RAJALAKSHMI INSTITUTE OF TECHNOLOGY

BELIEVE IN THE POSSIBILITIES

AN AUTONOMOUS INSTITUTION

B.E. MECHANICAL ENGINEERING

CURRICULUM AND SYLLABI FOR SEMESTER I TO VIII

(Batch 2023-2027)

REGULATIONS 2023

RAJALAKSHMI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Kuthambakkam, Chennai 600124

RAJALAKSHMI INSTITUTE OF TECHNOLOGY, CHENNAI
An Autonomous Institution, Affiliated to Anna University, Chennai

REGULATIONS 2023
CHOICE BASED CREDIT SYSTEM

B.E. MECHANICAL ENGINEERING

I VISION OF THE DEPARTMENT

To be the premier choice for cultivating proficient mechanical engineers equipped with the essential skills, ethical values, and innovative mindset to excel in a dynamic global landscape through unwavering academic excellence and cutting-edge research.

II MISSION OF THE DEPARTMENT

- To deliver high-quality education in mechanical engineering that meets the dynamic demand of the industries, instils ethical value and fosters innovative thinking and lifelong learning.
- To create a research-driven learning environment for developing sustainable technologies that contribute to societal and industrial growth.
- To cultivate a collaborative ecosystem with academia, industry, and professional bodies to enhance technical competence, leadership skills and global employability.

III PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates can:

1. **PEO 1: Excel in Professional Careers and Higher Education**
   Attain technical expertise, problem-solving skills, and global awareness to excel in industries, research organizations and higher education institutions.
2. **PEO 2: Innovate and Contribute to Sustainability**
   Develop innovative solutions, addressing the real-world mechanical engineering challenges while upholding principles of environmental sustainability.
3. **PEO 3: Demonstrate Ethical and Leadership Qualities**
   Exhibit professional ethics, effective communication, teamwork, and leadership qualities in multidisciplinary environments.
4. **PEO 4: Engage in Lifelong Learning**
   Pursue lifelong learning to adapt to the evolving technologies and contribute to the betterment of society through continuous self-improvement.

IV PROGRAM OUTCOMES (POs)

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics,

natural sciences, and engineering sciences.

3. **Design/ Development of Solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems**: Use research-based knowledge and research methods, including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability**: Understand the impact of the professional engineering solutions to societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong Learning**: Recognize the need and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

V PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates will be able to:

PSO 1: Core Mechanical Proficiency

Analyze, optimize and develop innovative solutions for the real-world mechanical challenges, by applying the principles of design, thermal engineering and computational tools effectively.

PSO 2: Sustainable and Advanced Manufacturing

Apply advanced manufacturing technologies, automation, and sustainable practices to design and execute efficient production systems, ensuring precision, and resource optimization.

PSO 3: Multidisciplinary Integration and Research

Integrate knowledge from various disciplines to solve complex engineering problems, and foster innovation and research in emerging fields such as mechatronics, robotics, and energy systems.

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REGULATIONS 2023 CHOICE BASED CREDIT SYSTEM
CURRICULUM FOR SEMESTER I TO VIII

B.E. MECHANICAL ENGINEERING

From 2023 – 2027 Batch

SEMESTER I

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
	IP23111	Induction Programme	-	-	-	-	-	0
THEORY COURSES								
1	HS23111	Communicative English	HSMC	3	0	0	3	3
2	MA23111	Matrices and Calculus	BSC	3	1	0	4	4
3	CY23111	Engineering Chemistry	BSC	3	0	0	3	3
4	GE23111	Problem Solving and C Programming	ESC	3	0	0	3	3
5	PH23113	Materials Science	BSC	3	0	0	3	3
6	GE23112	தமிழர் மரபு / Heritage of Tamils	HSMC	1	0	0	1	0
LABORATORY COURSES								
7	CY23121	Chemistry Laboratory	BSC	0	0	2	2	1
8	PH23121	Physics Laboratory	BSC	0	0	2	2	1
9	GE23121	Problem Solving and C Programming Laboratory	ESC	0	0	2	2	1
10	GE23122	Engineering Practices Laboratory	ESC	0	0	2	2	1
TOTAL								**20**

SEMESTER II

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSES								
1	HS23211	Professional English	HSMC	2	0	0	2	2
2	MA23211	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	AD23211	Python for Data Science	ESC	3	0	0	3	3
4	GE23212	Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
5	GE23213	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HSMC	1	0	0	1	0
LABORATORY ORIENTED THEORY COURSE								
6	GE23231	Engineering Graphics	ESC	3	0	2	5	4
LABORATORY COURSES								
7	AD23221	Python for Data Science Laboratory	ESC	0	0	2	2	1
8	GE23221	Communication Laboratory/Foreign Language	EEC	0	0	2	2	1
9	GE23222	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	2	2	1
-	-	NCC/Service Club Credit Course Level 1#		2	0	0	2	2#
TOTAL								19

 # NCC Credit Course Level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however, the same shall not be considered for the computation of CGPA.

SEMESTER III

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSES								
1	MA23313	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2	ME23311	Engineering Mechanics	PCC	3	0	0	3	3
3	ME23312	Engineering Thermodynamics	PCC	3	1	0	3	4
4	ME23313	Fluid Mechanics and Machinery	PCC	3	1	0	4	4
5	ME23314	Manufacturing Processes	PCC	3	0	0	3	3
6	CS23312	Object Oriented Programming	ESC	3	0	0	3	3
LABORATORY COURSES								
7	ME23321	Computer Aided Machine Drawing Laboratory	PCC	0	0	2	2	1
8	CS23322	Object Oriented Programming Laboratory	ESC	0	0	2	2	1
TOTAL								**23**

SEMESTER IV

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSES								
1	GE23412	Environmental Science for Mechanical Engineers	BSC	2	0	0	2	2
2	ME23411	Engineering Materials and Metallurgy	PCC	3	0	0	3	3
3	ME23412	Manufacturing Technology	PCC	3	0	0	3	3
4	ME23413	Mechanics of Solids	PCC	3	0	0	3	3
5	ME23414	Theory of Machines	PCC	3	1	0	4	4
LABORATORY ORIENTED THEORY COURSE								
6	ME23431	Thermal Engineering	PCC	2	1	2	5	4
LABORATORY COURSES								
7	ME23421	Manufacturing Technology Laboratory	PCC	0	0	2	2	1
8	ME23422	Strength of Materials and Fluid Machinery Laboratory	PCC	0	0	2	2	1
INDUSTRY ORIENTED COURSES								
9	ME23IC1	Introduction to Product Lifecycle Management	EEC	1	-	-	1	1
-	-	NCC/Service Club Credit Course level 2#		3	0	0	3	3#
TOTAL								22

#NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSES								
1	ME23511	Design of Machine Elements	PCC	3	1	0	4	4
2	ME23512	Heat and Mass Transfer	PCC	3	1	0	4	4
3		Professional Elective I	PEC	3	0	0	3	3
4		Professional Elective II	PEC	3	0	0	3	3
5		Mandatory Course – I&	MC	3	0	0	3	0
LABORATORY ORIENTED THEORY COURSE								
6	ME23531	Mechatronics	PCC	3	0	2	5	4

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
LABORATORY COURSES								
7	ME23521	Heat Transfer Laboratory	PCC	0	0	2	2	1
8	ME23522	Professional/Skill Development	EEC	0	0	2	2	1
INDUSTRY ORIENTED COURSE								
9	ME23IC2	Introduction to Supply Chain Management	EEC	1	-	-	1	1
TOTAL								**21**

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

SEMESTER VI

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSES								
1	ME23611	Design of Transmission Systems	PCC	3	0	0	3	3
2		Professional Elective III	PEC	3	0	0	3	3
3		Professional Elective IV	PEC	3	0	0	3	3
4		Open Elective – I*	OEC	3	0	0	3	3
5		Open Elective – II*	OEC	3	0	0	3	3
6		Mandatory Course- II&	MC	3	0	0	3	0
LABORATORY ORIENTED THEORY COURSE								
7	ME23631	Metrology and Measurements	PCC	3	0	2	5	4
LABORATORY COURSES								
8	ME23622	CAD and CAM Laboratory	PCC	0	0	2	2	1
9	ME23623	Design and Fabrication Project	EEC	0	0	4	4	2
INDUSTRY ORIENTED COURSE								
10	ME23IC3	Introduction to HVAC Systems	EEC	1	-	-	1	1
-	-	NCC/Service Club Credit Course level 3#		3	0	0	3	3#
TOTAL								**23**

**Open Electives shall be chosen from the emerging technologies from the list of courses.*

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

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

SEMESTER VII

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSES								
1	GE23711	Human Values and Ethics	HSMC	2	0	0	2	2
2		Elective – Management#	HSMC	3	0	0	3	3
3	ME23712	Industrial Robotics	PCC	4	0	0	4	4
4	ME23713	Finite Element Analysis	PCC	3	1	0	4	4
5		Professional Elective V	PEC	3	0	0	3	3
6		Professional Elective VI	PEC	3	0	0	3	3
LABORATORY COURSES								
7	ME23721	Internship/Certification Course	EEC	-	-	-	-	2
8	ME23722	Simulation Laboratory	PCC	0	0	2	2	1
TOTAL								**22**

 # Elective – Management shall be chosen from the list of Elective Management courses.

SEMESTER VIII

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
THEORY COURSE								
1		Open Elective – III**	OEC	3	0	0	3	3
LABORATORY COURSE								
2	ME23821	Project Work	EEC	0	0	20	20	10
TOTAL								**13**

**Open Elective III (Shall be chosen from the list of open electives offered by other programmes).

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Sl. No.	Vertical 1	Vertical 2	Vertical 3	Vertical 4	Vertical 5	Vertical 6
	MODERN MOBILITY SYSTEMS	**PRODUCT AND PROCESS DEVELOPMENT**	**ROBOTICS AND AUTOMATION**	**DIGITAL AND GREEN MANUFACTURING**	**DIVERSIFIED COURSES**	**SUPPLY CHAIN MANAGEMENT FOR INDUSTRY**
1	ME23V11 Automobile Engineering	ME23V21 Advanced Product Quality Planning (APQP)	ME23V31 Automation in Manufacturing	ME23V41 Carbon Footprint Estimation and Reduction	ME23V51 Computational Fluid Dynamics in Heat Transfer	ME23V61 Industry 5.0
2	ME23V12 Autonomous Vehicles	ME23V22 Intellectual Property Rights	ME23V32 Collaborative Robot (COBOT)	ME23V42 Composite Materials and Mechanics	ME23V52 Design of Jigs, Fixtures and Press Tools	ME23V62 Planning in Logistics
3	ME23V13 Battery Thermal Management System	ME23V23 Lean Manufacturing and Six Sigma	ME23V33 Drone Technology	ME23V43 Computer Integrated Manufacturing	ME23V53 Ergonomics in Design	ME23V63 Supply Chain Analytics
4	ME23V14 Hybrid and Electrical Vehicles	ME23V24 New Product Development	ME23V34 Embedded Systems and Programming	ME23V44 Digital Manufacturing and IoT	ME23V54 Gas Dynamics and Jet Propulsion	ME23V64 Supply Chain Information System
5	ME23V15 Off Road Vehicles	ME23V25 Process Planning and Cost Estimation	ME23V35 Haptic and Immersive Technologies	ME23V45 Green Manufacturing Design and Practices	ME23V55 Hydraulics and Pneumatics	ME23V65 Supply Chain for Manufacturing
6	ME23V16 Renewable Powered Off Highway Vehicles and Emission Control	ME23V26 Product Design and Manufacturing	ME23V36 Introduction to PLC Programming	ME23V46 Metal Additive Manufacturing	ME23V56 Power Plant Engineering	E23V67 Sustainable Inventory Management
7	ME23V17 Sustainable Energy Technology	ME23V27 Production Planning and Control	ME23V37 Mobile Robot	ME23V47 Smart Manufacturing	ME23V57 Refrigeration and Air Conditioning	ME23V68 Warehouse Automation

Registration of Professional Elective Courses from Verticals:

These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI. The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E./B.Tech (Honours) or Minor degree also.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: MODERN MOBILITY SYSTEMS

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23V11	Automobile Engineering	PEC	3	0	0	3	3
2	ME23V12	Autonomous Vehicles	PEC	3	0	0	3	3
3	ME23V13	Battery Thermal Management System	PEC	3	0	0	3	3
4	ME23V14	Hybrid and Electrical Vehicles	PEC	3	0	0	3	3
5	ME23V15	Off Road Vehicles						
6	ME23V16	Renewable Powered Off Highway Vehicles and Emission Control	PEC	3	0	0	3	3
7	ME23V17	Sustainable Energy Technology	PEC	3	0	0	3	3

VERTICAL 2: PRODUCT AND PROCESS DEVELOPMENT

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23V21	Advanced Product Quality Planning (APQP)	PEC	3	0	0	3	3
2	ME23V22	Intellectual Property Rights	PEC	3	0	0	3	3
3	ME23V23	Lean Manufacturing and Six Sigma	PEC	3	0	0	3	3
4	ME23V24	New Product Development	PEC	3	0	0	3	3
5	ME23V25	Process Planning and Cost Estimation	PEC	3	0	0	3	3
6	ME23V26	Product Design and Manufacturing	PEC	3	0	0	3	3
7	ME23V27	Production Planning and Control	PEC	3	0	0	3	3

VERTICAL 3: ROBOTICS AND AUTOMATION

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23V31	Automation in Manufacturing	PEC	3	0	0	3	3
2	ME23V32	Colloborative Robot (COBOT)	PEC	3	0	0	3	3
3	ME23V33	Drone Technology	PEC	3	0	0	3	3
4	ME23V34	Embedded Systems and Programming	PEC	3	0	0	3	3
5	ME23V35	Haptic and Immersive Technologies	PEC	3	0	0	3	3
6	ME23V36	Introduction to PLC Programming	PEC	3	0	0	3	3
7	ME23V37	Mobile Robot	PEC	3	0	0	3	3

VERTICAL 4: DIGITAL AND GREEN MANUFACTURING

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23V41	Carbon Footprint Estimation and Reduction	PEC	3	0	0	3	3
2	ME23V42	Composite Materials and Mechanics	PEC	3	0	0	3	3
3	ME23V43	Computer Integrated Manufacturing	PEC	3	0	0	3	3
4	ME23V44	Digital Manufacturing and IoT	PEC	3	0	0	3	3
5	ME23V45	Green Manufacturing Design and Practices	PEC	3	0	0	3	3
6	ME23V46	Metal Additive Manufacturing	PEC	3	0	0	3	3
7	ME23V47	Smart Manufacturing	PEC	3	0	0	3	3

VERTICAL 5: DIVERSIFIED COURSES

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23V51	Computational Fluid Dynamics in Heat Transfer	PEC	3	0	0	3	3
2	ME23V52	Design of Jigs, Fixtures and Press Tools	PEC	3	0	0	3	3
3	ME23V53	Ergonomics in Design	PEC	3	0	0	3	3
4	ME23V54	Gas Dynamics and Jet Propulsion	PEC	3	0	0	3	3
5	ME23V55	Hydraulics and Pneumatics	PEC	3	0	0	3	3
6	ME23V56	Power Plant Engineering	PEC	3	0	0	3	3
7	ME23V57	Refrigeration and Air Conditioning	PEC	3	0	0	3	3

VERTICAL 6: SUPPLY CHAIN MANAGEMENT FOR INDUSTRY

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23V61	Industry 5.0	PEC	3	0	0	3	3
2	ME23V62	Planning in Logistics	PEC	3	0	0	3	3
3	ME23V63	Supply Chain Analytics	PEC	3	0	0	3	3
4	ME23V64	Supply Chain Information System	PEC	3	0	0	3	3
5	ME23V65	Supply Chain for Manufacturing	PEC	3	0	0	3	3
6	ME23V67	Sustainable Inventory Management	PEC	3	0	0	3	3
7	ME23V68	Warehouse Automation	PEC	3	0	0	3	3

ELECTIVE – MANAGEMENT COURSES

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	GE23712	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
2	GE23713	Human Resource Management	HSMC	3	0	0	3	3
3	GE23714	Knowledge Management	HSMC	3	0	0	3	3
4	GE23715	Principles of Management						
5	GE23716	Software Project Management	HSMC	3	0	0	3	3
6	GE23717	Total Quality Management	HSMC	3	0	0	3	3
7	GE23718	Management Information Systems	HSMC	3	0	0	3	3

MANDATORY COURSES I

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	MX23511	Disaster Risk Reduction and Management	MC	3	0	0	3	0
2	MX23512	Elements of Literature	MC	3	0	0	3	0
3	MX23513	Film Appreciation	MC	3	0	0	3	0
4	MX23514	Introduction to Women and Gender Studies	MC	3	0	0	3	0

MANDATORY COURSES II

Sl.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	MX23611	History of Science and Technology in India	MC	3	0	0	3	0
2	MX23612	Industrial Safety	MC	3	0	0	3	0
3	MX23613	State, Nation Building and Politics in India	MC	3	0	0	3	0
4	MX23614	Well-Being with Traditional Practices- Yoga, Ayurveda and Siddha	MC	3	0	0	3	0

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES – I

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	O23AD11	Programming for Data science	OEC	3	0	0	3	3
2	O23AL11	Fundamentals of AI And ML	OEC	3	0	0	3	3
3	O23BT11	Mushroom Cultivation & Vermi Composting	OEC	3	0	0	3	3
4	O23CB11	Software Testing	OEC	3	0	0	3	3
5	O23CC11	AI For Robotics	OEC	3	0	0	3	3
6	O23CS11	Introduction To Cloud Computing	OEC	3	0	0	3	3
7	O23EC11	Space Engineering	OEC	3	0	0	3	3
8	O23EC12	IT in Agricultural System Theory	OEC	3	0	0	3	3
9	O23EV11	Fundamental of VLSI	OEC	3	0	0	3	3
10	O23MA11	Probability and Statistics for Data Analytics	OEC	3	0	0	3	3
11	O23ME11	Foundation of Robotics	OEC	3	0	0	3	3

OPEN ELECTIVES – II

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	O23AD21	Data Science Fundamentals	OEC	3	0	0	3	3
2	O23AL21	Fundamentals of Data Analytics	OEC	3	0	0	3	3
3	O23BT21	Bio Fuels	OEC	3	0	0	3	3
4	O23CB21	Essentials of Digital Marketing	OEC	3	0	0	3	3
5	O23CC21	Space Science	OEC	3	0	0	3	3
6	O23CS21	Introduction to Cyber Security	OEC	3	0	0	3	3
7	O23EC21	Wearable Devices and Its Applications	OEC	3	0	0	3	3
8	O23EC22	Introduction to IoT	OEC	3	0	0	3	3
9	O23EV21	Electrical Electronics and Magnetic Materials	OEC	3	0	0	3	3
10	O23MA21	Optimization Techniques	OEC	3	0	0	3	3
11	O23ME21	Fundamentals of Mechatronics	OEC	3	0	0	3	3

OPEN ELECTIVES – III

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	O23AD31	AI for Industrial Applications	OEC	3	0	0	3	3
2	O23AL31	Information Technology Essentials	OEC	3	0	0	3	3
3	O23BT31	Forensic Technology	OEC	3	0	0	3	3
4	O23CB31	Start-up & Innovations	OEC	3	0	0	3	3
5	O23CC31	Introduction to R Programming	OEC	3	0	0	3	3
6	O23CS31	Introduction to Block Chain	OEC	3	0	0	3	3
7	O23EC31	Batteries and Management Systems	OEC	3	0	0	3	3
8	O23EC32	Basics of Biomedical Instrumentation	OEC	3	0	0	3	3
9	O23EV31	HDL Programming	OEC	3	0	0	3	3
10	O23MA31	Multivariate Data Analysis	OEC	3	0	0	3	3
11	O23ME31	Introduction to 3D Printing Technologies	OEC	3	0	0	3	3

SUMMARY

Name of the Programme : B.E. Mechanical Engineering										
Sl.No.	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	3	2	-	-	-	-	5	-	10
2	BSC	8	8	4	2	-	-	-	-	22
3	ESC	9	8	-	-	-	-	-	-	17
4	PCC	-	-	19	19	13	8	9	-	68
5	PEC	-	-	-	-	6	6	6	-	18
6	OEC	-	-	-	-	-	6	-	3	9
7	EEC	-	1	-	1	2	3	2	10	19
8	Non-Credit /(Mandatory)	Y	Y	-	Y	-	Y	-	-	-
Total		**20**	**19**	**23**	**22**	**21**	**23**	**22**	**13**	**163**

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) to secure B.E./B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses should be from the same vertical or a combination of different verticals of the same programme of study only.

For a minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.

VERTICALS FOR MINOR DEGREE

(In addition to all the verticals of other programmes)

Sl. No.	Vertical 1	Vertical 2	Vertical 3	Vertical 4
	FINTECH AND BLOCK CHAIN	**ENTREPRENEURSHIP**	**BUSINESS DATA ANALYTICS**	**IOT**
1	Banking, Financial Services and Insurance	Foundations of Entrepreneurship	Data mining for Business Intelligence	IoT Architecture
2	Principles of Financial Management	Team Building and Leadership Management for Business	Financial Analytics	IoT Device Programming
3	Fintech Personal Finance And Payments	Creativity and Innovation in Entrepreneurship	Human Resource Analytics	IoT Foundation
4	Fundamentals of Investment	Principles of Marketing Management for Business	Marketing and Social Media Web Analytics	Industrial Internet of Things
5	Introduction to Block chain and its Applications	Human Resource Management for Entrepreneurs	Operation and Supply Chain Analytics	IoT protocols
6	Introduction to Fintech	Financing New Business Ventures	Statistics for Management	Sensor Technologies and IoT

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	CS23M01	Banking, Financial Services and Insurance	Minor	3	0	0	3	3
2	CS23M02	Principles of Financial Management	Minor	3	0	0	3	3
3	CS23M03	Fintech Personal Finance and Payments	Minor	3	0	0	3	3
4	CS23M04	Fundamentals of Investment	Minor	3	0	0	3	3
5	CS23M05	Introduction to Block chain and its Applications	Minor	3	0	0	3	3
6	CS23M06	Introduction to Fintech	Minor	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	ME23M01	Foundations of Entrepreneurship	Minor	3	0	0	3	3
2	ME23M02	Team Building and Leadership Management for Business	Minor	3	0	0	3	3
3	ME23M03	Creativity and Innovation in Entrepreneurship	Minor	3	0	0	3	3
4	ME23M04	Principles of Marketing Management for Business	Minor	3	0	0	3	3
5	ME23M05	Human Resource Management for Entrepreneurs	Minor	3	0	0	3	3
6	ME23M06	Financing New Business Ventures	Minor	3	0	0	3	3

VERTICAL 3: BUSINESS DATA ANALYTICS

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	CB23M01	Data mining for Business Intelligence	Minor	3	0	0	3	3
2	CB23M02	Financial Analytics	Minor	3	0	0	3	3
3	CB23M03	Human Resource Analytics	Minor	3	0	0	3	3
4	CB23M04	Marketing and Social Media Web Analytics	Minor	3	0	0	3	3
5	CB23M05	Operation and Supply Chain Analytics	Minor	3	0	0	3	3
6	CB23M06	Statistics for Management	Minor	3	0	0	3	3

VERTICAL 4: IOT

Sl. No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	EC23M01	IoT Architecture	Minor	3	0	0	3	3
2	EC23M02	IoT device Programming	Minor	3	0	0	3	3
3	EC23M03	IoT Foundation	Minor	3	0	0	3	3
4	EC23M04	Industrial IoT	Minor	3	0	0	3	3
5	EC23M05	IoT Protocols	Minor	3	0	0	3	3
6	EC23M06	Sensor Technologies and IoT	Minor	3	0	0	3	3

IP23111 INDUCTION PROGRAMME

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta- skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character."

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity:

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts:

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values:

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and

department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. 25 Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student forthe full duration of the UG programme.

(iv) Literary Activity:

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules:

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People:

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area:

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations:

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities :

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be notests / assessments during this programme.

References: Guide to Induction program from AICTE

SEMESTER I

HS23111	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To improve the communicative competence of the learners.
- To help learners use language effectively in academic / work contexts.
- To build English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To develop ability to read and write complex texts, summaries, articles,blogs, definitions, essays and user manuals.
- To improve language efficiently in expressing their opinions via various media.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 1

What is effective communication? (There are many interesting activities for this.) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do youas a learner need to enhance your English language and communication skills to get the best out of this course?

UNIT I COMMUNICATION SKILLS 9

Listening for general information – specific details – conversation: Introduction to classmates – Audio / video (formal & informal); Telephone conversation; Listening to voicemail; messages and filling a form.

Speaking – Self Introduction; Introducing a friend; Conversation – politeness strategies. Telephone conversation; Leave a voicemail; Leave a message with another person; askingfor information to fill details in a form.

Reading – Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails.

Writing – Writing emails/letters introducing oneself

Grammar & Vocabulary- Tenses (12 Forms); Question types: Wh/ Yes or No/, Tags Synonyms; One-word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II NARRATION AND SUMMATION 9

Listening – Listening to podcasts1, anecdotes/stories/event narration; documentaries and interviews with celebrities.

Speaking – Narrating personal experiences/events; interviewing a celebrity; Summarising and Reporting documentaries/podcasts/ interviews.

Reading – Reading biographies, travelogues, newspaper reports, Excerpts from literature,and travel & technical blogs.

Writing – Guided writing – Paragraph writing Short Report on an event (field trip etc.) Grammar & Vocabulary – Subject-Verb Agreement; and Prepositions, Word forms (prefixes & suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III WRITING SKILLS IN A PROCESS / PRODUCT DESCRIPTION 9

Listening – Listen to product and process descriptions; a classroom lecture; and advertisements about products.

Speaking – Picture description; Giving instruction to use the product; Presenting a product; and summarizing a lecture.

Reading – Reading advertisements, gadget reviews; user manuals.

Writing – Writing definitions; instructions; and Product /Process descriptions.

Grammar & Vocabulary- Imperatives; Adjectives; Degrees of comparison; Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)

UNIT IV CLASSIFICATION AND RECOMMENDATIONS 9

Listening – Listening to TED Talks; Scientific lectures and educational videos. Speaking – Small Talk; Mini presentations and making recommendations.

Reading – Newspaper articles; Journal reports – and Non-Verbal Communication (tables, pie charts, etc)

Writing – Note-making / Note-taking (Study skills to be taught, not tested); Writing recommendations; Transferring information from non-verbal (chart, graph etc, to verbal mode)

Grammar & Vocabulary – Articles; Pronouns - Possessive & Relative pronouns. Collocations; Fixed / Semi fixed expressions.

UNIT V EXPRESSION 9

Listening – Listening to debates / discussions; different viewpoints on an issue; and panel discussions.

Speaking – Group Discussions, Debates, and Expressing opinions through Simulations &Role – play.

Reading – Reading editorials; and Opinion Blogs. Writing – Essay Writing (Descriptive or narrative).

Grammar & Vocabulary – Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Cause & Effect Expressions – Content Vs Function words.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Listen and comprehend complex academic texts

CO2 : Read and infer the denotative and connotative meanings of technical texts

CO3 : Write definitions, descriptions, narrations and essays on various topics

CO4 : Speak fluently and accurately in formal and informal communicative contexts

CO5 : Express their opinions effectively in both oral and written medium of communication

TEXT BOOKS :

1 English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)

2 English for Science & Technology. Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. K.N. Shoba, and Dr.

Lourdes Joevani, Department of English, Anna University.

REFERENCES:

1 Technical Communication – Principles and Practices, Meenakshi Raman Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.

2 A Course Book on Technical English by Lakshminarayanan and Murugavel T, Scitech Publications (India) Pvt. Ltd.

3 English for Technical Communication (With CD) By Aysha Viswamohan, McGraw- Hill Education, ISBN: 0070264244.

4 Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna, 2021, Publishing House.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	-	-	-	-	1	-	-	-	3	-	3	-	-	1
2	2	-	-	-	1	2	-	-	-	3	-	1	-	-	1
3	2	-	-	-	1	1	-	-	-	3	1	3	-	-	1
4	2	-	-	-	1	1	-	-	-	3	1	2	-	-	1
5	2	-	-	-	-	1	-	-	-	3	1	-	-	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

MA23111 MATRICES AND CALCULUS L T P C

3 1 0 4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that are needed by engineers for their practical applications.
- To familiarize the students with differential calculus.
- To enhance the knowledge of the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES 9+3

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties ofEigenvalues and Eigenvectors – Cayley – Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications.

UNIT II DIFFERENTIAL CALCULUS 9+3

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (sum, product, quotient, chain rules) – Implicit differentiation – Logarithmic differentiation – Applications: Maxima and Minima of functions of one variable.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of

variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV INTEGRAL CALCULUS 9+3

Definite and Indefinite integrals – Substitution rule – Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions – Improper integrals- Applications.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals- Applications.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Use the matrix algebra methods for solving practical problems.

CO2 : Apply differential calculus tools in solving various application problems.

CO3 : Use differential calculus ideas on several variable functions.

CO4 : Apply different methods of integration in solving practical problems.

CO5 : Apply multiple integral ideas in solving areas, volumes and other practicalproblems.

TEXT BOOKS :

1 Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2018. (Units I,III & V)

2 James Stewart, " Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2022. [For Units II & IV – Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4. 1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 – 7.4 and 7.8.]

REFERENCES:

1 Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition , 2021.

2 Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2019.

3 Ramana. B.V., "Higher Engineering Mathematics", McGraw- Hill Education Pvt. Ltd, New Delhi, 2017.

4 Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	-	-	-	-	1	-	-	1	3	-	1
2	3	3	3	2	-	-	-	-	1	-	-	1	3	-	1
3	3	3	3	2	-	-	-	-	1	-	-	1	3	-	1
4	3	3	3	2	-	-	-	-	1	-	-	1	3	-	1
5	3	3	3	3	-	-	-	-	1	-	-	1	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

CY23111	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To acquaint the students with the basics of nanomaterial, their properties and uses.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy sources and storage devices.

UNIT I WATER TECHNOLOGY 9

Water quality parameters: physical, chemical & biological. Types of water – Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment–Demineralization and zeolite process. Specifications for drinking water BIS – WHO standards. Domestic water treatment- break-point chlorination. Desalination of brackish water: Reverse Osmosis.

UNIT II NANO MATERIALS 9

Introduction to molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of Nanomaterials (Nanorods, Nanotube, Nanowire, Nanoclusters) – Synthesis Of Nanomaterials (Sol-gel, Solvothermal, Laser ablation, Chemical vapour deposition, Electrochemical deposition, electrospinning) – Applications of nanomaterials.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule: Introduction, definition of terms with examples, One Component System- water system –Reduced phase rule – Two Component Systems- classification – lead-silver system- pattinson process, zinc magnesium system.

Composites –characteristics – constituents of composites – types of composites – polymer matrix composites (PMC) (Types of polymers-Properties), metal matrix composites (MMC) – FRP – Hybrid composites –Nanocomposites- properties and applications.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction: Classification of fuels – Analysis of coal (proximate and ultimate), Carbonization-Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking – octane number, diesel oil- cetane number; Power alcohol and biodiesel-LPG-Water gas

Combustion of fuels: Introduction: Calorific value – higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis – ORSAT Method.

UNIT V ENERGY SOURCES AND BATTERIES 9

Introduction – nuclear energy – nuclear fission – controlled nuclear fission- nuclear fusion- differences between nuclear fission and fusion – nuclear chain reactions nuclear reactor power generator classification of nuclear reactor- light water reactor- breeder reactor- solar energy

conversion solar cells- wind energy. **Batteries**: Types of batteries- alkaline battery- lead storage battery – lithium battery- fuel cell H2 -O2 fuel cell-applications. Electric vehicles – working principles.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Infer the quality of water, discuss the boiler feed water requirements, relatedproblems and identification of suitable water treatment methods.

CO2 : Differentiate the nano and bulk materials, their synthesis and its applications invarious fields.

CO3 : Apply the knowledge of phase rule and composites for material selectionrequirements.

CO4 : Recommend suitable fuels for engineering processes and applications.

CO5 : Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS :

1 P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.

REFERENCES:

1 B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

2 O.G. Palanna, "Engineering Chemistry" McGraw- Hill Education (India) Private Limited, 2nd Edition, 2017.

3 Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.

4 Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019

5 S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition,2018

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	-	1	1	-	-	-	-	1	-	-	-
2	2	1	-	1	-	2	2	-	-	-	-	-	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
4	3	1	1	-	-	1	2	-	-	-	-	-	-	-	-
5	3	1	2	2	-	2	2	-	-	-	-	2	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23111 PROBLEM SOLVING AND C PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of algorithmic problem solving
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop modular applications in C using functions
- To develop applications in C using pointers and structures and file handling

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING **9**

Fundamentals of Computing – Identification of Computational Problems –Algorithms, buildingblocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi

UNIT II BASICS OF C PROGRAMMING **9**

Introduction to programming paradigms – Applications of C Language – Structure of C program – C programming: Data Types – Constants – Enumeration Constants – Keywords – Operators: Precedence and Associativity – Expressions – Input / Output statements, Assignment statements– Decision making statements – Switch statement – Looping statements – Preprocessor directives- Compilation process

UNIT III ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays – String operations: length, compare, concatenate, copy – Selection sort, linear and binary search

UNIT IV FUNCTIONS AND POINTERS **9**

Modular programming – Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers

– Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference

UNIT V STRUCTURES, UNION AND FILES **9**

Structure – Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation – Singly linked list – typedef – Union – Storage classes and Visibility. Files – Types of file processing: Sequential access, Random access – Sequential access file – Random access file – Command line arguments

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Demonstrate knowledge on C Programming constructs

CO2 : Develop simple applications in C using basic constructs

CO3 : Design and implement applications using arrays and strings

CO4 : Develop and implement modular applications in C using functions.

CO5 : Develop applications in C using structures and pointers and sequential and random-access file processing.

TEXT BOOKS :

1 Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017. (Unit I)

2 Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2018 (Unit II,III,IV & V)

REFERENCES:

1 Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.

2 Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.

3 Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Pearson Education, 2016

4 Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	2	2	1	2	1	1	1	2	-	3	2	2	-	1
2	2	2	2	1	2	1	1	1	2	-	3	3	2	-	1
3	2	3	2	1	2	1	1	1	2	-	3	2	2	-	1
4	3	2	2	1	3	1	1	1	2	-	3	3	2	-	1
5	2	3	3	1	2	1	2	1	2	-	3	2	2	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

PH23113 **MATERIALS SCIENCE** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of advanced engineering materials.

UNIT I CRYSTALLOGRAPHY 9

Crystal structures: BCC, FCC and HCP – directions and planes – linear and planar densities – crystal imperfections- edge and screw dislocations – grain and twin boundaries – Burgers vector and elastic strain energy, Bragg's Law, X-ray Diffraction (XRD) for structure determination .

UNIT II MAGNETIC PROPERTIES OF MATERIALS 9

Magnetic materials: Dia, para and ferromagnetic effects – para-magnetism, anti-Ferro- magnetism, Ferrimagnetism, Ferrites – exchange interaction and ferromagnetism – Domain theory of Ferromagnetism- Hysteresis, soft and hard magnetic materials – GMR devices.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors – Variation of carrier concentration with temperature – Hall effect and devices.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells – Optoelectronic devices: light detectors and solar cells – light emitting diode – laser diode.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation – Ball milling method, pulsed laser deposition, chemical vapour deposition – Applications – Classification of Biomaterials and its applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Know basics of crystallography and its importance for varied materialsproperties.

CO2 : Gain knowledge on the electrical and magnetic properties of materials and their applications.

CO3 : Understand clearly of semiconductor physics and functioning of semiconductordevices.

CO4 : Understand the optical properties of materials and working principles of various optical devices.

CO5 : Appreciate the importance of Advanced engineering materials.

TEXT BOOKS :

1 V. Raghavan. Materials Science and Engineering: A First Course, Prentice HallIndia Learning Private Limited, 2015. (Unit I)

2 S. O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018. (Unit II,III & IV)

3 G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009. (Unit V)

REFERENCES:

1 Jasprit Singh, Semiconductor Devices: Basic Principles, Wiley (India), 2007.

2 Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, Mc- Graw Hill India

(2019)

3 R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.

4 Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.

5 Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
2	3	2	1	-	-	-	-	-	-	-	-	-	1	-	-
3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
4	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
5	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23112 HERITAGE OF TAMIL L T P C

1 0 0 0

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, Villu Pattu, Kaniyan Koothu, 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 : 15 PERIODS

TEXT BOOKS :

1 Social History of Tamils, Dr.K.K.Pillay, A joint publication of TNTB & ESC and RMRL,2011, 5th Edition.

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.Subaramanian, 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 ofArchaeology& TamilNadu 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

CY23121	CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metric, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles

LIST OF EXPERIMENTS

1. Determination of types and amount of alkalinity in a water sample - Split the first experiment into two
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by Argentometric method.
5. Determination of strength of given hydrochloric acid using pH meter.
6. Determination of strength of acids in a mixture of acids using conductivity meters.
7. Conductometric titration of barium chloride against sodium sulphate (Precipitation titration)
8. Estimation of iron content of the given solution using potentiometer.

9. Estimation of sodium /potassium present in water using a flame photometer.
10. Preparation of nanoparticles (TiO2/ZnO/CuO) by Sol-Gel method.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyse the quality of water samples with respect to their alkalinity, hardness andDO.

CO2 : Determine the amount of metal ions through volumetric and spectroscopictechniques

CO3 : Analyse and determine the composition of alloys.

CO4 : Learn simple methods of synthesis of nanoparticles.

CO5 : Quantitatively analyse the impurities in solution by electroanalytical techniques

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	-	-	2	2	-	-	-	-	2	-	-	-
2	2	2	2	-	-	2	2	-	-	-	-	2	-	-	-
3	2	2	1	2	-	-	2	-	-	-	-	-	-	-	-
4	2	2	2	2	-	2	2	-	-	-	-	-	-	-	-
5	2	2	2	2	-	2	2	-	-	-	-	1	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

PH23121 **PHYSICS LABORATORY** **L T P C**

0 0 2 1

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 physicsprinciples and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student an active participant in each part of all lab exercises.

(Any seven experiments)

1. Torsional pendulum – Determination of rigidity modulus of wire and momentof inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever. Determination of the hysteresis offerromagnetic material.
3. Determine the size of the nanoparticles particle by Debye –Scherrer's formula.
4. Laser- Determination of the wavelength of the laser using grating
5. Air wedge – Determination of thickness of a thin sheet/wire.
6. Optical fiber –Determination of Numerical Aperture and acceptance angle
7. Compact disc- Determination of width of the groove using laser.

8. Determination of the size of the particle using LASER.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Refractive index of the given prism – Using spectrometer.
13. Post office box –Determination of Band gap of a semiconductor.
14. Determination of the young's modulus of the given beam by non-uniform bending method.
15. Determination of the Wavelength of the given mercury vapour lamp – Usingspectrometer grating.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the functioning of various physics laboratory equipment.

CO2 : Use graphical models to analyze laboratory data.

CO3 : Use mathematical models as a medium for quantitative reasoning anddescribing physical reality.

CO4 : Access, process and analyze scientific information.

CO5 : Solve problems individually and collaboratively.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	0	0	-	-	-	-	-	-	-	-	-	-
3	3	2	3	0	0	-	-	-	-	-	-	-	-	-	-
4	3	3	2	0	1	-	-	-	-	-	-	-	-	-	-
5	3	2	3	0	1	-	-	-	-	-	-	-	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23121 PROBLEM SOLVING AND C PROGRAMMING LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To familiarise with C programming constructs
- To develop programs in C using basic constructs
- To develop programs in C using arrays.
- To develop applications in C using strings, pointers, and functions.
- To develop applications in C using structures and file processing.

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions.
2. Decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures andUnions.

   Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Demonstrate knowledge on C programming constructs

CO2 : Develop programs in C using basic constructs

CO3 : Develop programs in C using arrays.

CO4 : Develop applications in C using strings, pointers, and functions

CO5 : Develop applications in C using structures, Unions and File Processing.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	2	2	1	2	1	1	1	2	-	3	2	2	-	1
2	2	2	2	1	2	1	1	1	2	-	3	3	2	-	1
3	2	3	2	1	2	1	1	1	2	-	3	2	2	-	1
4	3	2	2	1	3	1	1	1	2	-	3	3	2	-	1
5	2	3	3	1	2	1	2	1	2	-	3	2	2	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23122 ENGINEERING PRACTICES LABORATORY

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To draw pipeline plan, lay and connect various pipe fittings used in common household plumbing work and make joints used in common household work.
- To weld various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts, Making a tray out using sheet metal work.
- To wire various electrical joints in common household electrical wire work.

- To Solder and test simple electronic circuits, assemble and test simple electronic components on PCB.
- To study the various domestic appliances and their working principles.

GROUP – A (MECHANICAL & CIVIL) 15

PART I MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

a) Welding of Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

SHEET METAL WORK:

Z) Making of a square tray

MECHANICAL EQUIPMENT STUDY:

a) Study of air-conditioner.
b) Study of centrifugal pump.

PART II CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Connecting pipes of different materials: Metal, plastic and flexible pipes used inhousehold appliances.

WOOD WORK:

a) Sawing and 33lanning,
b) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

GROUP – B (ELECTRICAL AND ELECTRONICS) 15

PART III ELECTRICAL ENGINEERING PRACTICES

Introduction to switches, fuses, indicators and lamps – Basic switch board wiring with lamp, fan and three pin socket.

a) Staircase wiring
b) Fluorescent Lamp wiring with introduction to CFL and LED types.

c) Energy meter wiring and related calculations/ calibration
d) Study of Iron Box wiring and assembly
e) Study of Fan Regulator (Resistor type and Electronic type usingDiac/Triac/quadrac)
f) Study of emergency lamp wiring/Water heater

PART IV ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:

Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Study an element of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in woodmaterials used in common household wood work.

CO2 : Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipment; Make a tray out of metal sheet using sheet metal work.

CO3 : Wire various electrical joints in common household electrical wirework.

CO4 : Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB

CO5 : Study the various domestic appliances and its functions.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
2	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
3	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
4	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1
5	3	2	-	-	1	1	1	-	-	-	-	2	2	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER II

HS23211	PROFESSIONAL ENGLISH	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To engage in the meaningful language activities to improve their LSRWskills.
- To enhance learners' awareness of general rules of writing for specificaudiences.
- To help learners understand the purpose, audience, contexts of different typesof writing.
- To develop analytical thinking skills for problem-solving in communicativecontexts.
- To demonstrate an understanding of job applications and interviews for internships and placements.

UNIT I MAKING COMPARISONS 6

Listening – Evaluative Listening: Advertisements, Product Descriptions, - Audio/video; Listening and filling a Graphic Organiser (Choosing a product or service by comparison) Speaking – Marketing a product, Persuasive Speech Techniques.

Reading – Reading advertisements, user manuals, and brochures;

Writing – Professional emails, Email etiquette – Compare and Contrast Essay; Grammar & Vocabulary – Mixed Tenses, Prepositional phrases

UNIT II EXPRESSING CASUAL RELATIONS IN SPEAKING & WRITING 6

Listening – Listening to longer technical talks and completing– gap – filling exercises.

