications.	K3
CO5	Utilize DCS software configuration, communication, and integration with PLCs and computers for effective industrial automation.	K3

Course Contents

Unit I INTRODUCTION 9

Automation overview, Requirement of automation systems, Architecture of IndustrialAutomation system, Introduction of PLC and supervisory control and data acquisition(SCADA). Industrial bus systems : Modbus &Profibus

Unit II AUTOMATION COMPONENTS 9

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and Measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC,power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

Unit III COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS 9

Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

Unit IV PROGRAMMABLE LOGIC CONTROLLERS 9

Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries

Unit V DISTRIBUTED CONTROL SYSTEM

9

Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS

Total Hours 45

Text Books:

1. S.K.Singh, “Industrial Instrumentation”, Tata Mcgraw Hill, 2nd edition companies, 2010.
2. C D Johnson, “Process Control Instrumentation Technology”, Prentice Hall India,8th Edition, 2013.
3. Frank D. Petruzella, “Programmable Logic Controllers”, 5th Edition, McGraw- Hill,New York, 2016.

Reference Books:

1. John W. Webb and Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications”, 5th Edition, Prentice Hall Inc., New Jersey, 2003
2. Krishna Kant, “Computer - Based Industrial Control”, 2nd Edition, Prentice Hall, New Delhi, 2011.
3. Gary Dunning, Thomson Delmar,“Programmable Logic Controller”, CeneageLearning, 3 rd Edition,2005.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc20_me39

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
C01	2	-	-	-	2	-	-	-	-	-	1			
C02	2	-	-	-	2	-	-	-	-	-	-			
C03	2	-	1	1	2	-	-	-	-	-	-			
C04	2	1	2	2	2	-	-	-	-	1	2			
C05	2	1	2	1	2	-	-	-	-	1	2			
Average	2.0	1.0	1.6	1.3	2.0	-	-	-	-	1.0	1.7			
3 –High; 2–Medium;1 –Low; - No Correlation														

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - Sustenance -Maintenance and Repair – Enhancements - Product EoL - Obsolescence Management – Configuration Management - EoL Disposal

Unit V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –The IPD Essentials - Introduction to Vertical Specific Product Development processes - Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

Total Hours 45

Text Books:

1. Ulrich,Karl,Steven Eppinger andMaria C.Yang."Product Design and Development",7th edition, Tata McGraw-Hill Education, 2020.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.
3. Chitale,AK,Gupta,RC," Product Design and Manufacturing "PHI,2013.

Reference Books:

1. Hiriappa B, “Corporate Strategy – Managing the Business”, Author House, 2013
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013
5. George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, 4th Edition, 2017.

Web URL(s):

1. <https://nptel.ac.in/courses/112107217>
2. <https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, POs and PSOs

COs	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	-	2	2	-	-	-	-			
CO2	2	-	2	-	-	-	-	-	-	-	-			
CO3	2	-	2	-	-	-	-	-	-	-	-			
CO4	2	-	-	-	-	2	2	1	-	-	-			
CO5	2	-	-	-	-	2	2	2	-	-	-			
AVG	2	-	2	-	-	2	2	1.5	-	-	-			
3 –High; 2–Medium;1 –Low; - No Correlation														

U23OE253	INTRODUCTION TO ROBOTICS	L	T	P	C
		3	0	0	3

Pre-Requisites :

Course Objectives:

- To provide fundamental knowledge about robotics, including their classification, configuration, and specifications.
- To introduce the concepts and mechanisms of mobile robotics with different locomotion systems.
- To familiarize students with the various sensors used for robot navigation and their functional applications.
- To impart knowledge about Robot Operating Systems (ROS) and their significance in simulation and visualization.
- To explore the diverse applications of industrial robots in real-world scenarios like welding, palletizing, and material handling.