Listening to technical information from podcasts –Listening to process/event descriptions to identify causes & effects.

Speaking – Describing and discussing the reasons of accidents or disasters based on news reports.

Reading – Reading longer technical texts– Cause and Effect Essays, and Letters/emails of complaint.

Writing – Writing responses to complaints.

Grammar & Vocabulary –Active / Passive Voice transformations, Infinitive and Gerunds.

UNIT III COMMUNICATION SKILLS FOR PROBLEM SOLVING 6

Listening – Listening / Watching movie scenes/ documentaries depicting a technical problem and suggesting solutions.

Speaking – Group Discussion (based on case studies) – Techniques and Strategies Reading – Case Studies, excerpts from literary texts, news reports etc.

Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay

Grammar & Vocabulary – Error correction; If conditional sentences.

UNIT IV REPORTING OF EVENTS AND RESEARCH 6

Listening – Listening Comprehension based on news reports – and documentaries – Precis writing, Summarising.

Speaking – Interviewing, Presenting an oral report, Mini presentations on selected topics.

Reading –Newspaper articles.

Writing – Recommendations, Transcoding, Accident Report, Survey Report. Grammar & Vocabulary – Reported Speech, Modals.

UNIT V PRESENTATION SKILLS 6

Listening – Listening to TED Talks, Presentations, Formal job interviews, (analysis of the interview performance)

Speaking – Participating in a Role play (interview/telephone interview), virtual interviews, Making presentations with visual aids;

Reading – Company profiles, Statement of Purpose (SOP), an excerpt of an interview with professionals;

Writing – Job / Internship application – Cover letter & Resume. Grammar – Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Compare and contrast products and ideas in technical texts.

CO2 : Identify the causes and effects in events, and industrial processes through technical texts.

CO3 : Analyze problems in order to arrive at feasible solutions and communicate them orally and in written format.

CO4 : Report events and processes of technical and industrial nature.

CO5 : Present their opinions in a planned and logical manner, and draft effective resumes in the context of job search.

TEXT BOOKS :

1 English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University. (Unit II & V)

2 English for Science & Technology Cambridge University Press 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. (Unit I,III & IV)

REFERENCES:

1 Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford University Press. New Delhi.

2 Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2011,4th Edition, New Delhi.

3 Learning to Communicate – Dr. V. Chellammal, Allied Publishers, New Delhi, 2017, 3rd Edition.

4 Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw- Hill & Co. Ltd., 2021, New Delhi.

5 Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd. 2018, Delhi.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	-	-	2	3	-	3	-	-	2
2	-	-	-	-	-	-	-	-	2	3	-	3	-	-	2
3	-	-	-	-	-	-	-	-	2	2	-	3	-	-	2
4	-	-	-	-	-	-	-	-	2	3	-	3	-	-	2
5	-	-	-	-	-	-	-	-	3	2	-	3	-	-	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

MA23211	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To provide the necessary basic concepts of a few parametric, test and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important rolein engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 9+3

Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9+3

One way and two way classifications – Completely randomized design – Randomized block design – Latin square design – 22 factorial design

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method- Solution of linear system of equations – Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9+3

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

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9+3

Single step methods: Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order differential equations – Multi step methods: Milne's and Adams – Bash forth predictor corrector methods for solving first order differential equations.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply the concept of parametric test in real time problems.

CO2 : Apply the basic concepts of classifications of design of experiments in the field of agriculture with sampling distributions and statistical techniques used in engineering problems

CO3 : Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO4 : Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO5 : Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with the respective engineering applications.

TEXT BOOKS :

1 Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015. (Unit III, IV & V)

2 Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2016. (Unit I & II)

REFERENCES:

1 Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2022.

2 Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2022.

3 Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2016.

4 Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2022.

5 Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2022.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	-	-	-	-	1	-	-	1	3	-	-
2	3	3	3	3	-	3	-	-	1	-	-	-	3	-	-
3	3	3	3	3	-	-	-	-	1	-	-	-	3	-	-
4	3	3	3	3	-	-	-	-	1	-	-	-	3	-	-
5	3	3	3	3	-	-	-	-	1	-	-	-	3	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

AD23211 PYTHON FOR DATA SCIENCE L T P C

3 0 0 3

COURSE OBJECTIVES:

- To expose fundamental Python programming concepts including control flow, functions, lists and tuples.
- To utilize Python data structures such as sets and dictionaries to represent complex data, and to perform input/output operations with files.

- To provide a comprehensive understanding of data science fundamentals, with a focus on exploratory data analysis (EDA) techniques.
- To impart Python packages viz. NumPy arrays, Pandas objects.
- To familiarize with Matplotlib for better data visualization through various plotting techniques.

UNIT I CONTROL FLOW, FUNCTIONS, LISTS, TUPLES 9

Python interpreter – Data types – variables – expressions – Boolean values and operators - Conditionals: conditional (if) – alternative (if-else) – chained conditional (if- elif- else);Iteration: while – for – break – continue – pass; Fruitful functions: return values parameters – local and global scope – function composition – recursion; Strings – String Operations – Lists as arrays. Lists: list operations – list slices – list methods – list loop – mutability – aliasing – cloning lists – list parameters; advanced list processing – list comprehension. Tuples: tuple assignment – tuple as return value

UNIT II SETS, DICTIONARIES, FILES, PACKAGES 9

Sets – operations – methods; Dictionaries – operations and methods;. Files and exceptions: text files – reading and writing files format operator; command line arguments – Errors and exceptions – handlingexceptions – Modules – Packages; Illustrative Programs.

UNIT III FUNDAMENTALS OF DATA SCIENCE 9

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing – integrating and transforming data – Exploratory Data Analysis(EDA) fundamentals – Understanding data science – Significance of EDA – Making sense of data –Software tools for EDA – Visual Aids for EDA. Case Study: Health care – Retail – Banking-Fraud Detection.

UNIT IV NUMPY AND PANDAS 9

Understanding Data Types in Python –The Basics of NumPy Arrays – Computation on NumPy Arrays: Universal Functions – Aggregations: Min, Max, and Everything In Between. Introducing Pandas Objects – Data Indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Combining Datasets: Concat and Append – Combining Datasets: Merge and Join – Aggregation and Grouping – Pivot Tables – Vectorized String Operations – Working with Time Series.

UNIT V VISUALIZATION WITH MATPLOTLIB 9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Formulate Programming in Python by using concepts such as control flow, functions, lists, and tuples.

CO2 : Perform input/output operations with files efficiently by using Python data structures like sets and dictionaries to represent complex data.

CO3 : Explore, retrieve and interpret the data by applying fundamental data science principles,

emphasizing exploratory data analysis (EDA) techniques.

CO4 : Handle various datasets using computation on Python packages such as NumPy arrays, Pandas objects.

CO5 : Handle Matplotlib for better data visualization through various plotting techniques.

TEXT BOOKS :

1 Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016. (Unit I & II)

2 David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.(Unit III)

3 Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. (Unit III)

4 JakeVanderPlas, "Python Data Science Handbook",2nd Edition,O'Reilly,2022(Unit IV & V)

REFERENCES:

1 Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.

2 John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data'', Third Edition, MIT Press , 2021.

3 Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.

4 Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

5 Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	3	2	-	-	-	-	-	-	2	2	2	1
2	3	2	2	2	2	-	-	-	-	-	-	1	2	2	1
3	3	1	3	3	-	-	-	-	2	3	3	3	2	2	1
4	3	1	3	3	-	-	-	-	2	3	3	3	2	2	1
5	3	2	2	1	1	-	-	-	3	2	3	1	2	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23212 ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To expose electric circuit analysis
- To gain familiarity in DC machines , transformers and AC machines
- To introduce analog electronics and digital logic circuits
- To get acquaintance in the measurement of energy and power.
- To facilitate in acquiring the knowledge on measuring instruments.

UNIT I CIRCUIT ANALYSIS 9

DC Circuits: Ohm's Law – Kirchhoff's Laws – Analysis with Independent sources only (Simple problems only)

AC Circuits: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II DC MACHINES AND TRANSFORMERS 9

Construction and Working of DC Motor and Generator – EMF and Torque equation – Internal and External Characteristics of Self and Separately excited Generator – Electrical and Mechanical Characteristics of shunt, series and compound motor – Starting and Speed Control – Applications Construction and Working of Single Phase Transformer – EMF equation – OC and SC Tests – Efficiency and Voltage Regulation – Applications – Three Phase Transformer

UNIT III AC MACHINES 9

Construction and Working of three phase squirrel cage and slip ring induction motors – Speed Control – Applications – Working of Single phase Induction motors – Double field revolving theory – Starting methods – Applications.

UNIT IV ELECTRONICS 9

Semiconductor Diodes – MOSFET, IGBT, SCR – VI Characteristics and Applications – Working of Rectifier and Inverter – Decimal, Binary, Hexadecimal and Octal systems – BCD – Logic gates – Combinational logic circuit – SOP and POS forms – Minimization using K maps (Simple Problems only)

UNIT V MEASUREMENTS AND INSTRUMENTATION 9

Measurement system – Standards and calibration – Error and its types – Operating Principle of Moving Coil and Moving Iron meters – Measurement of three phase power and energy – CT and PT.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Compute DC and AC circuit parameters

CO2 : Explain the construction, operation and applications of DC machines

CO3 : Explain the construction, operation and applications of AC machines

CO4 : Examine the features of analog electronic devices and develop a combinational logic circuit using Boolean algebra

CO5 : Use a measuring device for computing three phase power and energy

TEXT BOOKS :

1 Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw- Hill Education, 2020

REFERENCES:

1 Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw- Hill, 2002.

2 H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

3 A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

4 S. K. Bhattacharya, "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2017.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
2	2	1	1	1	-	-	-	-	-	-	-	-	-	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	1
5	2	2	1	1	-	-	-	-	-	-	-	-	-	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23213 TAMILS AND TECHNOLOGY L T P C

1 0 0 0

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)- Thirumalai Nayakar 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 goldCoins 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 Kumizhi Thoompu 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 : 15 PERIODS

TEXT 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 C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & 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) (Publishedby: The Author)

7 Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

8 Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference

GE23231	ENGINEERING GRAPHICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To impart knowledge for drawing various types of engineering curves and orthographic (freehand sketches) views.
- To foster the ability to draw orthographic projection of lines and planes.
- To facilitate in acquiring the knowledge for sketching orthographic projection of solids.
- To enable the skills for drawing the section of solids and development of solids.
- To impart the knowledge for drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING 9+6

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.

Orthographic views for simple objects. Visualization concepts and Free Hand sketching: Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 9+6

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces.

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes.

UNIT III PROJECTION OF SOLIDS 9+6

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 9+6

Sectioning simple solids like prisms, pyramids, cylinder and cone in simple vertical position and the cutting plane is inclined to one of the principal planes and perpendicular to the other — obtaining true shape of section.

Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and

cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 9+63

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

Perspective projection of simple solids – Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL : 75 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Construct the various types of curves like conic curves, involutes, cycloids and orthographic views.

CO2 : Solve practical problems involving projection of lines and planes.

CO3 : Draw the orthographic projections of simple solids.

CO4 : Draw the section and development of simple solids.

CO5 : Construct the isometric and perspective projections.

TEXT BOOKS :

1 Natarajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

REFERENCES:

1 Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw- Hill, 2nd Edition, 2019.

2 Gopalakrishna K.R., "Engineering Drawing" (Vol. I & IIcombined), Subhas Publications, Bangalore, 27th Edition, 2017.

3 Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.

4 Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	-	-	3	-	-	3	-	1
2	3	3	2	2	-	-	-	-	-	3	-	-	3	-	1
3	3	3	2	2	-	-	-	-	-	3	-	-	3	-	1
4	3	3	2	2	-	-	-	-	-	3	-	-	3	-	1
5	3	3	2	2	-	-	-	-	-	3	-	-	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

AD23221	PYTHON FOR DATA SCIENCE LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop proficiency in the concepts of lists, tuples, sets, and dictionaries to effectively address real-world challenges.
- To master the concepts such as functions, strings, modules, file handling, and exception handling.
- To expose the analysis of various datasets Pandas Data frame, utilizing NumPy arrays and Pandas Data frames, visualizing the data.
- To exhibit the analysis of various datasets using the Matplotlib package.
- To make the real time Projects with different Packages.

LIST OF EXPERIMENTS

1. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
2. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
3. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
4. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
5. Implementing real-time/technical applications using File handling. (copy from one file toanother, word count, longest word)
6. Implementing real-time/technical applications using Exception handling. (divide by zeroerror, voter's age validity, student mark range validation)
7. Perform exploratory data analysis (EDA) on with datasets like email data set. Export allyour emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.
8. Working with Numpy arrays (Append values to the end of an array, Real and imaginary parts of an array of complex numbers, list the second column elements from the shape of (3,3) array, find the maximum and minimum value from the shape of (3,3)array)
9. Working with Pandas data frames.(sort the dataframe first by 'name' in descending order, then by 'score' in ascending order, select the rows where the number of attempts in the examination isgreater than 2, append a new row 'k' to dataframe with given values for each column. Now delete the new row and return the original dataframe.)
10. Basic plots using Matplotlib (demonstrate various styles of Plotting graph)

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Address real time applications using the concepts of lists, tuples, sets, and dictionaries

CO2 : Manage functions, strings, modules, file handling and exception handling.

CO3 : Visualize the data interpretation by utilizing NumPy arrays and Pandas Data frames.

CO4 : Plot the real time datasets with the use of Matplotlib

CO5 : Construct real-time projects utilizing various packages

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	3	2	-	-	-	-	-	-	2	2	-	1
2	3	2	2	2	2	-	-	-	-	-	-	1	2	-	1
3	3	1	3	3	-	-	-	-	2	3	3	3	2	-	1
4	3	1	3	3	-	-	-	-	2	3	3	3	2	-	1
5	3	2	2	1	1	-	-	-	3	2	3	1	2	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23221 COMMUNICATION LABORATORY L T P C

0 0 2 1

COURSE OBJECTIVES:

- To identify varied group discussion skills and apply them to take part in effectivediscussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To communicate effectively through formal and informal writing.
- To use appropriate language structures to write emails, reports and essays.
- To give instructions and recommendations that are clear and relevant to the context

LIST OF EXPERIMENTS

1. Listening Comprehension
2. Reading Skills (Skimming & Scanning)
3. Reading Comprehension
4. Letter & Email Writing
5. Instruction Writing for a Product
6. Picture Description
7. Role Play/Dialogue Writing
8. Tell about your Friend
9. Kinds of Essay Writing
10. Presentation Skills

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Speak effectively in group discussions held in a formal/semi-formal contexts.

CO2 : Discuss, analyze and present concepts and problems from various perspectives to arrive at suitable solutions

CO3 : Write emails, letters and effective job applications.

CO4 : Write critical reports to convey data and information with clarity and precision

CO5 : Give appropriate instructions and recommendations for safe execution of task

ASSESSMENT PATTERN

1. One online / app based assessment to test speaking and writing skills
2. Proficiency certification is given on successful completion of speaking and writing.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	-	-	-	-	-	-	2	2	-	2	-	-	2
2	-	-	-	-	-	-	-	-	2	2	-	2	-	-	2
3	-	-	-	-	-	-	-	-	2	2	-	2	-	-	2
4	-	-	-	-	-	-	-	-	2	2	-	2	-	-	2
5	-	-	-	-	-	-	-	-	3	3	-	3	-	-	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

GE23222 BASIC ELECTRICAL AND ELECTRONICS LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.
- To get familiarity in DC machines and transformers.
- To gain knowledge in AC machines.

LIST OF EXPERIMENTS

1. Load test on DC Shunt Motor
2. Load test on DC Series Motor
3. Load characteristics of Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Single phase Induction Motor
6. Load Test on Three phase Squirrel cage Induction Motor
7. Characteristics of PN Diodes
8. Characteristics of IGBT, SCR and MOSFET
9. Half wave and Full Wave rectifiers
10. Design of a combinational logic circuit

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Use experimental methods to verify the Ohm's and Kirchhoff's Laws

CO2 : Analyze experimentally the load characteristics of electrical machines

CO3 : Analyze the characteristics of basic electronic devices

CO4 : Analyze the characteristics of basic Transformers

CO5 : Design of a combinational logic circuit

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
2	2	1	1	1	-	-	-	-	-	-	-	-	-	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	1
4	3	3	1	1	-	-	-	-	-	-	-	-	-	-	1
5	2	2	1	1	-	-	-	-	-	-	-	-	-	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER III

MA23313	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To enable the students to understand the basic concepts of PDE for solving standard partial differential equations.
- To impart knowledge to analyze Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To facilitate the students in acquiring the knowledge with Fourier series techniques in solving heat flow problems used in various situations.
- To equip students with the skills to analyze Fourier transform techniques used in wide variety of situations.
- To empower the students to learn the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations –Solutions of standard types of first order partial differential equations – First order partial differential equations reducible to standard types- Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series and cosine series – Root mean square value – Parseval's identity – Harmonic analysis.

UNIT III APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of PDE – Method of separation of variables – Fourier series solutions of one-dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 9+3

Statement of Fourier integral theorem– Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z-TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z-transforms – Elementary properties – Convergence of Z-transforms – Initial and final value theorems – Inverse Z-transform using partial fraction and convolution theorem – Formation of difference equations – Solution of difference equations using Z – transforms.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand how to solve the given standard partial differential equations

CO2 : Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.

CO3 : Appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.

CO4 : Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

CO5 : Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS :

1 Grewal. B.S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018. (Unit I & II)

2 Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, John Wiley, India, 2020. (Unit III, IV & V)

REFERENCES:

1 Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers" SPIE Press, 1999.

2 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd, New Delhi, 2007.

3 Bali. N.P, Goyal.M., Watkins. C., "Advanced Engineering Mathematics", 17th Edition Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2017.

4 Narayanan. S., Manicavachagam Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

5 Ramana. B.V., "Higher Engineering Mathematics ", McGraw-Hill Education Pvt. Ltd, New Delhi, 2006.

6 Wylie. R.C. and Barrett. L.C., "Advanced Engineering Mathematics "Tata McGraw-Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

7 Sundarapandian. V., "Ordinary and Partial Differential Equations". McGraw-Hill Education Private Limited. New Delhi, 2012.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	1	-	-	-	-	2	-	-	3	3	3	1
2	3	3	1	1	-	-	-	-	2	-	-	3	3	3	1
3	3	3	1	1	-	-	-	-	2	-	-	3	3	3	1
4	3	3	1	1	-	-	-	-	2	-	-	3	3	3	1
5	3	3	1	1	-	-	-	-	2	-	-	3	3	3	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23311 **ENGINEERING MECHANICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To enable the students to analyze and solve static equilibrium problems of particles using fundamental principles of mechanics, including vector analysis techniques, and apply them to real-world engineering scenarios.
- To equip students with the skills to analyze and solve complex engineering problems

involving rigid bodies, integrating principles of static equilibrium and friction.

- To foster the ability to apply centroid and moment of inertia concepts to analyze and solve engineering problems related to surfaces and solids.
- To impart knowledge to analyze particle motion using fundamental principles of kinematics, Newton's laws, work, energy, impulse, and impact mechanics.
- To cultivate students' proficiency in applying kinetic principles, encompassing equations of motion, work, energy, impulse, and momentum, to solve problems in rigid body dynamics.

UNIT I STATICS OF PARTICLES 9

Fundamental principles and concepts, Laws of Mechanics, Principle of transmissibility, Parallelogram, Triangle and Polygon law of forces, Resultant of two forces and several concurrent forces - Resolution of a force, Equilibrium of a particle, Lami's theorem, Free body diagram, Forces in space - equilibrium of a particle in space.

UNIT II EQUILIBRIUM OF RIGID BODIES AND FRICTION 9

External and internal forces, moment of a force, Varignon's theorem moment of a couple, resolution of a force into a force and a couple - reduction of a system of forces, reactions at supports and connections.

Friction: Laws of dry Friction, Angle of friction, Coefficient of friction, Wedge friction, Ladder friction, Wheel friction – rolling resistance

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9

Centroid of simple figures from first principle, centroid of composite sections; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Polar Moment of Inertia, Parallel axis theorem, Mass moment of inertia

UNIT IV DYNAMICS OF PARTICLES 9

Kinematics – Displacement, Velocity and Acceleration, Rectilinear Motion – Motion with uniform acceleration, Motion under gravity, Motion with variable acceleration, Curvilinear motion – Normal and tangential components, Radial and transverse components

Kinematics – Newton's laws of motion, D' Alembert's principle, Principle of work and energy, Principle of impulse and momentum, Impact of elastic bodies – Direct central impact

UNIT V DYNAMICS OF RIGID BODIES 9

Kinematics – Translation, Rotation about a fixed axis, General plane motion- Velocity, Instantaneous centre of rotation, Absolute and relative acceleration

Kinetics – Equations of motion – Kinetic analysis of rigid body motion – Principle of work and energy, Principle of impulse and momentum

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply laws of mechanics for equilibrium analysis, and construct detailed free-body diagrams for nuanced problem-solving in forces in space.

CO2 : Analyze the moments using Varignon's theorem and apply laws of friction to solve engineering problems.

CO3 : Evaluate centroids, area moments of inertia, and mass moments by investigating the surface

and solid properties.

CO4 : Solve the problems on particle dynamics by Newton's laws, D'Alembert's principle, work - energy, impulse, momentum, and impact mechanics.

CO5 : Calculate the dynamic forces exerted in rigid bodies using the principles of kinematics and kinetics for solving complex engineering problems involving translation, rotation, and general plane motion.

TEXT BOOKS :

1 Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, Sanjeev Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw-Hill Companies, Inc., 12th edition, 2019.

REFERENCES:

1 Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.

2 Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th edition, Prentice Hall, 2013.

3 Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th edition, Pearson Education Asia Pvt. Ltd., 2005.

4 Meriam J L and Kraige L G, Engineering Mechanics: Statics and Dynamics, 7th edition, Wiley student edition, 2013.

5 Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5th edition, McGraw-Hill Higher Education, 2013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
2	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
3	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
4	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-
5	3	3	3	2	-	-	-	-	-	-	-	1	3	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23312 ENGINEERING THERMODYNAMICS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To enable the students to understand the knowledge on the basics and application of zeroth and first law of thermodynamics.
- To equip the students to gain knowledge on the second law of thermodynamics, availability and applications of it.
- To impart knowledge to understand and apply the properties of pure substances and process.
- To facilitate the students in acquiring the knowledge on the macroscopic properties of ideal and real gases.

- To foster the ability among the students to analyze the properties of gas mixtures and Psychrometric processes

UNIT I BASICS, ZEROTH AND FIRST LAW 9+3

Review of Basics – Thermodynamic systems, Properties and processes Thermodynamic Equilibrium - Displacement work - P-V diagram. Thermal equilibrium - Zeroth law – Concept of temperature and Temperature Scales. First law – application to closed and open systems – steady and unsteady flow processes.

UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 9+3

Heat Engine – Refrigerator - Heat pump. Statements of second law and their equivalence & corollaries. Carnot cycle - Reversed Carnot cycle - Performance - Clausius inequality. Concept of entropy - T-s diagram - Tds Equations - Entropy change for a pure substance. Ideal gases undergoing different processes - principle of increase in entropy. Applications of II Law. High- and low-grade energy. Availability and Irreversibility for open and closed system processes - I and II law Efficiency

UNIT III PROPERTIES OF PURE SUBSTANCE 9+3

Steam - formation and its thermodynamic properties - P-v, P-T, T-v, T-s, h-s diagrams. PVT surface. Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart. Application of I and II law for pure substances.

UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9+3

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties-. Compressibility factor-. Principle of Corresponding states. Generalised Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations.

UNIT V GAS MIXTURES AND PSYCHROMETRY 9+3

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibb's function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply the first law of thermodynamics to closed and open systems for thermal equipment.

CO2 : Analyze the second law of thermodynamics, accurately calculating parameters like work, heat transfer, entropy, and availability for engineering applications.

CO3 : Apply thermodynamic principles to analyze the properties of pure substance, utilizing diagrams and charts to calculate work, heat transfer, and dryness fraction

CO4 : Solve the practical problems by understanding the behavior of Ideal gas and the interrelationship between thermodynamic functions.

CO5 : Evaluate the properties of gas mixtures and the psychrometric properties for various psychrometric processes.

TEXT BOOKS :

1 Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw-Hill (2017), New Delhi.

REFERENCES:

1 Cengel. Y and M. Boles, "Thermodynamics - An Engineering Approach, Tata McGraw-Hill, 8th Edition, 2015.

2 Chattopadhyay. P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.

3 Gordon Rogers, Yon Mayhew, "Engineering Thermodynamics: Work and Heat Transfer, 4th Edition, Pearson, 2002.

4 R.K.Rajput, "A text book of Engineering Thermodynamics", 5thEdition, Lakshmi Publications, New Delhi, 2016.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
2	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
3	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
4	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
5	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23313 FLUID MECHANICS AND MACHINERY L T P C

3 1 0 4

COURSE OBJECTIVES:

- To Enable the students to understand the properties of the fluids, behaviour of fluids under static conditions and pressure measurement.
- To Enrich the knowledge on the applications of the conservation laws to flow through pipes.
- To Equip students with the skills to apply dimensional analysis, similitude principles, and model testing techniques to tackle fluid mechanics challenges effectively.
- To Guide students in understanding various turbines, working principles, efficiencies, and performance analysis.
- To Foster student understanding of pump classifications, working principles, efficiencies, performance curves, and variations in reciprocating and rotary pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9+3

Units and dimension - Properties of fluids – Fluid statics - Fluid static pressure, absolute and gauge pressures, Hydrostatic Law - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in

series and parallel - Boundary Layer Theory - Definition - Types - Displacement, Energy and Momentum Thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9+3

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Applications - Similitude - Types - Prototype and Model – Model Testing and Analysis - Distorted and undistorted models.

UNIT IV TURBINES 9+3

Impact of jets - Force Exerted by a Jet on Normal, Inclined and Curved Surfaces (Concept only) Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT V PUMPS 9+3

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump classification, working principle, slip - Indicator diagram and it's variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply advanced principles of fluid mechanics to analyze and solve complex engineering problems in fluid properties, flow characteristics, and their practical applications.

CO2 : Estimate the losses in pipelines for both laminar and turbulent conditions and understand the concept of boundary layer and its thickness on the flat solid surface.

CO3 : Formulate the relationship among the parameters involved in the given fluid phenomenon and predict the performances of prototype by model studies

CO4 : Analyze and design the various types of turbines by applying the principles of fluid mechanics and machinery.

CO5 : Evaluate and design the centrifugal and reciprocating pumps by applying the principles of fluid mechanics and machinery.

TEXT BOOKS :

1 Bansal, R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., 2019.

REFERENCES:

1 Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

2 Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House (p) Ltd. New Delhi, 2016.

3 Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw- Hill Education Pvt. Ltd., 2014.

4 S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill Education Pvt. Ltd., 2012.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
2	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
3	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
4	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1
5	3	2	1	1	-	-	-	-	-	-	-	1	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23314 MANUFACTURING PROCESSES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To enable students to understand the working principles of various metal casting processes.
- To equip the students to learn and apply the working principles of various metal joining processes.
- To foster the ability to apply the working principles of bulk deformation of metals.
- To empower the students to learn the working principles of various sheet metal forming process.
- To impart knowledge on the working principles of plastics molding.

UNIT I METAL CASTING PROCESSES 9

Sand Casting – Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Molding sand Properties and testing – Cores –Types and applications – Molding machines – Types and applications– Melting furnaces – Principle of special casting processes- Shell, investment – Ceramic mould – Pressure die casting – low pressure, gravity- Tilt pouring, high pressure die casting- Centrifugal Casting – CO2 casting – Defects in Sand casting process-remedies.

UNIT II METAL JOINING PROCESSES 9

Fusion welding processes – Oxy fuel welding – Filler and Flux materials-Arc welding, Electrodes, Coating and specifications – Gas Tungsten arc welding –Gas metal arc welding - Submerged arc welding – Electro slag welding– Plasma arc welding –Resistance welding Processes -Electron beam welding –Laser beam Welding Friction welding – Friction stir welding – Diffusion welding – Thermit Welding, Weld defects – inspection & remedies – Brazing - soldering – Adhesive bonding.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – rolling of metals – Types of Rolling – Flat strip rolling – shape rolling operations – Defects in rolled parts – Principle of rod and wire drawing – Tube drawing – Principles of Extrusion – Types – Hot and Cold extrusion. Introduction to shaping operations.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics – Typical shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Test methods –special forming processes - Working principle and applications – Hydro forming – Rubber pad forming – Metal spinning – Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming – Micro forming – Incremental forming.

UNIT V MANUFACTURE OF PLASTIC COMPONENTS 9

Types and characteristics of plastics – molding of thermoplastics & Thermosetting polymers– working principles and typical applications – injection molding – Plunger and screw machines – Compression molding, Transfer molding – Typical industrial applications – introduction to blow molding – Rotational molding – Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics- duff moulding.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Illustrate the various principles of metal casting processes.

CO2 : Demonstrate the various metal joining processes.

CO3 : Elucidate the different bulk deformation processes.

CO4 : Explain the various sheet metal working processes.

CO5 : Apply suitable molding techniques for manufacturing of plastics components.

TEXT BOOKS :

1 Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2018.

REFERENCES:

1 Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2015.

2 S. Gowri P. Hariharan, A.Suresh Babu, Manufacturing Technology I, Pearson Education, 2008.

3 Paul Degarma E, Black J.T and Ronald A. Kosher, Materials and Processes, in Manufacturing, Tenth Edition, Prentice – Hall of India, 2007.

4 Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2018.

5 Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2006.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	-	-	-	-	1	1	-	1	-	3	-
2	3	2	1	-	-	-	-	-	1	1	-	1	-	3	-
3	3	2	1	-	-	-	-	-	1	1	-	1	-	3	-
4	3	2	1	-	-	-	-	-	1	1	-	1	-	3	-
5	3	2	1	-	-	-	-	-	1	1	-	1	-	3	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

CS23312 OBJECT ORIENTED PROGRAMMING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the foundational concepts of object-oriented programming including classes, objects, and inheritance in Java.
- To expose exception handling, Java streams, and Java-Doc comments for code

documentation.

- To emphasize the concepts of generics and multi-threading in Java, including synchronization techniques and the use of executors and synchronizers.
- To give insight into Java networking and JDBC, including socket programming, RMI, and database connectivity.
- To train GUI programming using Swing and JavaFX, including the implementation of the Model-View-Controller design pattern.

UNIT I PARADIGMS & BASIC CONSTRUCTS 9

Object oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism - Objects and classes in Java – defining classes – methods - access specifiers – static members – constructors – finalize method.

UNIT II EXCEPTION HANDLING & STREAMS 9

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – class hierarchy –polymorphism – dynamic binding – final keyword – abstract classes-Exception handling – exception hierarchy – throwing and catching exceptions-The Object class – Reflection – interfaces – object cloning – inner classes – proxies - I/OStreams

UNIT III GENERICS & MULTI THREADING 9

Motivation for generic programming – generic classes – generic methods – generic code and virtual machine – inheritance and generics – reflection and generics - Multi-threaded programming – interrupting threads – thread states – thread properties – thread synchronization – Executors – synchronizers.

UNIT IV JAVA NETWORKING & JDBC 9

Socket programming in Java-InetAddress and URL classes-TCP and UDP protocols in Java-ServerSocket and Socket Classes-Multi-threaded servers-Handling multiple client connections-Introduction to RMI-Creating RMI servers and clients-RMI registry-RMI and object serialization-Overview of JDBC-JDBC drivers-Connecting to databases-Executing SQL queries.

UNIT V GUI PROGRAMMING 9

Introduction to Swing – Model-View-Controller design pattern – layout management – Swing Components -Introduction to JavaFX - JavaFX components.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Implement Java classes and objects, abstraction, encapsulation, inheritance, and polymorphism by applying object-oriented programming principles.

CO2 : Handle exceptions effectively in Java programs, Java streams, and Java-Doc comments for effective documentation.

CO3 : Execute generic programming techniques, multi-threaded programming, and synchronization mechanisms in Java applications.

CO4 : Develop Java applications for network communication using socket programming, RMI, and JDBC, including the execution of SQL queries for database operations.

CO5 : Establish interactive graphical user interfaces using Swing and JavaFX, separation of concerns, and efficient layout management by applying the Model-View-Controller design pattern.

TEXT BOOKS :

1 Java: The Complete Reference, Thirteenth Edition,Herbert Schildt, Danny Coward, 2024,McGraw-Hill Companies, (Unit I, II &III)

2 Java for Dummies,Barry Burd,2022,For Dummies,ISBN: 9781119861645 (Unit IV & V)

REFERENCES:

1 Java Cookbook: Problems and Solutions for Java Developers, Ian Darwin,2020, O' Reilly Media,

2 www.javatpoint.com

3 www.w3schools.com

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	2	2	2	3	3	2	2	2	2	2
2	3	3	3	2	3	1	2	2	2	2	1	2	3	2	1
3	1	2	3	2	3	1	1	2	2	2	2	3	2	3	1
4	2	2	2	3	2	2	1	2	3	2	2	2	1	1	2
5	2	1	1	1	1	2	1	1	1	1	2	1	1	1	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

CS23322 OBJECT ORIENTED PROGRAMMING LABORATORY L T P C

0 0 2 1

COURSE OBJECTIVES:

- To develop foundational programming skills through algorithm implementation.
- To understand and implement inheritance and polymorphism, utilizing data structures and collections.
- To develop skills in exception handling, file management, multithreading, and generic programming.
- To acquire knowledge and skills in Java networking and JDBC.
- To gain proficiency in GUI programming using Swing.

LIST OF EXPERIMENTS:

Simple Experiments

Find the sum of all numbers from 1 to 100.

1. Develop a program that takes user input for a number and prints whether it's prime or not.
2. Fibonacci sequence up to the nth term using recursion.

Classes and Objects

3. Define a class "Car" with attributes like model, color, and methods to start and stop the car.
4. Implement inheritance by creating a base class "Shape" and derived classes like "Circle" and "Rectangle."
5. Develop a program that uses interfaces to model a simple banking system with classes like "Account" and "Transaction."

Exception Handling

6. Write a Java program to handle exceptions for dividing a number by zero.

7. Implement a multi-threaded program to simulate a race between two threads.
8. Develop a generic class for a binary tree and implement depth-first and breadth-first traversal algorithms.
9. Create a simple Java program to establish a client-server connection using sockets.

Application

10. Develop a Java application to connect to a MySQL database and retrieve information using JDBC.
11. Implement a multi-threaded server using Java RMI to handle concurrent client requests.
12. Design a simple GUI application to convert temperature between Celsius and Fahrenheit.
13. Create a JavaFX application for a basic media player with play, pause, and stop functionalities.
14. Develop an interactive graphical application using JavaFX that involves real-time data visualization.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Construct programs with effective control structures for decision-making and looping.

CO2 : Formulate programs using inheritance and polymorphism concepts, utilizing data structures and collections.

CO3 : Devise programs with effective exception handling, file management, multithreading, and generic programming.

CO4 : Establish Java programs that communicate over a network, and connect to databases using JDBC.

CO5 : Generate Graphical User Interfaces (GUIs) using Swing in Java.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	2	2	2	2	2	3	3	2	2	2	2	2
2	3	3	3	2	3	1	2	2	2	2	1	2	3	2	1
3	1	2	3	2	3	1	1	2	2	2	2	3	2	3	1
4	2	2	2	3	2	2	1	2	3	2	2	2	1	1	2
5	2	1	1	1	1	2	1	1	1	1	2	1	1	1	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23321 COMPUTER AIDED MACHINE DRAWING LABORATORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

- To instill the ability to interpret and apply Drawing Standards, Fits, and Tolerances based on BIS specifications for engineering drawings, encompassing symbols and fasteners, ensuring students comprehend and implement industry-standard practices.
- To equip students with the skills to proficiently use CAD software for drawing creation, editing, and detailing in both 2D and 3D.

- To guide students in constructing basic and mechanical assemblies using 2D CAD packages.
- To facilitate the assessment and assembly of intricate mechanical components.
- To develop students' capability to produce 2D/3D models using CAD, engage in reverse engineering processes, apply parametric modelling techniques, and prototype mechanical components using 3D printing technology.

LIST OF EXPERIMENTS

Module 1 : Basics of Machine Drawing

Drawing Standards & Fits and Tolerances: Code of practice for Engineering Drawing, Understanding the BIS specifications for engineering drawing, including welding symbols, riveted joints, keys, fasteners, etc. Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerance of individual dimensions IS919- Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerance

Module 2 : Introduction to CAD Software,

Drawing creation, editing, dimensioning, layering, hatching, block creation, array usage, detailing, and detailed drawing. 3D : Drawing creation, editing, dimensioning, hatching, array usage – Sketcher Module

Module 3 : Basic Assemblies

Assembly of Plumber Block – Assembly of Flange Coupling - - Assembly of Screw Jack- Assembly of knuckle joint

Module 4 : Mechanical Assemblies

Assembly of Safety Valve - Assembly of Non-return Valve -, Oldham's coupling, muff coupling, and gear couplings. Assembly of Universal Joint - Assembly of Gib and Cotter Joint - Assembly of Sleeve and Cotter Joint - Assembly of Stuffing Box, universal joint - Assembly of Bush Bearing.

Module 5: Advanced Modelling and Prototyping

Practice in creating 2D/3D models using CAD software - Reverse engineering of a given mechanical component using CAD tools - Parametric modelling and design modifications in CAD software - Prototyping a mechanical component using 3D printing technology.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Interpret and apply Drawing Standards, Fits, and Tolerances based on BIS specifications for engineering drawings, including symbols and fasteners..

CO2 : Utilize CAD software for drawing creation, editing, and detailing in both 2D and 3D, employing techniques like layering, hatching, and array usage.

CO3 : Construct basic and mechanical assemblies using 2D CAD packages.

CO4 : Assess and assemble complex mechanical components like Safety Valve, Non-return Valve, Oldham's coupling, and Universal Joint.

CO5 : Produce 2D/3D models using CAD, perform reverse engineering, apply parametric modelling,

and prototype mechanical components using 3D printing technology.

TEXT BOOKS :

1 Gopalakrishna K.R., "Machine Drawing", 17th Edition, Subhas Stores Books Corner, Bangalore, 2019.

REFERENCES:

1 N. Siddeshwar, P. Kanniah, V.V.S. Sastri," Machine Drawing" , published by Tata McGraw-Hill, 2006

2 N. D. Bhatt and V.M. Panchal, "Machine Drawing", 51st Edition, Charator Publishers, 2022.

3 S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

4 NPTEL COURSE : https://onlinecourses.nptel.ac.in/noc20_me79/preview - Engineering drawing and computer graphics By Prof. Rajaram Lakkaraju | IIT Kharagpur

5 https://www.autodesk.com/learn/ondemand/curated/autocad-quick-start-guide

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	-	-	3	-	-	-	1	-	-	1	3	1	1
2	2	2	-	-	3	-	-	-	1	-	-	1	3	1	1
3	2	2	-	-	3	-	-	-	1	-	-	1	3	1	1
4	2	2	-	-	3	-	-	-	1	-	-	1	3	1	1
5	2	2	-	-	3	-	-	-	1	-	-	1	3	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER IV

GE23412	ENVIRONMENTAL SCIENCE FOR MECHANICAL ENGINEERS	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of natural resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, effects and preventive measures of water, soil, air and noise pollution. Types of wastes and E-waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III NATURAL RESOURCES 6

Environment - definition - scope and importance - forest resources - use and overexploitation - water resources - use and over utilization - dams - benefits and problems - water conservation - energy resources - growing energy needs - renewable and non-renewable energy sources - use of alternate energy sources - role of an individual in conservation of natural resources

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP , Sustainability - concept, needs and challenges - economic and social aspects of sustainability - from unsustainability to sustainability - millennium development goals, and protocols- Sustainable development goals - targets, indicators and intervention areas. Climate change - Global, regional and local environmental issues and possible solutions-case studies. Concept of carbon credit, Carbon footprint. Environmental management in industry - A case study.

UNIT V SUSTAINABILITY PRACTICES FOR MECHANICAL ENGINEERS 6

Importance of integrating sustainability into mechanical engineering practices. Zero waste and R concept, Circular economy, ROHS, REACH 84, Material life cycle assessment, Environmental Impact Assessment of Mechanical processes. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports in mechanical engineering. Carbon emission and sequestration in mechanical systems. Green Engineering: Sustainable urbanization- Socio economical and

technological considerations in mechanical aspects.

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : To recognize and understand the functions of the environment, ecosystems and biodiversity and their conservation.

CO2 : To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.

CO3 : To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

CO4 : To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.

CO5 : To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS :

1 Benny Joseph, ―Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2017. (I,II, & III)

2 Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case studies, Prentice Hall, 2011. (IV & V)

REFERENCES:

1 R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38th edition 2010.

2 Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.

3 Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.

4 Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.

5 Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	-	-	-	3	3	2	-	-	-	2	1	-	1
2	3	2	-	-	-	3	3	2	-	-	-	2	1	-	1
3	3	2	1	-	-	3	3	2	-	-	-	2	1	-	1
4	3	2	1	1	-	3	3	2	-	-	-	2	1	-	1
5	3	2	1	-	-	3	3	2	-	-	-	2	1	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23411 ENGINEERING MATERIALS AND METALLURGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To enable the students to learn the construction of the phase diagram and using of iron-iron carbide phase diagram for microstructure formation.
- To impart the knowledge to select and apply various heat treatment processes and understand the microstructure formation.
- To foster the capability to illustrate the different types of ferrous and non-ferrous alloys and their uses in engineering field.
- To facilitate the students to interpret the different polymers, ceramics and composites and their uses in engineering field.
- To familiarize the students about the various testing procedures and failure mechanism in engineering field.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, Substitutional and Interstitial – phase diagrams, Isomorphous, Eutectic, Eutectoid, Peritectic, and Peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and Cast-Iron microstructure, properties and application.

UNIT II HEAT TREATMENT 9

Definition – Full annealing, stress relief, Recrystallisation and Spheroidising –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram – continuous cooling Transformation (CCT) diagram – Austempering, Martempering – Hardenability, Jominy end quench test -case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening – Thermo-mechanical treatments- elementary ideas on sintering.

UNIT III FERROUS AND NON-FERROUS METALS 9

Effect of alloying additions on steel (Mn, Si, Cr, Mo, Ni, V, Ti & W) – stainless and tool steels – HSLA - Maraging steels – Grey, white, malleable, spheroidal – alloy cast irons, Copper and its alloys – Brass, Bronze and Cupronickel – Aluminium and its alloys; Al-Cu – precipitation strengthening treatment – Titanium alloys, Mg-alloys, Ni-based super alloys – shape memory alloys- Properties and Applications overview of materials standards

Case Study: Ferrous (Fe-based) shape memory alloys (SMAs): properties, processing and applications

UNIT IV NON-METALLIC MATERIALS 9

Polymers – types of polymers, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PAI, PPO, PPS, PEEK, PTFE, Thermoset polymers – Urea and Phenol formaldehydes –Nylon, Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON – Intermetallics - Composites- Matrix and reinforcement Materials applications of Composites - Nano composites.

Case Study: Light Weight Material in Mechanical and Automobile Applications

UNIT V DEFORMATION MECHANISMS AND TESTING OF MATERIALS 9

Mechanisms of plastic deformation, slip and twinning – Types of fracture – fracture mechanics-Griffith's theory- Testing of materials under tension, compression and shear loads – Hardness tests

(Brinell, Vickers and Rockwell), Micro and nano-hardness tests, Impact test lzod and Charpy, fatigue and creep failure mechanisms.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Explain the classification and differentiation of various phases and reactions within alloy systems, including solid solutions, substitutional, and interstitial, by interpreting phase diagrams effectively.

CO2 : Demonstrate heat treatment processes like annealing, normalizing, hardening, tempering, and case hardening, and their impacts on alloy microstructure and properties.Top of Form

CO3 : Analyze the effect of alloying elements on ferrous and non-ferrous metals' properties and applications.

CO4 : Analyze properties and applications of non-metallic materials like polymers, engineering ceramics, and composites, for lightweight solutions in mechanical and automotive contexts.

CO5 : Explain the testing of mechanical properties.

TEXT BOOKS :

1 Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 9th edition, 2018.

REFERENCES:

1 A. Alavudeen, N. Venkateshwaran, and J. T. Winowlin Jappes, A Textbook of Engineering Materials and Metallurgy, Laxmi Publications, 2006.

2 Amandeep Singh Wadhwa, and Harvinder Singh Dhaliwal, A Textbook of Engineering Material and Metallurgy, University Sciences Press, 2008.

3 G.S. Upadhyay and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd, New Delhi, 2020.

4 Sydney H.Avner, “Introduction to Physical Metallurgy”, McGraw-Hill Book Company, Second Edition, 1994.

5 Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd. 6th edition, 2019.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	1	3	2	-	-	-		-	-	-	2	1	-	1
2	3	1	3	1	-	2	-	1	-	-	-	2	1	-	1
3	3	1	3	-	-	-	-	-	-	-	-	2	1	1	1
4	3	1	3	-	-	-	2	-	-	-	-	2	1	1	1
5	3	1	3	2	2	-	-	-	-	-	-	2	1	-	1

1 - low, 2 - medium, 3 -high, ‘-' - no correlation

ME23412	MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the concepts and basic mechanics of metal cutting and the factors affecting machinability.
- To facilitate the students to interpret the working of basic and advanced turning machines.
- To foster the ability of the students to realize the basics of machine tools with reciprocating and rotating motions and abrasive finishing processes.
- To nurture the students to understand the basic concepts of CNC machine tools and constructional features of CNC.
- To equip the students with the basics of CNC programming concepts to develop the part program for Machining centre and turning centre.

UNIT I MECHANICS OF METAL CUTTING 9

Mechanics of chip formation, forces in machining, Types of chip, cutting tools – 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 II CONVENTIONAL MACHINE TOOLS –TURNING, MILLING AND DRILLING 9

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, surface roughness in turning, machining time and power estimation. Special lathes - Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle, Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation - Gear cutting, Multi Axis Machining - 5 Axis.

UNIT III CONVENTIONAL MACHINE TOOLS – SHAPING, PLANING GRINDING 9

Reciprocating machine tools: shaper, planer, slotter: Types and operations, Gear hobbing and gear shaping – gear finishing methods Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding, internal grinding - micro finishing methods.

UNIT IV CNC MACHINE TOOLS 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 – Work holding methods in Turning and machining centres, Coolant systems; Direct numerical control (DNC), Supervised control Vertical machining centers (VMC), horizontal machining centers (HMC) and Safety features.

UNIT V PROGRAMMING OF CNC MACHINE TOOLS 9

Coordinates, axis and motion, Absolute vs Incremental, Interpolators, Polar coordinates, Program planning, G and M codes, Manual part programming for CNC machining centers and Turning centers – Fixed cycles, Loops and subroutines, Setting up a CNC machine for machining.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyze the relationship between cutting parameters, tool geometry, and material properties to optimize machining processes for desired outcomes, including surface finish, tool life, and machinability.

CO2 : Apply the principles to execute diverse machining tasks using the turning, milling and drilling machine tools.

CO3 : Explain principles of shaping, planning and grinding tools and gear hobbing and shaping techniques for manufacturing applications.Top of Form

CO4 : Demonstrate the constructional features and working principles of CNC machine tools.

CO5 : Analyze and integrate manual part programming techniques, G and M codes, and CNC machine setup procedures, showcasing the problem-solving skills.

TEXT BOOKS :

1 Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India, 7th Edition, 2018.

REFERENCES:

1 Roy. A. Lindberg, Processes and materials of manufacture, PHI/Pearson Education, 2015.

2 Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw-Hill, 2005.

3 Rao. P.N "Manufacturing Technology," Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2018.

4 A. B. Chattopadhyay, "Machining and Machine Tools", Wiley, 2nd Edition, 2017.

5 Peter Smid, "CNC Programming Handbook", Industrial Press Inc.; Third Edition, 2007.

6 Michael Fitzpatrick, "Machining and CNC Technology", McGraw-Hill Education; 4th Edition, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	1	-	1	-	-	-	-	1	1	3	-
2	3	3	3	1	1	-	1	-	-	-	-	1	1	3	-
3	3	3	3	1	1	-	1	-	-	-	-	1	1	3	-
4	3	3	3	1	1	-	1	-	-	-	-	1	1	3	-
5	3	3	3	1	2	-	1	-	-	-	-	1	1	3	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23413 **MECHANICS OF SOLIDS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To enable students in comprehending the foundational principles related to stress, strain, and the elastic constants of solids when exposed to external loads.
- To facilitate students in acquiring knowledge about shear force, bending moment, and the bending stress developed in beams under the influence of transverse loads.

- To foster the ability to analyze the deformation exhibited by shafts and springs under torsional loads.
- To inculcate the students in exploring different methodologies for calculating beam deflection and analyzing column buckling failure caused by external loads.
- To familiarize students with the various stresses inherent in shell structures, including cylinders and spheres.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads – Volumetric strains

UNIT II STRESSES IN BEAMS 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stresses in beams – Shear flow.

UNIT III TORSION ON SHAFTS AND SPRINGS 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Maximum shear stress in spring section including Wahl Factor - Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS AND COLUMNS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams – Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT V STRESSES IN CYLINDERS AND SPHERES 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem. Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyze the stress, strain and elastic constants of solids under external loading conditions.

CO2 : Evaluate the shear force, bending moment and bending stress for beams subjected to transverse loading conditions.

CO3 : Apply the principles of torsion and spring mechanics to analyze the deformation of shafts under various loading conditions.

CO4 : Calculate the deflection of beams using various methods and design the columns in order to withstand buckling and crushing loads.

CO5 : Evaluate the stresses acting on cylinders and spheres, and determine the Principal stresses using Mohr's circle

TEXT BOOKS :

1 Egor. P. Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, Second edition, 2009.

REFERENCES:

1 Hibbeler, R.C., "Mechanics of Materials", Pearson Education, 11th Edition, 2022.

2 Ramamurtham S., "Strength of Materials", Dhanpat rai publishing company, 2011.

3 Jindal U.C., "Strength of Materials", Pearson Pvt. Ltd., New Delhi, 2012.

4 Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2015.

5 Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, David F. Mazurek and Sanjeev Sanghi "Mechanics of Materials", Tata McGraw-Hill Publishing co. Ltd., New Delhi, Eighth Edition, 2020.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	-	-	1	-	-	-	-	1	2	1	-
2	3	3	2	1	-	-	1	-	-	-	-	1	2	1	-
3	3	3	2	1	-	-	1	-	-	-	-	1	2	1	-
4	3	3	2	1	-	-	1	-	-	-	-	1	2	1	-
5	3	3	2	1	-	-	1	-	-	-	-	1	2	1	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23414 THEORY OF MACHINES L T P C

3 1 0 4

COURSE OBJECTIVES:

- To instill the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
- To impart the knowledge on basic concepts of toothed gearing and kinematics of gear trains
- To prepare the students to evaluate the effects of friction in machine elements
- To equip the students to analyze the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- To make the students to study the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

UNIT I KINEMATICS OF MECHANISMS 9+3

Mechanisms – Terminology and definitions – degrees of freedom - kinematics inversions of 4 bar and single and double slider crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons– Analytical methods – computer approach

UNIT II GEARS, GEAR TRAINS AND CAMS 9+3

Types of gear - Spur gear terminology – law of toothed gearing – cycloidal and involute profiles – Interchangeability – interference and undercutting – gear trains –speed ratio, train value - parallel axis gears trains – epicyclic gear trains – cams – classifications – types of follower - displacement diagrams - layout of plate cam profiles with knife edge and roller followers (without and with offset)

UNIT III FRICTION IN MACHINE ELEMENTS 9+3

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – screw jack - Bearings and lubrication – Friction clutches – Belt and rope drives – Friction aspects in

brakes– Friction in vehicle propulsion and braking.

UNIT IV FORCE ANALYSIS 9+3

Applied and Constrained Forces –Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members – flywheels and governors (applications)

UNIT V BALANCING AND VIBRATION 9+3

Static and Dynamic balancing – Balancing of revolving and reciprocating masses –free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyze and solve complex kinematic problems in various mechanisms using analytical methods

CO2 : Solve problems on gear trains and design the CAM

CO3 : Evaluate the effect of friction in machine elements.

CO4 : Calculate the static and dynamic forces of mechanisms.

CO5 : Estimate the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

TEXT BOOKS :

1 Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019.

REFERENCES:

1 Amitabha Ghosh and Asok Kumar Mallik, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., 1988.

2 Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition, 2014.

3 Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019.

4 Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.

5 Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.

6 Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill, 2013.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
2	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
3	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
4	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
5	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23431	THERMAL ENGINEERING	L	T	P	C
		2	1	2	4

COURSE OBJECTIVES:

- To equip the students with the concepts and laws of thermodynamics to predict the operation of thermodynamic cycles and performance of Internal Combustion (IC) engines and Gas Turbines.
- To enable the students to understand the performance of steam nozzle, calculate critical pressure ratio
- To foster the capability to calculate the performance of steam turbines through velocity triangles, understand the need for governing and compounding of turbines
- To facilitate the students to understand the working of IC engines and various auxiliary systems present in IC engines
- To Impart knowledge to the students to evaluate the performance of refrigeration and air-conditioning systems.

UNIT I THERMODYNAMIC CYCLE **9**

Air Standard Cycles–Carnot, Otto, Diesel, Dual, Brayton–Cycle Analysis, Performance and Comparison, Basic Rankine Cycle, modified, reheat and regenerative cycles.

UNIT II STEAM NOZZLES AND INJECTOR **9**

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flowrate with pressure ratio. Effect of friction. Metastable flow.

UNIT III STEAM AND GASTURBINES **9**

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing. Gas turbine cycle analysis – open and closed cycle. Performance and its improvement- Regenerative, Intercooled, Reheated cycles and their combination.

UNIT IV INTERNAL COMBUSTION ENGINES – FEATURES AND COMBUSTION **9**

IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation–lean and rich mixtures. Combustion in SI & CI Engines–Knocking–phenomena and control.

UNIT V REFRIGERATION AND AIR – CONDITIONING **9**

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

45 PERIODS

LIST OF EXPERIMENTS

1. Valve Timing and Port Timing diagrams
2. Determination of Flash Point and Fire Point of various fuels / lubricants
3. Determination of Viscosity – Red Wood Viscometer
4. Performance Test on 4 – stroke Diesel Engine

5.Heat Balance Test on 4 – stroke Diesel Engine
6.Morse Test on Multi-cylinder Petrol Engine
7.Retardation Test on a Diesel Engine
8.Study on Steam Generators and Turbines
9.Performance test on Refrigeration test rig.
10. Performance test on Air-conditioning test rig.

30 PERIODS
TOTAL : 75 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply thermodynamic concepts to different air standard cycle sand solve problems.
CO2 : Solve the problems in steam nozzle and calculate critical pressure ratio.
CO3 : Evaluate the performance of steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems.
CO4 : Analyze internal combustion engines, comparing SI and CI types, calculating air-fuel ratios, and addressing combustion phenomena like knocking with suitable control methods.
CO5 : Calculate the performance of the refrigerator and air-conditioning

TEXT BOOKS :

1 R.K.Rajput, "A text book of Engineering Thermodynamics", 5thEdition, Lakshmi Publications, New Delhi, 2016. (Unit I,II ,III & V)
2 Ganesan. V, "Internal Combustion Engines" 4th Edition, Tata McGraw-Hill, 2012. (Unit IV)

REFERENCES:

1 Ballaney. P, "Thermal Engineering", 25th Edition, Khanna Publishers, 2017.
2 Domkundwar, Kothandaraman, & Domkundwar, "A Course in Thermal Engineering", 6th Edition, Dhanpat Rai& Sons, 2011.
3 Gupta H. N, "Fundamentals of Internal Combustion Engines", 2nd Edition Prentice Hall of India, 2013.
4 Mathur M. L and Mehta F.S., "Thermal Science and Engineering", 3rd Edition, Jain Brothers Pvt. Ltd, 2017.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
2	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
3	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
4	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1
5	3	2	2	1	-	-	-	-	-	-	-	1	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23421	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enable the students to select appropriate tools, equipment's and machines to complete a given job.
- To equip students with the skills to accomplish various gear fabrication processes using gear making machines.
- To facilitate the students to produce diverse green sand molds using a variety of patterns.
- To nurture the skills for various machining process such as shaping and grinding process and analysing the defects in the machined components.
- To foster the ability to perform various machining process such as drilling and milling and analysing the defects in the machined components.

LIST OF EXPERIMENTS

1. Preparing green sand moulds with cast patterns.
2. Taper Turning and Eccentric Turning on circular parts using lathe machine.
3. Knurling, external and internal thread cutting on circular parts using lathe machine.
4. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
5. Drilling and Reaming using vertical drilling machine.
6. Milling contours on plates using vertical milling machine.
7. Cutting spur and helical gear using milling machine.
8. Generating gears using gear hobbing machine.
9. Generating gears using gear shaping machine.
10. Grinding components using cylindrical and centerless grinding machine.
11. Grinding components using surface grinding machine.
12. Cutting force calculation using dynamometer in lathe and milling machine.
13. Manual part programming for CNC Turning and milling centers

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyze and evaluate the selection of appropriate equipment and machines to efficiently complete assigned tasks.

CO2 : Synthesize and integrate knowledge of gear fabrication processes to execute complex tasks utilizing diverse machine setups.

CO3 : Design and create green sand molds with intricate patterns, demonstrating mastery of molding techniques.

CO4 : Apply advanced machining techniques, including shaping and grinding, with precision and expertise on provided components.

CO5 : Innovate and devise machining strategies for drilling and milling operations, showcasing mastery in machining processes and problem-solving skills.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	-	2	-	1	-	2	1	-	1	-	3	1
2	3	2	2	-	2	-	1	-	2	1	-	1	-	3	1
3	3	2	2	-	2	-	1	-	2	1	-	1	-	3	1
4	3	2	2	-	2	-	1	-	2	1	-	1	-	3	1
5	3	2	2	-	2	-	1	-	2	1	-	1	-	3	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23422 STRENGTH OF MATERIALS AND FLUID MACHINERY LABORATORY

L	**T**	**P**	**C**
0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To enable the students to study the mechanical properties of metals by standardised testing methods
- To explore and analyze the mechanical characteristics exhibited by helical and carriage springs through practical experimentation.
- To foster the ability to perform tests on the venturimeter, orifice meter and flow through pipes to verify the principles studied in fluid mechanics and machinery theory
- To facilitate the students to interpret the performance characteristics of centrifugal, reciprocation pumps and Gear pump
- To equip the students to analyse the performance of turbine

STRENGTH OF MATERIALS LABORATORY

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Impact test on metal specimen
5. Deformation test on springs

FLUID MECHANICS AND MACHINES LABORATORY

LIST OF EXPERIMENTS

1. Determination of coefficient of discharge of a Venturimeter
2. Determination of the coefficient of discharge of Orifice meter
3. Determination of friction factor for flow through pipes
4. Characteristics of Centrifugal pump
5. Characteristics of Reciprocating pump
6. Characteristic of Gear pump
7. Characteristics of Pelton wheel turbine

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Estimate the tensile, torsion, impact and hardness properties of metals by testing

CO2 : Calculate the stiffness properties of spring

CO3 : Apply the conservation laws to determine the coefficient of discharge of a venturimeter & orificemeter and to find the friction factor of given pipe

CO4 : Evaluate the performance characteristics of centrifugal, reciprocation and Gear pump

CO5 : Determine the performance characteristics of turbine

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	1	-	-	-	-	1	1	-	1	2	-	1
2	3	2	2	1	-	-	-	-	1	1	-	1	2	-	1
3	3	2	2	1	-	-	-	-	1	1	-	1	2	-	1
4	3	2	2	1	-	-	-	-	1	1	-	1	2	-	1
5	3	2	2	1	-	-	-	-	1	1	-	1	2	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23IC1 INTRODUCTION TO PRODUCT LIFECYCLE MANAGEMENT

L	**T**	**P**	**C**
1	**0**	**0**	**1**

COURSE OBJECTIVES:

- To introduce students to the concept of Product Lifecycle Management.
- To familiarize students with the stages of the product lifecycle.
- To explore the tools and techniques used in PLM.
- To understand the significance of PLM in modern engineering practices.
- To develop critical thinking and problem-solving skills related to PLM.

CONTENTS

Introduction to Product Lifecycle Management 1

Definition and significance of PLM, Overview of the product lifecycle stages.

Product Design Phase 2

Conceptualization and ideation, CAD/CAM tools in product design, Design for manufacturability (DFM) principles.

Product Development Phase 2

Prototyping and testing, Concurrent engineering approaches, Risk assessment and mitigation in product development.

Product Manufacturing Phase 2

Manufacturing process planning, Supply chain management, Lean manufacturing principles in PLM.

Product Distribution Phase 2

Logistics and transportation considerations, Inventory management, Global distribution challenges and strategies.

Product Utilization Phase 2

Customer feedback and product improvement, After-sales service and support, End-of-life considerations.

PLM Software and Tools 2

Overview of PLM software solutions, Hands-on demonstration of PLM tools, Case studies on successful PLM implementations.

Future Trends in PLM 2

Emerging technologies in PLM, Sustainable practices in product lifecycle management. Q&A session, Presentation of PLM project by students.

TOTAL : 15 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the concept of Product Lifecycle Management (PLM) and its significance in modern engineering practices.

CO2 : Identify and differentiate between the stages of the product lifecycle, and explain their relevance in the context of PLM.

CO3 : Apply CAD/CAM tools and design principles to effectively contribute to the product development phase within a PLM framework.

CO4 : Analyze manufacturing processes, supply chain management strategies, and their integration with PLM to optimize production efficiency.

CO5 : Evaluate the impact of customer feedback, after-sales service, and end-of-life considerations on product lifecycle management, and propose strategies for improvement within a PLM context.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	-	2	-	1	-	-	-	-	3	3	2	3
2	3	3	1	-	2	-	1	-	-	-	-	3	3	2	3
3	3	3	1	-	2	-	1	-	-	-	-	3	3	2	3
4	3	3	1	-	2	-	1	-	-	-	-	3	3	2	3
5	3	3	1	-	2	-	1	-	-	-	-	3	3	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER V

ME23511	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To guide students in comprehending the sequential stages of the Design Process.
- To instruct students in the art of designing shafts and couplings tailored for diverse applications.
- To educate students on the intricacies of designing both temporary and permanent Joints.
- To provide students with the knowledge and skills necessary to design helical, leaf springs, flywheels, connecting rods, and crankshafts for a variety of applications.
- To equip students with the ability to design and select sliding and rolling contact bearings, as well as seals and gaskets, based on specific requirements and constraints.

UNIT I FUNDAMENTAL CONCEPTS IN DESIGN 9+3

Design Process and Procedure - Stresses - Static, residual, stress concentration, types of stresses - Factors of safety - Theories of failure – Stress concentration factors - Goodman, Soderberg equations - Limits, Fits and Tolerances. Design based on strength and stiffness. Design for finite and infinite life under variable loading

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9+3

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings. Selection Criteria for Couplings in Machinery Applications

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9+3

Mechanical joints: Bolted joints, Knuckle Joint, Cotter and pin Joint. Riveted Joints: Types, Rivet Materials, Failures of Riveted Joints, and Boiler Joints – longitudinal and circumferential. Welded Joints: Types, Strength of Butt and Fillet welds, Eccentrically loaded Welded Joints. Power screws: Types of Screw Threads.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9+3

Types of springs, design of helical and concentric springs – surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines-- Solid and Rimmed flywheels- connecting rods and crank shafts.

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9+3

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, - Selection of Rolling Contact bearings –Design of Seals and Gaskets

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Explain the design of machine members under static and variable loads.

CO2: Apply the principles of design to shafts, keys, and couplings.

CO3: Utilize design concepts to analyze bolted, knuckle, cotter, riveted, and welded joints.

CO4: Implement design principles to develop helical, leaf springs, flywheels, connecting rods, and

crankshafts.

CO5: Employ design methodologies to choose sliding and rolling contact bearings, as well as seals and gaskets.

TEXT BOOKS :

1 Bhandari V B, "Design of Machine Elements", 4th Edition , Tata McGraw-Hill Book Co, 2016

REFERENCES:

1 Jose ph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015

2 Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

3 Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017

4 Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	-	-	-	-	-	-	-	-	3	2	-
2	3	3	3	1	-	-	-	-	-	-	-	-	3	2	-
3	3	3	3	1	-	-	-	-	-	-	-	-	3	2	-
4	3	3	3	1	-	-	-	-	-	-	-	-	3	2	-
5	3	3	3	1	-	-	-	-	-	-	-	-	3	2	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23512 HEAT AND MASS TRANSFER L T P C

3 1 0 4

COURSE OBJECTIVES:

- To enable the students to understand the mechanisms of conduction heat transfer under steady and transient conditions.
- To enrich the knowledge on the applications of the convection heat transfer.
- To equip students with the skills to apply phase change concept to determine the performance.
- To guide students in understanding various radiation laws and to determine the radiation heat transfer in various configurations.
- To foster student understanding of Heat exchange, diffusion and convective mass transfer.

UNIT I CONDUCTION 9+3

General Differential equation of Heat Conduction– Cartesian and Polar Coordinates – One Dimensional Steady State Heat Conduction –– plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts.

UNIT II CONVECTION **9+3**

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over plates and cylinders and Internal flow through tubes.

UNIT III PHASE CHANGE HEAT TRANSFER **9+3**

Nusselt's theory of condensation - Regimes of pool boiling and flow boiling. Correlations in boiling and condensation.

UNIT IV RADIATION **9+3**

Black Body Radiation – Grey body radiation - Shape Factor – Electrical Analogy – Radiation Shields. Radiation through gases.

UNIT V HEAT EXCHANGERS AND MASS TRANSFER **9+3**

Heat exchangers - types - fouling factor - LMTD and NTU methods - Mass transfer - Fick's law - analogy between heat and mass transfer

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems

CO2: Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems

CO3: Analyze the phenomena of boiling and condensation,

CO4: Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems

CO5: Apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and diffusive and convective mass transfer correlations to solve problems for different applications

TEXTBOOKS:

1 R.C. Sachdeva, "Fundamentals of Engineering Heat and Mass transfer", New Age International Publishers, 6th Edition, 2022.

REFERENCES:

1 Frank P. Incropera and David P. Dewitt, "Principles of Heat and Mass Transfer", John Wiley & Sons, 2018.

2 Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 2006.

3 Nag, P.K., "Heat Transfer", Tata McGraw – Hill Education, New Delhi, 2011

4 Ozisik, M.N., "Heat Transfer A Basic Approach", Mc Graw-Hill Book Co., 1985.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23531	MECHATRONICS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To select appropriate sensors for developing efficient and responsive mechatronics systems.
- To explain the architecture and timing diagrams of microprocessors, enabling students to interpret these diagrams and develop programs independently.
- To design effective interfacing circuits for connecting I/O devices with microprocessors, fostering practical application and understanding.
- To apply PLC and SCADA systems as controllers in mechatronics systems.
- To design and develop a tailored mechatronics system for an application.

UNIT I INTRODUCTION AND SENSORS **9**

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach - Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance Sensors – Strain Gauges – Eddy Current Sensor – Hall Effect Sensor –Temperature Sensors – Light Sensors – Selection of Sensors – Application of Sensors in Healthcare, Agriculture, Manufacturing, Chemical Industries.

UNIT II 8085 MICROPROCESSOR **9**

Introduction – Architecture of 8085 – Pin Configuration- Addressing Modes – Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram – Introduction to Arduino and Raspberry Pi.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE **9**

Introduction – Architecture of 8255, Keyboard Interfacing, LED display – Interfacing, ADC and DAC Interface, Temperature Control – Stepper Motor Control – Traffic Control Interface

UNIT IV PROGRAMMABLE LOGIC CONTROLLER and SCADA **9**

Introduction – Architecture – Input / Output Processing – Programming – Mnemonics - Timers, Counters, Shift Registers and Internal relays – Data Handling – Selection of PLC

Introduction to SCADA - SCADA System Components – Functions – RTU Technology - Applications

UNIT V ACTUATORS AND MECHATRONICS SYSTEM DESIGN **9**

Types of Stepper and Servo motors – Construction – Working Principle – Characteristics, Stages of Mechatronics Design Process – Comparison of Traditional and Mechatronics Design Concepts – Case studies of Mechatronics Systems – Pick and Place Robot – Engine Management system – Automatic Car Park Barrier –IoT based Case studies

TOTAL: 45 PERIODS

LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.

7. Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using software.
8. Study of PLC and its applications.
9. Study of image processing technique

TOTAL: 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1: Explain the fundamentals of Mechatronics systems and classify various sensors, understanding their applications in healthcare, agriculture, and industry.

CO2: Describe the architecture, pin configuration, and operation of the 8085 microprocessor, developing an understanding of microcontroller basics and Arduino, Raspberry Pi boards.

CO3: Design interfacing circuits to connect I/O devices with microprocessors.

CO4: Demonstrate the use of SCADA and PLCs, including timers, counters, shift registers, and data handling, for controlling, monitoring and analyzing industrial devices and processes.

CO5: Analyze and design Mechatronics systems using actuators, motors, and IoT, covering design stages and applications like robotics and automotive systems.

TEXTBOOKS :

1 Bolton W., "Mechatronics", Pearson Education, 6th Edition, 2015.

2 Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing Private Limited, 6th Edition, 2013.

REFERENCES:

1 Bradley D.A., Dawson D., Buru N.C. and Loader A.J., "Mechatronics", Chapman and Hall, 1993.

2 Davis G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", McGraw Hill Education, 2011.

3 Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", Cengage Learning, 2010.

4 Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applications", McGraw Hill Education, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	-	-	-	2	-	-	-	-	-	-	1	1	2	3
2	3	-	-	2	2	-	-	-	-	-	-	1	2	1	3
3	3	1	1	2	2	-	-	-	-	-	-	1	2	2	3
4	3	1	1	2	2	-	-	-	-	-	-	1	2	2	3
5	3	-	-	-	2	-	-	-	-	-	-	1	1	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23521 **HEAT TRANSFER LABORATORY** **L T P C**

0 0 2 1

COURSE OBJECTIVES:

- To enable the students to study the thermal conductivity of various materials.
- To explore and analyse the heat transfer coefficient of forced convection and free convection.

- To foster the ability to perform tests on parallel flow and counter flow heat exchanger
- To equip the students to determine the emissivity by radiation.
- To facilitate the students to interpret in measuring temperature using various thermocouple.

LIST OF EXPERIMENTS

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils, and water.
3. Determination of heat transfer coefficient of air under natural convection.
4. Determination of heat transfer coefficient of air forced convection.
5. Heat transfer from pin-fin under natural convection.
6. Heat transfer from pin-fin under forced convection.
7. Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of a tube-in-tube heat exchanger.
8. Determination of Stefan – Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Calibration of thermocouples / RTDs at standard reference temperatures.

TOTAL: 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1: Estimate the thermal conductivity of lagged pipe and insulating material

CO2: Calculate the heat transfer coefficient from forced convection and free convection.

CO3: Evaluate the performance of parallel flow and counter flow heat exchangers.

CO4: Determine the emissivity of various materials by radiation.

CO5: Measure the temperature using thermocouple.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
2	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
3	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
4	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1
5	3	2	1	1	1	-	-	-	-	-	-	1	3	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23522 PROFESSIONAL/SKILL DEVELOPMENT L T P C

0 0 2 1

COURSE OBJECTIVES:

- To enable the students to study in importance Microsoft Office tools: MS Word, EXCEL, and PowerPoint.
- To foster the ability to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and

overall utility value of content by using MS Word.

- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc.,
- To foster the ability to perform the operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered using MS EXCEL.
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MODULE 1 MS WORD 10

Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MODULE 2 MS EXCEL 10

Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate, Convert data
Sort and filter data
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,) Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MODULE 3 MS POWERPOINT 10

Select slide templates, layout and themes

Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, the students will be able to

CO1: Utilize MS Word, MS Excel, and MS PowerPoint for various technical and professional tasks.
CO2: To create quality documents, by structuring and organizing content for their day to day technical and academic requirements using MS Word.
CO3: Perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding Using MS EXCEL
CO4: Create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects using MS EXCEL
CO5: To create and share quality presentations by using the features of MS PowerPoint.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	-	1	-	-	-	-	1		2	-	-	-
2	1	-	-	-	1	-	-	-	-	1		2	-	-	-
3	1	-	-	-	1	-	-	-	-	1		2	-	-	-
4	1	-	-	-	1	-	-	-	-	1		2	-	-	-
5	1	-	-	-	1	-	-	-	-	1		2	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23IC2 INTRODUCTION TO SUPPLY CHAIN MANAGEMENT

L	**T**	**P**	**C**
1	**0**	**0**	**1**

COURSE OBJECTIVES:

- To introduce the fundamental concepts and principles of supply chain management (SCM), highlighting its importance in modern businesses.
- To provide insights into logistics and transportation strategies to optimize supply chain operations.
- To explore various supply chain strategies, including lean and agile approaches, for efficiency and sustainability.
- To familiarize students with technological advancements such as AI, IoT, and blockchain in transforming supply chain processes.
- To develop problem-solving skills to address real-world challenges in supply chain

management using analytical tools and techniques.

MODULE 1 FUNDAMENTALS OF SUPPLY CHAIN MANAGEMENT **3**

Definition, importance, and objectives of SCM - Key components and stakeholders of a supply chain - Types of supply chains: Push, pull, and hybrid models - Globalization and its impact on supply chains

MODULE 2 LOGISTICS AND TRANSPORTATION **3**

Overview of logistics: Inbound and outbound logistics -Role of transportation in supply chains - Modes of transportation and their selection criteria - Warehousing and distribution strategies - Freight management and cost optimization

MODULE 3 SUPPLY CHAIN STRATEGIES AND SUSTAINABILITY **3**

Lean supply chains and agile supply chains - Risk management and mitigation in supply chains - Sustainability in SCM: Green logistics and circular supply chains - Strategic sourcing and supplier relationship management

MODULE 4 ROLE OF TECHNOLOGY AND AI IN SUPPLY CHAINS **3**

Digitalization and Industry 4.0 in SCM - Role of ERP, blockchain, IoT, and AI in supply chain operations - AI applications: Demand forecasting, route optimization, and inventory management - Emerging trends: Automation, predictive analytics, and robotics

MODULE 5 INTEGRATION AND PERFORMANCE MEASUREMENT IN SUPPLY CHAINS **3**

Supply chain integration and collaboration - Key performance indicators (KPIs) for supply chain performance - Models and its applications - Case studies on supply chain optimization

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the fundamental concepts and significance of supply chain management.

CO2 : Identify and illustrate key processes and functions in supply chain operations, including logistics and transportation.

CO3 : Analyze supply chain strategies to improve efficiency, sustainability, and risk management.

CO4 : Evaluate the impact of technological advancements, including AI, on supply chain performance.

CO5 : Develop solutions to address real-world supply chain challenges using practical tools, strategies, and technology.

TEXT BOOKS :

1 Chopra, S., & Meindl, P. (2019). Supply Chain Management: Strategy, Planning, and Operation. Pearson Education.

2 Simchi-Levi, D., Kaminsky, P., & Simchi-Levi, E. (2021). Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies. McGraw Hill.

REFERENCES:

1 Hugos, M. (2020). Essentials of Supply Chain Management. Wiley.

2 Stadtler, H., Kilger, C., & Meyr, H. (2015). Supply Chain Management and Advanced Planning: Concepts, Models, Software, and Case Studies. Springer.

Web Resources:

1 MIT OpenCourseWare - Supply Chain Management

http://ocw.mit.edu/courses/sloan-school-of-management/15-501-introduction-to-supply-chain-management/

2 Coursera - Supply Chain Management Specialization (Rutgers University)
http://www.coursera.org/specializations/supply-chain-management

3 EdX - MicroMasters in Supply Chain Management (MITx)
http://micromasters.mit.edu/scm/

4 APICS (ASCM) Learning Resources
http://www.ascm.org/

5 Investopedia - Supply Chain Management
http://www.investopedia.com/terms/s/supply-chain-management.asp

6 SCM Globe - Supply Chain Simulation Tool
http://www.scmglobe.com/

7 AI in Supply Chain - IBM Blogs
http://www.ibm.com/blogs/supply-chain/

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
3	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
4	3	3	3	3	3	2	2	2	-	-	-	-	3	3	3
5	3	3	3	3	3	3	3	2	2	2	2	3	3	3	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER VI

ME23611	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

(Use of P S G Design Data Book permitted)

COURSE OBJECTIVES:

- To educate students on the principles and design of belts, chains and rope drives.
- To provide students with the standard procedure available for design to spur and helical gears.
- To instruct students in the art of designing worm and bevel gears.
- To equip students with the ability to design gear boxes
- To guide students in design of cams, brakes and clutch

UNIT I DESIGN OF FLEXIBLE ELEMENTS **9**

Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS **9**

Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teetbileh-forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS **9**

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXES **9**

Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gearbox, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES **9**

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Articulate the concepts of design to belts, chains and rope drives.

CO2 : Develop the concepts of design to spur & helical gears.

CO3 : Experimenting the design of worm and bevel gears.

CO4 : Validate the design of gear boxes
CO5 : Correlate the design of cams, brakes and clutches

TEXT BOOKS :

1 Bhandari V, "Design of Machine Elements", 4th Edition, Tata McGraw-Hill Book Co, 2016.(Unit 1,2,3)
2 Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.
(Unit 4,5)

REFERENCES:

1 Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2003.
2 Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3 Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4 Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4th Edition, Wiley, 2005
5 Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	1	-	-	-	-	-	-	-	3	2	1
2	3	3	2	1	-	-	-	-	-	-	-	-	3	2	1
3	3	3	3	2	1	-	-	-	-	-	-	-	3	3	1
4	3	3	3	3	1	-	-	-	-	-	2	3	3	3	3
5	3	3	3	3	1	-	-	-	2	2	2	3	3	3	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23631 METROLOGY AND MEASUREMENTS L T P C
3 0 2 4

COURSE OBJECTIVES:

- To impart knowledge on basic concepts of metrology and the importance of measurements.
- To expose the students in the measurement of linear and angular dimensions' assembly and transmission elements.
- To provide knowledge about tolerance analysis in manufacturing.
- To have well founded knowledge on fundamentals of GD & T and surface metrology.
- To familiarize the concepts of the advanced measurements for quality control in manufacturing industries.

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, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

UNIT II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS **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, Autocollimator, Angle dekkor, Alignment telescope. 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 III TOLERANCE ANALYSIS **9**

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV METROLOGY OF SURFACES **9**

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT V ADVANCES IN METROLOGY **9**

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi- sensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in- process monitoring in production - Computed tomography – White light Scanners

TOTAL : 45 PERIODS

METROLOGY AND MEASUREMENTS LABORATORY

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge and Comparators.
2. Measurement of angles using bevel protractor, sine bar and autocollimator.
3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.
4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.
6. Non-contact (Optical) measurement using a Measuring microscope / Profile projector and Video

measurement system.

7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, and Concentricity – in the given component using a Roundness tester.
8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

TOTAL: 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Discuss the concepts of measurements to apply in various metrological instruments.

CO2 : Describe the principle and applications of linear and angular measuring instruments, assembly and transmission elements.

CO3 : Identify the tolerance symbols and tolerance analysis for industrial applications.

CO4 : Apply GD & T and surface metrology.

CO5 : Determine the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS :

1 Dotson Connie, "Fundamentals of Dimensional Metrology", Cengage Learning, First edition, 2012. (Unit-1,4,3)

2 Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013. (Unit-2,5)

REFERENCES:

1 AmmarGrous, J "Applied Metrology for Manufacturing Engineering", John Wiley & sons-ISTE, 2011.

2 Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.

3 Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.

4 Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley &Sons, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
2	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
3	3	1	-	-	-	-	-	-	-	-	-	1	1	-	-
4	3	1	-	-	1	-	-	-	-	-	-	1	1	-	-
5	3	1	-	-	1	-	-	-	-	-	-	1	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23622	CAD AND CAM LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To impart knowledge on the application of CAD tools for parametric modeling and design optimization.
- To Design 3 Dimensional geometric model of parts, sub-assemblies, and assemblies and export it to drawing.
- To familiarise on G & M Codes and subsequent simulation in CNC program.
- To generate part programming (canned cycle) data through CAM software.
- To provide an understanding of real-world applications of CNC programming.

CAD

1. CAD Introduction Sketch:
    - Solid modeling: Extrude, Revolve, Sweep, Variational sweep and Loft.
    - Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.
    - Feature manipulation: Copy, Edit, Pattern, Suppress, and History operations.
    - Assembly: Constraints, Exploded Views, Interference check
    - Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting
2. Creation of 3D assembly model of the following machine elements using 3D Modelling software
    - Engine parts - Connecting rod, Piston, Crankshaft, etc.
    - Machine tool parts - Lathe Tailstock, Machine Vice, etc.
    - Miscellaneous Parts - Flange Coupling, Plummer Block, Screw Jack, Universal Joint, etc.
3. Creation of 3D assembly model of real-time products like pet bottles, computer monitors, sitting tools, etc. using 3D Modelling software

* Students may also be trained in manual drawing of some of the above components (specify the number – progressive arrangement of 3D)

CAM

1. CNC Machining Centre

i) Linear Cutting.
ii) Circular cutting.
iii) Cutter Radius Compensation.
iv) Canned Cycle Operations.

2. CNC Turning Centre

i) Straight, Taper and Radial Turning.
ii) Thread Cutting.
iii) Rough and Finish Turning Cycle.
iv) Drilling and Tapping Cycle.

3. COMPUTER AIDED PART PROGRAMMING

i) Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.
ii) Application of CAPP in Machining and Turning

4. STL file generation and real time engineering component fabrication using 3D printing machine.
5. Generation of part program for sheet metal cutting using software

TOTAL: 30 PERIODS

COURSE OUTCOMES :

On successful completion of the course, the students will be able to

CO1 : Utilize CAD tools for parametric modeling, design optimization, and efficient product development in engineering applications.

CO2 : Develop 3D models of parts, assemblies, and export detailed 2D engineering drawings for manufacturing and documentation.

CO3 : Interpret and apply G & M codes for CNC programming, machining simulations, and process validation in automated manufacturing.

CO4 : Generate CNC programs using CAM software, incorporating canned cycles for precise and efficient automated machining operations.

CO5 : Analyze CNC applications in real-world manufacturing, optimizing machining processes, productivity, and operational efficiency.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	-	-	-	2	1	-	-	-	3	-	2
2	3	2	1	-	-	-	-	2	1	1	-	-	3	-	2
3	3	2	1	-	-	-	-	2	1	1	-	-	3	-	2
4	3	2	1	-	-	-	-	2	1	1	-	-	3	-	2
5	3	2	1	-	-	-	-	2	1	1	-	-	3	-	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME 23623 DESIGN AND FABRICATION PROJECT

L	**T**	**P**	**C**
0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To improve the communicative competence of learners
- To learn basic grammatical structures in suitable contexts
- To design and fabricate the machine element or the mechanical product.
- To demonstrate the working model of the machine element or the mechanical product.
- To solve any challenging practical problems and find solutions by formulating proper methodology.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination, the mini project is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 30 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1 : Design the machine element or the mechanical product.

CO2 : Develop a 3D model of the designed product.

CO3 : Fabricate the machine element or the mechanical product.

CO4: Demonstrate the working model of the machine element or the mechanical product.

CO5: Prepare the necessary documents and reports for the final fabricated product.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	1	1	1	1	1	1	1	2	1	1
2	3	2	2	2	2	1	1	1	1	1	1	1	2	1	1
3	3	2	2	2	2	1	1	1	1	1	1	1	2	1	1
4	3	2	2	2	2	1	1	1	1	1	1	1	2	1	1
5	3	2	2	2	2	1	1	1	1	1	1	1	2	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23IC3 INTRODUCTION TO HVAC SYSTEMS L T P C

1 0 0 1

COURSE OBJECTIVES :

- To introduce students to the fundamental concepts of Heating, Ventilation, and Air Conditioning (HVAC) systems.
- To equip students with knowledge of thermodynamic principles and psychrometric processes in HVAC applications.
- To provide an understanding of HVAC components, including air distribution, refrigeration systems, and energy-efficient design.
- To explore design methodologies and sustainability practices in HVAC systems.
- To highlight the role of advanced technologies and AI in optimizing HVAC systems for improved performance.

MODULE 1 FUNDAMENTALS OF HVAC SYSTEMS 3

Introduction to HVAC: Definitions, scope, and significance - Basic thermodynamic principles in HVAC systems. - Heat transfer mechanisms in building systems: Conduction, convection, and radiation. - Indoor air quality and thermal comfort standards.

MODULE 2 PSYCHROMETRICS AND AIR DISTRIBUTION SYSTEMS 3

Psychrometric chart: Properties of moist air and processes. - Air distribution systems: Ductwork, diffusers, and air-handling units (AHUs). - Design considerations for air velocity, pressure drop, and balancing. - Ventilation strategies: Natural and mechanical ventilation.

MODULE 3 REFRIGERATION AND COOLING SYSTEMS 3

Refrigeration cycle and working principles of vapor compression and vapor absorption systems. - Refrigerants: Types, properties, and environmental impacts. - Cooling load estimation: Internal and external heat loads. - Energy-efficient refrigeration systems and components.

MODULE 4 HVAC DESIGN AND SUSTAINABILITY **3**

HVAC system design methodologies for residential, commercial, and industrial buildings. - Energy-efficient HVAC design: LEED and green building considerations. - Integration of renewable energy in HVAC systems. - Case studies on sustainable HVAC designs.

MODULE 5 AI AND ADVANCED TECHNOLOGIES IN HVAC SYSTEMS **3**

Role of AI in HVAC: Predictive maintenance, fault detection, and energy management. - IoT-enabled HVAC systems: Smart thermostats and building automation. - AI-driven optimization for indoor air quality and thermal comfort. - Future trends in HVAC technologies: Adaptive systems and digital twins.

TOTAL : 15 PERIODS

COURSE OUTCOMES :

At the end of the course, the students will be able to

CO1: Define and explain the fundamental principles of HVAC systems and their significance in building applications.

CO2: Apply psychrometric processes and thermodynamic principles to analyze air distribution and ventilation systems.

CO3: Analyze refrigeration systems and cooling load calculations for energy-efficient HVAC design.