Course Outcomes:

Upon completion of the course, students would be able to

**BT Level
(highest
level)**

CO1	Describe the fundamental concepts of industrial robotics, including configurations, specifications, and dynamic characteristics.	K2
CO2	Explain the mechanisms and key issues involved in the locomotion of mobile robots, including stability and controllability.	K2
CO3	Apply the principles of magnetic, optical, gyroscope, accelerometer, and range finder sensors to select and use them in automation systems.	K3
CO4	Develop and simulate ROS nodes using ROS tools, messages, classes, and servers for robotic applications.	K3
CO5	Apply robotic technologies in welding, palletizing, deburring, assembly, and material handling to enhance industrial automation.	K3

Course Contents

Unit I	INDUSTRIAL ROBOTICS	9
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Introduction to Robotics-classification with respect to geometrical configuration (Anatomy), Industrial robots specifications, Selection based on the Application, Controlled system & chain type: Serial manipulator & Parallel Manipulator, Components of Industrial robotics- precession of movement-resolution, accuracy & Repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response

Unit II	MOBILE ROBOTICS	9
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Introduction to Robotics – key issues in robot locomotion – Types of Locomotion -legged robots – wheeled mobile robots – aerial mobile robots – stability - robot maneuverability – controllability

Unit III	SENSORS FOR ROBOT NAVIGATION	9
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Types of sensors - magnetic and optical position sensor - gyroscope - accelerometer - magnetic compass inclinometer - tactile and proximity sensor - ultrasound range finder - laser scanner, infrared range finder - visual and motion sensing systems.

Unit IV	ROBOT OPERATING SYSTEMS (ROS)	9
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ROS Concepts, Writing ROS Nodes, ROS Tools; Messages, Classes and Servers in ROS; Simulation and Visualization in ROS.



Unit V APPLICATIONS OF INDUSTRIAL ROBOTS

9

Robot Applications – Welding, Palletizing, Deburring, Assembly- material handling and processing applications, recent trends in industrial robots

Total Hours 45

Text Books:

1. Groover Mikell .P, “Industrial Robotics -Technology Programming and Applications”, McGraw Hill,2014.
2. Nikolaus Correll, “Introduction to Autonomous Robots”, 1st edition, 2016 Magellan Scientific, USA.
3. Lentin Joseph, Aleena Johny, “Robot Operating System (ROS) for Absolute Beginners Robotics Programming Made Easy”, Second Edition, Apress, 2022.

Reference Books:

1. Luc Jaulin, “Mobile Robotics”, 2nd edition, 2019, Wiley,United Kingdom.
2. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2017.
3. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.
4. Pratihari. D.K, “Fundamentals of Robotics”, Narosa Publishing House,India,2019.

Web URL(s):

1. https://onlinecourses.nptel.ac.in/noc21_me44

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	-	-	-	-	-	-			
CO2	2	-	1	-	1	-	-	-	-	-	-			
CO3	2	-	-	-	2	-	-	-	-	-	-			
CO4	2	-	-	1	2	-	-	-	-	-	-			
CO5	2	-	1	-	1	-	-	-	-	-	-			
Average	2.0	-	1.0	1.0	1.4	-	-	-	-	-	-			
3 –High; 2–Medium;1 –Low; - No Correlation														

Unit V Sensor Interfacing

9

Smart Sensor Systems – Role of sensors in IOT - Multichannel Sensor Interfacing - Standards - Integrated Circuit Bus (I2C) - Serial Peripheral Interface (SPI) - Controller Area Network (CAN) Bus - Universal Transducer Interface (UTI)

Total Hours 45

Text Books:

1. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 3rd edition, Springer, New York, 2015.
2. John G Webster, “Measurement, Instrumentation and sensor Handbook”, 2nd edition, CRC Press, Florida, 2014.
3. Kirianaki N.V., Yurish S.Y., Shpak N.O., Deynega V.P., Data Acquisition and Signal Processing for Smart Sensors, John Wiley & Sons, Chichester, UK, 2002.

Reference Books:

1. Ramon Pallas-Areny and John G Webster, Sensors and Signal Conditioning, 2nd ed., Wiley India Pvt. Ltd, 2012.
2. John Park and Steve Mackay, Practical Data acquisition for Instrumentation and Control, 1st ed., Newness publishers, Oxford, UK, 2011.
3. Paul P.L Regtien, “Sensors for Mechatronics”, Elsevier publications, 1st edition, 2012.

Web URL(s):

1. <https://nptel.ac.in/courses/108105062>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	1	-	-	1	-	-	-	-	-	-			
CO2	2	-	-	-	1	-	-	-	-	-	-			
CO3	2	-	-	-	2	-	-	-	-	-	-			
CO4	2	-	-	-	2	-	-	-	-	-	-			
CO5	2	-	-	-	2	-	-	-	-	-	-			
Average	2.0	1.0	-	-	1.6	-	-	-	-	-	-			
3 –High; 2–Medium; 1 –Low; - No Correlation														

U230E255	3D PRINTING TECHNOLOGY	L	T	P	C
		3	0	0	3

Pre-Requisites : NIL

Course Objectives:

- Familiarize students with the foundational concepts and terminologies of 3D printing.
- Introduce various additive manufacturing processes and technologies.
- Explain commonly used materials and software tools involved in 3D printing.
 - Highlight key industrial applications and the role of 3D printing in modern engineering.