CO4: Evaluate HVAC design methodologies with a focus on sustainability and energy optimization.

CO5: Develop insights into the application of AI and advanced technologies for the future of HVAC systems.

TEXTBOOKS:

1 Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw Hill, 3rd Edition.

2 Dossat, R.J., Principles of Refrigeration, Pearson Education, 4th Edition.

REFERENCE BOOKS:

1 Haines, Roger W., and Hittle, Michael E., Control Systems for Heating, Ventilating, and Air Conditioning, Springer.

2 Kreider, Jan F., and Rabl, Ari, Heating and Cooling of Buildings: Design for Efficiency, McGraw Hill.

WEB LINKS/STUDY MATERIALS:

1 ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers): www.ashrae.org

2 Energy.gov on HVAC Basics: www.energy.gov

3 Green Building Council: www.usgbc.org

4 HVAC Fundamentals Online Resources: www.hvactraining101.com

5 AI in HVAC Technologies: www.iotforall.com

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
2	3	3	-	2	-	-	-	-	-	-	-	-	3	2	-
3	3	3	2	2	-	2	1	-	-	-	-	-	3	3	2
4	3	3	3	2	2	3	3	-	-	-	-	-	3	3	3
5	3	3	3	3	3	2	2	2	3	3	2	3	3	3	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER VII

ME23711	HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explore and understand the values and ethics outlined in the Constitution of India to build a strong foundation for personal and societal growth.
- To recognize and embrace democratic values that are essential for fostering harmony and justice in modern society.
- To develop respect and inclusivity by appreciating people from all religions and diverse backgrounds.
- To cultivate a scientific mindset and enhance critical thinking skills for informed decision-making and problem-solving.
- To inspire a sense of responsibility and awareness about the rights and duties of being an active and conscientious citizen.

UNIT I DEMOCRATIC VALUES **9**

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.

Reading Text: Excerpts from John Stuart Mills' On Liberty

UNIT II SECULAR VALUES **9**

Understanding Secular values – Interpretation of secularism in the Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani

UNIT III SCIENTIFIC VALUES **9**

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R

UNIT IV SOCIAL ETHICS **9**

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari

UNIT V SCIENTIFIC ETHICS **9**

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientists in modern society.

Reading Text: Excerpt from American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer by Kai Bird and Martin J. Sherwin.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the importance of democratic, secular and scientific values in the harmonious

functioning of social life

CO2 : Practice democratic and scientific values in both their personal and professional life.

CO3: Find rational solutions to social problems

CO4: Behave ethically in society

CO5: Practice critical thinking and the pursuit of truth.

TEXT BOOKS :

1 The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.

2 Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016

REFERENCES:

1 The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.

2 The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,

3 Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	-	-	1	1	3	-	-	-	1	-	-	1
2	1	-	-	-	-	1	1	3	-	-	-	1	-	-	1
3	1	-	-	-	-	1	1	3	-	-	-	1	-	-	1
4	1	-	-	-	-	1	1	3	-	-	-	1	-	-	1
5	1	-	-	-	-	1	1	3	-	-	-	1	-	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23712 INDUSTRIAL ROBOTICS L T P C

4 0 0 4

COURSE OBJECTIVES:

- To understand about basics of robots and their classifications
- To familiarize with the robot drive systems and various end effectors
- To Impart knowledge of the concepts in a selection of sensors
- To develop the concepts in kinematics and dynamics of robots and to program in robotics.
- To apply knowledge in robot path programming and various applications of robots

UNIT I FUNDAMENTALS OF ROBOT 12

Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, PayLoad- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 12

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End

Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS **12**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezoelectric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT IV ROBOT KINEMATICS AND DYNAMICS **12**

Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms, Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT V TRAJECTORY, PATH PLANNING AND PROGRAMMING & IMPLEMENTATION IN INDUSTRIES **12**

Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS. Rail Guided Vehicle (RGV), Automated Guided Vehicle (AGV); Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations.

TOTAL: 60 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to,

CO1 : Explain the concepts of industrial robots, classification and specifications.

CO2 : Illustrate the different types of robot drive systems as well as robot end effectors.

CO3 : Apply the different sensors in robotics to improve the ability of robots.

CO4 : Develop the kinematics and dynamic motions of the robot.

CO5 : Examine the path planning programming and implementation of robots in various industrial sectors.

TEXT BOOKS :

1 Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2012. (Unit-1,2,3,5)

2 Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”,Prentice Hall, 2008. (Unit 3,4)

REFERENCES:

1 Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.

2 Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 2013.

3 Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 2021.

4 Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co., 2012.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	1	-	-	-	-	-	-	1	2	1	3
2	3	1	1	1	1	-	-	-	-	-	-	1	2	1	3
3	3	1	1	1	1	-	-	-	-	-	-	1	2	1	3
4	3	1	1	1	2	-	-	-	-	-	-	1	2	2	3
5	3	1	1	1	3	-	-	-	-	-	-	1	2	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23713 FINITE ELEMENT ANALYSIS L T P C

3 1 0 4

COURSE OBJECTIVES:

- To introduce students to the mathematical foundations and historical development of the finite element method (FEM) as a powerful tool for solving engineering field problems.
- To guide students in understanding the formulation and application of one-dimensional finite element models for structural, thermal, and vibrational analysis.
- To facilitate exploration of two-dimensional FEM models for scalar and vector field problems, ensuring students grasp their formulation and practical utility.
- To teach iso-parametric formulation and numerical integration techniques to analyze complex stress and strain conditions effectively.
- To provide hands-on experience with computational software for FEM applications, to perform detailed analyses of static and dynamic engineering problems.

UNIT I INTRODUCTION 12

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 12

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation –Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 12

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 12

Equations of elasticity – Plane stress, plane strain and axisymmetric problems –Temperature effects – Stress calculations - Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION 12

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL : 60 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1 : Explain the theoretical foundation and evolution of FEM and apply it to solve boundary value problems in engineering.

CO2 : Formulate and solve one-dimensional FEM problems, including structural deformation and thermal conduction analysis.

CO3 : Develop FEM models for two-dimensional scalar field problems, such as heat transfer and torsion, and solve them using appropriate elements.

CO4 : Apply FEM to two-dimensional vector field problems in elasticity, including plane stress, plane strain, and axisymmetric cases.

CO5 : Use isoparametric elements and numerical techniques to analyze structural systems and apply FEM software for advanced dynamic problem-solving.

TEXT BOOKS :

1 Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2005.

2 Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

REFERENCES:

1 Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)*.

2 Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990.

3 Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002.

4 Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004.

5 Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	-	-	-	-	2	3	2	1
2	3	3	2	2	-	-	-	-	-	-	-	2	3	2	1
3	3	3	2	2	-	-	-	-	-	-	-	2	3	2	1
4	3	3	2	2	-	-	-	-	-	-	-	2	3	2	1
5	3	3	2	2	-	-	-	-	-	-	-	2	3	2	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23722	SIMULATION LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To simulate various mechanisms and robot configuration
- To analyze the force, stress, and deflection in mechanical components.
- To analyze thermal stress and heat transfer in mechanical components.
- To analyze the vibration of mechanical components.
- To analyze the modal, harmonic, transient, and spectrum concepts in mechanical components.

LIST OF EXPERIMENTS

1. Stress analysis of Trusses.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of rectangular plate and rectangular plate with hole.
4. Stress analysis of axis–symmetric components.
5. Thermal Analysis of Fin and chip.
6. Unsteady Thermal analysis of fin.
7. Modal analysis of Beams.
8. Stress analysis in pressure vessel
9. Linear Column Buckling Analysis
10. Project Work – Analysis of any one mechanical component

TOTAL : 30 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Perform Stress analysis of the beam.

CO2 : Evaluate stress distribution in axisymmetric components.

CO3 : Perform heat transfer analysis on mechanical components.

CO4 : Carry out modal analysis of mechanical components.

CO5 : Assess buckling behaviour in columns.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	2	-	-	-	-	-	-	1	3	1	1
2	3	3	3	2	2	-	-	-	-	-	-	1	3	1	-
3	3	3	3	2	2	-	-	-	-	-	-	1	3	1	-
4	3	3	3	2	2	-	-	-	-	-	-	1	3	1	-
5	3	3	3	2	2	-	-	-	-	-	-	1	3	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

SEMESTER VIII

ME23821	PROJECT WORK	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same
- To train the students in preparing project reports and to face reviews and viva voce examination.

GUIDELINE FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 300 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1 : Take up any challenging practical problems and find solution by formulating proper methodology.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

VERTICAL 1: MODERN MOBILITY SYSTEMS

ME23V11	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To recognize the various parts of the automobile and their functions and materials.
- To impart knowledge on the engine auxiliary systems and engine emission control.
- To distinguish the working of different types of transmission systems.
- To familiarize students with the steering, brake and suspension Systems.
- To predict possible alternate sources of energy for IC Engines.

UNIT I VEHICLE STRUCTURE AND ENGINES **9**

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**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system),Turbochargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS). Introduction to Lighting and electrical accessories - Panel board instruments - Automobile air conditioning - Troubleshooting.

UNIT III TRANSMISSION SYSTEMS **9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, 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 and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES **9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gas and Hydrogen in Automobiles-Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Identify the various parts of the automobile and their functions.

CO2 : Describe the engine auxiliary systems and engine emission control.

CO3 : Demonstrate the working of different types of transmission systems.
CO4 : Apply knowledge on steering, brake, and suspension systems.
CO5 : Classify possible alternate sources of energy for IC engines.

TEXT BOOKS :

1 Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.(Unit-2,3,5)
2 Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014..(Unit-1,4)

REFERENCES:

1 Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2 Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3 Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4 Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-
2	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-
3	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-
4	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-
5	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V12 **AUTONOMOUS VEHICLE** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To familiarize students with the fundamental concepts of autonomous vehicle technology.
- To enable students to understand the path planning and decision-making processes involved in autonomous vehicle operations.
- To help students comprehend the sensing and visualization techniques used by autonomous vehicles to perceive their environment.
- To introduce students to the concepts of networking and communication that facilitate the connection of autonomous vehicles with other vehicles and systems.
- To encourage students to explore the impact of human factors on ethical decision-making in autonomous vehicle systems.

UNIT I INTRODUCTION TO AUTONOMOUS VEHICLE TECHNOLOGY 9

Introduction - SAE autonomous Level Classification-Examples-Application of Autonomous Vehicle Advantages and Disadvantages of Autonomous Vehicles.

UNIT II PATH PLANNING AND DECISION MAKING 9

Principles of decision making and path planning for autonomous vehicles-Decision making

approaches-Approximation-Heuristic-Graph based-Point guidance. Verification and validation of decision making and path planning- Application examples of task allocation and path planning algorithms.

UNIT III SENSORS, PERCEPTION AND VISUALISATION 9

Introduction to sensors, perception and visualisation for autonomous vehicles-Sensor integration architectures and multiple sensor fusion-AI algorithms for sensing and imaging-neural networks.

UNIT IV NETWORKING AND CONNECTED VEHICLES 9

Current and future vehicle networking technologies- CAN, LIN, MOST and Flex-ray. The use of modern validation and verification methods- software-in-the-loop, and hardware-in-the-loop techniques. The role of Functional Safety and ISO26262 within the overall control system. Interdependency between software engineering and control system-advanced test methods for the validation of safety-critical systems. Connected vehicle control (CACC). vehicle-to-vehicle [V2V],vehicle-to-infrastructure [V2I], and Vehicle to "Cloud" [V2C]. Applications such as intelligent traffic signals, collaborative adaptive cruise and vehicle platooning.

UNIT V HUMAN FACTORS AND ETHICAL DECISION MAKING 9

Introduction to Human Factors-Human Performance: Perception and Attention-Situation Awareness and Error-Human Reliability: Driver Workload and Fatigue-Emotion and Motivation in Design-Trust in Autonomous Vehicles and Assistive Technology-Designing ADAS Systems Driverless Vehicles and Ethical Dilemmas: Human Factors and Decision Making Software Application of Human Factors in Autonomous Vehicles. International and national regulatory frameworks for CAV and their safe operation.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Classify the SAE levels of Autonomous vehicles to learn about its advantages and disadvantages.

CO2 : Explain Path planning and Decision making process of Autonomous vehicle and validating the same by task allocation and path planning algorithms.

CO3 : Explain the working of sensors involved in the process of perception and visualization of Autonomous vehicles to learn about its integration architectures for AI algorithms.

CO4 : Discuss different networking technologies to create connected vehicle control.

CO5 : Develop Driverless vehicles by employing human factors in decision making software's to enable autonomous vehicle to take ethical decisions.

TEXT BOOKS :

1 Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, Connected and Autonomous Vehicles in Smart Cities,CRC Press, 1st Edition, 2020

2 Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002

REFERENCES:

1 Autonomous Driving: How the Driverless Revolution will Change the World, by Andreas Herrmann, Walter Brenner, Rupert Stadler, ISBN-10 1787148343, ISBN-13 978-1787148345, Emerald Publishing Limited, 26 March 2018.

2 Autonomous Vehicles: Technologies, Regulations, and Societal Impacts, George

Dimitrakopoulos, Aggelos Tsakanikas, Elias Panagiotopoulos, Paperback ISBN: 9780323901376, eBook ISBN: 9780323901383, 1st Edition - April 14, 2021, Elsevier

3 Driverless: Intelligent Cars and the Road Ahead (MIT Press) 1St Edition, by Hod Lipson , Melba Kurmanr), ISBN-13: 978-0262035224, ISBN-10: 0262035227, September 23, 2016.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
2	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
3	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
4	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1
5	3	2	1	1	-	-	-	-	-	-	-	1	3	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V13 BATTERY THERMAL MANAGEMENT SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To enable the students to study of batteries, its parameters, modelling and charging requirements.
- The students to develop battery management algorithms for batteries
- To analyze the battery state of charge and its functions
- To evaluate models using the range of simulation.
- To examine the design standards of a battery.

UNIT I INTRODUCTION 9

Introduction to Battery Management System, Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel, Electrochemical and lithium ion cells, Rechargeable cell, Charging and Discharging Process, Overcharge and Undercharge, Modes of Charging

UNIT II BATTERY MANAGEMENT SYSTEM REQUIREMENT 9

Introduction and BMS functionality, Battery pack topology, BMS Functionality, Voltage Sensing, Temperature Sensing, Current Sensing, BMS Functionality, High-voltage contactor control, Isolation sensing, Thermal control, Protection, Communication Interface, Range estimation, State-of- charge estimation, Cell total energy and cell total power.

UNIT III BATTERY STATE OF CHARGE AND STATE OF HEALTH ESTIMATION, CELL BALANCING 9

Battery state of charge estimation (SOC), voltage-based methods to estimate SOC, Modelbased state estimation, Battery Health Estimation, Lithium-ion aging: Negative electrode, Lithium-ion aging: Positive electrode, Cell Balancing, Causes of imbalance, Circuits for balancing

UNIT IV MODELLING AND SIMULATION 9

Equivalent-circuit models (ECMs), Physics-based models (PBMs), Empirical modelling approach, Physics-based modelling approach, simulating an electric vehicle, Vehicle range calculations, simulating constant power and voltage, Simulating battery packs,

UNIT V DESIGN OF BATTERY BMS **9**

Design principles of battery BMS, Effect of distance, load, and force on battery life and BMS, energy balancing with multi-battery system

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Interpret the role of battery management

CO2 : Identify the requirements of Battery Management

CO3 : Interpret the concept associated with battery charging / discharging

CO4 : Calculate the various parameters of battery and battery pack

CO5 : Design the model of battery pack

TEXT BOOKS :

1 Jiuchun Jiang and Caiping Zhang, "Fundamentals and applications of Lithium-Ion batteriesin Electric Drive Vehicles'', Wiley, 2015.

2 Davide Andrea ,"Battery Management Systems for Large Lithium-Ion Battery Packs" ARTECH House, 2010.

REFERENCES:

1 Developing Battery Management Systems with Simulink and Model-Based Design-whitepape

2 Panasonic NCR18650B- Data Sheet

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	-	1	1	3	1
2	3	2	2	2	-	-	-	-	-	-	-	1	1	3	1
3	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1
4	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1
5	3	2	1	1	2	-	-	-	-	-	-	1	2	3	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V14 HYBRID AND ELECTRICAL VEHICLES **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To enable the students to know the design consideration of Electric Vehicle
- To empower the students to learn the different types of energy source.
- To facilitate the students to learn the concepts of motors and drives.
- To guide the students in understanding various power convertors and controllers.
- To foster the ability among the students to understand hybrid and electric vehicles

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 ionSodium 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 COMPONENTS OF HYBRID VEHICLE 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 : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the operation and architecture of electric and hybrid vehicles.

CO2 : Identify various energy source options like battery and fuel cell.

CO3 : Select suitable electric motor for applications in hybrid and electric vehicles.

CO4 : Explain the role of power electronics in hybrid and electric vehicles.

CO5 : Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS :

1 Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", Third Edition, CRC Press,2021.

REFERENCES:

1 Mehrdad Ehsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRCPress,2005.

2 James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1	-	1	1	-	-	-	-	1	1	1	1
2	2	2	1	1	-	1	1	-	-	-	-	1	1	1	1
3	2	2	1	1	-	1	1	-	-	-	-	1	1	1	1
4	2	2	1	1	-	1	1	-	-	-	-	1	1	1	1
5	2	2	1	1	-	1	1	-	-	-	-	1	1	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V15	OFF ROAD VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To classify the off road vehicles and gain knowledge about its requirements
- To impart knowledge on the design aspects and safety features of earthmoving and construction machines
- To Identify the Constructional and working details of industrial vehicles and its applications.
- To gain knowledge on the constructional details of Farm equipment, Military and combat vehicles
- To Interpret and understand various off road vehicle features.

UNIT I CLASSIFICATION AND REQUIREMENTS OF OFF-ROAD VEHICLES 9

Construction layout, capacity and applications of off-road vehicle – prime mover, chassis and transmission, Multiaxle vehicles

UNIT II EARTH MOVING CONSTRUCTIONAL MACHINES 9

Dumpers – safety features, safe warning system for dumper, Design aspects on dumper body, Articulated Dumpers, loaders – single bucket, Multi bucket and rotary types – bulldozers, kinematics for loader and bulldozers with operational linkages, excavators, backhoe loaders, scrappers, motor graders, power shawl, bush cutters, Bush cutters, stumpers, rippers

UNIT III INDUSTRIAL APPLICATIONS 9

Constructional and working details of Jib crane, concrete ready mixers, compactors – vibratory compactors, forklift, utility vehicles and man – lift, scissors, lift trucks, material handlers, power generators.

UNIT IV FARM EQUIPMENT'S, MILITARY AND COMBAT VEHICLES 9

Tractors, classification – working attachments, power take off, special implements, paddy harvester, sugarcane harvester, feller bunchers, special features and constructional details of military tankers, AVLB gun carriers and transport vehicles.

UNIT V VEHICLE SYSTEMS, FEATURES 9

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Articulated steering assembly – power and capacity of earth moving machines.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Identify the types and classifications of off-road vehicles based on construction, capacity, and application.

CO2 : Examine the kinematics and operational linkages for loaders, bulldozers, and other earth-moving equipment to optimize performance.

CO3 : Use knowledge of industrial applications to evaluate the efficiency of material-handling equipment in various industries..

CO4 : Assess the suitability of specific farm implements and military vehicles for particular operational tasks.

CO5 : Explain the functioning of hydro-pneumatic suspension cylinders, articulated steering, and bucket hydraulic systems.

TEXT BOOKS :

1 Abrosimov. K. Bran berg. A and Katayer. K., "Road making machinery", MIR Publishers, Moscow, 1971.

2 Nakra C.P., "Farm machines and equipments" Dhanparai Publishing company Pvt. Ltd.

3 Robert L Peurifoy, "Construction, planning, equipment and methods" Tata McGraw Hill Publishing company Ltd.

4 SAE Handbook Vol. III., Society of Automotive Engineers, 1997

5 Wong. J. T., "Theory of Ground Vehicles", John Wiley & Sons, New York, 1987.

REFERENCES:

1 Bart H Vanderveen, "Tanks and Transport Vehicles", Frederic Warne and Co Ltd., London. Ia. S. Ageikin, "Off the Road Wheeled and Combined Traction Devices: Theory and Calculation", Ashgate Publishing Co. Ltd. 1988.

2 .Schulz Erich. J, "Diesel equipment I & II", McGraw Hill company, London, 1982.

3 Satyanarayana. B., "Construction planning and equipment", standard publishers and distributors, New Delhi, 1985.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	-	-	1	-	-	-	-	-	1	2	1	1
2	3	1	1	-	-	1	-	-	-	-	-	1	2	1	1
3	3	1	1	-	-	1	-	-	-	-	-	1	2	1	1
4	3	1	1	-	-	1	-	-	-	-	-	1	2	1	1
5	3	1	1	-	-	1	-	-	-	-	-	1	2	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V16 RENEWABLE POWERED OFF HIGHWAY VEHICLES AND EMISSION CONTROL TECHNOLOGY **L T P C 3 0 0 3**

COURSE OBJECTIVES:

- To gain knowledge about suitability methods and types of carbon fuels in off-road vehicles.
- To understand the concept of green energy production methods and their application in off-road vehicle.
- To provide the knowledge of various fuel cell types for off-highway vehicles.
- To guide students in illustrating the impact of in-cylinder technologies on engine-out emissions control.
- To assist students in studying existing after-treatment technologies used in off-highway vehicle applications.

UNIT I LOW AND ZERO CARBON FUELS POWERED OFF-HIGHWAY VEHICLES 9

Ethanol, Methanol, Butanol, Biodiesel, CNG, LNG, DME, Polyoxymethylene Dimethyl Ether (PODE),

Ammonia and Hydrogen Fuels suitability, methods, and technologies for powering off-road vehicles

UNIT II GREEN ENERGY POWERED OFF-HIGHWAY VEHICLES 9

Solar Technology for Green Electricity, Green Electricity for Hydrogen Production, Hydrogen Smart Grid Technologies, Hydrogen to ICE powered vehicles, Hydrogen to Fuel Cell Powered Vehicles.

UNIT III FUEL CELL POWERED OFF-HIGHWAY VEHICLES 9

Fuel Cell, Types, Applications, Fuel Cell Requirement, Sizing and Design for Off-Highway applications, Merits and Demerits, Pathway to overcome the limitations. Scope of the fuel cell research on Off-road vehicle applications.

UNIT IV IN-CYLINDER TREATMENT TECHNOLOGIES 9

Low Temperature Combustion Modes - Homogeneous Charge Compression Ignition, Premixed-Charge Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition, Water Injection Technologies.

UNIT V AFTER TREATMENT TECHNOLOGIES 9

Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction, Ammonia slip / clean up catalyst. CO2 absorption techniques, Waste Heat Recovery and Organic Rankine Cycle.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Interpret the suitability of low and zero carbon fuels in off-road vehicles to select appropriate method of technologies for powering off-road vehicles.

CO2 : Describe the method of green energy production to meet the energy demand of off-road vehicles.

CO3 : Predict the sizing of fuel cells for powering off-road vehicle by understanding the importance of scope and limitations.

CO4 : Recognize the various in-cylinder low temperature combustion technologies to control engine-out emissions.

CO5 : Distinguish the after treatment methods to adopt suitable method for controlling emissions of engines.

TEXT BOOKS :

1 John Twidell, and Tony Weir. Renewable Energy Sources – 3 rd Edition 2015,

2 Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines

REFERENCES:

1 Daniel J Holt. Fuel Cell Powered Vehicles: Automotive Technology of the Future. Society of Automotive Engineers, 2001 - Technology & Engineering,

2 W. Addy Majewski, Magdi K. Khair. Diesel Emissions and Their Control.

3 Toward Zero Carbon: The Chicago Central Area DeCarbonization Plan by Adrian Smith and Gordon Gill | 1 June 2011

4 Transportation in a Net Zero World: Transitioning Towards Low Carbon Public Transport (Green Energy and Technology) by Kathryn G. Logan, Astley Hastings, et al. | 7 April 2022

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	-	1	1	-	-	-	-	1	2	1	1
2	3	1	1	1	-	1	1	-	-	-	-	1	2	1	1
3	3	2	2	1	-	1	1	-	-	-	-	1	2	1	1
4	3	1	1	1	-	1	1	-	-	-	-	1	2	1	1
5	3	2	1	1	-	1	1	-	-	-	-	1	2	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V17 SUSTAINABLE ENERGY TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge on current energy scenario in India across various sectors.
- To help students explore various solar energy technologies and their applications.
- To facilitate students to study the methods of wind energy generation and their practical uses.
- To provide knowledge about energy generation techniques from biomass.
- To guide students in generation methods from ocean and geothermal sources.

UNIT I ENERGY SCENARIO **9**

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status - Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT II SOLAR ENERGY **9**

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT III WIND ENERGY **9**

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics - Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT IV BIO-ENERGY **9**

Bio resources – Biomass direct combustion – thermochemical conversion - biochemical conversion, mechanical conversion - Biomass gasifier - Types of biomass gasifiers - Cogeneration –- Carbonisation – Pyrolysis - Biogas plants – Digesters –Biodiesel production – Ethanol production - Applications.

UNIT V OCEAN AND GEOTHERMAL ENERGY **9**

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications

- Environmental impact.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, the students will be able to

CO1: Review the present scenario of energy in various sectors of India to understand the needs and plans for utilizing renewable energy sources.

CO2: Classify the methods of energy generation from solar to use them with respect to the application requirements.

CO3: Explain the wind energy generation methods to understand its performance and its environmental issues.

CO4: Explain different methods of producing energy from biomass to study its applications.

CO5: Summarize the energy generation from ocean and geothermal sources to study its applications.

TEXT BOOKS :

1 Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 : 9390385636

2 Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1 Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.

2 Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.

3 Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009

4 Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.

5 Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	-	1	2	-	-	-	-	1	1	3	-
2	3	1	1	1	-	1	2	-	-	-	-	1	1	3	-
3	3	1	1	1	-	1	2	-	-	-	-	1	1	3	-
4	3	1	1	1	-	1	2	-	-	-	-	1	1	3	-
5	3	1	1	1	-	1	2	-	-	-	-	1	1	3	-

1 - low, 2 - medium, 3 -high, ‘-' - no correlation

VERTICAL 2: PRODUCT AND PROCESS DEVELOPMENT

ME23V21	ADVANCED PRODUCT QUALITY PLANNING(APQP)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of APQP and its role in ensuring product quality and customer satisfaction.
- To understand the planning phase and process design of APQP with emphasis on key deliverables.
- To explore product validation, production readiness, and control plan development in APQP.
- To examine APQP tools such as FMEA, SPC, and MSA for quality improvement.
- To analyze continuous improvement practices and the role of APQP in a global manufacturing context.

UNIT I INTRODUCTION TO APQP **9**

Overview of Advanced Product Quality Planning (APQP), Importance of APQP in the automotive and manufacturing industries, Phases of APQP: Planning, Product Design and Development, Process Design and Development, Product and Process Validation, and Launch, Core tools of APQP: PPAP, FMEA, SPC, and MSA, Link between APQP, ISO/TS 16949, and IATF 16949

UNIT II PLANNING AND PROCESS DESIGN **9**

Planning phase: Voice of Customer (VoC), project charter, and feasibility studies, Product design and development: Key deliverables, design records, and engineering drawings, Process design and development: Flow charts, control plans, and capacity studies, Product realization: Process Failure Mode and Effects Analysis (PFMEA), Case study: Effective planning in APQP

UNIT III PRODUCT VALIDATION AND CONTROL PLANS **9**

Product and process validation: Prototype testing, production trials, and run-at-rate studies, Validation techniques: Gage R&R, measurement systems analysis (MSA), and process capability studies, Control plans: Development, types, and implementation, Production Part Approval Process (PPAP): Submission levels and elements, Case study: Successful validation using APQP

UNIT IV APQP TOOLS AND TECHNIQUES **9**

Failure Mode and Effects Analysis (FMEA): Types, steps, and implementation, Statistical Process Control (SPC): Control charts, process monitoring, and variation analysis, Measurement Systems Analysis (MSA): Gage studies and measurement system accuracy, Problem-solving techniques: 8D, root cause analysis, and corrective action, Case study: Application of APQP tools in real-world scenarios.

UNIT V CONTINUOUS IMPROVEMENT AND GLOBAL PERSPECTIVES **9**

Continuous improvement in APQP: Lean principles, Kaizen, and waste reduction, Lessons learned and feedback loops in APQP, Role of APQP in global manufacturing and supply chains, Challenges in implementing APQP in dynamic environments, Industry 4.0 and digital tools for APQP: Smart quality management systems, Case study: Global APQP practices and success stories

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the Phases, core tools and importance of APQP in the automotive and manufacturing industries

CO2 : Implement the process design and development procedure with PFMEA in various manufacturing industries.

CO3 : Validate the product and process in real – world scenarios.

CO4 : Apply and Assess the APQP tools in real-world scenarios

CO5 : Analyze and Implement continuous improvement strategies using APQP

TEXT BOOKS :

1 D. H. Stamatis, Advanced Product Quality Planning: The Road to Success, Productivity Press.

2 Dean H. Stamatis, APQP and PPAP: The Complete Guide, CRC Press.

REFERENCES:

1 Automotive Industry Action Group (AIAG), Advanced Product Quality Planning (APQP) and Control Plan Manual.

2 Juran and Gryna, Juran's Quality Planning and Analysis for Enterprise Quality, McGraw Hill.

3 Geoffrey Boothroyd, Design for Manufacture and Assembly (DFMA), CRC Press.

4 Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	-	-	-	-	1	-	1	-	2	2	-
2	3	2	2	2	-	-	-	-	1	-	1	-	2	2	-
3	3	2	2	2	-	-	-	-	1	-	1	-	2	2	-
4	3	2	2	2	-	-	-	-	1	-	1	-	2	2	-
5	3	2	2	2	-	-	-	-	1	-	1	-	2	2	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V22 INTELLECTUAL PROPERTY RIGHTS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To equip students with foundational knowledge of intellectual property rights (IPR)
- To guide learners in understanding the patenting process, including patentability criteria, filing procedures, and the scope of patent protection.
- To familiarize students with the protection mechanisms for plant varieties, traditional knowledge, and geographical indications.
- To demonstrate practical enforcement strategies for IPR, including legal remedies and licensing agreements
- To explore the global IPR landscape by analyzing key treaties, conventions, and organizations.

UNIT I INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS 9

Overview of Intellectual Property- Definition, types, and importance-Types of IPR: Patents, copyrights, trademarks, trade secrets, geographical indications, and plant variety protection.

UNIT II PATENTS 9

Introduction to patents: Objectives and scope- Patentability requirements: Novelty, inventive step, and industrial application-Non-patentable inventions, rights of patent holders, and patent specifications- Filing and grant process-Provisional and complete specifications, claims, and compulsory licensing.

UNIT III PLANT VARIETY, TRADITIONAL KNOWLEDGE, AND GEOGRAPHICAL INDICATIONS 9

Plant Variety Protection-Justification, criteria, and Indian legal frameworks. Traditional Knowledge-Concepts, protection mechanisms, and the Traditional Knowledge Digital Library (TKDL). Geographical Indications-Importance and legal framework at national and global levels.

UNIT IV ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

Legal enforcement-Civil remedies (injunctions, damages) and criminal remedies. Licensing-Types, key clauses, and benefits. Practical applications-Case studies on patent infringement and compulsory licensing.

UNIT V INTERNATIONAL INTELLECTUAL PROPERTY FRAMEWORK 9

Global organizations and treaties-TRIPS, WIPO, WTO, and the Paris and Berne Conventions. Patent Cooperation Treaty (PCT) - Objectives and significance in international patent filings.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand and differentiate the various types of intellectual property rights (IPR)

CO2 : Demonstrate about the patents and the patenting process,

CO3 : Apply knowledge of plant variety protection, traditional knowledge, and geographical indications.

CO4 : Identify and implement appropriate legal remedies, including civil and criminal enforcement actions, to protect intellectual property rights.

CO5 : Analyze international IPR treaties and organizations, such as TRIPS and WIPO

TEXT BOOKS :

1 N. Nagpal, M. Arora, M.R.D. Usman, S. Rahar, Intellectual Property Rights, Educreation Publishing, New Delhi, 2021.

2 The Patents Act, 1970 (Bare Act with Short Notes), Universal Law Publishing Company Pvt. Ltd., 2020

REFERENCES:

1 Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Seventh Edition, 2023.

2 Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2023.

3 Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward

Elgar Publishing Ltd., 2023.

4 S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2024.

5 V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2023.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	-	-	1	-	-	1	-	-	-	1	-	-	1
2	2	2	-	-	1	-	-	2	-	2	-	1	-	-	1
3	2	2	-	-	1	-	-	2	-	2	-	2	-	-	1
4	2	2	-	-	2	-	-	2	-	2	-	2	-	-	1
5	2	2	-	-	-	1	-	1	-	-	-	1	-	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V23 LEAN MANUFACTURING AND SIX SIGMA L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic tools and concepts of Six Sigma, including problem-solving approaches, statistical measures, and quality costs.
- To understand the process capability indices and foundational Six Sigma methodologies such as DMAIC, DMEDI, and PDCA.
- To learn the Differentiate between process management and Six Sigma, including an introduction to the Deming cycle and the Toyota Production System.
- To familiarize Lean concepts, including in-built quality, lead time reduction, and zero-defect capabilities.
- To understand the importance of Implement checks and balances in processes, including robust information systems, audits, and continuous improvement techniques.

UNIT I BASICS OF 6 SIGMA 9

Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources variation, Mean and moving the mean, Various quality costs, cost of poor quality. Green Belt and Black Belt Certifications in Six Sigma

UNIT II INTRODUCTION TO LEAN MANUFACTURING TOOLS 9

Process Capability Indices, Cause and Effect diagram, Control Charts, Introduction to FMEA, APQP, PPAP. 3 foundational 6 Sigma methodologies: DMAIC, DMEDI, and Process Management DMEDI for process creation, DMAIC for process improvement and PDCA for sustaining improvements. Measurement System Analysis (MSA)

UNIT III DEEPER UNDERSTADING METHODOLOGIES 9

What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous

improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration. Lean Six Sigma Integration

UNIT IV LEAN ELEMENTS **9**

Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects. JIT

UNIT V IMPLEMENTATION AND CHALLENGES **9**

Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc. Lean Enterprises Simulation. TQM in Lean Enterprises

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Explain the basic tools of Six Sigma related to problem-solving approaches, analyze various quality costs, and understand the importance of Six Sigma certifications.

CO2 : Describe the foundational Six Sigma methodologies related to process creation, process improvement, and sustaining process performance, with a focus on DMAIC, DMEDI, and PDCA

CO3 : Distinguish between process management and Six Sigma by gaining a clear understanding of the Deming Cycle and its application within the Toyota Production System.

CO4 : Summarize Lean concepts to optimize resources and processes, aiming for zero defects, with a clear understanding of Just-In-Time (JIT) principles

CO5 : Outline the challenges in implementing Lean in enterprises, with a clear understanding of continuous improvement through corrective and preventive actions

TEXT BOOKS :

1. Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill

REFERENCES:

1. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
2. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	-	-	-	-	-	-	2	2	3	3	-
2	3	3	3	2	-	-	-	-	-	-	2	2	3	3	-
3	3	3	3	2	-	-	-	-	-	-	2	2	3	3	-
4	3	3	3	2	-	-	-	2	-	-	2	2	3	3	-
5	3	3	3	2	-	-	-	1	-	-	2	2	3	3	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V24	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To enable the students to understand the fundamental concepts of Product Design and Development.
- To explore the material specifications, analysis and process.
- To learn about manufacturing process selection, various inspection methods, Tool design.
- To study the New product qualification and Market Survey on similar products of new product development
- To Foster student understanding of Reverse Engineering and Cloud points generation.

UNIT I FUNDAMENTALS OF NPD **9**

Introduction – Reading of Drawing – Grid reading, Revisions, ECN (Engg. Change Note), Component material grade, Specifications, customer specific requirements – Basics of monitoring of NPD applying Gantt chart, Critical path analysis – Fundamentals of BOM (Bill of Materials), Engg. BOM & Manufacturing BOM. Basics of MIS software and their application in industries like SAP, MS Dynamics, Oracle ERP Cloud – QFD – Product Life Cycle.

UNIT II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS **9**

Material Selection Criteria - Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis,), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT III ESSENTIALS OF NPD **9**

RFQ (Request of Quotation) Processing – Feasibility Studies & reporting – CFT (Cross Function Team) discussion on new product and reporting – Concept design, Machine selection for tool making, Machining – Manufacturing Process selection, Machining Planning, cutting tool selection – Various Inspection methods – Manual measuring, CMM – GOM (Geometric Optical Measuring), Lay out marking and Cut section analysis. Tool Design and Detail drawings preparation, release of details to machine shop and CAM programing. Tool assembly and shop floor trials. Initial sample submission with PPAP documents.

UNIT IV CRITERIONS OF NPD **9**

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD - Advanced NDT Techniques

UNIT V REPORTING & FORWARD-THINKING OF NPD **9**

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its

advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Discuss fundamental concepts and customer specific requirements of the New Product development

CO2 : Discuss the Material specification standards, analysis and manufacturing process.

CO3 : Develop Feasibility Studies and report on New Product development

CO4 : Analyse the New product qualification and Market Survey on similar products of new product development

CO5 : Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS :

1 Product Design and Development - Anita Goyal, Karl T Ulrich, Steven D Eppinger, 4th Edition, 2009, Tata McGraw-Hill Education, ISBN-10-007-14679-9.

2 Product Design - Kevin Otto, Kristin Wood, Indian Reprint 2015, Pearson Education, ISBN 9788177588217.

REFERENCES:

1 Engineering Design - Clive L.Dym, Patrick Little, A Project-based Introduction, 3rd Edition, John Wiley & Sons, 2009, ISBN 978-0-470-22596-7.

2 Engineering Design - George E.Dieter, Linda C.Schmidt, , McGraw-Hill International Edition, 4th Edition, 2009, ISBN 978-007-127189-9.

3 Engineering Design Process - Yousef Haik, T. M. M. Shahin ,2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	3	1	-	-	-	1	1	-	-	1	1	2	-
2	1	1	3	1	-	-	-	1	1	-	-	1	1	2	-
3	1	1	3	1	-	-	-	1	1	-	-	1	1	2	-
4	1	1	3	1	-	-	-	1	1	-	-	1	1	2	-
5	1	1	3	1	-	-	-	1	1	-	-	1	1	2	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V25 PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To guide students through the intricacies of process planning concepts and enable them to proficiently estimate costs for diverse products.
- To instruct students in the various activities involved in process planning.
- To impart an understanding of the significance of costing and estimation in the manufacturing process.

- To equip students with the knowledge required for estimating production costs accurately.
- To facilitate learning on various machining time calculations to enhance students' proficiency in manufacturing processes.

UNIT I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection. Group technology and methods. Influence of materials and tooling.

UNIT II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies. Influence of Size, tolerance, surface finish, materials.

UNIT III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop - Illustrative examples

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyze and select appropriate processes, equipment, and tools for various industrial products.

CO2 : Interpret and construct process planning activity charts.

CO3 : Describe the concept of cost estimation.

CO4 : Calculate job order costs for different types of shop floors.

CO5 : Compute machining time for various machining operations.

TEXT BOOKS :

1 Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.

REFERENCES:

1 Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

2 Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.

3 Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.

4 Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	-	-	-	-	-	-	1	1	2	2	-
2	3	2	1	1	-	-	-	-	-	-	1	1	2	2	-
3	3	2	1	1	-	-	-	-	-	-	1	1	2	2	-
4	3	2	1	1	-	-	-	-	-	-	1	1	2	2	-
5	3	2	1	1	-	-	-	-	-	-	1	1	2	2	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V26 PRODUCT DESIGN AND MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide students with a comprehensive understanding of design principles for manufacturability and process capability in the design process.
- To enable students to analyse how material selection and manufacturing processes influence component design.
- To teach practical approaches for component design, focusing on machining features.
- To guide students in the redesign of castings and the use of software tools for Design for Manufacturing and Assembly (DFMA).
- To explore additive manufacturing (AM) concepts, equipping students with knowledge of AM design tools, capabilities, and techniques.

UNIT I INTRODUCTION TO DESIGN FOR MANUFACTURABILITY 9

Design principles for manufacturability -Strength and mechanical factors, mechanism selection, evaluation methods. Tolerance analysis-Feature tolerances, geometric tolerances, assembly limits, datum features, and tolerance stacks. Process capability and its impact on design

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Material selection- Working principles and influence on design. Form design for welded members, forgings, and castings. Identification of potential design solutions and materials choice.

UNIT III COMPONENT DESIGN-I 9

Design features for machining-Drills, milling cutters, and keyways. Simplification techniques: Separation, amalgamation, and reduction of machined areas. Designing for machinability, economy, clampability, and accessibility.

UNIT IV COMPONENT DESIGN-II 9

Redesign of castings: Parting lines, core minimization, and machined holes. Addressing uneconomical design through modifications. Introduction to group technology and its application. Computer applications for DFMA-Role of software tools in optimizing design.

UNIT V DESIGN FOR ADDITIVE MANUFACTURING 9

Overview of AM: Unique capabilities and design freedoms. Design tools for AM: Part orientation,

support removal, and hollowing parts. Inclusion of undercuts and other manufacturing-constraining features. Reducing part count in assemblies and integrating markings/numbers.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply design principles to evaluate and enhance manufacturability.

CO2 : Analyze the influence of material properties and manufacturing processes on the component design.

CO3 : Demonstrate the ability to design components that are optimized for machining, assembly, and automation.

CO4 : Redesign components for improved manufacturability, using techniques such as parting line considerations, core reduction, and group technology.

CO5 : Utilize additive manufacturing design tools and principles to create optimized parts that take full advantage of AM's capabilities.

TEXT BOOKS :

1 Product design and development, by K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill, 7th Edition, 2023

2 O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 2012.

REFERENCES:

1 Fixel, J. Design for the Environment, Tata McGraw Hill, 2nd Edition,2024.

2 Dickson, John. R, and Corroda Poly, Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 2021.

3 Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 3rd Edition, 2010

4 Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2019.

5 James G. Bralla, "Design for Manufacturability Handbook", McGraw Hill Professional, 2020.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	-	-	-	-	-		-	1	2	3	-
2	3	2	-	-	-	-	-	-	-		-	1	2	3	-
3	3	2	-	1	1	-	-	-	-	1	-	1	2	3	-
4	3	2	-	1	1	-	-	-	-	1	-	1	2	3	-
5	3	2	-	1	1	-	-	-	-	1	-	1	2	3	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V27 PRODUCTION PLANNING AND CONTROL L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce objectives, functions, and types of production planning and control to enhance operational efficiency.

- To understand work study techniques—method study, time study, work measurement—to optimize production processes.
- To facilitate a detailed exploration of product and process planning, focusing on value analysis and assessing process capabilities.
- To apply production scheduling techniques, like Gantt charts and scheduling rules, for efficient workflow management.
- To learn inventory management principles and advancements, including MRP II, ERP, and Just-in-Time systems.

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II WORK STUDY **9**

Overview of work study techniques. Method study procedures: selection, recording, and analysis. Work measurement: time study, work sampling. Advanced tools: value stream mapping and digital work measurement (Industry 4.0).

UNIT III PRODUCT PLANNING AND PROCESS PLANNING **9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING **9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling-Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control-Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory control fundamentals: EOQ, ABC analysis, and reorder techniques. Advancements in inventory management with RFID and IoT. Basics of MRP II and ERP systems. Overview of additive manufacturing's impact on PPC.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Define and discuss the goals, benefits, and functions of production planning and control across various production types, including job, batch, and continuous production.

CO2 : Apply work study techniques to analyze, measure, and improve productivity in production processes.

CO3 : Formulate product and process plans that optimize product design, balance machine capacity, and address batch production challenges.

CO4 : Develop and implement production schedules, utilizing tools like Gantt charts, master scheduling, and MRP, and apply production control systems to meet production deadlines.

CO5 : Manage inventory using EOQ, ABC analysis, and reorder procedures; explore JIT and ERP for streamlined production.

TEXT BOOKS :

1 James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.

2 Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

REFERENCES:

1 Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.

2 Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.

3 Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.

4 Kanishka Bedi, "Production and Operations management", 2nd Edition, Oxford university press, 2007.

5 Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	-	-	-	-	-	-	1	1	3	1	-
2	3	2	1	1	-	-	-	-	-	-	1	1	3	1	-
3	3	2	1	1	-	-	-	-	-	-	1	1	3	1	-
4	3	2	1	1	-	-	-	-	-	-	1	1	3	1	-
5	3	2	1	1	-	-	-	-	-	-	1	1	3	1	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

VERTICAL 3: ROBOTICS AND AUTOMATION

ME23V31 AUTOMATION IN MANUFACTURING

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To impart knowledge on manufacturing systems, production types, and automation principles.
- To familiarize students with components and classifications of automated manufacturing systems.
- To introduce automated material handling systems like conveyors, AGVs, and storage systems.
- To explain industrial control systems and their significance in manufacturing support.
- To explore power hydraulics and pneumatics, focusing on components, circuit design, and applications

UNIT I FUNDAMENTALS OF MANUFACTURING 9

Production system facilities, manufacturing support systems, different types of manufacturing systems, automation in production systems, automation principles & strategies, manufacturing operations and production relationships, Mathematical concepts & models: production concepts & mathematical models, costs of manufacturing operations, numerical problems

UNIT II AUTOMATED IN MANUFACTURING SYSTEMS 9

Manufacturing Systems- Components & classifications, Automation in manufacturing systems, principles and strategies, mathematical models, costs. Single-station manufacturing cells. Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

UNIT III AUTOMATED MATERIAL HANDLING 9

Types and functions of material handling equipment. Conveyor systems and automated guided vehicles (AGVs). Automated storage and retrieval systems (ASRS)- Design and applications. Integration of material handling with manufacturing processes-Case studies.

UNIT IV INDUSTRIAL CONTROL AND PROCESS PLANNING 9

Industrial control systems: Sensors, actuators, and other control elements. Discrete control using PLCs and PLC networks. Manufacturing support systems: Introduction to CAPP, advanced manufacturing, and lean production. Introduction to Industry 4.0 and smart manufacturing techniques.

UNIT V POWER HYDRAULICS & PNEUMATICS 9

Concepts and features of fluid power systems. Parameters for selecting components and designing circuits. Circuit design and analysis for industrial applications. Energy-efficient hydraulics and pneumatics: Case studies. Electro-hydraulic servo systems and fluid logic controls.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the basic principles and mathematical models of manufacturing systems.

CO2 : Identify and classify the components of automated manufacturing systems.

CO3 : Design and evaluate automated material handling systems for production integration.

CO4 : Implement industrial control systems and analyze the role of sensors and actuators in automation.

CO5 : Analyze and optimize fluid power and pneumatic systems for automation applications.

TEXT BOOKS :

1 M.P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson and PHI, 5th Edition, 2019.

2 N. Viswanandham and Y. Narahari, Performance Modeling of Automated Manufacturing Systems, IISc. Bangalore, PHI, New Delhi, 2020

REFERENCES:

1 Histand B.H., Alciatore D.G., Introduction to Mechatronics and Measurement Systems, 3rd Edition, Tata McGraw Hill, 2012.

2 Bolton W., Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering,

4th Edition, Pearson Education Press, 2015.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	-	-	-	1	2	-	2	3	3	2
2	3	3	3	3	2	-	-	-	1	2	-	2	3	3	2
3	3	3	3	3	2	1	-	-	2	2	-	2	3	3	3
4	3	3	3	3	2	1	-	-	2	3	1	2	3	3	3
5	3	3	3	3	3	1	-	-	2	3	1	2	3	3	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V32 COLLABORATIVE ROBOT (COBOT) **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To teach the principles and properties of collaborative robotics to help students understand co-robotics.
- To introduce swarm robotics and its applications in collective decision-making and methods.
- To explain modular robotics by focusing on the design, movement, and function of modular robots.
- To discuss naturally inspired collaboration and how robots make decisions together.
- To introduce reconfigurable robots and their formation control in swarm systems.

UNIT I INTRODUCTION TO COBOTICS **9**

Collaborative Robotics- Properties - Introduction to Modern Mobile Robots: Swarm Robots, Cooperative and Collaborative Robots, Mobile Robot Manipulators-Current Challenges.

UNIT II SWARM ROBOTICS **9**

Introduction, mapping, kinematics and trajectory error compensation, state transitions, collective decision making and methodologies, swarm robot scenarios-aggregation, clustering dispersion, pattern formation, sorting, flocking and collective motion, shepherding, heterogeneous swarms, Error Detection and Security.

UNIT III MODULAR ROBOTICS **9**

Module Designs - Modular Robot Representation -Modular Serial Robot Kinematics - Kinematic Calibration for Modular Serial Robots- Modular Serial Robot Dynamics - Modular Parallel Robot Kinematics.

UNIT IV NATURALLY INSPIRED COLLABORATION **9**

Collective Decision-Making. Group Decision Making in Animals, Collective Motion as Decision Process, Models for Collective Decision-Making Processes, Urn Models, Voter Model ,Majority Rule , Hegselmann and Krause , Kuramoto Model , Axelrod Model, Ising Model, Fiber Bundle Model, Sznajd Model, Bass Diffusion Model, Sociophysics and Contrarians.

UNIT V RECONFIGURABLE ROBOTS **9**

V-Shaped Formation Control for Robotic Swarms Constrained by Field of View – formation of

reconfigurable virtual linkage - Reconfigurable Formation Control of Multi-Agents - Self-Assembly Modular Robot Platform Based on Sambot - Swarm Dynamics Emerging from Asymmetry.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Demonstrate collaborative robotics and its properties in co-robotics.

CO2 : Analyze swarm robotics scenarios and apply collective decision-making methods.

CO3 : Understand the design, kinematics, and dynamics of modular robots.

CO4 : Evaluate naturally inspired collaboration models and collective decision-making processes.

CO5 : Visualize reconfigurable robots and understand their formation control and dynamics in swarm systems.

TEXT BOOKS :

1 Guilin Yang, I-Ming Chen, "Modular Robots: Theory and Practice", Springer, 2022.

2 GiandomenicoSpezzano, "Swarm Robotics", Applied Sciences, MDPI, 2019.

REFERENCES:

1 Heiko Hamann, "Collective Decision-Making in Swarm Robotics: A Formal Approach", Springer, 2019.

2 Jiming Liu , Jianbing Wu, Multiagent Robotic Systems, 2001, CRC press.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	-	-	-	1	-	-	3	3	2	3
2	3	3	3	3	3	-	-	-	1	-	-	3	3	2	3
3	3	3	3	3	3	-	-	-	1	-	-	3	3	2	3
4	3	3	3	3	3	-	-	-	1	-	-	3	3	2	3
5	3	3	3	3	3	-	-	-	1	-	-	3	3	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V33 DRONE TECHNOLOGY L T P C

3 0 0 4

COURSE OBJECTIVES:

- To introduce drone technology, its evolution, and industrial impact.
- To impart knowledge on drone design, fabrication, and programming.
- To develop hands-on skills in flying and operating drones.
- To explore commercial applications of drones across various sectors.
- To discuss future trends, safety guidelines, and regulatory frameworks..

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.

Advanced Drone Propulsion Systems.

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 : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the concepts, history, and impact of drone technology.

CO2 : Design, fabricate, and program drones by understanding their components and functions.

CO3 : Demonstrate drone operation and control in different flight modes.

CO4 : Evaluate commercial drone applications for entrepreneurship and industry needs.

CO5 : Analyze future trends, safety guidelines, and regulatory standards in drone technology.

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”, 2021 John Wiley & Sons, Inc.

2 Sachi Nandan Mohanty, J. V. R. Ravindra, G. Surya Narayana, Chinmaya Ranjan Pattnaik, Y. Mohamed Sirajudeen , “Drone Technology”, 2023, Wiley-Scrivener

REFERENCES:

1 Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016

2 John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016

3 Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance”, Springer, 2018

4 Y. Mohamed Sirajudeen, Sachi Nandan Mohanty, "Drone Technology: Future Trends and Practical Applications", Wiley publications, ISBN: 978-1-394-16653-4, 2023.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	-	-	-	1	2	-	1	3	2	2
2	3	3	3	3	2	1	-	-	2	3	1	2	3	2	3
3	3	3	3	3	2	-	-	-	1	3	-	1	3	2	2
4	3	3	3	3	2	1	-	-	2	3	1	2	3	3	3
5	3	3	3	3	2	-	-	-	1	3	-	1	3	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V34 EMBEDDED SYSTEMS AND PROGRAMMING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce microcontroller architecture and its fundamental units.
- To explain microcontroller programming and communication protocols for data exchange.
- To develop interfacing and programming skills for I/O devices, sensors, and actuators.
- To illustrate ARM processor architecture and its role in mechatronic systems.
- To impart knowledge on real-time embedded operating systems for advanced applications.

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 - 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, KeyBoard 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 Servo Motor – Traffic Light.

UNIT IV ARM PROCESSOR 9

Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set – Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM 7 - Applications.

UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the architecture and functional units of microcontrollers and processors.

CO2 : Identify and explain the roles of various functional units in embedded systems.
CO3 : Integrate sensors, actuators, and I/O interfaces with microcontrollers and processors.
CO4 : Design and develop circuits and programs for microcontrollers and system-on-chip platforms.
CO5 : Develop embedded applications by integrating hardware and software components.

TEXT BOOKS :

1 Frank Vahid and Tony Givagis, "Embedded System Design", 2011, Wiley.(Unit 1,3)

2 Kenneth J. Aylala, "The 8051 Microcontroller, the Architecture and Programming Applications", 2007.(Unit 2,4,5)

REFERENCES:

1 Muhammad Ali Mazidi and Janice GillispicMazdi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2006.

2 Simon Monk, Programming the Raspberry Pi, Second Edition: Getting Started with Python McGraw Hill TAB; 2nd edition,2015

3 James W. Stewart, "The 8051 Microcontroller Hardware, Software and Interfacing", Regents Prentice Hall, 2003.

4 John B. Peatman, "Design with Microcontrollers", McGraw Hill International, USA, 2005.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	2	-	-	-	1	2	-	1	3	3	2
2	3	3	3	3	2	-	-	-	1	2	-	1	3	3	2
3	3	3	3	3	2	-	-	-	1	2	-	1	3	3	2
4	3	3	3	3	2	1	-	-	2	3	1	2	3	3	3
5	3	3	3	3	2	1	-	-	2	3	1	2	3	3	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V35 HAPTIC AND IMMERSIVE TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To impart knowledge in various immersive technologies of VR, AR and MR.
- To educate students about the software and different types of Tools and Devices.
- To equip students on concepts of developing AR applications.
- To provide students with the knowledge of VR applications and unreal engines.
- To educate the haptic perception and extended reality.

UNIT I INTRODUCTION TO IMMERSIVE TECHNOLOGIES 9

Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices – Applications - Visual scripting.

UNIT II SOFTWARE TOOLS 9

Intro to Unity – Unity editor workspace – Intro to C# and visual studio - Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in UE4.

UNIT III BUILDING AR APPLICATION WITH UNITY **9**

AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity - Building AR application.

UNIT IV BUILDING VR APPLICATION WITH UNREAL ENGINE **9**

VR SDKs for unity and unreal engine – Developing VR application in UE4 – Building VR application.

UNIT V HAPTIC PERCEPTION AND EXTENDED REALITY **9**

Extended Reality - Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply detailed knowledge about immersive technology of VR, AR and MR.

CO2 : Gaining the knowledge of different types of Tools and Devices

CO3 : Developing Concepts of AR applications.

CO4 : Developing Concepts of VR and unreal engines.

CO5 : Interpert about haptic perception and extended reality.

TEXT BOOKS :

1 Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2014, ISBN-10 : 1447162137 (Unit 1,2,3)

2 XR Haptics, Implementation & Design Guidelines, by Eric Vezzoli , Chris Ullrich , Gijs den Butter , Rafal Pijewski, March 13, 2022 (Unit 4,5)

REFERENCES:

1 Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016)

2 Augmented Reality - Theory, Design and Development, by Chetankumar G Shetty.

3 Strategic Communication and AI, by Simon Moore , Roland Hübscher, Routledge; 1st edition (10 September 2021), ISBN-10 : 0367627795

4 Immersive Analytics, by Kim Marriott , Falk Schreiber, Springer; 1st ed. 2018 edition (15 October 2018).

5 Immersive Analytics A Clear and Concise Reference, by Gerardus Blokdyk, 5STARCooks(5 September 2018).

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	-	-	-	1	-	-	1	3	3	2
2	3	3	3	3	2	-	-	-	1	-	-	1	3	3	2
3	3	3	3	3	2	-	-	-	1	-	-	1	3	3	2
4	3	3	3	3	2	-	-	-	1	-	-	1	3	3	2
5	3	3	3	3	2	-	-	-	1	-	-	1	3	3	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V36 INTRODUCTION TO PLC PROGRAMMING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To guide students in basic of PLC terminologies digital principles, PLC architecture and operation.
- To educate students in different programming language of PLC.
- To provide students with the knowledge of PLC logic for simple applications using ladder logic.
- To impart the knowledge of hardware and software behind PLC and SCADA.
- To exposure about awareness of different case studies.

UNIT I INTRODUCTION TO PLC **9**

Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, , PLC Special I/O,Types of PLC.

UNIT II PLC INSTRUCTIONS **9**

PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays-Interlock examples- Timers, Counters.

UNIT III PLC PROGRAMMING **9**

Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions.

UNIT IV COMMUNICATION OF PLC AND SCADA **9**

Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures - advantages and limitations of SCADA systems.

UNIT V CASE STUDIES **9**

Stepper Motor Control- Elevator Control-CNC Machine Control- conveyor control-Interlocking Problems.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Explain PLC terminologies, digital principles, architecture, and operations.

CO2 : Apply basic instruction sets for ladder and function block programming.

CO3 : Design PLC programs using timers, counters, and logic instructions.

CO4 : Explore the hardware and software components of PLC and SCADA.

CO5 : Apply PLC knowledge to real-world case studies.

TEXT BOOKS :

1 Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill EditionEducation Private Limited, 2010 ; ISBN, 128318706X, 9781283187060.(Unit 1,2,5)

2 John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication Prentice Hall, 2012 (Unit 3,4)

REFERENCES:

1 Madhuchannd Mitra and Samerjit Sengupta, Programmable Logic Controllers Industrial Automation an Introduction, Penram International Publishing Pvt. Ltd. ISBN 8187972173, 9788187972174

2 J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles andApplications, Pearson, 2006.

LIST OF OPEN SOURCE SOFTWARE/ LEARNING WEBSITE:

1 https://nptel.ac.in/courses/108105063

2 https://www.electrical4u.com/industrial-automation

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	3	2	-	-	-	1	-	-	2	3	2	2
2	3	3	3	3	2	-	-	-	1	-	-	2	3	3	2
3	3	3	3	3	3	-	-	-	1	-	-	2	3	2	2
4	3	3	2	3	3	-	-	-	1	-	-	3	3	2	2
5	3	3	3	3	3	-	-	-	1	-	-	2	3	3	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V37 MOBILE ROBOT L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce concepts of mobile robot locomotion, design, and stability.
- To explain kinematic models and constraints for motion control and path planning.
- To develop an understanding of sensors and perception techniques in mobile robots.
- To explore localization methods and map-building challenges.
- To provide knowledge on navigation strategies and collaborative robotics principles

UNIT I INTRODUCTION TO MOBILE ROBOTICS 9

Introduction – Locomotion of the Robots – Key Issues on Locomotion – Legged Mobile Roots – Configurations and Stability – Wheeled Mobile Robots – Design Space and Mobility Issues – Unmanned Aerial and Underwater Vehicles. Advanced Locomotion Techniques.

UNIT II 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. Numerical Methods for Kinematic Analysis.

UNIT III PERCEPTION 9

Sensor for Mobile Robots – Classification and Performance Characterization – Wheel/Motor, Sensors – Heading Sensors - Ground-Based Beacons - Active Ranging - Motion/Speed Sensors – Camera -

Visual Appearance based Feature Extraction. Sensor Fusion Techniques.

UNIT IV 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). Advanced SLAM Algorithms

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 – Collaborative Robots – Swarm Robots. Collaborative Robot Case Studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the principles of mobile robot locomotion and design considerations.

CO2 : Analyze kinematic models, constraints, and motion control strategies.

CO3 : Evaluate sensor performance and perception techniques in mobile robots.

CO4 : Implement localization and mapping techniques for autonomous navigation.

CO5 : Develop collaborative mobile robotics for planning, navigation, and intelligence.

TEXT BOOKS :

1 Roland Siegwart and IllahR.Nourbakish, “Introduction to Autonomous Mobile Robots” MIT Press, Cambridge, 2004.

2 Eugene Kagan, Nir Shvalb, Irad Ben-Gal, "Autonomous Mobile Robots and Multi-Robot Systems: Motion-Planning, Communication, and Swarming", 1st Edition, 2019, Wiley

REFERENCES:

1 Dragomir N. Nenchev, Atsushi Konno, TeppeiTsujita, “Humanoid Robots: Modelling and Control”, Butterworth-Heinemann, 2018

2 MohantaJagadish Chandra, “Introduction to Mobile Robots Navigation”, LAP Lambert Academic Publishing, 2015.

3 Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer, 2003.

4 iao Qi Chen, Y.Q. Chen and J.G. Chase, “Mobile Robots - State of the Art in Land, Sea, Air, and Collaborative Missions”, Intec Press, 2009.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	3	-	-	-	1	-	-	3	3	3	3
2	3	3	3	3	3	-	-	-	1	-	-	3	3	3	3
3	3	3	3	3	3	-	-	-	1	-	-	3	3	3	3
4	3	3	3	3	3	-	-	-	1	-	-	3	3	3	3
5	3	3	3	3	3	-	-	-	1	-	-	3	3	3	3

1 - low, 2 - medium, 3 -high, ‘-' - no correlation

VERTICAL 4: DIGITAL AND GREEN MANUFACTURING

ME23V41	CARBON FOOTPRINT ESTIMATION AND REDUCTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand eco-design principles, life cycle assessment, and green manufacturing technologies for sustainable development.
- To analyze air pollution causes, sampling methods, and real-time air quality monitoring systems.
- To evaluate noise pollution effects, mitigation techniques, and occupational health impacts using advanced tools.
- To study water demand, quality standards, and advanced treatment technologies for sustainable water management.
- To apply green co-rating systems, ecological footprints, and their benefits using by case studies.

UNIT I CLIMATE CHANGE AND CARBON FOOTPRINT 9

Green House Effect and Climate Change - Causes and Impacts of Climate Change – Economic implications of Climate Change -IPCC Reports and Projected Climate Change Scenarios – Green House Gas (GHG) Emission – Carbon footprint of Activities, Processes, Products and Services of Organisations – GHG Emission factors and Calculations. Computer Applications for Carbon footprints

UNIT II PRODUCT LIFE CYCLE AND GHG EMISSIONS 9

Life-cycle GHG Accounting - Principles of Product Life Cycle GHG Accounting and Reporting - Fundamentals of Product Life Cycle GHG Accounting - Establishing the Scope of a Product Inventory- GHG Emission Inventories and Accounting - Collecting Data and Assessing Data Quality-Allocation and Assessing Uncertainty.

UNIT III METHODOLOGICAL ASPECTS OF CARBON FOOTPRINT 9

Methodology for Carbon Footprint Calculation in Crop and Livestock Production, End of Life Scenarios and Carbon Footprint of Wood Cladding, Carbon Footprints and Greenhouse Gas Emission Savings of Alternative Synthetic Biofuels, Making Food Production GHG Efficient, Carbon Footprint of Wood-Based Products and Buildings, Challenges and Merits of Choosing Alternative Functional Units, modeling aspects of carbon footprint, Quantifying Spatial–Temporal Variability of Carbon Stocks and Fluxes.

UNIT IV EMISSION MITIGATION AND CARBON SINK 9

Setting GHG Reduction Targets and Tracking Inventory Changes – Non-Fossil Fuel based Energy Systems - Carbon Dioxide capture and Storage Technologies –Mitigation potentials of different Sectors and systems – Innovation, Technology Development and Transfer, - Social aspects of mitigation –Policies, Institutions and international corporations – Carbon Pricing and Finance –GHG Offsetting and Green marketing.

UNIT V CASE STUDIES 9

Carbon Footprint Estimation from Building Sector - Urban Carbon Footprint Evaluation - Applications of carbon footprint in urban planning – Mechanical Equipment and Electronic Product Carbon Footprint - Carbon Footprint of Aqua and Agriculture products- GHG Emissions from

Municipal Wastewater Treatment and Solid waste management. Ecosystem services in carbon dynamics/ carbon sequestration, biodiversity, land – surface energy balance

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply eco-design principles and green manufacturing technologies to develop sustainable and environmentally friendly solutions.

CO2 : Analyze air pollution causes, implement advanced sampling methods, and utilize real-time air quality monitoring systems.

CO3 : Implement noise pollution control strategies, assess impacts on health, and use advanced tools for noise mitigation.

CO4 : Evaluate water quality standards, identify pollution sources, and apply advanced water treatment technologies for sustainable water management.

CO5 : Utilize green co-rating systems, assess ecological footprints, and apply sustainability concepts through practical case studies.

TEXT BOOKS :

1 Muthu, S.S., Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1, Springer, 1st Edition, 2016.

2 Muthu, S.S., Assessment of Carbon Footprint in Different Industrial Sectors, Volume 2, Springer Nature, 2014.

REFERENCES:

1 Muthu, S.S., Carbon Footprint Handbook, CRC Press, 2016.

2 Muthu, S.S., Environmental Carbon Footprint: Industrial Case Studies, Butterworth-Heinemann, 2016.

3 World Resources Institute, Greenhouse Gas Protocol: Product Life Cycle Accounting and Reporting Standard, World Resources Institute, 2011.

4 International Organization for Standardization, ISO 14067:2018 Greenhouse Gases and Carbon Footprint of Products: Requirements and Guidelines for Quantification, ISO, 2018.

5 Intergovernmental Panel on Climate Change, Sixth Assessment Report, United Nations Framework Convention on Climate Change, 2022.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	2	2	-	-	-	-	1	1	-	1
2	3	3	2	2	2	2	2	-	-	-	-	1	1	-	1
3	3	3	2	2	2	2	2	-	-	-	-	1	1	-	1
4	3	3	2	2	2	2	2	-	-	-	-	1	1	-	1
5	3	3	2	2	2	2	2	-	1	-	-	1	1	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V42	COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the properties and applications of different fibers and matrices used in composite materials.
- To apply lamina constitutive equations to analyze and design composite structures.
- To analyze the strength of laminates using various failure criteria and predict laminate failure.
- To perform thermal analysis of composite laminates and evaluate their behavior under thermal loads.
- To analyze the static, dynamic, and buckling behavior of laminated composite flat plates.

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 9

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes. Advanced Manufacturing Techniques for Composites.

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates. Numerical Methods for Laminate Analysis.

UNIT III LAMINA STRENGTH ANALYSIS 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure. Case Studies on Laminate Failures.

UNIT IV THERMAL ANALYSIS 9

Assumption of Constant C.T. E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T. E's. C.T. E's for special Laminate Configurations –Unidirectional, Offaxis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates. Thermal Analysis using Finite Element Methods.

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies. Dynamic Analysis of Composite Structures.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Summarize the properties and Metal matrices of different composite materials and their manufacturing techniques.

CO2 : Demonstrate the strain displacements in different flat plate laminates using Constitutive equations and Numerical methods.

CO3 : Reveal the prediction of laminate failure of Isotropic, Anisotropic and composite material for different criterion.

CO4 : Clarify the Mechanical and Thermal behavior of composite materials laminates using Finite Element Method.

CO5 : Validate the behavior of composite materials under bending and Buckling load using dynamic analysis of composite structures.

TEXT BOOKS :

1 Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 2007.

REFERENCES:

1 Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 1998

2 Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990

3 Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007

4 Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	3	3	-	2	2	-	-	-	-	1	1	2	1
2	3	3	3	3	-	2	2	-	-	-	-	1	1	2	1
3	3	3	3	3	-	2	2	-	-	-	-	1	1	2	1
4	3	3	3	3	-	2	2	-	-	-	-	1	1	2	1
5	3	3	3	3	-	2	2	-	-	-	-	1	1	2	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V43 COMPUTER INTEGRATED MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide knowledge on the evolution, components, and future trends of CIM.
- To introduce automated manufacturing systems, including production lines, assembly, and material handling.
- To understand group technology and flexible manufacturing systems (FMS) and their benefits.

- To familiarize the students to process planning from design to implementation, including both manual and computer-aided methods.
- To describe process control and data analysis techniques, including modern control systems and quality management.

UNIT I INTRODUCTION 9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM. Green Manufacturing Technologies in CIM.

UNIT II AUTOMATED MANUFACTURING SYSTEMS 9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types &applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing. Real-Time Monitoring in Automated Systems.

UNIT III GROUP TECHNOLOGY AND FMS 9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS – FMS applications, Benefits. Advanced FMS Simulation Techniques

UNIT IV PROCESS PLANNING 9

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP. Integration of AI in Process Planning.

UNIT V PROCESS CONTROL AND DATA ANALYSIS 9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer

process interface –Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control- Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection. IoT in Process Control Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Analyze CAD, CAM, CIM concepts, and their integration in automated manufacturing systems for efficient production.

CO2 : Design automated manufacturing systems, considering material handling, storage systems, and smart manufacturing concepts like Industry 4.0.

CO3 : Apply Group Technology (GT) and Flexible Manufacturing Systems (FMS) for efficient part family classification and system layout.

CO4 : Develop process planning strategies using both manual and Computer Aided Process Planning (CAPP) methods.

CO5 : Implement process control techniques, including PLC, SCADA, IoT, and quality management for improved system performance.

TEXT BOOKS :

1 Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.

REFERENCES:

1 CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

2 Alavudeen and Venkateshwaran, Computer Integrated Manufacturing||, PHI Learning Pvt. Ltd., New Delhi, 2013

3 James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturing||, Pearson Education, Asia,3rdEdition,2004.

4 Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	-	-	-	1	2	2	2
2	3	3	2	2	2	-	-	-	-	-	-	1	2	2	2
3	3	3	2	2	2	-	-	-	-	-	-	1	2	2	2
4	3	3	2	2	2	-	-	-	-	-	-	1	2	2	2
5	3	3	2	2	2	-	-	-	-	-	-	1	2	2	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V44 DIGITAL MANUFACTURING AND IOT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce foundational principles of Digital Manufacturing and IoT, enhancing modern manufacturing environments.

- To understand digital lifecycle management and its application in supply chain management using tools like digital mockups.
- To educate on the Smart Factory, integrating advanced technologies, core principles, and emphasizing cybersecurity in manufacturing.
- To study Industry 4.0, IIoT, machine-to-machine communication, and intelligent manufacturing networks..
- To understand Digital Twin technology, its features, types, implementation strategies, and potential in adaptive manufacturing systems.

UNIT I INTRODUCTION TO DIGITAL MANUFACTURING 9

Overview and evolution of Digital Manufacturing. Concepts: Product lifecycle, Smart factory, and value chain management. Emerging trends: Additive Manufacturing and Advanced Robotics. Sustainability and Digital Manufacturing: Impacts and opportunities.

UNIT II DIGITAL LIFE CYCLE & SUPPLY CHAIN 9

Collaborative Product Development and Mapping Requirements to Specifications. Engineering Vaulting and Change Management. Virtual Prototyping: Digital Mockups and Virtual Testing. Role of Artificial Intelligence (AI) in Supply Chain Management. Digital Transformation Challenges and Practices.

UNIT III SMART FACTORY 9

Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT- Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity.

UNIT IV INDUSTRY 4.0 9

Introduction – Industry 4.0 –Internet of Things – Industrial Internet of Things – Framework: Connectivity devices and services – Intelligent networks of manufacturing – Cloud computing – Data analytics –Cyber physical systems –Machine to Machine communication – Case Studies.

UNIT V STUDY OF DIGITAL TWIN 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the evolution of digital manufacturing to develop sustainable manufacturing practices by adopting emerging trends.

CO2 : Explain the importance of collaborative product development by employing AI to develop virtual prototyping and testing.

CO3 : Develop the concept for smart factory by understanding levels and benefits using key technologies and IoT.

CO4 : Demonstrate the use of IoT and cloud computing in industries by creating intelligent networks for communication and manufacturing.

CO5 : Summarize the concept of Digital twin and its implementation to use its benefits in monitoring, analysis and decision making of Digital Manufacturing.

TEXT BOOKS :

1 Zude Zhou, Shane (Shengquan) Xie and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.

2 Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", A press, 2016.

REFERENCES:

1 Lihui Wang and Andrew YehChing Nee, Collaborative Design and Planning for Digital Manufacturing, Springer-Verlag London Limited, 2009.

2 Andrew Yeh Chris Nee, Fei Tao, and Meng Zhang, "Digital Twin Driven Smart Manufacturing", Elsevier Science., United States, 2019.

3 Alp Ustundag and Emre Cevikcan, "Industry 4.0: Managing The Digital Transformation", Springer Series in Advanced Manufacturing., Switzerland, 2017.

4 Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

5 Ronald R. Yager and Jordan Pascual Espada, "New Advances in the Internet of Things", Springer., Switzerland, 2018.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	-	-	-	-	-	-	1	1	2	2
2	3	2	1	1	2	-	-	-	-	-	-	1	1	2	2
3	3	2	1	1	2	-	-	-	-	-	-	1	1	2	2
4	3	2	1	1	2	-	-	-	-	-	-	1	1	2	2
5	3	2	1	1	2	-	-	-	-	-	-	1	1	2	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V45 GREEN MANUFACTURING DESIGN AND PRACTICES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand eco-design principles, life cycle assessment, green manufacturing, pollution prevention, and environmentally friendly material selection.
- To analyse air pollution causes, sampling techniques, dispersion models, and real-time air quality monitoring systems.
- To evaluate noise pollution impacts, control methods, mitigation strategies, and occupational health hazards using advanced tools and techniques.
- To study water demand, quality standards, pollutants, and advanced treatment technologies for sustainable water resource management.
- To recognize green co-rating systems, ecological footprints, assessment methods, and benefits through practical case studies.

UNIT I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT 9

Environmental effects of design -selection of natural friendly material - Eco design - Environmental damage Material flow and cycles – Material recycling – Emission less manufacturing- Industrial Ecology– Pollution prevention – Reduction of toxic emission – design for recycle. Green

Manufacturing Technologies

UNIT II AIR POLLUTION SAMPLING AND MEASUREMENT 9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behaviour dispersion of air Pollutants-solution to the atmosphere dispersion equation the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulphur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone. Real-Time Air Quality Monitoring Systems

UNIT III NOISE POLLUTION AND CONTROL 9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects. Noise Mapping and Prediction Software

UNIT IV WATER DEMAND AND WATER QUALITY 9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues. Advanced Water Treatment Technologies

UNIT V GREEN CO-RATING 9

Ecological Footprint - Need For Green Co-Rating – Green Co-Rating System – Intent – System Approach – Weightage- Assessment Process – Types Of Rating – Green Co-Benefits – Case Studies Of Green CoRating. Case Studies on Green Co-Rating

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply eco-design, life cycle assessment, and green manufacturing principles in sustainable product development.

CO2 : Utilize suitable air pollution control strategies with respect to the type and source of air pollutant.

CO3 : Develop appropriate measuring and analysis methods for noise pollution in diverse environments to develop and implement effective noise control strategies.

CO4 : Summarize the factors influencing water demand and quality and apply advanced water treatment technologies for sustainable water management.

CO5 : Employ Green Co-Rating to assess ecological footprints and promote environmental sustainability.

TEXT BOOKS :

1 Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010

REFERENCES:

1 Rao, M.N., and Dutta, A.K. "Wastewater Treatment," Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006.

2 World Commission on Environment and Development (WCED), "Our Common Future," Oxford University Press, 2005.
3 Rao, C.S. "Environmental Pollution Control Engineering," Wiley Eastern Ltd., New Delhi, 2006.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	2	2	2	-	-	-	-	1	3	3	1
2	3	3	3	3	2	2	2	-	-	-	-	1	3	1	1
3	3	3	3	3	2	2	2	-	-	-	-	1	3	1	1
4	3	3	3	3	2	2	2	-	-	-	-	1	2	1	2
5	3	3	3	3	2	2	2	-	-	-	-	1	3	2	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V46 METAL ADDITIVE MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the history, principles, and applications of additive manufacturing, especially in metal-based processes.
- To learn about various metal additive manufacturing processes like SLM, DMLS, EBM, and others, including industry examples.
- To learn about materials and alloys used in metal additive manufacturing, including powder production, characterization, and post-processing techniques.
- To study design principles for metal AM, focusing on topology optimization, CAD for AM, and design for manufacturability.
- To analyze real-world applications and case studies of metal additive manufacturing in industries such as aerospace, automotive, and medical.

UNIT I Introduction to Additive Manufacturing 9

History and Evolution of Additive Manufacturing, Basic Principles of Additive Manufacturing, Classification of Additive Manufacturing Processes, Introduction to Metal Additive Manufacturing, Comparison with Traditional Manufacturing Methods, Applications of Metal Additive Manufacturing in Various Industries, Challenges and Future Trends

UNIT II Metal Additive Manufacturing Processes 9

Selective Laser Melting (SLM), Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM), Directed Energy Deposition (DED), Binder Jetting for Metals, Metal Extrusion Processes, Comparative Analysis of Different Metal AM Processes, Case Studies and Industry Examples

UNIT III Materials for Metal Additive Manufacturing 9

Metals and Alloys Used in Additive Manufacturing, Powder Production and Characterization, Properties and Performance of Additive Manufactured Metals, Post-Processing Techniques, Material Testing and Quality Assurance, Standards and Certification

UNIT IV Design for Metal Additive Manufacturing 9

Design Principles for Additive Manufacturing, Topology Optimization, Computer-Aided Design (CAD)

for AM, Design for Manufacturability (DFM), Simulation and Modeling, Case Studies in Design for Metal AM

UNIT V Applications and Case Studies **9**

Aerospace and Defense Applications, Automotive and Transportation Applications, Medical and Dental Applications, MRI scan data, Customized implant, Reverse engineering, Future Trends and Research Directions in Metal AM,

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the need for metal additive manufacturing by comparing it with traditional manufacturing methods and discussing its associated challenges.

CO2 : Summarize the various metal additive manufacturing processes and their applications across different industries.

CO3 : Interpret the properties and performance of additively manufactured metals, along with their quality assurance standards and certifications

CO4 : Demonstrate proficiency in designing components for metal additive manufacturing using CAD tools.

CO5 : Recap the applications of metal additive manufacturing across industries, its future trends, and provide insights through relevant case studies

TEXT BOOKS :

1 Gibson, I., Rosen, D. W., & Stucker, B. (2015). Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing. Springer. (Unit 1,2,4,5)

2 Kruth, J.-P., Leu, M. C., & Nakagawa, T. (1998). Progress in Additive Manufacturing and Rapid Prototyping. CIRP Annals. (Unit 4,5)

3 DebRoy, T., Zhang, W., Turner, J., & Babu, S. S. (2018). Building Digital Twins of Metal Additive Manufacturing Processes: Beyond Process Monitoring and Data Analytics. Materials Research Letters. (Unit 1)

REFERENCES:

1 Thompson, M. K., et al. (2016). *Design for Additive Manufacturing: Trends, Opportunities, Considerations, and Constraints*. CIRP Annals.

2 Frazier, W. E. (2014). *Metal Additive Manufacturing: A Review*. Journal of Materials Engineering and Performance.

3 Herzog, D., Seyda, V., Wycisk, E., & Emmelmann, C. (2016). *Additive Manufacturing of Metals*. Acta Materiali

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1
2	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1
3	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1
4	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1
5	3	2	2	2	2	-	-	-	-	-	-	1	2	3	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V47	SMART MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the evolution, key concepts, and benefits of smart manufacturing, focusing on data and connectivity.
- To understand fundamental technologies like IoT, automation, robotics, CPS, and additive manufacturing, and their industrial applications.
- To gain knowledge on big data, AI, machine learning, and predictive maintenance to improve manufacturing processes.
- To implement smart manufacturing systems, integrate with existing systems, and train the workforce.
- To investigate emerging technologies, sustainability, and global challenges in smart manufacturing, with a focus on industry advancements.

UNIT I INTRODUCTION TO SMART MANUFACTURING 9

Historical Background – Evolution from Traditional to Smart Manufacturing – Key Concepts and Definitions – Benefits and Challenges – Enabling Technologies – Role of Data and Connectivity.

UNIT II SMART MANUFACTURING TECHNOLOGIES 9

Internet of Things (IoT) – Industrial IoT (IIoT) – Automation and Robotics – Cyber-Physical Systems (CPS) – Additive Manufacturing (3D Printing) – Smart Sensors and Actuators.

UNIT III DATA AND ANALYTICS IN SMART MANUFACTURING 9

Big Data and Data Analytics – Machine Learning and Artificial Intelligence Applications – Predictive Maintenance – Real-Time Monitoring and Control Systems – Data Security and Privacy – Case Studies.

UNIT IV IMPLEMENTATION OF SMART MANUFACTURING 9

Roadmap for Smart Manufacturing Implementation – Integration with Existing Systems – Workforce Training and Development – Change Management – Case Studies of Successful Implementations.

UNIT V FUTURE TRENDS AND INNOVATIONS 9

Emerging Technologies in Smart Manufacturing – Industry 4.0 and Beyond – Sustainability in Smart Manufacturing – Challenges and Opportunities – Future of Work in Smart Manufacturing – Global Perspectives and Trends.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Explain the evolution, key concepts, and benefits of smart manufacturing, and understand the role of data and connectivity.

CO2 : Describe fundamental smart manufacturing technologies such as IoT, automation, robotics, CPS, and additive manufacturing, and their industry applications.

CO3 : Understand big data, AI, machine learning, and predictive maintenance, and their significance in real-time monitoring and improving manufacturing processes.

CO4 : Outline and apply strategies for implementing smart manufacturing systems, including integration with existing systems and workforce training.

CO5 : Study and discuss emerging technologies, sustainability practices, and future challenges in smart manufacturing, and understand global industry trends.

TEXT BOOKS :

1 Masoud Soroush, Michael Baldea, Thomas F. Edgar (Editors), "Smart Manufacturing: Concepts and Methods", Elsevier, 2020.

2 Ajay Hari Singh, Parveen Bandar AlMangour (Editors), "Handbook of Smart Manufacturing: Forecasting the Future of Industry 4.0", CRC Press, 2023.

REFERENCES:

1 Ajay Kumar, Parveen, Yang Liu, Rakesh Kumar (Editors), "Handbook of Intelligent and Sustainable Manufacturing: Tools, Principles, and Strategies", CRC Press, 2024.

2 Ajay Hari Singh, Parveen Bandar AlMangour (Editors), "Smart Manufacturing: Applications and Case Studies", Elsevier, 2020.

3 Sanfoundry, "Best Books on Manufacturing Processes", Sanfoundry, 2023.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	-		1	-	-	2	3	2	1
2	3	3	2	2	-	-	-		1	-	-	2	3	2	1
3	3	3	2	2	-	-	-		1	-	-	2	3	2	1
4	3	3	2	2	-	-	-		1	-	-	2	3	2	1
5	3	3	2	2	-	-	-		1	-	-	2	3	2	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

VERTICAL 5: DIVERSIFIED COURSES

ME23V51 COMPUTATIONAL FLUID DYNAMICS IN HEAT TRANSFER **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To provide a strong foundation in Computational Fluid Dynamics by analyzing its governing equations through Partial Differential Equations.
- To develop problem-solving skills using Finite Difference and Finite Volume methods for one-dimensional and two-dimensional flows.
- To train learners in applying the Finite Volume Method to solve convection-diffusion problems effectively.
- To enhance understanding of Flow Field Analysis through the PISO algorithm and thermal boundary layer computations.
- To introduce various turbulence modeling techniques and mesh generation methods using computational tools.

UNIT I INTRODUCTION **9**

Basics of Computational Fluid Dynamics – Governing equations– Continuity, Momentum and Energy equations – Boundary conditions & Types– Time-averaged equations for Turbulent Flow –

Classification and Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations, comparison between Analytical, Experimental and Numerical techniques, Techniques of Discretisation and Numerical errors

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion 1D and 2D problems – Use of Finite Difference and Finite Volume methods, Accuracy of solution, optimum step-size, Euler, Crank-Nickolson, and pure implicit methods, stability of schemes.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Computation of Boundary layer flow, von Neumann stability analysis.

UNIT IV FLOW FIELD ANALYSIS 9

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms, Computation of internal and external thermal boundary layer

UNIT V TURBULENCE MODELLING 9

Turbulence model requirement and types, mixing length model, Two equation (k-Є) models – High and low Reynolds number models, LES, DNS, Mesh Generation and refinement Techniques-software tools, Stability of solver, Courant Fredrick Levy number, relaxation factor, and grid independence test.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Apply the fundamentals of CFD, and develop specific governing equations.

CO2 : Discuss finite difference and finite volume-based analysis for steady and transient diffusion problems.

CO3 : Implement various mathematical schemes under the finite volume method for convention diffusion.

CO4 : Solve complex problems in the field of fluid flow and heat transfer with the support of high-speed computers

CO5 : Apply the various discretization methods, solution procedures and the concept of turbulence modelling

TEXT BOOKS :

1 Versteeg, H.K., and Malalasekera, W.,"An Introduction to Computational Fluid Dynamics": The finite volume Method, Pearson Education, 2014 .

2 Ghoshdastidar, P.S., "Computational Fluid Dynamics and Heat Transfer", Cengage Learning, 2017.

REFERENCES:

1 John. F. Wendt, "Computational Fluid Dynamics – An Introduction", Springer, 2013.

2 K. Muralidhar & T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora

Publishing House, 1994.