Course Outcomes:

Upon completion of the course, students would be able to

**BT
Level
(highest
level)**

CO1	Summarize the key terminology and process classification of 3D printing and infer its differences from subtractive and formative methods.	K2
CO2	Describe 3D printing processes like FDM, SLA, DLP, SLS, DMLS, binder jetting, and DED, and their comparative benefits.	K3
CO3	Discuss the properties, applications, and selection criteria of materials used in additive manufacturing,	K2
CO4	Paraphrase the 3D printing workflow, including modeling, file formats, and slicing.	K2
CO5	Apply additive manufacturing concepts to industrial applications and emerging trends.	K3

Course Contents

Unit I FUNDAMENTALS OF 3D PRINTING 9

History and evolution of 3D printing - Definition and key terminology - Comparison of additive, subtractive, and formative processes - General process chain of 3D printing - Classification of additive manufacturing processes (ASTM F42)

Unit II ADDITIVE MANUFACTURING TECHNOLOGIES 9

Process overview and categorization - Fused Deposition Modeling (FDM): principles, components, advantages - Stereolithography (SLA) - Digital Light Processing (DLP) - Selective Laser Sintering (SLS) - Direct Metal Laser Sintering (DMLS) - Binder Jetting and Direct Energy Deposition (DED) - Comparative analysis of technologies

Unit III MATERIALS FOR 3D PRINTING 9

Thermoplastics: PLA, ABS, PETG, Nylon - properties and applications - Metals: Titanium, Aluminum, Stainless Steel – overview - Composites and ceramics – basic characteristics - Criteria for material selection in additive manufacturing - Limitations and challenges in material usage

Unit IV 3D PRINTING WORKFLOW AND SOFTWARE 9

Overview of digital workflow: CAD → STL → Slicing → Printing - CAD modeling guidelines for AM - File formats used in 3D printing: STL, OBJ, AMF - Slicing software: Cura, Prusa Slicer – basic interface and functions - Print settings: layer height, infill, speed, support structures - Common print issues and troubleshooting basics.

Unit V APPLICATIONS AND FUTURE TRENDS

9

Industrial applications: aerospace, automotive, biomedical, tooling - Rapid prototyping and product customization - Educational and consumer-level 3D printing - Environmental and economic considerations - Introduction to bioprinting, 4D printing, and Industry 4.0 context - Current challenges and future scope

TotalPeriods 45

Text Books:

1. Gibson, I., Rosen, D. W., &Stucker, B, Additive manufacturing technologies: 3D printing, rapid prototyping, and direct digital manufacturing, 3rd edition, Springer, 2021.
2. Chua, C. K., Leong, K. F., & Lim, C. S, 3D printing and additive manufacturing: Principles and applications, 5th edition, World Scientific, 2017.

Reference Books:

1. Gebhardt, A., & Hotter, J, Additive manufacturing: 3D printing for prototyping and manufacturing, 2nd edition, Hanser Publishers,2016.
2. Ngo, T. D., Kashani, A., Imbalzano, G., Nguyen, K. T. Q., &Hui, D, Additive manufacturing (3D printing): A review of materials, methods, applications and challenges,2018.
3. ASTM International, ISO/ASTM 52900:2021 -Additive manufacturing – General principles — Terminology. ASTM International, 2020.

Web URL(s):

1. <https://www.hubs.com/knowledge-base/>
2. <https://www.thingiverse.com>
3. <https://eng.libretexts.org>

Bloom’s Taxonomy Level

K1- Remember, K2 – Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6 – Create

Mapping COs, Pos and PSOs

Course Outcomes	Programme Outcomes (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	-	-	-	1	-	-	-	-	-	-			
CO2	2	-	1	-	1	-	-	-	-	-	-			
CO3	2	-	-	-	2	-	-	-	-	-	-			
CO4	2	-	-	1	2	-	-	-	-	-	-			
CO5	2	-	1	-	1	-	-	-	-	-	-			
Average	2.0	-	1.0	1.0	1.4	-	-	-	-	-	-			
3 –High; 2–Medium;1 –Low; - No Correlation														