3 Suhas V, Patankar, "Numerical Heat transfer and Fluid flow", Taylor & Francis, 2009.

4 Uriel Frisch, Turbulence, Cambridge University Press, 1999.

5 Yogesh Jaluria & Kenneth E. Torrance, "Computational Heat Transfer", CRC press, 2002.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
2	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
3	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
4	3	3	2	1	1	-	-	-	-	-	-	1	3	-	1
5	3	3	2	1	1	-	-	-	-	-	-	1	3	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V52 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To make the students to understand the locating and clamping principles.
- To familiarize the students with different types of Jigs and Fixtures and their Optimization techniques.
- To equip the students to learn the design of Press Tools and Dies with their types.
- To train the students to gain knowledge of Bending and Drawing Dies.
- To instill the students to gain awareness of different Forming techniques and their applications.

UNIT I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used - Design of locators and supports - Advanced clamping techniques.

UNIT II JIGS AND FIXTURES 9

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures –Optimization techniques in Jig and Fixture design - Smart Jigs and Fixtures for industry 4.0.

UNIT III DESIGN OF PRESS TOOL AND DIES 9

Press working terminologies – operations – types of presses – press accessories – computation of press capacity – strip layout – material utilization – shearing action – clearances – press work materials – centre of pressure- design of various elements of dies – design of blanking, piercing dies- compound and progressive dies - design considerations in forging, extrusion, casting and plastic

dies.- Advanced Die Design Techniques - Emerging Trends in Press Working and Die Design.

UNIT IV BENDING AND DRAWING DIES 9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads-ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V FORMING TECHNIQUES AND EVALUATION 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

Note: (Use of P S G Design Data Book is permitted in the University examination)

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Summarize the principles of Location and Clamping methods used in Jigs and Fixtures by Mechanical, Hydraulic and Pneumatic actuation.

CO2 : Utilize optimization techniques to develop Smart Jigs and Fixtures for Industry 4.0.

CO3 : Design and develop Press Tools and Dies for different Press work operations.

CO4 : Explain and develop Dies for different bending and drawing operations.

CO5 : Illustrate the different Forming techniques and use of Computer Aids in Metal forming.

TEXT BOOKS :

1 Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., NewDelhi, 2010.

2 Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996

REFERENCES:

1 ASTME Fundamentals of Tool Design Prentice Hall of India. 2. 3. 4. 5. 6.

2 Donaldson, Lecain and Goold “Tool Design”, 5th Edition, Tata McGraw Hill, 2017.

3 Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.

4 Kempster, “Jigs and Fixture Design”, Third Edition, Hoddes and Stoughton, 1974.

5 Venkataraman. K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	1	-	-	-	-	-	-	1	2	2	0
2	3	3	3	3	1	-	-	-	-	-	-	1	2	2	0
3	3	3	3	3	1	-	-	-	-	-	-	1	2	2	0
4	3	3	3	3	1	-	-	-	-	-	-	1	2	2	0
5	3	3	3	3	1	-	-	-	-	-	-	1	2	2	0

1 - low, 2 - medium, 3 -high, ‘-' - no correlation

ME23V53	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the importance of Ergonomics for the integration of Man-machine relationship in work environment based on Human-centred design principles.
- To familiarize the students with the importance of Anthropometric data in Ergonomics for the design of workstations in Industries.
- To understand the display design principles and its Controls to overcome the challenges of Human-Machine interactions.
- To equip students with knowledge of environmental factors and simulate the physical parameters using software.
- To comprehend the Ergonomic design concepts for the development of plant layout using 3D modelling and simulation software.

UNIT I INTRODUCTION TO ERGONOMICS 9

An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound. Physical, cognitive, and occupational aspects. Human-centered design principles.

UNIT II ERGONOMICS AND PRODUCTION 9

Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt's perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form. Industrial applications of ergonomic workstation design.

UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS 9

Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts - Push button, Switches, rotating Knobs. Controls with muscular effort - Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools. Designing for advanced and intelligent systems. Human-machine interaction: principles and challenges.

UNIT IV ENVIRONMENTAL FACTORS and TOOLS & TECHNIQUES IN ERGONOMICS 9

Colour: Colour and light, Colour and objects, Colour and the eye - after Image, Colour blindness, Colour constancy, Colour terms - Colour circles, Munsel colour notation, reactions to colour and colour combination - colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style. Techniques for analyzing physical environments. Ergonomic simulation and evaluation using software like Delmia.

UNIT V APPLICATIONS AND TRENDS IN ERGONOMIC DESIGN 9

Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components

of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software's, total layout design. Topics on advanced 3D modeling and simulation. Smart product design and Industry 4.0 integration.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Summarize the importance of Ergonomics in industrial design to create an effective Man-machine relationship.

CO2 : Explain the importance of using Anthropometric data for the industrial workstation design.

CO3 : Summarize the features of different displays and their controls to overcome the challenges of Human-Machine interaction in industries.

CO4 : Describe the importance of environmental factors in ergonomic design and simulating ergonomics using software tools.

CO5 : Develop plant layouts using 3D modelling and simulation software for effective Industry 4.0 integration.

TEXT BOOKS :

1 Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares, Francisco Rebelo.

2 Ergonomics in Product Design by Sendpoints Publishing Co. Ltd.

REFERENCES:

1 Benjamin W.Niebel, Motion and Time Study, Richard, D. Irwin Inc., 7thEdition, 2002

2 Brain Shakel,"Applied Ergonomics Hand Book", Butterworth Scientific London 1988.

3 Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006

4 NPTEL: Applied Ergonomics.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	1	_	_	_	_	_	_	1	3	2	1
2	3	3	3	1	1	_	_	_	_	_	_	1	3	2	1
3	3	3	3	1	1	_	_	_	_	_	_	1	3	2	1
4	3	3	3	1	1	_	_	_	_	_	_	1	3	2	1
5	3	3	3	1	1	_	_	_	_	_	_	1	3	2	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V54 GAS DYNAMICS AND JET PROPULSION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of Compressible and Isentropic flow concepts and their relations.
- To learn the behaviour of compressible flow through constant area ducts.
- To instil the knowledge of variation in flow properties under Normal and Oblique shocks.
- To equip the students for gaining knowledge on the operations of Jet engines and their performance analysis.

- To make students familiarised with Rocket engines and Propellants and their performance calculations.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows, Concepts of compressible flow – Mach waves and Mach cone. Flow regimes, effect of Mach number on compressibility. Stagnation, static, critical properties and their interrelationship. Isentropic flow and its relations. Isentropic flow through variable area ducts – nozzles and diffusers. Use of Gas tables.

UNIT II COMPRESSIBLE FLOW THROUGH DUCTS 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties. Choking. Isothermal flow with friction. Use of Gas tables.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Rankine-Hugoniot Relation. Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer expansion and relation. Use of Gas tables.

UNIT IV JET PROPULSION 9

Theory of jet propulsion – thrust equation – Performance parameters - thrust, power and efficiency. Operation, cycle analysis and performance of ram jet, turbojet, turbofan, turbo prop and pulse jet engines.

UNIT V SPACE PROPULSION 9

Types of rocket engines and propellants. Characteristic velocity – thrust equation. Theory of single and multistage rocket propulsion. Liquid fuel feeding systems. Solid propellant geometries. Orbital and escape velocity. Rocket performance calculations.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Summarize the relations between the properties and Mach number for Compressible flow and Isentropic flow.

CO2 : Relate the change of flow properties for Rayleigh and Fanno flow through constant area ducts.

CO3 : Relate the changes of flow properties for Normal and Oblique shocks using Rankine-Hugoniot and Meyer relations.

CO4 : Explain the construction, the working principle and performance analysis of jet engines.

CO5 : Elucidate the types of rocket engines and their performance parameters.

TEXT BOOKS :

1 S.M. Yahya, “Fundamentals of Compressible Flow with Aircraft and Rocket propulsion”, New Age International (P) Limited, 6th Edition, 2018.

REFERENCES:

1 R. D. Zucker and O Biblarz, “Fundamentals of Gas Dynamics”, 3nd edition, Wiley, 2020.

2 Balachandran, P., “Fundamentals of Compressible Fluid Dynamics”, Prentice-Hall of India, 2007.

3 Radhakrishnan, E., “Gas Dynamics”, PHI Learning Pvt. Ltd, 7th Edition 2020.

4 Anderson, J.D., “Modern Compressible flow”, Third Edition, McGraw Hill, 2004.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
2	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
3	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
4	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-
5	3	3	2	1	-	-	-	-	-	-	-	1	3	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V55 HYDRAULICS AND PNEUMATICS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide fundamental knowledge of fluid power systems, their applications, and hydraulic fluid properties.
- To develop the ability to understand, analyse, and operate hydraulic actuators, control valves, and system accessories.
- To enhance skills in identifying, constructing, and troubleshooting various hydraulic control components in circuits.
- To guide the design and implementation of pneumatic and electro-pneumatic circuits for automation.
- To impart knowledge on fault diagnosis, system maintenance, and the design of practical hydraulic and pneumatic applications.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Physical Properties of hydraulic fluids – Energy and Power in Hydraulic Systems - Frictional Losses in Hydraulic pipelines - General types of fluids – Fluid power symbols.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Rotary Actuators-Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Accessories: Reservoirs, Pressure Switches – Filters –types and selection- Applications – Fluid Power ANSI Symbols – Problems

UNIT III COMPONENTS OF HYDRAULIC CIRCUITS 9

Construction of Control Components: Directional control valve – 3/2-way valve – 4/2-way valve – Shuttle valve – check valve – pressure control valves – Simple Pressure relief, Compound pressure relief, pressure reducing valve, unloading, Counterbalance valve and sequence valve, Flow control valve – Fixed and adjustable, Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air –Air preparation and distribution – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –

classification- single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, Electro Pneumatic System – Elements – Ladder diagram – timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications- mobile hydraulics; Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. – Low-cost Automation – Hydraulic and Pneumatic power packs, IOT in Hydraulics and pneumatics.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Summarize the properties of fluids used in hydraulic systems and to identify the different fluid power symbols.

CO2 : Describe the construction and working of Hydraulic systems and its components.

CO3 : Outline the different components of hydraulic circuit and its applications.

CO4 : Explain the construction and working of Pneumatic and Electro-Pneumatic systems and their components.

CO5 : Develop Hydraulic and Pneumatic circuits for Machining and industrial applications for Automate the systems using IoT.

TEXT BOOKS :

1 Anthony Esposito, “Fluid Power with Applications”, Prentice Hall, 2009.

2 James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997

REFERENCES:

1 Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.

2 Joshi.P., Pneumatic Control”, Wiley India, 2008.

3 Majumdar, S.R., “Oil Hydraulics Systems – Principles and Maintenance”,TataMcGraw Hill, 2001.

4 Shanmugasundaram.K., “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.

5 Srinivasan.R., “Hydraulic and Pneumatic Controls”, Vijay Nicole Imprints, 3rd edition,2019.

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-
2	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-
3	3	3	1	-	-	-	-	-	-	-	-	1	3	1	-
4	3	3	1	-	-	-	-	-	-	-	-	1	3	1	2
5	3	3	1	-	-	-	-	-	-	-	-	1	3	1	2

1 - low, 2 - medium, 3 -high, ‘-' - no correlation

ME23V56	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide insights into Rankine cycle improvisations, plant layout, and key subsystems of modern coal power plants.
- To develop an understanding of thermodynamic cycles, plant components, and optimization techniques for efficient operation.
- To make the students to understand on nuclear reactor types, plant layouts, subsystems, and essential safety measures in nuclear power generation.
- To elucidate the principles, construction, and working of hydro, wind, solar, tidal, geothermal, and fuel cell power systems.
- To make awareness on analyzing the power plant economics, tariff structures, site selection, cost factors, and pollution control technologies.

UNIT I COAL-BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration Systems.

UNIT II DIESEL, GAS TURBINE, AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier-based Combined Cycle Systems

UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand Rankine cycle improvisations, modern coal power plant layouts, and key subsystems.

CO2 : Analyze thermodynamic cycles, evaluate plant components, and optimize performance in diesel and gas turbine power plants.

CO3 : Explain the working principles, subsystems, and safety measures of different types of nuclear reactors.

CO4 : Learn the principles and working of hydro, wind, solar, tidal, geothermal, and fuel cell power systems.

CO5 : Assess power plant economics, tariff structures, site selection criteria, cost factors, and pollution control methods.

TEXT BOOKS :

1 Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd.,2008.

2 A Textbook of Power Plant Engineering by R.K. Rajput | 1 January 2016

REFERENCES:

1 El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.

2 Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

3 Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

4 Power Plant Engineeringby B. Vijaya Ramnath C. Elanchezhian, L. Saravanakumar | 1 November 2019

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	-	1	1	-	-	-	-	2	3	-	-
2	3	3	1	1	-	1	1	-	-	-	-	2	3	-	-
3	3	3	1	1	-	1	1	-	-	-	-	2	3	-	-
4	3	3	1	1	-	1	1	-	-	-	-	2	3	-	-
5	3	3	1	1	-	1	1	-	-	-	-	2	3	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V57 REFRIGERATION AND AIR CONDITIONING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce refrigeration nomenclature and explain the desirable properties of refrigerants.
- To provide in-depth knowledge of the Vapour Compression Refrigeration system and its key components.
- To explain the working principles and components of the Vapour Absorption Refrigeration system.
- To develop an understanding of psychrometric properties and processes in air conditioning systems.
- To train learners in air conditioner load estimation and component selection based on design considerations.

UNIT I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable

properties – Classification - Nomenclature - ODP & GWP.

UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapour compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system –low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators

UNIT III VAPOUR ABSORPTIONS SYSTEM 9

Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium- Bromide water vapour absorption system, Comparison. Three fluid system

UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams

UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Describe the basic concepts of refrigeration, refrigerant properties, and its environmental impacts (ODP and GWP).

CO2 : Model vapour compression cycles using p-h and T-s diagrams, selecting appropriate components to optimize refrigeration performance

CO3 : Contrast the construction, working and performance of Vapour absorption systems with Vapour refrigeration systems.

CO4 : Select components of an air conditioning system by applying an understanding of psychrometric properties and processes to optimize system performance.

CO5 : Determine the heating and cooling loads for air-conditioning system design by considering factors such as human comfort, environmental conditions, and building characteristics.

TEXT BOOKS :

1 Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010

2 Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi | 10 February 2019.

REFERENCES:

1 ASHRAE Hand book, Fundamentals, 2010

2 JonesW.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann,2007

3 . Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.

4 Stoecker,W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi,1986.

5 A Textbook of Refrigeration and Air-Conditioning by R.K. Rajput | 1 January 2013

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	-	-	-	-	-	-	1	3	-	-
2	3	2	2	1	-	-	-	-	-	-	-	1	3	-	-
3	3	2	2	1	-	-	-	-	-	-	-	1	3	-	-
4	3	2	2	1	-	-	-	-	-	-	-	1	3	-	-
5	3	2	2	1	-	-	-	-	-	-	-	1	3	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

VERTICAL 6: SUPPLY CHAIN MANAGEMENT FOR INDUSTRY

ME23V61 INDUSTRY 5.0 L T P C

3 0 0 3

COURSE OBJECTIVES:

- To educate students on the evolution of industrial revolutions and highlight the key drivers and challenges of Industry 5.0.
- To illustrate the concept and applications of IoT and IIoT in transforming industrial processes.
- To instil knowledge on the basics of cyber-physical systems, process automation, and collaborative robots in modern industries.
- To guide students in creating and implementing a technology roadmap framework.
- To provide hands-on experience and insights through case studies from various sectors such as healthcare, education, and bioenergy.

UNIT I INTRODUCTION TO INDUSTRIAL TRANSFORMATIONS 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.

UNIT II IMPORTANCE OF INTERNET OF THINGS (IOTs) 9

Introduction to Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Services, Fundamental of Predictive Analytics, Smart Logistics, Smart Devices and Products.

UNIT III TECHNOLOGY EVOLUTION **9**

Basics of cyber Physical Systems, Process automation and Collaborative robots, Fundamental to artificial Intelligence, Mobile Computing, Cyber Security, Ethical technology, Responsive and distributed supply chain system, Human-centric and Value-oriented approaches - Human-Robot Collaboration in Smart Factories.

UNIT IV TECHNOLOGY ROADMAP **9**

Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, New Product and Process Development Phase.

UNIT V TECHNOLOGY IMPLEMENTATION AND CASE STUDIES **9**

3D printing, Solar energy sector, Healthcare sector, Maintain records related to education, finance, clean bioenergy generation and Intelligent NextG Wireless Networks. Case studies on CNC/NC automation, In-house, Healthcare services.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the evolution of industrial revolutions and assess the key drivers, enablers, and challenges for Industry 5.0.

CO2 : Explain the importance of IoT and IIoT in transforming industrial processes, including smart logistics and smart devices.

CO3 : Analyze the role of cyber-physical systems, artificial intelligence, and collaborative robots in shaping modern industries with a human-centric approach.

CO4 : Develop strategies using a technology roadmap framework to design and implement new product and process development initiatives.

CO5 : Apply concepts from technology evolution and implementation in real-world scenarios through case studies

TEXT BOOKS :

1 Uthayan Elangovan, Industry 5.0, "The Future of the Industrial Economy", First Edition, Taylor & Francis, ISBN: 978-1-032-04127-8, 2022.

2 Alessandro Massaro, "Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances", Wiley-IEEE Press, 2021, ISBN: 2021028944.

REFERENCES:

1 Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.

2 Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.

3 Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, "The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0", Industrial Press Inc., U.S.ISBN 0831136367, Nov 2021.

4 Andreas Gebhardt, "Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing", Hanser Publisher, 2011.

5 Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, "Healthcare 4.0 Next Generation Processes with the Latest Technologies", Palgrave Pivot, 2019, ISBN978-981-13-8113-3.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	1	2	-	-	-	-	-	-	1	3	1	1
2	3	2	1	1	2	-	-	-	-	-	-	1	3	1	1
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4	3	2	1	1	2	-	-	-	-	-	-	1	3	1	1
5	3	2	1	1	2	-	-	-	-	-	-	1	3	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V62 PLANNING IN LOGISTICS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide an overview of strategic logistics management, highlighting its importance in strategic decision-making and its role as the backbone of business operations.
- To impart knowledge in logistics system design, including reengineering, environmental assessment, and the integration of logistical strategies.
- To equip students with knowledge about designing and planning logistics strategies, setting customer service levels, and formulating strategies for optimal logistics operations.
- To explain transportation and location strategies, focusing on transportation systems, international logistics, and location-based decision-making for warehouses and services.
- To familiarize students with emerging trends in logistics, such as outsourcing, reverse logistics, green logistics, and the impact of digitalization on logistics management.

UNIT I INTRODUCTION TO LOGISTICS 9

An introduction to the strategic logistics management: meaning, strategic logistics planning; the importance of strategic logistics planning; the operating plan vs the strategic plan, logistic competitive frame work, logistic strategies across PLC, Logistic strategies – cost leadership, differentiation, value addition, outsourcing, diversification. Significance of logistics in strategic decisions, Logistics as backbone of business propositions.

UNIT II LOGISTICS SYSTEM DESIGN 9

Logistics reengineering, Logistical environmental assessment, Time based logistics, Anticipatory and Response based strategies, Alternative strategies, Logistical operational arrangements, Time based control techniques; Integration theory – Location structure, Transportation economies, Inventory economies, Formulating logistics strategy.

UNIT III LOGISTICS STRATEGY AND PLANNING 9

Strategic Role of logistics, designing Logistic strategy and operation, Logistics planning Triangle, Network appraisal; Guidelines for strategy formulation – total cost concept, Setting customer service level, Setting number of warehouses in logistics system, Setting safety stock levels, Differential distribution, Postponement, Consolidation, Selecting proper channel strategy.

UNIT IV TRANSPORTATION AND LOCATION STRATEGY 9

Importance of effective transportation system, service choice and its characteristics, inter model

service, agencies and small shipments centre, agencies and small shipment centre, transportation cost, international transportation, transportation decisions. Location strategy - single facility location, multi facility, retail / service location, importance of location decisions, choosing geographical region, Warehouse Management System.

UNIT V RECENT TRENDS IN LOGISTICS 9

Logistics outsourcing - benefits, Reverse Logistics- scope of reverse Logistics, scope design consideration, reverse Logistics a competitive tool, Green Logistics- introduction, drivers of green Logistics, Green Logistics Management: control and compliances, Digitalization. Digital Freight Matching Platforms.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the role of strategic logistics management and its importance in aligning logistics with business propositions.

CO2 : Design and assess logistics systems using time-based logistics strategies, reengineering processes, and environmental evaluation techniques.

CO3 : Formulate effective logistics strategies, including customer service levels, safety stock settings, and network appraisals, to optimize supply chain performance.

CO4 : Analyze transportation systems and location strategies to make informed decisions on transportation modes, cost structures, and warehouse locations.

CO5 : Evaluate recent trends in logistics, including reverse logistics, green logistics, and digital freight platforms, and their impact on competitive advantage and sustainability.

TEXT BOOKS :

1 Vinod.V.Sople, Logistics Management, Pearson Education, 3rd edition 2012.

2 Business Logistics / Supply chain management Ronald H Ballou, Samir K Srivastava

REFERENCES:

1 Logistic management, an introduction to supply chain management, Donald Waters 2004.

2 Logistic management Ganapathi Nandi, Oxford publication 2015

3 John Mangan, Chandra Lalwani, “Global Logistics and Supply Chain Management”, Tim Butcher John Wiley & Sons, 2nd Edition, 2011.

4 Pierre A. David International Logistics: the Management of International Trade Operations 5th Edition 2017

CO’s-PO’s & PSO’s MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	-	-	-	-	-	-	2	1	-	1	2
2	3	2	2	2	-	-	-	-	-	-	2	1	-	1	2
3	3	2	2	2	-	-	-	-	-	-	2	1	-	1	2
4	3	2	2	2	-	-	-	-	-	-	2	1	-	1	2
5	3	2	2	2	-	-	-	-	-	-	2	1	-	1	2

1 - low, 2 - medium, 3 -high, ‘-' - no correlation

ME23V63	SUPPLY CHAIN ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students to various types of analytics and their application in transforming supply chains, including barriers and roadmaps.
- To emphasize warehouse design and layout optimization using mathematical programming models and simulations.
- To impart knowledge in advanced inventory management techniques, aggregation models, and risk analysis strategies for supply chain optimization.
- To analyse transportation networks using graph theory, algorithms, and transhipment models, focusing on real-world logistics challenges.
- To familiarize students with multi-criteria decision-making models (MCDM), including AHP, DEA, TOPSIS, and quantum computing techniques, for supply chain optimization with practical applications.

UNIT I INTRODUCTION TO DATA-DRIVEN DECISION-MAKING 9

Introduction to analytics – descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains, Barriers to implementation, Road Map. AI/ML in supply chain analytics.

UNIT II WAREHOUSING DECISIONS 9

Mathematical Programming Models - P-Median Methods - Guided LP Approach - Balmer – Wolfe Method, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods. simulations for layout optimization.

UNIT III INVENTORY MANAGEMENT 9

Inventory aggregation Models, Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain - Measuring transit risks, supply risks, delivering risks, Risk pooling strategies. Agile inventory management.

UNIT IV TRANSPORTATION NETWORK MODELS 9

Notion of Graphs, Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Multistage Transshipment and Transportation Problems, Set covering and Set Partitioning Problems, Traveling Salesman Algorithms.

UNIT V MCDM MODELS 9

Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS-Application in SCM. Real- world applications and live datasets as case studies. Quantum Computing for Supply Chain Optimization.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the fundamentals of analytics (descriptive, predictive, and prescriptive) and the integration of AI/ML into data-driven supply chain transformation.

CO2 : Apply mathematical programming and heuristic models to design and optimize warehouse layouts and logistics networks.

CO3 : Evaluate inventory management strategies, including dynamic lot-sizing, multi-echelon

models, and risk pooling, to enhance supply chain agility and efficiency.

CO4 : Solve transportation network problems using graph theory, spanning tree algorithms, and multistage transshipment models for logistics optimization.

CO5 : Utilize MCDM models such as AHP, DEA, ANP, and TOPSIS in supply chain scenarios, with exposure to quantum computing for optimization problems.

TEXT BOOKS :

1 Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.

2 Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.

REFERENCES:

1 Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.

2 Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	1	1	1	-	-	-	-	-	-	1	1	1	1
2	3	3	1	1	1	-	-	-	-	-	-	1	1	1	1
3	3	3	1	1	1	-	-	-	-	-	-	1	1	1	1
4	3	3	1	1	1	-	-	-	-	-	-	1	1	1	1
5	3	3	1	1	1	-	-	-	-	-	-	1	1	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V64 SUPPLY CHAIN INFORMATION SYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the concept of electronic supply chain management (e-SCM) and explore the role of communication networks in improving logistics and supply chain operations.
- To provide an understanding of enterprise information systems (EIS), their functionality, and their significance in integrating supply chain operations.
- To analyze the development and management of SCM systems, focusing on methodologies, stakeholder roles, and system scalability and adaptability.
- To explain the deployment techniques, IT infrastructure management, and risk management practices for effective SCM systems.
- To make students familiar with information integration, supply chain visibility, and advanced tools like decision support systems (DSS) and blockchain for secure information sharing.

UNIT I ELECTRONIC SCM AND COMMUNICATION NETWORKS 9

Introduction to e-SCM-Overview and significance- e-SCM framework and critical success factors-Key

benefits of e-SCM in logistics-Strategic positioning of information in supply chains, Role and impact of supply chain communication networks-Telecommunication networks overview-Applications in logistics-Electronic Data Interchange (EDI) and its role in secure communication, Introduction to internet-enabled supply chain models.

UNIT II ENTERPRISE INFORMATION SYSTEMS 9

Overview and classification of enterprise information systems (EIS)-Functional principles of EIS in logistics-Framework for managing supply chain information - Case Studies-Popular enterprise application software-Benefits of EIS in integration and efficiency improvement.

UNIT III DEVELOPMENT AND MANAGEMENT OF SCM SYSTEMS 9

Key stakeholders in SCM systems: Roles and responsibilities-SCM system development processes and methodologies (e.g., Agile, Lean)-Enterprise architecture design for supply chain management design principles: Scalability and adaptability.

UNIT IV DEPLOYMENT AND IT INFRASTRUCTURE MANAGEMENT 9

Deployment techniques for supply chain information systems- IT operations and infrastructure management for supply chains- basics of portfolio, program, and project management- Risk management and value optimization in SCM systems.

UNIT V INFORMATION INTEGRATION AND SUPPLY CHAIN VISIBILITY 9

Enterprise application integration (EAI) for supply chain management - Enhancing supply chain visibility-Tools and strategies - Decision Support Systems (DSS): Applications in supply chains- Data analysis and planning methodologies for problem-solving and implementation. Blockchain-based Information Security in SCM.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the significance of e-SCM, the strategic role of communication networks, and the application of technologies like EDI in modern supply chain models.

CO2 : Analyze and evaluate enterprise information systems (EIS), their frameworks, and benefits in improving logistics integration and operational efficiency.

CO3 : Design SCM systems by applying development methodologies, stakeholder management principles, and scalable system architecture strategies.

CO4 : Demonstrate knowledge of deploying SCM information systems, managing IT infrastructure, and optimizing risk and value in supply chains.

CO5 : Utilize tools for information integration, enhance supply chain visibility through DSS, and apply blockchain for secure and transparent supply chain operations.

TEXT BOOKS :

1 Bowersox, Donald J., Closs, David J., and Cooper, M. Bixby. Supply Chain Logistics Management, 6th Edition, McGraw-Hill, 2023

2 R.H. Ballou, Business Logistics Management, Prentice-Hall, 2004.

REFERENCES:

1 Strauss, E-Marketing, 4th edition, Pearson Education, 2023.

2 Chaffey, E-Business and E-Commerce Management, 3rd edition, Pearson Education, 2022.

3 Blanchard, Logistics Engineering & Management, 6th edition, Pearson Education, 2022.

4 Levine, Statistics for Managers Using MS Excel, 4th edition, Pearson Education, 2021.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	1	1	-	-	-	-	-	1	1	1	1
2	3	2	2	1	1	1	-	-	-	-	-	1	1	1	1
3	3	2	2	1	1	1	-	-	-	-	-	1	1	1	1
4	3	2	2	1	1	1	-	-	-	-	-	1	1	1	1
5	3	2	2	1	1	1	-	-	-	-	-	1	1	1	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V65 SUPPLY CHAIN FOR MANUFACTURING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce the fundamental concepts and frameworks of Supply Chain Management (SCM), towards to enhance customer service and managing supply chain relationships.
- To develop knowledge of the role of information systems, demand forecasting techniques, and inventory management strategies in logistics and supply chain management.
- To familiarize with transportation, warehousing, and distribution management, focusing on cost elements, decision-making, and operational mechanisms.
- To understand protective packaging, order processing, material handling, and sourcing management, including contemporary trends in supplier relationships.
- To analyze logistics and supply chain management administration, including organizational principles, performance measurement, and case studies for effective decision-making.

UNIT I FUNDAMENTALS OF SUPPLY CHAIN PROCESSES AND STRATEGIC RELATIONSHIPS 9

Supply Chain Management (SCM): Nature & Concepts – Value chain – Functions & Contribution – Effectiveness – Framework – Outsourcing – 3 PLs – 4 PLs – Bull whip effect – SC Relationships – Conflict resolution – Harmonious relationship – Customer Service: Nature & Concepts – Importance – Components – Cost – Gap analysis – Strategic management.

UNIT II INFORMATION, DEMAND FORECASTING, INVENTORY MANAGEMENT 9

Information: Position of Information in L & SCM – Logistical Informational Systems – Operational Logistical Informational Systems – Integrated Information Technology Solution for L & SCM – Emerging L & SCM – Demand Forecasting: Nature & Components – Impact of forecast on L & SCM – Effective forecasting – Techniques – Selection – Principles – Inventory: Concepts – Types – Functions – Elements – Inventory management – ABC analysis – ABC-VED matrix – Materials Requirement Planning – Distribution Requirement Planning – Just in Time System.

UNIT III TRANSPORTATION, WAREHOUSING & DISTRIBUTION 9

Transportation: Introduction – Position of transportation in L & SCM – Elements of transportation cost – Modes – Multimodal transport – Containerization – Selection of transportation modes – Transportation decision – Transportation network: routing & scheduling – Warehousing & Distribution Centers: Introduction – Concepts – Types – Functions – Strategy – Design – Operational

Mechanism – Case study. Decentralized Manufacturing Systems.

UNIT IV PROTECTIVE PACKAGING, ORDER PROCESSING, MATERIALS HANDLING, PURCHASING & SOURCING MANAGEMENT 9

Protective Packaging: Introduction – Concepts – Functions – Forms – Problems – Policy – Order Processing: Introduction – Concepts – Functions – Elements – Significance – Materials Handling: Introduction – Concept – Objective- Principles – Equipments – Considerations – Purchasing & Sourcing Management: Introduction – Nature – Scope – Importance – Trends – Contemporary sourcing & supplier management – Case study.

UNIT V LOGISTICS & SCM ADMINISTRATION 9

Organization: Introduction – Evolutionary trends of L & SCM – Principles – Factors. Performance Measurement: Introduction – Dimensions – Basic tools – Impediments to improve performance – Case Study.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Comprehend the nature, concepts, and strategic management practices of SCM, including the value chain, outsourcing, and customer service.

CO2 : Evaluate the role of information systems, demand forecasting, and inventory management techniques, such as MRP, DRP, and JIT, for supply chain efficiency.

CO3 : Design and manage transportation, warehousing, and distribution networks by applying routing, scheduling, and operational strategies.

CO4 : Develop strategies for protective packaging, order processing, and materials handling while addressing modern trends in purchasing and sourcing management.

CO5 : Assess logistics and supply chain performance using tools and techniques to overcome impediments and improve organizational efficiency.

TEXT BOOKS :

1 Agrawal, D. K., "A Textbook of Logistics & Supply Chain Management",MacMillan Publishers India Ltd., 2009.

2 Sunil Chopra & Peter Meindl, "Supply Chain Management, Strategy, Planning, and Operation", 2nd Edition, PHI, 2004.

REFERENCES:

1 David J. Bloomberg, Stephen Lemay & Joe B. Hanna, "Logistics", PHI, 2002.

2 Jeremy F. Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.

3 James B. Ayers, "Handbook of Supply Chain Management", St. Lucle Press, 2000.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-
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3	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-
4	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-
5	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

E23V67	SUSTAINABLE INVENTORY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamentals of inventory management, emphasizing its key functions, costs, and evolution towards sustainability.
- To elucidate the sustainable procurement strategies and ethical sourcing practices for achieving environmental and social responsibility in supply chains.
- To examine demand forecasting techniques and lean inventory management practices for balancing sustainability with operational efficiency.
- To understand the role of technology, including AI, IoT, and blockchain, in transforming inventory management toward sustainability.
- To evaluate environmental impacts and frameworks, including lifecycle analysis, circular economy principles, and compliance with environmental policies.

UNIT I FOUNDATIONS OF INVENTORY PRACTICES 9

Definition and objectives of inventory management - Key functions and importance in organizational success - Environmental, social, and economic dimensions of sustainability - Evolution of sustainable inventory management practices - Types: raw materials, work-in-progress (WIP), finished goods, and maintenance, repair, and operations (MRO) inventory - Inventory costs: holding, ordering, stockout, and opportunity costs - Comparison of traditional inventory models (EOQ, ABC analysis) and sustainability-focused approaches - Case studies of successful sustainable inventory practices.

UNIT II SUSTAINABLE PROCUREMENT AND INVENTORY CONTROL 9

Principles and benefits of green procurement - Selecting vendors based on sustainability criteria. Addressing supply chain ethics and social responsibility - Real-world challenges in implementing ethical sourcing. Traditional systems: JIT, Kanban, and Vendor-Managed Inventory (VMI) - Sustainable approaches: minimizing waste, prioritizing recyclable inventory. Tools for evaluating supplier sustainability - Real-life examples of companies achieving sustainable procurement.

UNIT III DEMAND FORECASTING AND LEAN INVENTORY 9

Qualitative methods: expert judgment, Delphi method - Quantitative methods: time-series analysis, regression models. Strategies for identifying and addressing overstocking - Impact of excess inventory on financial and environmental performance. Core concepts: eliminating waste, continuous improvement - Application of lean tools: 5S, Value Stream Mapping (VSM), and Kaizen. Aligning inventory levels with demand fluctuations - Balancing sustainability goals with operational efficiency.

UNIT IV TECHNOLOGY IN SUSTAINABLE INVENTORY MANAGEMENT 9

Role of AI and machine learning in demand forecasting - Data analytics for predictive and prescriptive inventory management. Enhancing traceability and accountability in inventory systems - Real-world applications and benefits of blockchain in inventory management. Sensors and smart devices for real-time inventory monitoring - Case studies of IoT-enabled inventory systems - Analysis of successful implementations of digital tools in sustainable inventory practices. Circular Economy in Sustainable Inventory Practices.

UNIT V ENVIRONMENTAL IMPACT AND FRAMEWORKS 9

Lifecycle inventory analysis - Assessing the carbon footprint of inventory practices. Principles of circular economy in inventory management - Designing systems for reuse, recycling, and remanufacturing - Compliance with environmental laws and policies - Role of certifications in enhancing credibility and compliance - Emerging practices and technologies

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Explain the fundamentals of inventory management, including types, costs, and the integration of sustainable practices into inventory systems.

CO2 : Apply principles of green procurement and inventory control to address ethical and sustainability challenges in supply chains.

CO3 : Demonstrate proficiency in demand forecasting methods and lean tools, such as 5S and Value Stream Mapping, to optimize inventory levels while achieving sustainability goals.

CO4 : Utilize advanced technologies like AI, IoT, and blockchain to enhance real-time monitoring, traceability, and accountability in sustainable inventory systems.

CO5 : Assess inventory practices using lifecycle analysis and circular economy principles, ensuring compliance with environmental standards and policies.

TEXT BOOKS :

1 Chopra, S., & Meindl, P. (2020). Supply Chain Management: Strategy, Planning, and Operation. Pearson.

2 Richards, G. (2021). Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse. Kogan Page.

REFERENCES:

1 Coyle, J. J., Langley, C. J., & Gibson, B. (2022). Supply Chain Management: A Logistics Perspective. Cengage Learning

2 Christopher, M. (2021). Logistics and Supply Chain Management. FT Press

CO's-PO's & PSO's MAPPING

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3	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-
4	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-
5	3	2	2	1	-	-	1	-	-	-	-	1	2	1	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ME23V68 WAREHOUSE AUTOMATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of warehouse management functions, operations, and the role of warehouse managers in supply chain success.

- To equip the students in effective warehouse layout designs and material handling systems for operational efficiency.
- To address warehouse safety, people management, and cost analysis techniques, ensuring compliance and improved performance.
- To introduce technological advancements in warehouse automation and their applications in modern supply chains.
- To analyse the role of data analytics and optimization techniques in improving warehouse processes such as inventory, order fulfilment, and storage.

UNIT I WAREHOUSE MANAGEMENT FUNCTION AND OPERATIONS 9

Understanding Warehouse Management Function and Operations - Role of a Warehouse and a Warehouse Manager, Major warehouse processes and End-to-End Warehouse Operations.

UNIT II WAREHOUSE LAYOUT AND MATERIAL HANDLING 9

Warehouse Layout and Material Handling - Order picking methods, Warehouse Layout, Material Handling Systems in a Warehouse and Other resources, Dock Leveler and Conveyor- Types and their purposes.

UNIT III WAREHOUSE SAFETY AND COST ANALYSE 9

People Aspects in a Warehouse and Warehouse Safety - People management in Warehouse, Health and Safety issues in a Warehouse. Cost Analysis and Performance Management - Inventory Accounting and Cost analysis, Key Performance Indicators.

UNIT IV WAREHOUSE AUTOMATION 9

Warehouse Automation - Warehouse Automation Analysis, Warehouse design - RFID leveraged warehouse systems, Application areas and technological advancements in Warehouse automation, Latest trends in Warehouse Automation.

UNIT V WAREHOUSE MANAGEMENT 9

Use of Analytics and Optimization in Warehouse Management - Optimizing order picking, Data Analytics in different functions – Inventory, Order fulfilment, Procurement and storage.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Explain the role and functions of warehouses, as well as the responsibilities of warehouse managers in end-to-end operations.

CO2 : Design efficient warehouse layouts and implement effective material handling systems, considering various resources and operational needs.

CO3 : Demonstrate proficiency in people management, safety practices, cost analysis, and performance measurement in warehouse environments.

CO4 : Apply advanced technologies, such as RFID systems and warehouse automation techniques, to streamline and modernize warehouse operations.

CO5 : Utilize analytics and optimization tools to enhance warehouse management functions, including inventory control, order fulfillment, and storage systems.

TEXT BOOKS :

1 Richards, G. (2017). Warehouse management: a complete guide to improving efficiency and minimizing costs in the modern warehouse. Kogan Page Publishers.

REFERENCES:

1 Keller, S., & Keller, B. C. (2014). The definitive guide to warehousing: managing the storage and handling of materials and products in the supply chain. Pearson Education.

2 Smith, J. D. (1998). The warehouse management handbook. Tompkins press.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	1	1	1	-	-	-	1	-	1	1	2	1	-
2	2	2	1	1	1	-	-	-	1	-	1	1	2	1	-
3	2	2	1	1	1	-	-	-	1	-	1	1	2	1	-
4	2	2	1	1	1	-	-	-	1	-	1	1	2	1	-
5	2	2	1	1	1	-	-	-	1	-	1	1	2	1	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

ELECTIVE – MANAGEMENT COURSES

GE23712	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students to the fundamental concepts of engineering economics and financial accounting.
- To develop an understanding of cost concepts, cost analysis, and decision-making techniques relevant to engineering projects.
- To equip students with the knowledge of time value of money and its applications in capital budgeting and financial analysis.
- To provide students with the skills to analyse financial statements and make informed financial decisions.
- To enable students to understand the principles of financial management, budgeting, and risk analysis.

UNIT I INTRODUCTION TO ENGINEERING ECONOMICS **9**

Introduction to Engineering Economics - Definition, scope, and significance; Microeconomics vs. Macroeconomics - Basic concepts, demand and supply analysis; Law of Demand and Supply - Price determination, market structures; Engineering Decision Making - Types of decisions, techniques for evaluating alternatives; Cost Concepts - Fixed, variable, and semi-variable costs, direct and indirect costs; Time Value of Money - Interest calculation, simple and compound interest.

UNIT II COST CONCEPTS AND ANALYSIS **9**

Break-Even Analysis - Break-even point, margin of safety, break-even chart; Depreciation and Its Calculation - Straight-line method, declining balance method, sum-of-the-years-digits; Cost-Volume-Profit Analysis (CVP) - Profit planning, cost structure analysis, and sensitivity analysis; Fixed vs. Variable Costs - Implications for pricing and cost control; Standard Costing and Variance Analysis - Introduction to budgeting, fixed and flexible budgets; Operational Costing - Role of operational costing in decision-making.

UNIT III FINANCIAL ACCOUNTING **9**

Accounting Basics - Introduction to financial accounting, accounting principles, and the accounting cycle; Balance Sheet and Profit & Loss Account - Structure and format, assets, liabilities, and equity; Cash Flow Statement - Types of activities—operating, investing, and financing, calculation methods; Ratio Analysis - Liquidity ratios, profitability ratios, solvency ratios, and efficiency ratios; Accounting Standards and Policies - Overview of IFRS, GAAP, and Indian accounting standards; Depreciation and Amortization in Accounting - Methods and impact on financial statements

UNIT IV TIME VALUE OF MONEY **9**

Interest and Discounting - Simple interest vs. compound interest, present value, and future value; Applications of Time Value of Money - Cash flow analysis, decision-making in capital budgeting; Cost of Capital - Methods of determining cost of capital, WACC; Capital Budgeting - Techniques

like NPV (Net Present Value), IRR (Internal Rate of Return), Payback Period; Financial Modeling - Introduction to financial models used in project evaluation; Risk Analysis in Time Value of Money Applications - Sensitivity analysis, risk-adjusted discount rate.

UNIT V FINANCIAL MANAGEMENT AND BUDGETING **9**

Financial Planning and Budgeting - Introduction to financial planning and budgeting process, types of budgets; Capital Budgeting Decisions - Techniques—NPV, IRR, Payback Period, profitability index; Budgeting Process - Creating operational, cash, and capital budgets; Risk and Uncertainty in Financial Decision Making - Scenario analysis, Monte Carlo simulation; Break-Even Analysis and its Role in Budgeting - Profitability analysis; Cost of Capital and Its Determination - Importance of understanding WACC and its impact on investment decisions.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Apply engineering economics principles to solve real-world engineering problems.
CO2: Analyze and calculate costs, break-even points, and profitability in engineering projects.
CO3: Evaluate financial statements and apply financial ratios for decision-making.
CO4: Utilize time value of money concepts for capital budgeting and financial analysis.
CO5: Assess financial planning, budgeting, and risk in engineering project management.

TEXTBOOKS:

1. Leland T. Blank, Anthony J. Tarquin, *"Engineering Economy"*, McGraw Hill, 2017 (UNIT I & IV)
2. Jerry J. Weygandt, Paul D. Kimmel, Donald E. Kieso, " Accounting Principles, 15th edition, McGraw Hill, 2024, (UNIT II & III, V)

REFERENCES:

1. Prasanna Chandra, "Financial Management: Theory & Practice", 11th Edition, McGraw Hill, 2023
2. Chan S. Park, "Fundamentals of Engineering Economics", 3rd Edition , Pearson, 2017
3. William F. Samuelson, Stephen G. Marks, Jay L. Zagorsky , "Managerial Economics",9th Edition, Willey, 2021
4. Ramachandran, V., and Kakani, R.K , "Financial Accounting for Management", 5th Edition, McGraw Hill, 2020

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	2	-	-	-	1	-	-	1	3	2	-
2	3	3	2	2	3	-	-	-	2	-	-	2	3	2	-
3	3	3	3	2	3	-	-	-	2	-	-	2	3	3	1
4	3	3	3	2	3	-	2	-	3	1	-	2	3	3	2
5	3	3	3	3	3	-	3	-	3	1	-	2	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE23713	HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide knowledge about management issues related to staffing.
- To provide knowledge about management issues related to training.
- To provide knowledge about management issues related to performance.
- To provide knowledge about management issues related to compensation.
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

The importance of human resources – Objective of Human Resource Management - Human resource policies - Role of human resource manager.

UNIT I I HUMAN RESOURCE PLANNING 9

Importance of Human Resource Planning – Internal and External sources of Human Resources - Recruitment - Selection – Socialization.

UNIT I II TRAINING AND EXECUTIVE DEVELOPMENT 9

Types of training and Executive development methods – purpose – benefits.

UNIT I V EMPLOYEE COMPENSATION 9

Compensation plan – Reward – Motivation – Career Development - Mentor – Protege relationships.

UNIT V PERFORMANCE APPRAISAL AND EMPLOYEE RELATIONS 9

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Gain knowledge of various aspects of HRM.

CO2: Acquire the expertise needed for success as a human resource professional.

CO3: Develop essential skills for effective HR management.

CO4: Apply learned concepts effectively in the workplace.

CO5: Understand and stay updated on emerging concepts in the field of HRM

TEXTBOOKS:

1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007 (Unit I & II)
2. John Bernardin. H., "Human Resource Management – An Experimental Approach", 5th Edition, Tata McGraw Hill, 2013. (Unit III, IV, V)

REFERENCES:

1. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources", 7th Edition, PHI, 2012.
2. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	2	2	2	1	1	2	1	1	1	1	1	1
2	3	3	2	3	2	2	2	2	3	1	2	1	1	2	1
3	3	3	3	3	3	3	2	2	3	1	2	1	1	2	1
4	3	3	2	3	3	2	2	2	2	1	1	1	1	1	1
5	3	3	1	2	2	2	2	2	2	1	1	1	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE23714 KNOWLEDGE MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts, evolution, and significance of knowledge management in organizations.
- To explore different types of knowledge (tacit, explicit, embedded) and their role in decision-making and competitive advantage.
- To analyze knowledge creation and sharing models, including Nonaka's SECI model and frameworks for fostering a knowledge-sharing culture.
- To understand the role of IT and emerging technologies such as AI, big data analytics, and knowledge graphs in knowledge management systems.
- To examine real-world applications, industry case studies, and the impact of KM on innovation, cloud computing, and ethical considerations.

UNIT I FUNDAMENTALS OF KNOWLEDGE MANAGEMENT 9

Knowledge Management Overview - Definitions and Importance - Evolution and Scope. Types of Knowledge - Tacit Knowledge - Explicit Knowledge - Embedded Knowledge - Their Characteristics and Applications. Knowledge Life Cycle - Stages - Creation - Storage - Sharing - Utilization. Drivers of KM - Role of Knowledge in Competitive Advantage and Decision-Making.

UNIT II KNOWLEDGE CREATION AND SHARING 9

Knowledge Creation Models - Nonaka's SECI Model - Socialization - Externalization - Combination - Internalization. Knowledge Conversion Processes - Tools and Techniques for Tacit and Explicit Knowledge Conversion. Knowledge Sharing Frameworks - Barriers to Knowledge Sharing - Strategies for Building a Sharing Culture. Role of Communities of Practice in KM.

UNIT III TECHNOLOGY FOR KNOWLEDGE MANAGEMENT 9

Role of IT in Knowledge Management - IT as an Enabler of KM Processes. Knowledge Management Tools - Content Management Systems - Features and Applications - Document Management Systems - Best Practices. Big Data Analytics - Artificial Intelligence in KM Applications. Knowledge Graph(KG) Definition – Construction of KG - Case Studies: Real-World Applications of IT-Driven KM – Knowledge Graph applications.

UNIT IV KNOWLEDGE MANAGEMENT SYSTEMS (KMS) 9

Design and Implementation of KMS - Phases - Needs Analysis - Design - Implementation. KMS

Architecture - Knowledge Repositories - Collaboration Tools - Integration with Enterprise Systems. Evaluation of KMS - Success Metrics - Performance Indicators. Industry Case Studies - Examples of Successful KMS.

UNIT V EMERGING TRENDS AND CHALLENGES 9

Knowledge-Driven Innovation - Role of KM in Innovation - Examples and Best Practices. KM in the Cloud - Features - Benefits - Security and Privacy Concerns. Ethical Issues in KM - Data Ownership - Intellectual Property Rights - Addressing Security Challenges. Future Trends - Industry 4.0 and KM - Blockchain in Knowledge Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: Explain the principles and importance of knowledge management in the digital era.

CO2: Evaluate knowledge creation and sharing techniques for organizational growth.

CO3: Design and analyse knowledge management systems leveraging IT tools.

CO4: Apply knowledge management practices to solve practical problems in organizational settings.

CO5: Analyse emerging trends and challenges in knowledge management.

TEXT BOOKS:

1. Kimiz Dalkir, Knowledge Management in Theory and Practice, MIT Press, Latest Edition. (Unit I,II & III)
2. Irma Becerra-Fernandez, Avelino Gonzalez, and Rajiv Sabherwal, Knowledge Management Systems and Processes, Routledge, Latest Edition. (Unit IV & V)

REERENCES:

1. Ashok Jashapara, Knowledge Management: An Interdisciplinary Perspective, Pearson, Latest Edition.
2. Amrit Tiwana, The Knowledge Management Toolkit: Orchestrating IT, Strategy, and Knowledge Platforms, Prentice Hall.
3. Elias M. Awad and Hassan M. Ghaziri, Knowledge Management, Pearson.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	-	-	2	-	-	-	1	-	-	1	3	2	-
2	3	3	2	2	3	-	-	-	2	-	-	2	3	2	-
3	3	3	3	2	3	-	-	-	2	-	-	2	3	3	1
4	3	3	3	2	3	-	2	-	3	1	-	2	3	3	2
5	3	3	3	3	3	-	3	-	3	1	-	2	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE23715	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the foundational principles, functions, and theories of management.
- To develop skills in planning, decision-making, organizing, staffing, and team management.
- To analyze leadership styles, motivation theories, and their impact on organizational effectiveness.
- To explore control mechanisms, performance evaluation techniques, and corporate social responsibility.
- To examine emerging trends in management, including digital transformation, AI, and agile practices.

UNIT I INTRODUCTION TO MANAGEMENT **9**

Definition and Nature of Management: Scope, significance, and principles. - Functions of Management: Planning, organizing, leading, and controlling. - Management Theories: Classical (Henry Fayol), Behavioral, Modern (Peter Drucker). - Levels of Management: Top, middle, and lower levels.- Business Environment: Internal and external factors, SWOT Analysis.

UNIT II PLANNING AND DECISION MAKING **9**

Planning Fundamentals: Objectives, importance, and types of plans. - Planning Process: Steps and techniques in planning. - Management by Objectives (MBO): Concept and benefits. - Decision-Making Process: Importance, types, tools, and techniques. - Risk and Uncertainty in Decisions: Managing challenges in decision-making.

UNIT III ORGANIZING AND STAFFING **9**

Organizational Structure: Types (functional, divisional, matrix), pros and cons. - Formal vs. Informal Organization: Features and significance. - Delegation and Decentralization: Principles, benefits, and barriers. - Staffing Process: Recruitment, selection, orientation, training, and development. - Managing Teams: Characteristics of effective teams, group dynamics.

UNIT IV LEADERSHIP AND MOTIVATION **9**

Leadership Fundamentals: Definition, styles (autocratic, democratic, laissez-faire). - Leadership Theories: Trait, behavioral, situational, transformational leadership. - Motivation Theories: Maslow's Hierarchy, Herzberg's Two-Factor Theory, McGregor's Theory X and Y. - Communication: Process, channels, barriers, and strategies for effective communication. - Conflict and Stress Management: Causes, types, and resolution techniques.

UNIT V CONTROLLING AND EMERGING TRENDS IN MANAGEMENT **9**

Controlling Process: Steps, importance, and types (budgetary, non-budgetary) - Control Techniques: Benchmarking, TQM, Six Sigma, Balanced Scorecard - Corporate Social Responsibility (CSR): Ethics, sustainability, and social impact - Emerging Trends: Digital transformation, AI in management, agile practices - Case Studies: Application of management principles in real-world scenarios.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Demonstrate an understanding of management principles and their application.

CO2: Apply planning and decision-making techniques effectively in organizational contexts.

CO3: Design efficient organizational structures and staffing strategies.

CO4: Exhibit leadership and motivational skills in managing individuals and teams.

CO5: Employ control techniques to achieve organizational objectives while considering ethical and social responsibilities.

TEXTBOOKS:

1. Koontz, H., & Weihrich, H. "Essentials of Management: An International Perspective". McGraw Hill. 2021 (Unit I,II & III)
2. Stoner, J., Freeman, R., & Gilbert, D. "Management". Pearson Education. 2020 (Unit IV & V)

REFERENCES:

1. Robbins, S. P., & Coulter, M., "Management". Pearson Education.2021
2. Peter Drucker, "The Practice of Management", Harper Business, 2017
3. Ramaswamy, T. "Principles of Management", Himalaya Publishing House, 2018

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	3	2	2	3	3	2	3	3	2	3	3	3
2	2	3	3	3	2	3	3	3	3	3	2	3	2	3	3
3	3	2	3	3	3	2	3	3	3	3	2	3	3	3	2
4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE23716 SOFTWARE PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the principles, scope, and importance of software project management.
- To evaluate software process models and estimation techniques for effective project planning.
- To apply activity planning, scheduling, and risk management strategies in software projects.
- To utilize project monitoring, control, and change management tools for decision-making.
- To develop leadership, communication, and team management skills for successful project execution and closure

UNIT I FOUNDATIONS OF SOFTWARE PROJECT MANAGEMENT **9**

Introduction to Software Project Management - Importance and Need for Software Project Management - Categories of Software Projects - Project Portfolio Management - Objectives and Scope of Software Projects - Management Principles and Control Mechanisms - Cost-Benefit Evaluation Techniques - Stepwise Project Planning.

UNIT II SOFTWARE PROCESS MODELS AND ESTIMATION TECHNIQUES **9**

Software Process Models: Waterfall, Incremental, Spiral, Agile, and Extreme Programming - Rapid Application Development (RAD) - Dynamic System Development Method (DSDM) - Software Estimation: Basics, Techniques, and Tools - Function Points - COSMIC Full Function Points - COCOMO II Model - Effort Estimation Techniques - Cost Estimation Techniques.

UNIT III ACTIVITY PLANNING, SCHEDULING, AND RISK MANAGEMENT **9**

Activity Planning in Software Projects - Sequencing and Scheduling Activities - Network Planning Models: CPM, PERT - Forward and Backward Pass Techniques - Critical Path Method (CPM) - Risk Management: Identification, Assessment, and Planning - Risk Mitigation Strategies - Resource Allocation and Cost Scheduling - Project Monitoring and Tracking - Earned Value Management (EVM).

UNIT IV PROJECT MANAGEMENT, CONTROL, AND CHANGE MANAGEMENT **9**

Project Monitoring and Control Frameworks - Visualizing Project Progress - Cost and Resource Monitoring - Prioritizing and Tracking Project Tasks - Change Control in Software Projects - Software Configuration Management (SCM) - Contract Management - Use of Project Management Tools (e.g., MS Project, JIRA, Trello) - Change Management Strategies - Tools for Impact Analysis and Change Control.

UNIT V PEOPLE MANAGEMENT, COMMUNICATION, AND PROJECT CLOSURE **9**

Organizational Behavior and Staff Management - Methods for Team Selection and Motivation - Stress Management, Health, and Safety Concerns - Ethical and Professional Responsibilities - Decision Making in Teams - Communication Plans and Strategies - Managing Dispersed and Virtual Teams - Leadership in Project Management - Project Closure: Documentation, Lessons Learned, and Client Acceptance - Post-Project Evaluation and Benefits Realization.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Demonstrate an understanding of fundamental management principles, functions, and theories to analyze business environments.

CO2: Apply planning and decision-making techniques to enhance organizational effectiveness in dynamic situations.

CO3: Evaluate organizational structures, staffing processes, and team management strategies for efficient workforce management.

CO4: Analyze leadership and motivation theories to improve team performance, communication, and conflict resolution.

CO5: Assess controlling mechanisms, ethical considerations, and emerging management trends to drive innovation and sustainability.

TEXTBOOKS:

1. Bob Hughes, Mike Cotterell, and Rajib Mall, "Software Project Management", McGraw Hill, 2009 (Unit I & II)
2. Ian Sommerville," Software Engineering",10th Edition Pearson Education. 2017 (Unit II, III, IV,V)

REFERENCES:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", 9th edition, McGraw Hill. 2023
2. Royce, "Software Project Management: A Unified Framework", Addison-Wesley, 1998

3. Watts S. Humphrey, "Managing the Software Process", Addison-Wesley, 1989
4. Harold Kerzner, "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", 12th edition, Wiley. 2017

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	2	-	-	-	-	-	-	3	2	2
2	3	3	3	2	2	1	-	-	-	-	-	-	3	3	3
3	3	3	3	3	3	2	-	2	2	-	-	-	3	3	3
4	3	3	3	3	2	2	2	2	-	-	-	-	3	3	3
5	3	3	2	3	3	1	2	2	2	3	3	2	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE23717 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the principles, concepts, and philosophies of Total Quality Management.
- To explore various quality control tools and techniques in real-world scenarios.
- To learn about quality standards, certifications, and their significance.
- To appreciate the role of quality in improving business performance and customer satisfaction.
- To gain knowledge about the implementation of TQM in industries and service sectors

UNIT I INTRODUCTION TO TQM **9**

TQM Evolution: Historical background, contributions of quality gurus (Deming, Juran, Crosby, Feigenbaum, Ishikawa). - Principles of TQM: Customer focus, continuous improvement, employee involvement, leadership, process approach, fact-based decision making. - Key Concepts: Quality, cost of quality, quality improvement, quality control, quality assurance

UNIT II TQM TOOLS AND TECHNIQUES **9**

Quality Control Tools: Pareto chart, fishbone diagram, control charts, histogram, scatter diagram, flowchart. - Problem Solving Tools: 7 QC tools, Brainstorming, Affinity diagrams, Root cause analysis. - Statistical Process Control (SPC): Process capability, control charts, process performance, and quality improvement.

UNIT III QUALITY MANAGEMENT SYSTEMS **9**

ISO 9000 Standards: Evolution of ISO, structure, and requirements of ISO 9001:2015, certification process. - Six Sigma: DMAIC methodology (Define, Measure, Analyse, Improve, Control), tools used in Six Sigma. - Total Productive Maintenance (TPM): Objectives, principles, and techniques of TPM.

UNIT IV IMPLEMENTATION OF TQM **9**

TQM Implementation Process: Phases of TQM implementation, role of management, creating quality culture, overcoming resistance to change. - Quality Circles: Concept, benefits, and challenges, formation, and working of quality circles. - Benchmarking: Definition, types of benchmarking, process of benchmarking, case studies.

UNIT V QUALITY IN SERVICE AND PRODUCT DESIGN 9

Quality in Service Sector: Service quality, SERVQUAL model, strategies for service improvement. - Design for Quality: Design thinking, Quality Function Deployment (QFD), Failure Mode and Effect Analysis (FMEA), Reliability engineering. - Case Studies and Applications: Case studies of TQM implementation in manufacturing and service sectors.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Understand the concepts and principles of Total Quality Management.

CO2: Apply TQM tools and techniques for quality improvement.

CO3: Understand and implement quality management systems and standards.

CO4: Apply TQM principles in organizational settings for continuous improvement.

CO5: Understand the impact of quality on service and product design.

TEXTBOOKS:

1. Besterfield, D.H., et al., "Total Quality Management",Pearson Education. (Unit I, II & III)
2. P. Besterfield,"Quality Management for Organizational Excellence",Pearson Education (Unit IV & V)

REFERENCES:

1. Dale H. Besterfield ,"Total Quality Management", Pearson Education.
2. Joseph M. Juran ,"Juran's Quality Handbook", McGraw-Hill.
3. John S. Oakland,"Principles of Total Quality", Butterworth-Heinemann.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	2	3	-	2	3	3	3
2	3	3	3	2	3	2	-	3	3	-	-	3	3	3	2
3	3	3	2	3	2	3	2	-	3	3	2	-	3	2	3
4	3	3	3	3	2	2	2	3	-	2	2	3	3	3	3
5	2	3	3	3	3	-	2	2	3	3	3	2	2	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE23718 MANAGEMENT INFORMATION SYSTEMS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts, role, and significance of information systems in organizations.
- To explore different types of information systems, including Transaction Processing Systems, Decision Support Systems, and Enterprise Systems.
- To analyze the architecture, design, and maintenance of information systems, focusing on their impact on business efficiency.
- To understand the role of information systems in decision-making processes, including programmed and non-programmed decisions.

- To examine enterprise management technologies such as ERP, SCM, CRM, and e-commerce, and their role in business process optimization.

UNIT I BASIC CONCEPTS OF INFORMATION SYSTEM **9**

Role of data and information, Organization structures, Business Process, Systems Approach and introduction to Information Systems.

UNIT II TYPES OF IS **9**

Resources and components of Information System, integration and automation of business functions and developing business models. Role and advantages of Transaction Processing System, Management Information System, Expert Systems and Artificial Intelligence, Executive Support Systems and Strategic Information Systems.

UNIT III ARCHITECTURE & DESIGN OF IS **9**

Architecture, development and maintenance of Information Systems, Centralized and Decentralized Information Systems, Factors of success and failure, value and risk of IS.

UNIT IV DECISION MAKING PROCESS **9**

Programmed and Non-Programmed decisions, Decision Support Systems, Models and approaches to DSS

UNIT V INTRODUCTION TO ENTERPRISE MANAGEMENT TECHNOLOGIES **9**

Business Process Reengineering, Total Quality Management and Enterprise Management System viz. ERP, SCM, CRM and Ecommerce.

TOTAL:45 PERIODS

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Assess the basic concepts and technologies used in the field of management information system.

CO2: Understand various types of Information Systems and technologies used in real time applications.

CO3: Assess the role of information system in organizations, the strategic management processes and the implications for the management.

CO4: Learn different types of decision-making process.

CO5: Assess the knowledge of contemporary issues related to the field of managing information systems to enterprise management technologies.

TEXTBOOKS:

1. Effy OZ, Thomson Leaning , "Management Information Systems", Vikas Publications (Unit I,II,III & V)
2. James A. O'Brein, "Management Information Systems", Tata McGraw-Hill (Unit IV & V)

REFERENCES:

1. W.S Jawadekar, "Management Information System", Tata Mc Graw Hill Publication.
2. David Kroenke, "Management Information System", Tata Mc Graw Hill Publication.
3. D.P. Goyal, "MIS: Management Perspective", Macmillan Business Books.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	1	2	-	-	-	2	1	2	-	3	2	3
2	3	2	2	2	1	-	-	-	2	2	2	-	3	1	3
3	3	2	2	2	2	-	-	-	2	2	1	-	3	2	2
4	3	2	2	2	1	-	-	-	2	2	2	-	2	2	2
5	2	1	1	1	2	-	-	-	2	1	2	-	2	1	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

MANDATORY COURSES I

MX23511	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To impart knowledge on various types of disasters and their characteristics.
- To understand strategies and measures for disaster risk reduction.
- To learn the principles and practices of effective disaster management.
- To acquire skills for planning and organizing disaster response efforts.
- To develop the ability to coordinate and execute disaster response activities efficiently.

UNIT I HAZRADS, VULNERABILITY AND DISASTER RISKS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: 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.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - Inter relations between Disasters and Sustainable development Goals

UNIT II DISASTER RISK REDUCTION (DRR) 9

Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III DISASTER MANAGEMENT 9

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 - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT 9

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, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment. - Elements of Climate Resilient Development –Standard operation Procedure for disaster response – Financial planning for disaster Management

UNIT V DISASTER MANAGEMENT: CASE STUDIES 9

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, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

CO1 : Impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)

CO2 : Enhance the understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction

CO3 : Develop disaster response skills by adopting relevant tools and technology

CO4 : Enhance awareness of institutional processes for Disaster response in the country and

CO5 : Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity

TEXTBOOKS :

1 Taimpo (2016), Disaster Management and Preparedness, CRC Publications

2 Singh R (2017), Disaster Management Guidelines for earthquakes, Landslides, Avalanches and tsunami, Horizon Press Publications

REFERENCES:

1 Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.

2 Government of India, National Disaster Management Policy, 2009.

3 Shaw R (2016), Community based Disaster risk reduction, Oxford University Press

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	-	-	-	2	2	-	-	2	1	1	-	-
2	1	1	1	-	-	-	2	1	-	-	2	1	1	-	-
3	1	1	1	-	-	-	2	2	-	-	-	1	1	-	-
4	1	1	1	-	-	-	2	1	-	-	2	1	1	-	-
5	1	1	1	-	-	-	2	2	-	-	2	1	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

MX23512 ELEMENTS OF LITERATURE L T P C

3 0 0 0

COURSE OBJECTIVES:

- To identify and analyze thematic and stylistic elements of diverse literary texts.
- To understand literature's role in reflecting and shaping cultural and social values.
- To develop a deeper appreciation for the aesthetic and emotional power of language and literary expression.
- To articulate interpretations and responses to literary texts both orally and in writing.
- To recognize the interconnectedness of literature with other art forms, such as visual arts, music, and performance.

UNIT I INTRODUCTION TO ELEMENTS OF LITERATURE 9

Relevance of literature- Enhances Reading, thinking, discussing and writing skills- Develops finer

sensibility for better human relationship- Increases understanding of the problem of humanity without bias- Providing space to reconcile and get a cathartic effect.

UNIT II ELEMENTS OF FICTION **9**

Fiction, fact and literary truth- Fictional modes and patterns - Plot character and perspective.

UNIT III ELEMENTS OF POETRY **9**

Emotions and imaginations - Figurative language - Simile, metaphor, conceit, symbol, pun and irony - Personification and animation - Rhetoric and trend.

UNIT IV ELEMENTS OF DRAMA **9**

Drama as representational art - Content mode and elements - Theatrical performance - Drama as narration, mediation and persuasion - Features of tragedy, comedy and satire.

UNIT V ELEMENTS OF SHORT STORIES **9**

Plot, setting and theme – core elements – Narrative structure in short stories – Characterization techniques – Genre and subgenres in short stories.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

The students will able to

CO1 : Cultivate empathy by exploring diverse perspectives and experiences.

CO2 : Showcase the critical thinking and analytical skills by engaging deeply with literary texts.

CO3 : Fosters emotional intelligence and sensitivity through connection with characters and narratives.

CO4 : Exposure various cultural heritages in literature promotes appreciation and respect for diversity.

CO5 : Express themselves creatively through writing, art, and other forms of personal expression.

TEXTBOOKS :

1 An Introduction to Literary Studies, Mario Klarer, Routledge, 2013.

2 The Elements of Fiction: A Survey, Ulf Wolf (ed), Wolfstuff, 2114.

REFERENCES:

1 Literary Theory: An Introduction by Terry Eagleton

2 The Cambridge Introduction to Literature and the Environment by Timothy Clark

3 How to Read Literature by Terry Eagleton

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	-	-	1	-	-	2	-	3	3	2	2	2	-	-	1
2	-	3	3	2	-	-	-	-	-	3	1	2	-	-	1
3	-	-	-	-	-	2	-	3	3	2	1	2	-	-	1
4	-	-	-	-	-	3	3	3	-	1	-	2	-	-	1
5	-	-	-	-	2	-	-	-	2	3	2	2	-	-	1

1 - low, 2 - medium, 3 -high, '-' - no correlation

MX23513	FILM APPRECIATION	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To introduce the evolution of film as both an art form and entertainment medium.
- To explore cinematic language and its evolution over the past century.
- To offer guidance on reading and interpreting a film, understanding its nuances as a text.
- To teach students to appreciate the intricate and subtle aspects of film-making.
- To foster a joyful and enthusiastic approach to the study of films.

Theme - A: The Component of Films

A-1: The material and equipment

A-2: The story, screenplay and script

A-3: The actors, crew members, and the director

A-4: The process of film making… structure of a film

Theme - B: Evolution of Film Language

B-1: Film language, form, movement etc.

B-2: Early cinema… silent film (Particularly French)

B-3: The emergence of feature films: Birth of a Nation

B-4: Talkies

Theme - C: Film Theories and Criticism/Appreciation

C-1: Realist theory; Auteurists

C-2: Psychoanalytic, Ideological, Feminists C-3: How to read films?

C-4: Film Criticism / Appreciation

Theme – D: Development of Films

D-1: Representative Soviet films

D-2: Representative Japanese films D-3: Representative Italian films

D-4: Representative Hollywood film and the studio system

Theme - E: Indian Films

E-1: The early era

E-2: The important films made by the directors E-3: The regional films

E-4: The documentaries in India

READING:

A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Demonstrate an understanding of the evolution of film as both an art form and an entertainment medium.

CO2 : Analyze and appreciate the development of cinematic language over the past century.

CO3 : Read and interpret films, recognizing and understanding their nuanced elements as texts.

CO4 : Cultivate an appreciation for the various subtle aspects of film-making, including direction, cinematography, editing, and sound.

CO5 : Approach the study of films with enthusiasm and joy, fostering a deeper interest and engagement with the medium.

TEXT BOOKS :

1 Film Art: An Introduction by David Bordwell and Kristin Thompson

2 An Introduction to Film Studies by Jill Nelmes

REFERENCES:

1 Understanding Movies by Louis Giannetti

2 Film Theory and Criticism: Introductory Readings by Leo Braudy and Marshall Cohen

3 The Technique of Film and Video Editing: History, Theory, and Practice by Ken Dancyger

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	2	-	-	3	2	1	2	2	1	2	-	-	-
2	1	3	2	2	-	2	1	2	2	3	-	3	-	-	-
3	1	2	2	3	-	2	-	3	-	2	-	3	-	-	-
4	1	2	3	2	-	2	-	3	2	2	1	2	-	-	-
5	-	1	-	1	-	2	1	2	3	3	-	3	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

MX23514 INTRODUCTION TO WOMEN AND GENDER STUDIES

L	T	P	C
3	0	0	0

COURSE OBJECTIVES:

- To understand key gender concepts and their impact on society.
- To connect the exploitation of women with exploitation of Nature
- To examine the origins, progress, and impact of women's movements in India.
- To understand how gender influences linguistic forms and communication styles.
- To explore the role of gender in shaping social media interactions and representations.

UNIT I CONCEPTS **9**

Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY **9**

Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL **9**

Rise of Feminism in Europe and America- Women's Movement in India.

UNIT IV GENDER AND LANGUAGE **9**

Linguistic Forms and Gender - Gender and narratives.

UNIT V GENDER AND REPRESENTATION **9**

Advertising and popular visual media- Gender and Representation in Alternative Media. Gender and social media.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understanding the influence of patriarchy, power, and hierarchy on gender relations.

CO2 : Provide liberation of women through socialist restructuring of society.

CO3 : Gain thorough understanding of the rise and evolution of feminist movements globally.

CO4 : Gain insights into the relationship between linguistic forms and gender.

CO5 : Develop a critical understanding of gender representation in various media forms.

TEXT BOOKS :

1 Introduction to Women's & Gender Studies by Colleen Lutz Clemens, First Edition,her: The Pennsylvania Alliance for Design of Open Textbooks (PA-ADOPT),2023

2 The History of Doing: The Women's Movement in India by Radha Kumar

REFERENCES:

1 "An Introduction to Feminist Philosophy" by Alison Stone

2 Narrative and Gender as Mutually Constituted Meaning-Making Systems" by Robyn Fivush and Azriel Grysman, Cambridge University Press,2021.

3 Gender and Media Representations: A Review of the Literature on Gender Stereotypes, Objectification and Sexualization" by Fabrizio Santoniccolo et al. MDPI publisher, 2023

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	3	-	-	2	3	2	2	-	1	-	1	-	-	-
2	1	2	2	2	-	3	3	1	-	-	2	2	-	-	-
3	1	2	3	2	-	3	2	1	-	-	2	3	-	-	-
4	2	-	-	-	3	-	1	2	1	1	-	2	-	-	-
5	2	-	1	-	2	-	1	1	2	3	2	2	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

MANDATORY COURSES II

MX23611	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES:

- To understand key concepts in the philosophy of history and the role of science and technology in shaping societies.
- To explore the contributions of prominent scholars in the field of history, science, and technology, particularly in the Indian context.
- To explore the evolution of technology and its impact on society from pre-historic times to the early medieval period in India.
- To examine the technological advancements and scientific knowledge in medieval India, including interactions with Arab cultures and the development of various fields.
- To analyze the role of science and technology in India's development, policy formation, and global integration, alongside the social impacts of emerging technologies.

UNIT I CONCEPTS AND PERSPECTIVES 9

Meaning of History Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.

Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

UNIT II HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA 9

Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT III SCIENCE AND TECHNOLOGY IN ANCIENT INDIA 9

Technology in pre-historic period- Beginning of agriculture and its impact on technology

Science and Technology during Vedic and Later Vedic times - Science and technology from 1st century AD to C-1200.

UNIT IV SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Legacy of technology in Medieval India, Interactions with Arabs Development in medical knowledge, interaction between Unani and Ayurveda and alchemy Astronomy and Mathematics: interaction with Arabic Sciences Science and Technology on the eve of British conquest

UNIT V SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 9

Science and the Empire -Indian response to Western Science Growth of techno-scientific institutions

UNIT VI SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA 9

Science, Technology and Development discourse Shaping of the Science and Technology Policy Developments in the field of Science and Technology Science and technology in globalizing India

Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Gain a comprehensive understanding of historical interpretation, the relationship between science, technology, and society.

CO2 : Get insight into the diverse perspectives and methodologies used by these scholars to study

history, science, and society in India.

CO3 : Understand the development of agriculture, scientific, and technological advancements from the pre-historic period.

CO4 : Get acumen into the legacy of technological innovations, the fusion of medical traditions, and advancements in astronomy and mathematics.

CO5 : Understand science and technology policies have shaped India's growth, its global standing, and the social implications of innovations like IT and biotechnology.

TEXT BOOKS :

1 History of Science and Technology in India" by G. Kuppuram

2 The Philosophy of History" (Oxford Readings in Philosophy) by Patrick Gardiner

REFERENCES:

1 History of Science and Technology in Ancient India" by Debiprasad Chattopadhyaya

2 History of Technology in India" by A.K. Bag

3 Science and Technology Policy in India" by R. Govindarajan

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	1	-	-	-	2	2	-	-	2	1	1	-	-
2	1	1	1	-	-	-	2	1	-	-	2	1	1	-	-
3	1	1	1	-	-	-	2	2	-	-	-	1	1	-	-
4	1	1	1	-	-	-	2	1	-	-	2	1	1	-	-
5	1	1	1	-	-	-	2	2	-	-	2	1	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

MX23612 INDUSTRIAL SAFETY L T P C

3 0 0 3

COURSE OBJECTIVES:

- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES 9

Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS 9

Indian Factories Act-1948- Health- Safety- Hazardous materials and Welfare- ISO 45001:2018

occupational health and safety (OH&S) - Occupational Safety and Health Audit IS14489:1998- Hazard Identification and Risk Analysis- code of practice IS 15656:2006

UNIT III SAFETY ACTIVITIES **9**

Toolbox Talk- Role of safety Committee- Responsibilities of Safety Officers and Safety Representatives- Safety Training and Safety Incentives- Mock Drills- On-site Emergency Action Plan- Off-site Emergency Action Plan- Safety poster and Display- Human Error Assessment

UNIT IV WORKPLACE HEALTH AND SAFETY **9**

Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES **9**

Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Understand the basic concept of safety.

CO2 : Obtain knowledge of Statutory Regulations and standards.

CO3 : Know about the safety Activities of the Working Place.

CO4 : Analyze on the impact of Occupational Exposures and their Remedies

CO5 : Obtain knowledge of Risk Assessment Techniques.

TEXT BOOKS :

1 R.K. Jain and Prof. Sunil S. Rao Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER

2 L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES:

1 Frank Lees (2012) 'Lees' Loss Prevention in Process Industries.Butterworth-Heinemann publications, UK, 4th Edition.

2 John Ridley & John Channing (2008)Safety at Work: Routledge, 7th Edition.

3 Dan Petersen (2003) Techniques of Safety Management: A System Approach.

4 Alan Waring.(1996).Safety management system: Chapman &Hall,England

5 Society of Safety Engineers, USA

ONLINE RESOURCES

1. ISO 45001:2018 occupational health and safety (OH&S) International Organization for Standardization https://www.iso.org/standard/63787.html
2. Indian Standard code of practice on occupational safety and health audit https://law.resource.org/pub/in/bis/S02/is.14489.1998.pdf
3. Indian Standard code of practice on Hazard Identification and Risk Analysis IS 15656:2006 https://law.resource.org/pub/in/bis/S02/is.15656.2006.pdf

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	1	1	3	2	2	3	3	1	3	1	-	-
2	2	3	2	2	1	3	2	3	3	2	1	3	1	-	-
3	2	2	2	2	1	2	2	2	3	2	1	2	1	-	-
4	3	3	3	2	2	3	2	3	3	2	1	3	1	-	-
5	3	2	3	2	2	3	2	2	3	2	2	3	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

MX23613 STATE, NATION BUILDING AND POLITICS IN INDIA

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To comprehend the state functioning through its primary organs and the importance of politics and political processes.
- To gain the concept of sovereignty and its evolving contours in a globalized context.
- To familiarize students with the main developments and legacies of the national movement and constitutional development in India.
- To comprehend the rationale behind the adoption of a parliamentary-federal system and appreciate the core philosophy of the Indian Constitution.
- To examine contemporary challenges and issues related to national integration and nation-building, fostering a vision for a better India.

TOPICS:

Understanding the need and role of State and politics.

Development of Nation-State, sovereignty, sovereignty in a globalized world.

Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary, The idea of India.

1857 and the national awakening. 1885 Indian National Congress and development of national movement – itslegacies. Constitution making and the Constitution of India.

Goals, objective a nd philosophy.Why a federal system? National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari)New social movements.

The changing nature of Indian Political System, the future scenario.What can we do?

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Gain awareness of the theoretical aspects of the state and its organs.

CO2 : Understand the background and philosophy behind India's political system.

CO3 : Examine broad streams and challenges of national integration and nation-building in India.

CO4 : Develop a real understanding of the political system/process from a correct perspective.
CO5 : Improve better participation in the system governance and delivery for the common man.

TEXT BOOKS:

1 Sunil Khilnani, The Idea of India. Penguin India Ltd., New Delhi.

2 Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.

REFERENCES:

1. Brij Kishore Sharma, Introduction to the Indian Constitution, PHI, New Delhi, latest edition.
2. Sumantra Bose, Transforming India: Challenges to the World's Largest Democracy, Picador India, 2013.
3. Atul Kohli, Democracy and Discontent: India's Growing Crisis of Governability, Cambridge University Press, Cambridge, U. K., 1991.
4. M. P. Singh and Rekha Saxena, Indian Politics: Contemporary Issues and Concerns, PHI, New Delhi, 2008, latest edition.
5. Rajni Kothari, Rethinking Democracy, Orient Longman, New Delhi, 2005.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	3	2	2	2	2	-	2	1	-	-
2	2	3	2	2	1	3	2	2	2	3	1	3	1	-	-
3	2	3	3	3	1	3	3	2	2	3	2	3	1	-	-
4	2	2	2	2	-	3	2	2	2	2	-	3	1	-	-
5	2	1	2	2	-	3	3	2	3	3	2	3	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

MX23614 WELL-BEING WITH TRADITIONAL PRACTICES YOGA, AYURVEDA AND SIDDHA

L	**T**	**P**	**C**
3	**0**	**0**	**0**

COURSE OBJECTIVES:

- To enjoy life happily with fun filled new style activities that help to maintain health also
- 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

UNIT I HEALTH AND ITS IMPORTANCE **2+4**

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 - Occupational/Professional heath.

Present health status - The life expectancy-present status - mortality rate - dreadful diseases - Non-communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities.

Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes - Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues.

Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI- Importance and actions to be taken

UNIT II DIET 4+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 - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.

Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

Definition of BMI and maintaining it with diet

Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

Common cooking mistakes

Different cooking methods, merits and demerits of each method

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy.

Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

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 3+4

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 - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.

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 **2+12**

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 - What yoga can bring to our life.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, students will be able to

CO1 : Learn the importance of different components of health

CO2 : Gain confidence to lead a healthy life

CO3 : Learn new techniques to prevent lifestyle health disorders

CO4 : Understand the importance of diet and workouts in maintaining health

TEXT BOOKS :

1 Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA

2 Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:

1 WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts

2 A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

3 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/

4 Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.

5 Read more: https://www.legit.ng/1163909-classes-food-examples-functions.html

6 https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926

7 Benefits of healthy eating https://www.cdc.gov/nutrition/resources-publications/benefits-of-

healthy-eating.html

8 Food additives https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/food-additives

9 BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/ https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations

10 Yoga https://www.healthifyme.com/blog/types-of-yoga/ https://yogamedicine.com/guide-types-yoga-styles/

Ayurveda : https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda

11 Siddha: http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp

12 CAM : https://www.hindawi.com/journals/ecam/2013/376327/

13 Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-
2	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-
3	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-
4	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-
5	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

OPEN ELECTIVES - I

O23AD11	PROGRAMMING FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the object-oriented programming concepts using python
- To Understand the desktop software development and deployment in windows / linux using PyQt6
- To learn the web application development using flask python
- To gain knowledge about how to deploy machine learning models
- To make and understand various data science techniques and integrate them using full stack.

UNIT I OBJECT ORIENTED PROGRAMMING IN PYTHON 9

Object Oriented Programming Introduction-Class and Objects -Variables, Methods, Types of Access modifiers, Constructors, Inheritance-Types, Polymorphism-Operator Overloading-Types, Class Polymorphism.

UNIT II FULL STACK DEVELOPMENT USING WINDOWS PYTHON 9

Introduction to PyQt6-Installation-UI Widgets-Layout Management-Dialogs-Events-Example Applications-Packaging PyQt6 Applications for Windows-Deployment of PyQt6 Software in Windows / Linux. Introduction to SQlite. Working with SQlite Database with PyQt6.

UNIT III FULL STACK DEVELOPMENT USING WEB PYTHON 9

Overview of Flask-Routes-Templates-Forms-Creating Web Applications using Flask-Examples. Introduction to MongoDB-Working with MongoDB with Flask-Simple Application Examples.

UNIT IV DEPLOYING MACHINE LEARNING (ML) MODELS 9

Introduction to ML Deployment – Model Development Lifecycle - Data Collection and Preparation, Model Training and Evaluation – Deployment of Platforms and Tools – Cloud Platforms, Containerization-Docker / Kubernetes, Frameworks and Tools – Model Serving – Rest APIs with Flask / Fast API and Microservices for Model Inference – Case Studies- Real world Examples of ML model deployment.

UNIT V DATA SCIENCE PROJECTS - DATABASE AND DATA VISUALIZATION 9

Relational SQL-MySQL setup and queries, database optimization and integration with tools and languages. Data Visualization-Importance, Types of data visualization in data science, Visualization with open-source python libraries, Power BI, Tableau with examples. Data science projects using NLP / ML / Data Visualization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand the essential oops concepts of python for data science
CO2: Develop and Package Desktop GUI applications using PyQt6 python.
CO3: Learn and Develop Web Applications with Database using Flask
CO4: Practice the data science techniques using data processing and modelling, machine learning
CO5: Practice the data science techniques using data visualization, data mining and natural language processing.

TEXTBOOKS:

1. Steven F. Lott, Dusty Phillips, Python Object-Oriented Programming - Fourth Edition, Packt Publishing, 2021. (Unit I)

2. Alan D Moore, Mastering GUI Programming with Python, Packt Publishing, 2019. (Unit II)
3. Miquel Grinberg "Flask Web Development 2e: Developing Web Applications with Python". O'Reilly, 2nd edition, 2018 (Unit III)
4. Kyran Dale, Data Visualization with Python and JavaScript, 2nd Edition, O'Reilly Media, Inc, 2022. (Unit IV - V)

REFERENCES:

1. Fabrizio Romano, Learn Python Programming, Second Edition, Packt Publishing, 2018.
2. Avishek Nag, Pragmatic Machine Learning with Python: Learn How to Deploy Machine Learning Models in Production, BPB Publications, 2020.
3. Gareth Dwyer, "Flask by Example", Packet Publishers, 2016.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	1	2	-	-	-	-	-	2	1	-	3	1	1	1
2	1	3	3	1	3	1	1	2	3	1	2	2	1	1	2
3	1	3	3	1	3	1	1	-	3	1	2	2	3	1	2
4	1	3	3	2	2	2	1	1	3	1	2	2	2	3	3
5	1	3	3	2	2	2	1	1	3	1	2	2	2	2	3

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O23AL11 FUNDAMENTALS OF AI and ML

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of artificial intelligence and machine learning.
- To learn the feature extraction and selection techniques for processing data set.
- To understand the basic algorithms used in classification and regression problems.
- To learn the steps involved in development of machine learning model.
- To familiarize with concepts of reinforced and deep learning.

UNIT I INTRODUCTION TO AI and ML **9**

History of AI, Comparison of AI with Data Science, Need of AI in Mechanical Engineering, Introduction to Machine Learning. Basics: Reasoning, problem solving, Knowledge representation, Planning, Learning, Perception, Motion and manipulation.

UNIT II FEATURE EXTRACTION AND SELECTION **9**

Feature extraction: Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree - Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward, Applications of feature extraction and selection algorithms in Mechanical Engineering.

UNIT III CLASSIFICATION & REGRESSION **9**

Decision tree, Random forest, Naive Bayes, Support vector machine. Regression: Logistic Regression, Support Vector Regression. Regression trees: Decision tree, random forest, K-Means, K-Nearest Neighbor (KNN). Applications of classification and regression algorithms in Mechanical Engineering.

UNIT IV DEVELOPMENT OF ML MODEL **9**

Problem identification: classification, clustering, regression, ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training (Training, Testing, K-fold Cross Validation), Model evaluation (understanding and interpretation of confusion matrix, Accuracy, Precision, Recall, True positive, false positive etc.), Hyper parameter Tuning, Predictions.

UNIT V REINFORCED AND DEEP LEARNING 9

Characteristics of reinforced learning; Algorithms: Value Based, Policy Based, Model Based; Positive vs Negative Reinforced Learning; Models: Markov Decision Process, Q Learning. Characteristics of Deep Learning, Artificial Neural Network, Convolution Neural Network. Application of Reinforced and Deep Learning.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Demonstrate the fundamentals of artificial intelligence and machine learning.
CO2: Apply feature extraction and selection techniques.
CO3: Apply machine learning algorithms for classification and regression problems.
CO4: Develop a machine learning model using various steps.
CO5: Explain the concepts of reinforced and deep learning.

TEXTBOOKS:

1. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020. (Unit II)
2. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020. (Unit V)
3. Parag Kulkarni and Prachi Joshi, "Artificial Intelligence – Building Intelligent Systems", PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015. (Unit III - IV)
4. Stuart Russell and Peter Norvig (1995), "Artificial Intelligence: A Modern Approach," Third edition, Pearson, 2003 (Unit I)

REFERENCES:

1. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.
2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.
3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.
4. Zsolt Nagy - Artificial Intelligence and Machine Learning Fundamentals-Apress (2018)

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	2	1	-	-	1	2	2	3	2	1	2
2	2	2	3	2	2	1	-	-	2	3	2	3	2	1	3
3	3	2	3	2	2	1	-	-	1	2	3	3	3	2	3
4	2	3	3	3	2	2	-	-	2	3	3	3	3	2	3
5	3	3	3	2	3	1	-	-	2	2	3	3	2	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23BT11 MUSHROOM CULTIVATION AND VERMICOMPOSTING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To make the students understand the basic concepts, principles, potentials and limitations of mushroom cultivation.
- To obtain knowledge in mushroom cultivation techniques.

- To make the students aware of the diseases in mushroom and processing techniques.
- To introduce the students, about the basics of vermiculture technology.
- To familiarize the students with various methods of vermicomposting.

UNIT I INTRODUCTION 9

Introduction and Importance of mushrooms; History of mushroom cultivation; Present status of mushroom industry in India; Cultivable edible mushroom; Biology of mushroom; Food value of edible mushrooms; Uses of mushrooms, Poisonous mushrooms, and Medicinal mushrooms.

UNIT II MUSHROOM CULTIVATION AND BIOLOGICAL IMPORTANCE 9

Mushrooms farm structure; design and layout; Spawn principles, techniques of spawn production; Principle and techniques of compost and compositing; Cultivation techniques of White button mushroom, oyster mushroom.

UNIT III DISEASE AND POST-HARVEST TECHNOLOGY 9

Management of fungal, bacterial and viral diseases in mushroom; Competitors, pests and nematodes in mushrooms. Post-harvest technology, Freezing, Dry freezing, Drying, Canning.

UNIT IV VERIMICULTURE TECHNOLOGY 9

Permaculture Technology; organic farming, soil fertility; Distribution and Ecology of Earthworms Earthworm taxonomy -Morphological and Anatomical characteristics of Earthworm -Food habits, excretion and life cycle. Types of Earthworms -Exotic and native species.

UNIT V METHODS OF VERMICOMPOSTING 9

Collection and preservation of earthworms for vermicomposting and culturing techniques of earthworms. Preparation of vermicomposting requirement, different methods of Vermicomposting (Heap method, Pot method, and Tray method). Changes during vermin compositing, Nutrient value of Vermicomposting; Problems in vermicomposting preparation; Earthworm as bioreactors. Influence of chemical inputs on earthworms activities. Large scale manufacture of Vermicomposting, packaging; financial supporting (Government and NGOs for vermi culture work).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1**:** Apply the active compounds of mushroom in food and pharmaceutical industry

CO2: Implement the cultivation techniques for mushroom production

CO3: Apply post-harvest technology to preserve the quality of the product

CO4: Evaluate the significance of earthworms in increasing the soil fertility

CO5: Execute the techniques of vermicomposting for large scale production and marketing

TEXTBOOKS:

1. S.C. Tiwari & Pankaj Kapoor, Mushroom Cultivation, 2018
A.” Organic Chemistry”. VIIth Edition, Tata McGraw Hill, 2009.

REFERENCES:

1. Robin Gogoi Yella Rathaiah T R Borah, Mushroom Cultivation Technology, Scientific Publishers, 2006
2. Keshav Singh, Textbook of Vermicompost: Vermiwash and Biopesticides, 2014
3. NPCS Board of Consultants & Engineers, The Complete Technology Book on Vermiculture and Vermicomposting, 2004

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-
2	-	-	3	-	2	-	3	-	-	-	-	-	-	-	1
3	-	-	2	-	3	-	3	-	-	-	-	-	-	-	1
4	-	3	2	-	-	-	2	-	-	-	-	-	-	1	1
5	-	-	2	-	2	-	3	-	-	-	-	-	-	2	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23CB11 **SOFTWARE TESTING**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To understand the fundamental concepts of software testing and its importance in the software development lifecycle.
- To explore different testing techniques, strategies, and methodologies used in modern software projects.
- To apply automation tools for functional and non-functional testing.
- To understand the role of software testing in agile and DevOps environments.
- To analyze recent trends in software testing, including AI-driven testing, cloud-based testing, and security testing.

UNIT I FUNDAMENTALS OF SOFTWARE TESTING **9**

Introduction to Software Testing – Importance of Software Testing in Business Systems - Software Development Life Cycle (SDLC) and Testing Life Cycle - Verification and Validation – Difference between QA and Testing - Types of Testing: Functional vs Non-functional Testing - Black-Box Testing: Equivalence Partitioning, Boundary Value Analysis - White-Box Testing: Control Flow, Data Flow, Decision Table Testing - Regression Testing, Smoke Testing, Sanity Testing

UNIT II LEVELS OF TESTING AND TESTING TECHNIQUES **9**

Unit Testing, Integration Testing, System Testing, and Acceptance Testing - Static Testing: Reviews, Walkthroughs, and Inspections - Dynamic Testing: Exploratory Testing, Ad-hoc Testing - Test-Driven Development (TDD) and Behavior-Driven Development (BDD) - Model-Based Testing (MBT) - Mutation Testing, Fuzz Testing

UNIT III TEST AUTOMATION AND TOOL **9**

Introduction to Test Automation – Benefits and Challenges - Automation Testing Frameworks and Design - Selenium for Web Testing – Basics and Scripting - JUnit, TestNG for Unit Testing - Performance Testing: JMeter, LoadRunner - Security Testing: OWASP ZAP, Burp Suite - Mobile App Testing: Appium

UNIT IV AGILE TESTING, DEVOPS, AND CLOUD-BASED TESTING **9**

Agile Methodology and Agile Testing Strategies - Continuous Integration and Continuous Testing in DevOps - Test Automation in DevOps: Jenkins, Docker for Testing - Cloud-Based Testing: Introduction to AWS Device Farm, Sauce Labs - AI and Machine Learning in Software Testing - Challenges in Agile and DevOps Testing

UNIT V SPECIALIZED TESTING AND INDUSTRY TRENDS **9**

Software Testing for IoT, Blockchain, and Cybersecurity Applications - API Testing using Postman - Big Data Testing – Tools and Challenges - Security Testing and Penetration Testing - Case Study: Software Testing in Business Applications (ERP, CRM, E-Commerce) - Emerging Trends: AI-Based Testing, Robotic Process Automation (RPA) Testing - Career Opportunities in Software Testing

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1**:** Understand the fundamental principles of software testing and its application in business systems

CO2: Apply appropriate testing techniques for functional and non-functional testing

CO3: Utilize automation testing tools to improve testing efficiency

CO4: Integrate software testing principles in Agile and DevOps environments

CO5: Analyze and implement advanced testing methodologies for specialized applications

TEXT BOOKS:

1. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, CRC Press, 4th Edition, 2018.

REFERENCES:

1. Aditya P. Mathur, Foundations of Software Testing, Pearson, 2nd Edition, 2013.
2. Ron Patton, Software Testing, Sams Publishing, 2nd Edition, 2005.
3. Rex Black, Advanced Software Testing – Vol. 1, 2, and 3, Rocky Nook, 4th Edition, 2021.
4. Glenford J. Myers, The Art of Software Testing, John Wiley & Sons, 3rd Edition, 2011.
5. Srinivasan Desikan, Gopalaswamy Ramesh, Software Testing: Principles and Practices, Pearson Education, 2nd Edition, 2017.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2	-	-	-	1	1	-	2	2	2	2
2	3	3	3	2	2	-	-	-	1	2	-	2	2	2	2
3	2	3	2	2	2	-	-	-	1	2	-	2	2	2	2
4	2	2	2	2	2	-	-	-	1	2	-	2	2	2	2
5	2	2	2	2	2	-	-	-	1	2	-	2	2	2	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23CC11 AI FOR ROBOTICS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the foundational concepts of artificial intelligence and their applications in robotics.
- To explore various machine learning techniques pertinent to robotic systems.
- To examine the integration of perception and sensor fusion in enhancing robotic functionalities.
- To analyze planning and navigation strategies employed in autonomous robots.
- To Investigate advanced topics such as human-robot interaction and ethical considerations in robotics.

UNIT – I INTRODUCTION 9

Over view of Ai in robotics, Historical development, Components of Intelligent robots, Current trends in AI for Robotics, Ethical Considerations, Challenges in Implementing AI in Robotics

UNIT – II MACHINE LEARNING TECHNIQUES FOR ROBOTICS 9

Introduction to Machine Learning Concepts, Supervised Learning Methods, Unsupervised Learning Approaches, Reinforcement Learning, Deep Learning Applications, Training and Validation of Machine Learning Models, Over fitting and Under fitting in Robotic Learning, Hyper parameter Tuning for Robotic Algorithms, Implementing Machine Learning in Robotic Systems

UNIT III ROBOTIC PERCEPTION AND SENSOR INTEGRATION 9

Overview of Robotic Perception Systems, Types of Sensors Used in Robotics Sensor Data Processing Techniques, Computer Vision in Robotics, Sensor Fusion Strategies, Probabilistic Models for Perception, Real-Time Data Processing Challenges, Implementing Perception Algorithms in Robots

UNIT IV PLANNING AND NAVIGATION IN AUTONOMOUS ROBOTS 9

Introduction to Robotic Path Planning, Graph-Based Search Algorithms, Sampling-Based Planning Methods, Motion Planning Under Uncertainty, Localization Techniques Simultaneous Localization

and Mapping (SLAM), Obstacle Avoidance Strategies, Trajectory Generation and Control, Case Studies in Autonomous Navigation

UNIT V APPLICATIONS OF AI FOR ROBOTICS 9

Human-Robot Interaction (HRI), Natural Language Processing in Robotics, Robotic Learning from Demonstration, Multi-Robot Systems and Swarm Intelligence, Robustness and Safety in AI Systems, AI in Robotics for Healthcare, Robotics in Unstructured Environments, Future Trends in AI and Robotics

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the students will be able to

CO1: Apply AI principles to develop intelligent robotic systems.

CO2: Implement machine learning algorithms to improve robot learning and adaptation.

CO3: Integrate sensor data to enhance robot perception and decision-making.

CO4: Design effective planning and navigation algorithms for autonomous robots.

CO5**:** Critically assess the ethical implications of deploying AI in robotics.

TEXTBOOKS

1. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th ed.). Pearson. (UNIT- I to IV)
2. Siciliano, B., & Khatib, O. (Eds.). (2016). Springer Handbook of Robotics (2nd ed.). Springer. (UNIT- V)

REFERENCES:

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
2. Thrun, S., Burgard, W., & Fox, D. (2005). Probabilistic Robotics. MIT Press.
3. Sutton, R. S., & Barto, A. G. (2018). Reinforcement Learning: An Introduction (2nd ed.). MIT Press.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	2	-	-	-	-	-	-	2	3	2	2
2	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
5	3	3	3	3	3	3	3	3	2	2	2	2	3	3	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23CS11	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Learn basic concepts of cloud computing and its evolution
- To Learn cloud enabling technologies and its applications
- To Understand the basic concept of cloud computing architecture
- To Analyze the cost metrics and construct different cloud delivery design models
- To Understand the security threats in cloud

UNIT I FUNDAMENTALS OF CLOUD COMUTING AND MODELS **9**

Understanding cloud computing: origin and influences, Basic Concepts and Terminology - Goals and Benefits, Risks and Challenges - Cloud service provider and consumer, Cloud Characteristics - Cloud Service Models, Cloud Deployment Models.

UNIT II CLOUD-ENABLING TECHNOLOGY AND APPLICATIONS **9**

Broadband Networks, Internet Architecture, Data Center Technology, Virtualization Technology - Web Technology, Multitenant Technology, Service Technology - Applications: Cloud computing for healthcare, energy systems, Transportation systems, Manufacturing industry, Government, Education and Mobile Communication.

UNIT III CLOUD COMPUTING ARCHITECTURE **9**

Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture - Elastic Resource Capacity Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture, Elastic Disk Provisioning Architecture - Redundant Storage Architecture.

UNIT IV COST METRICS AND SERVICE QUALITY METRICS **9**

Cost Metrics and Pricing Models: Business Cost Metrics, Cloud Usage Cost Metrics, Cost Management Considerations - Service Quality Metrics and SLAs: Service Quality Metrics, SLA Guidelines - Fundamental Cloud Architectures: Illustration with case study - Design approaches with Case Study, Design methodology for IaaS Service Model, Google API - Design methodology for PaaS Service Model, Study of SaaS Service model.

UNIT V CLOUD SECURITY **9**

Encryption, Hashing, Digital Signature, Public Key Infrastructure (PKI), Identity and Access Management (IAM) - Single Sign On (SSO) : Kerberos authentication- One-time password- Basic cloud data security mechanisms - Cloud Based Security Groups, Hardened Virtual Server Images.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Recognize and describe the basic concepts of cloud computing, including its architecture, services, and deployment models.

CO2: Assess the cloud enabling technologies and its applications

CO3: Identify the different types of cloud computing architecture

CO4: Analyze cost metrics and design various cloud delivery models to address specific organizational requirements.

CO5: Identify and explain security threats in cloud environments to develop effective mitigation strategies.

TEXTBOOKS

1. Thomas Erl, Zaigham Mahmood,Richardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Fourth Printing, Prentice Hall/PearsonPTR, 2014, ISBN: 9780133387520.

REFERENCES:

1. Thomas Erl, Robert Cope, Amin Naserpour, "Cloud Computing Design Patterns", Prentice Hall/Service Tech Press, Pearson, 2015, ISBN: 978-0133858563.
2. ArshdeepBahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN: 9780996025508.
3. K.Chandrasekaran, "Essentials of Cloud Computing", Chapman and Hall/CRC Press, 2014, ISBN 9781482205435Patterns: Elements of Reusable Object-Oriented Software," Addison-Wesley.

O's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	2	-	-	-	1	1	-	2	2	2	2
2	3	3	3	2	2	-	-	-	1	2	-	2	2	2	2
3	2	3	2	2	2	-	-	-	1	2	-	2	2	2	2
4	2	2	2	2	2	-	-	-	1	2	-	2	2	2	2
5	2	2	2	2	2	-	-	-	1	2	-	2	2	2	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23EC11 Space Engineering

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the standard atmosphere tables and equations.
- To elaborate the lift and drag coefficient data from NACA plots.
- To analyze the concept of static stability to flight vehicles.
- To describe the concepts of stress, strain, Young's modulus, Poisson's ratio, yield strength.
- To demonstrate a basic knowledge of dynamics relevant to orbital mechanics

UNIT I STANDARD ATMOSPHERE 6

History of aviation, Basics of Altitude, Hydrostatic Equation-Relation between Geopotential and Geometric altitudes– standard atmosphere - pressure, temperature and density altitude.

UNIT II AERODYNAMICS 10

Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.

UNIT III PERFORMANCE AND PROPULSION 9

Viscous and pressure drag - flow separation - aerodynamic drag - propeller -thrust calculations - thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY 10

Degrees of freedom of aircraft motions - stable, unstable and neutral stability - concept of static stability - Hooke's Law- brittle and ductile materials - moment of inertia – section modulus.

UNIT V SPACE APPLICATIONS 10

History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler's laws of orbits - Newtons law of gravitation- Unmanned Space Flight, Manned Space Flight.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Illustrate the history of aviation & developments over the years

CO2: Identify the types & classifications of components and control systems
CO3: Explain the basic concepts of flight & Physical properties of Atmosphere
CO4: Identify the types of fuselage and constructions.
CO5: Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

1. John D. Anderson, Introduction to Flight, 8th Ed., McGraw-Hill Education, New York,2015.

REFERENCES:

1. Kermode, A.C., "Mechanics of Flight", Himalayan Book, 1997.
2. E Rathakrishnan, "Introduction to Aerospace Engineering: Basic Principles of Flight", John Wiley, NJ, 2021.
3. Stephen. A. Brandt; Introduction to Aeronautics: A design perspective; American

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	-	2	-	-	-	-	-	-	-	3	2	-
2	3	3	2	-	2	-	-	-	-	-	-	-	2	3	-
3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	2
4	2	2	3	3	3	-	-	-	-	-	-	-	2	3	3
5	3	3	2	3	3	-	-	-	-	-	-	-	3	3	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23EC12 IT IN AGRICULTURAL SYSTEM L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the principles of precision agriculture and its impact on efficient agricultural management.
- To explore techniques for managing crop growth within greenhouse environments.
- To provide a managerial overview of agricultural systems and their components.
- To highlight the importance of climate variability and its impact on seasonal forecasting.
- To examine e-commerce and e-business systems tailored for agricultural applications.

UNIT I PRECISION FARMING 9

Precision agriculture and agricultural management – Ground based sensors, Remote sensing, GPS, GIS and mapping software, Yield mapping systems, Crop production modelling, Decision Support system.

UNIT II ENVIRONMENT CONTROL SYSTEMS 9

Artificial light systems, management of crop growth in greenhouses, simulation of CO_2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture, On-line climate control.

UNIT III AGRICULTURAL SYSTEMS MANAGEMENT 9

Agricultural systems - managerial overview, Reliability of agricultural systems, Simulation of crop growth and field operations, Optimizing the use of resources, Linear programming, Project scheduling, Artificial intelligence and decision support systems.

UNIT IV WEATHER PREDICTION MODELS 9

Importance of climate variability and seasonal forecasting, Understanding and predicting world's climate system, Global climatic models and their potential for seasonal climate forecasting, General systems approach to applying seasonal climate forecasts, Global climatic models and their potential for seasonal climatic forecasting.

UNIT V E-GOVERNANCE IN AGRICULTURAL SYSTEMS 9

Expert systems, decision support systems, Agricultural and biological databases, e-commerce, e-business systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Demonstrate a clear understanding of the principles of precision agriculture and its role in enhancing agricultural management efficiency.

CO2: Analyze the components of agricultural systems and their interconnections from a managerial perspective.

CO3: Assess the role of e-commerce and e-business systems in improving agricultural practices and systems.

CO4: Demonstrate a clear understanding of the principles of precision agriculture and its role in enhancing agricultural management efficiency.

CO5: Analyze the components of agricultural systems and their interconnections from a managerial perspective.

TEXTBOOKS:

1. National Research Council, "Precision Agriculture in the 21st Century", National Academies Press, Canada, 1997. (Unit I)
2. H. Krug, Liebig, H. "International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation", 1989. (Unit II)
3. Agricultural Systems Management Optimizing Efficiency and Performance, 1st Edition Edited By Robert M. Peart, W. David ShoupCopyright 2004 (Unit III)
4. Hammer,G.L.,Nicholls,N., and Mitchell,C., "Applications of Seasonal Climate",Springer, Germany,2000. (Unit IV)
5. ICTs for agricultural extension : global experiments, innovations and experiences R. Saravanan, 2010, Publisher: New India Pub. Agency, New Delhi, 2010 (Unit V)

REFERENCES:

Peart,R.M., and shoup,W.D., "Agricultural systems Management", Marcel Dekkar, New York, 2004.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	1	1	2	-	-	-	-	-	-	2	1	1	3
2	1	2	2	2	2	-	-	-	-	-	-	1	2	2	1
3	1	1	3	2	2	-	-	-	-	-	-	1	2	3	2
4	2	2	3	1	2	-	-	-	-	-	-	1	2	1	3
5	3	2	2	2	2	-	-	-	-	-	-	2	3	2	3

1 - low, 2 - medium, 3 -high, '-' - no correlation

023EV11	FUNDAMENTAL OF VLSI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand different CMOS logic families and their circuit layout.
- To understand the basic concept of integrated circuit layout.
- To understand the different types of latches, registers and memory control circuits and their appropriate applications in designing of digital circuits.
- To design arithmetic circuits with low speed, area etc.
- To Understand the FPGA building block architecture routing procedures for chip design.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling

UNIT II INTEGRATED CIRCUIT LAYOUT 9

Integrated Circuit Layout: Introduction to CMOS Layout, Design Rules, Parasitic component in layout, latch-up, ESD Protection.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Mono-stable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Memory/register, Structure Design; ROM Design, SRAM and DRAM Design, Building blocks: ALU's, FIFO's, counters.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Knowledge about the basics, operation, characteristics and layout design rules for CMOS fabrication.

CO2: An ability to compute delay in digital circuits and design knowledge

CO3: Knowledge about the different types of latches, registers and memory control circuits and their appropriate applications in designing of digital circuits.

CO4: An ability to design arithmetic circuits with low speed, area etc

CO5: Knowledge about the FPGA building block architecture routing procedures for chip design.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris —CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson , 2017

REFERENCES:

1. M.J. Smith, —Application Specific Integrated Circuits, Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim —CMOS Digital Integrated Circuits: Analysis &

Design,4th edition McGraw Hill Education,2013
3. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, ||Digital Integrated Circuits: A Design perspective, Second Edition , Pearson , 2016

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	3	3	2	-	2	-	-	-	-	-	-	3	2	-
2	2	3	3	2	-	2	-	-	-	-	-	-	2	3	
3	3	3	2	3	2	3	-	-	-	-	-	-	3	3	2
4	4	2	2	3	3	3	-	-	-	-	-	-	2	3	3
5	5	3	3	2	3	3	-	-	-	-	-	-	3	3	2

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23MA11 PROBABILITY AND STATISTICS FOR DATA ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To equip engineers with statistical techniques for practical applications.
- To introduce the foundational concepts of random variables.
- To build a solid understanding of probability distributions.
- To develop knowledge in correlation and regression analysis.
- To explore the characteristics and representation of time series data.

UNIT I DATA ANALYTICS USING STATISTICS 9

Collection of data – Classification and Tabulation of data –Plotting of data - Stem and Leaf Plots – Box Plots - Frequency Distributions and Histograms – Measures of Central Tendency (Mean, Median and Mode) – Measures of Dispersion (Quartile Deviation, Mean Deviation, Standard Deviation)

UNIT II RANDOM VARIABLES 9

Discrete and Continuous random variables – Moments – Mean and Variance-Moment generating functions – Joint distributions – Independence of random variables-Marginal and conditional distributions.

UNIT III STANDARD PROBABILITY DISTRIBUTIONS 9

Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable- Transformation of random variables (one dimensional) – Central limit theorem (without proof) (for independent and identically distributed random variables).

UNIT IV CORRELATION AND REGRESSION 9

Covariance and its properties - Correlation and its properties- Linear Regression and its applications- Spearman's Rank Correlation – Curve fitting - Fitting of a Straight Line -Fitting of a Second-Degree Parabola.

UNIT V TIME SERIES 9

Time Series definition – Components and Decomposition of time series- Characteristics and Representation - Mathematical Models – Freehand Curves- Method of Moving Averages - Method of Semi-averages.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Demonstrate fundamental knowledge of statistical concepts to summarize, interpret, and effectively present data.

CO2: Apply basic concepts of random variables in engineering applications.

CO3: Utilize the principles of probability distributions and understand standard distributions to model real-life phenomena

CO4: Analyse relationships between variables using correlation and regression techniques

CO5: Forecast time series data using methods such as moving averages and semi averages.

TEXT BOOKS:

1. Johnson. R.A., Miller. I.R and Freund. J.E, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.

REFERENCES:

1. Jay, L.Devore, "Probability and Statistics for Engineering and Sciences", Brooks Cole Publishing Company, Monterey, California, 1982
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2010.
3. Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2002.
3. Montgomery, D.C., Johnson, L.A. and Gardiner, J.S. "Forecasting and Time Series Analysis", McGraw-Hill, 2nd Edition, 1990
4. Sundarapandian, V., "Probability, Statistics and Queueing Theory", PHI Learning Private Ltd., New Delhi, 2009.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
2	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
3	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
4	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
5	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-

1 - low, 2 - medium, 3 -high, '-' - no correlation

O23ME11 **FOUNDATION OF ROBOTICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To teach robot anatomy, classification, coordinate systems, and applications for foundational understanding.
- To explain forward and inverse kinematics, transformations, and problem-solving for robot motion analysis.
- To introduce drive mechanisms and grippers for effective robot movement and manipulation.

- To familiarize students with sensors, machine vision, and safety mechanisms for robotic perception.
- To teach robot programming and applications in inspection, assembly, handling, and medical fields.

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

UNIT II ROBOT KINEMATICS 9

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, internal grippers and external grippers, selection and design considerations of a gripper

UNIT IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, the students will be able to

CO1: Explain robot anatomy, coordinate systems, classifications, and applications in various industries.

CO2: Apply forward and inverse kinematics to solve motion-related problems in robotic systems.

CO3: Differentiate between mechanical, electrical, pneumatic, and hydraulic drives and select

suitable grippers.

CO4: Implement various sensors and image processing techniques for robotic perception and control.

CO5: Write and execute robot programs for applications in inspection, assembly, material handling, and medical fields.

TEXT BOOKS :

1. Ganesh.S.Hedge,"A textbook of Industrial Robotics", Lakshmi Publications, 2006.

REFERENCES:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision and Intelligence", McGraw Hill book co. 2007.
2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 2010.
6. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications" McGraw Hill 2ND edition 2012.

Os-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	-	-	-	-	-	-	-	1	1	-	3
2	3	2	1	-	-	-	-	-	-	-	-	1	1	-	3
3	3	2	1	-	-	-	-	-	-	-	-	1	1	-	3
4	3	2	1	-	-	-	-	-	-	-	-	1	1	-	3
5	3	2	1	-	-	-	-	-	-	-	-	1	1	-	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

OPEN ELECTIVE – II

O23AD21	DATA SCIENCE FUNDAMENTALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To define key concepts and terminologies in data science
- To describe the methods used in descriptive data analysis
- To use machine learning techniques to build and test models for both regression and classification tasks.
- To explore data handling strategies and model evaluation techniques to ensure data quality and assess model performance.
- To assess various data analytics approaches, including feature selection, error measurement, and predictive modeling, to derive insights from data and improve model performance.

UNIT – I INTRODUCTION **9**

Introduction to Data Science - Overview of Data - Sources of Data - Types of Data - data distribution - Small Data and Big Data - Data collection methods - Surveys - Interviews - Log and Diary data - User studies in Lab and Field - Web Scraping - Public datasets - Data cleaning - Tools for Data Science

UNIT – II DESCRIPTIVE DATA ANALYSIS **9**

Dataset Construction - Sampling of data - Stem and Leaf Plots - Frequency table - Time Series data - Central Tendency Measures of the location of data - Dispersion measures - Correlation analysis - Data reduction techniques – basics of Principal Component analysis (PCA) - Independent component analysis – Hypothesis testing – Statistical Tests

UNIT – III MODEL CONSTRUCTION **9**

Overview of Machine learning concepts – Rules for data splitting - Model construction using regression and Classification models - Linear regression and multiple regression models - KNN classification models - Comparison models - Training Data construction - Regression line – least squares regression line – standard error of estimate – interpretation of r^2 – multiple regression equations – regression toward the mean

UNIT – IV DATA HANDLING AND MODEL EVALUATION **9**

Data aggregation – Data Transformation: merging datasets, reshaping data – Data enrichment: missing values - Normalization - Cross-validation techniques - Accuracy metrics for evaluation of models – Contingency table, ROC curve, Precision-recall curves - A/B testing

UNIT – V DATA ANALYTICS **9**

Introduction- Information-based learning- Handling alternative feature selection - Impurity metrics - Continuous descriptive features and targets- Similarity-based learning- Feature space- Predicting continuous targets-Error based learning- Measuring Error-Error surfaces.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Apply the skills of data inspecting and cleansing.

CO2: Determine the relationship between data dependencies using statistics

CO3: Can handle data using primary tools used for data science in Python

CO4: Represent the useful information using mathematical skills

CO5: Can apply the knowledge for data describing and visualization using tools.

TEXT BOOKS:

1. Chirag Shah, "A Hands-on Introduction to Data Science", Cambridge University Press, UK, 2020.

REFERENCES:

1. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017.
2. Grus, Joel, "Data science from scratch: first principles with python", O'Reilly Media, 2019.
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016
4. Davy Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016
5. Peter Bruce, Andrew Bruce, Peter Gedeck," Practical Statistics for Data Scientists", O'Reilly; 2nd edition, 2020.

Os-POs & PSOs MAPPING

CO	PO												P		
	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3
1	1	1	1	-	-	-	2	2	-	-	2	1	1	-	-
2	1	1	1	-	-	-	2	1	-	-	2	1	1	-	-
3	1	1	1	-	-	-	2	2	-	-	-	1	1	-	-
4	1	1	1	-	-	-	2	1	-	-	2	1	1	-	-
5	1	1	1	-	-	-	2	2	-	-	2	1	1	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23AL21 FUNDAMENTALS OF DATA ANALYTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand fundamental concepts and tools in data analytics.
- To develop skills in data collection, cleaning, preprocessing, and exploratory analysis.
- To apply statistical methods and data visualization techniques for insights.
- To introduce machine learning techniques and their applications in analytics.
- To explore Big Data Analytics, Time-Series Analysis, and NLP through case studies.

UNIT I INTRODUCTION TO DATA ANALYTICS **9**

Overview of Data Analytics: Definition, Importance, and Applications. Types of Data Analytics: Descriptive, Diagnostic, Predictive, and Prescriptive Analytics. Data Science Lifecycle: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, and Deployment. Tools and Technologies for Data Analytics: Python, R, SQL, Excel, Introduction to BI Tools like Power BI and Tableau.

UNIT II DATA COLLECTION AND PREPROCESSING **9**

Data Collection Techniques: APIs, Web Scraping, Databases, Surveys, and Sensors. Data Cleaning and Preprocessing: Handling Missing Values, Duplicates, and Outliers; Data Transformation: Normalization, Scaling, and Encoding categorical Data. Exploratory Data Analysis (EDA): Understanding and Summarizing Data. Feature Engineering: Feature Selection and Extraction, Dimensionality Reduction using PCA.

UNIT III DATA ANALYSIS AND VISUALIZATION **9**

Statistical Analysis: Measures of Central Tendency and Dispersion, Hypothesis Testing, Correlation, and Regression Analysis. Data Visualization: Principles of Data Visualization, Visualization Techniques for Univariate, Bivariate, and Multivariate Data, Visualizing Geospatial Data. Tools: Creating Visualizations

using Python (Matplotlib, Seaborn), Introduction to Power BI and Tableau for Dashboards

UNIT IV MACHINE LEARNING BASICS FOR DATA ANALYTICS **9**

Introduction to Machine Learning: Overview of Supervised and Unsupervised Learning. Common Algorithms: Linear Regression, Decision Trees, Clustering. Model Building Workflow: Train-Test Split, Cross-validation, Model Evaluation Metrics: Accuracy, Precision, Recall, F1 Score. Applications of Machine Learning in Data Analytics with Hands-on Practice using Scikit-learn.

UNIT V ADVANCED TOPICS AND CASE STUDIES **9**

Big Data Analytics: Overview of Big Data Concepts, Introduction to Hadoop, Spark, and Cloud-based Data Analytics, Introduction to Streaming Data with tools like Apache Kafka and Spark Streaming. Time-Series Analysis: Components of Time-Series Data, Forecasting Methods, Real-Time Time-Series Data Processing. Case Studies: End-to-End Analytics Projects, Real-Time Data Processing Case Studies, Presenting Actionable Insights through Visualization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Describe the role of data analytics across industries and its key components.

CO2: Collect, preprocess, and analyze data using suitable tools and techniques.

CO3: Perform statistical analysis and create visualizations for decision-making.

CO4: Build and evaluate machine learning models for various tasks.

CO5: Apply advanced analytics techniques, including Big Data and NLP, to solve real-world problems

TEXT BOOKS:

1. Joel Grus, *Data Science from Scratch: First Principles with Python*, 2nd Edition, O'Reilly Media, 2019. (Unit I & II)
2. Wes McKinney, *Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython*, 2nd Edition, O'Reilly Media, 2017 (Unit II)
3. Dean Abbott, *Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst*, Wiley, 2014. (Unit III – IV)
4. Ethan Rosenthal, *Hands-On Machine Learning with Python*, Packt Publishing, 2020. (Unit V)

REFERENCES:

1. Cathy O'Neil and Rachel Schutt, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly Media, 2013.
2. Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, Springer, 2009.
3. Jake VanderPlas, *Python Data Science Handbook: Essential Tools for Working with Data*, O'Reilly Media, 2016.
4. Daniel T. Larose and Chantal D. Larose, *Data Science Using Python and R*, Wiley, 2019.
5. Alberto Boschetti and Luca Massaron, *Python Data Science Essentials*, Packt Publishing, 2016.

COs-POs & PSOs MAPPING

CO	PO												P		
	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3
1	3	3	2	1	2	1	-	-	1	2	2	3	2	1	2
2	3	3	3	2	3	1	-	-	2	3	2	3	3	2	3
3	3	2	3	3	3	2	-	-	2	2	3	3	3	2	3
4	2	3	3	2	3	2	-	-	1	3	3	3	3	3	3
5	3	3	3	3	3	2	-	-	2	2	3	3	3	2	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23BT21	BIOFUELS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and explore the scope of biofuels, the most efficient renewable source of energy.
- To provide students with a comprehensive understanding of the process of converting vegetable oils into biodiesel, its purification strategies and properties.
- To enable the students to understand biofuel and in particular biodiesel blends
- To provide the students a substantial knowledge of bio fuel production technologies.
- To help students learn about the concept of biorefinery and economy.

UNIT I CLASSIFICATION AND RESOURCES **9**

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II BIODIESEL **9**

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Transesterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III QUALITY BIODIESEL AND ENVIRONMENT **9**

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV BIOETHANOL AND BIOGASES **9**

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, and purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of biomethane and biohydrogen.

UNIT V BIOREFINERIES **9**

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Apply the bio resources that can be used for the production of biofuels.

CO2: Evaluate the physical and chemical properties of the biodiesel.

CO3: Analyze the mechanisms of improvising the quality and performance of engines using biofuels

CO4: Develop & analyze biofuel conversion technologies and their environmental attributes

CO5: Design major unit processes/operations of an integrated bio-refinery

TEXTBOOKS:

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.

REFERENCES:

1 Mousdale, Biofuels, CRC Press, 2008

2 Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.

3 Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	-	-	-	-	-	3	-	-	-	-	-	-	-	1
2	2	-	-	-	-	-	1	-	-	-	-	-	-	-	3
3	1	-	-	-	-	-	3	-	-	-	-	-	-	-	2
4	2	-	-	-	-	-	3	-	-	-	-	-	-	-	3
5	1	-	-	-	-	-	1	-	-	-	-	-	-	-	

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23CB21 **ESSENTIALS OF DIGITAL MARKETING**

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- To understand influence of Search Engine Optimization and techniques in digital marketing.
- To elaborate the digital marketing utilization by organizations and measurement of its effectiveness.
- To comprehend market trends and its influence on business.
- To understand marketing strategies for different digital market places.

UNIT I INTRODUCTION TO ONLINE MARKET 9

Digital marketing and its origin – need for Digital marketing - Online Market space- Online marketing mix - E-product - E-price, E-Promotion - Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Online tools for Content Marketing

UNIT II SEARCH ENGINE BASICS AND OPTIMISATION 9

Search Engine optimisation - Need for SEO and success & Failure - Domain Name,-Linking - Keywords and site content - Tags – Title, Meta, Alt Tag - Optimized website - SEO Strategy - On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement

UNIT III E- MAIL MARKETING 9

E- Mail Marketing - email marketing process, design and content, delivery, discovery - Types of E-Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Commerce - Enhancing Digital Experiences with Mobile Apps. Pros and Cons; Targeted advertising

UNIT IV SOCIAL MEDIA MARKETING 9

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing. Issues: Credibility, Fake News, Paid Influencers; Social Media and Hate/ Phobic campaigns

UNIT V DIGITAL ANALYTICS AND AFFILIATE MARKETTING 9

Digital Transformation & Channel Attribution- Key features and capabilities of Google analytics - Google Analytics: Key Metrics and Reports - Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Introduction to Affiliate Marketing and Referral Programs - Affiliate Networks: Amazon Associates, CJ Affiliate, Rakuten - Recent trends in Digital marketing

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Examine and explore the role and importance of digital marketing in today's rapidly changing business environment..

CO2: Focus on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

CO3: Know the key elements of a digital marketing strategy.

CO4: Study how the effectiveness of a digital marketing campaign can be measured.

CO5: Demonstrate advanced practical skills in common digital marketing tools such as SEO.

TEXT BOOKS:

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education; First edition (July 2017)

REFERENCES:

1. Rob Stokes, (2014), eMarketing: The Essential Guide to Digital Marketing, 5thedition, Quirk Education. Dave Chaffey, Fiona Ellis-Chadwick, Richard Mayer, Kevin Johnston, (2012), Internet Marketing: Strategy, Implementation and Practice, Prentice Hall.
2. Dodson, Ian: The Art of Digital Marketing - The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns. Wiley
3. Jennifer Grappone, Search Engine Optimization (SEO): An Hour a Day, Sybex; 3rd edition, 2018.
2. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	3	-	-	-	1	2	3	3	3	3	3
2	2	2	2	1	3	-	-	-	1	2	3	3	3	3	3
3	1	1	1	2	2	-	-	-	1	2	1	1	3	2	1
4	3	2	2	3	1	-	-	-	1	3	2	3	2	3	2
5	2	3	1	3	3	-	-	-	2	3	1	2	1	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23CC21 **SPACE SCIENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVE:

- To outline the space environment and their effects.
- To extend the origin of universe and development.
- To classify the galaxies and their evolution.
- To interpret the variable stars in the galaxies.
- To explain theory of formation of our solar system.

UNIT I INTRODUCTION **9**

Introduction to space science and applications – historical development – Space Environment- Vacuum and its Effects, Plasma & Radiation Environments and their Effects, Space Weather and Its Effects on Spacecraft, Debris Environment and its Effects - Newton's Law of gravitation – Kepler's Laws of Planetary Motion- Fundamental Physical Principles.

UNIT II ORIGIN OF UNIVERSE **9**

Early history of the universe – Big-Bang and Hubble expansion model of the universe -cosmic microwave background radiation – dark matter and dark energy

UNIT III GALAXIES **9**

Galaxies, their evolution and origin – Galaxy Clusters and Superclusters-active galaxies and quasars - Galactic rotation – Stellar populations – galactic magnetic field and cosmic rays.

UNIT IV STARS **9**

Stellar spectra and structure – stellar evolution – Nucleo-synthesis and formation of elements – Classification of stars – Harvard classification system – Hertsprung-Russel diagram – Luminosity of star – variable stars – composite stars (white dwarfs, Neutron stars, black hole, star clusters, supernova and binary stars) – Chandrasekhar limit.

UNIT V SOLAR SYSTEM **9**

Nebular theory of formation of our Solar System – Solar wind and nuclear reaction as the source of energy – Sun and Planets: Brief description about shape size – period of rotation about axis and period of revolution – distance of planets from sun – Bode's law –Newton's deductions from Kepler's Laws – correction of Kepler's third law – determination of mass of earth – determination of mass of planets with respect to earth – Brief description of Asteroids – Satellites and Comets- Space Missions and Solar System Exploration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Obtain a broad, basic knowledge of the space sciences.
CO2: Explain the scientific concepts such as evolution by means of natural selection, age of the Earth and solar system and the Big-Bang.
CO3: Describe the main features and formation theories of the various types of observed galaxies, in particular the Milky Way.
CO4: Explain stellar evolution, including red giants, supernovas, neutron stars, pulsars, white dwarfs and black holes, using evidence and presently accepted theories;
CO5: Describe the presently accepted formation theories of the solar system based upon Observational and physical constraints;

TEXT BOOKS:

1. Krishnaswami K. S., "Astrophysics: A modern Perspective", New Age International, 2006.

REFERENCES:

1. Arnab Rai Choudhuri, "Astrophysics for Physicists", Cambridge University Press, New York, 2010.
2. 1. Hess W., "Introduction to Space Science", Gordon & Breach Science Pub; Revised Ed., 1968.
3. Krishnaswami K. S., "Understanding cosmic Panorama", New Age International, 2008

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	-	2	-	-	-	-	-	-	-	3	2	-
2	3	3	2	-	2	-	-	-	-	-	-	-	2	3	-
3	3	2	3	2	3	-	-	-	-	-	-	-	3	3	2
4	2	2	3	3	3	-	-	-	-	-	-	-	2	3	3
5	3	3	2	3	3	-	-	-	-	-	-	-	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23CS21 INTRODUCTION TO CYBER SECURITY

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES :

- To understand the Basics of Cybercrime
- To analyze Cyber Offenses
- To explore Tools and Techniques Used in Cybercrime
- To understand Phishing and Identity Theft
- To introduce Computer Forensics

UNIT I INTRODUCTION TO CYBERCRIME **9**

Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cybercrimes, An Indian Perspective, Hacking and Indian Laws., Global Perspectives

UNIT II CYBER OFFENSES **9**

How Criminals Plan Them: Introduction, How criminals plan the attacks,Social Engineering, Cyber Stalking, Cybercafe & cybercrimes. Botnets: The fuel for cybercrime, Attack Vector.

UNIT III TOOLS AND METHODS USED IN CYBERCRIME **9**

Introduction, Proxy Servers, Anonymizers, Phishing, Password Cracking, Key Loggers and Spyways, Virus and Worms, Trozen Horses and Backdoors, Steganography, DoS and DDOS Attackes, Attacks on Wireless networks

UNIT IV PHISHING AND IDENTITY THEFT **9**

Introduction, methods of phishing, phishing, phising techniques, spear phishing, types of phishing scams, phishing toolkits and spy phishing, counter measures, Identity Theft

UNIT V UNDERSTANDING COMPUTER FORENSICS **9**

Introdcution, Historical Background of Cyberforensics, Digital Foresics Science, Need for Computer Foresics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, network forensics.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Define and Classify Cybercrimes
CO2: Analyze Cyber Offenses and Attacks
CO3: Identify Cybercrime Tools and Methods
CO4: Understand Phishing and Identity Theft
CO5: Apply Digital Forensics Techniques

TEXT BOOKS:

1. Sunit Belapure and Nina Godbole "Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives" Wiley India Pvt Ltd First Edition (Reprinted 2018)

REFERENCES:

1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013
2. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	1	1	-	1	-	-	-	-	1	-	2	2	1
2	1	3	1	3	2	1	-	-	-	-	-	-	2	2	1
3	2	1	1	1	-	1	-	-	-	-	1	-	2	2	2
4	3	3	2	2	2	1	-	-	-	-	-	-	2	2	3
5	3	2	1	1	1	1	-	1	-	-	1	-	2	2	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

23EC21 WEARABLE DEVICES AND ITS APPLICATIONS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES

- To identify the need and influence of wearable devices across various sectors.
- To understand the applications of wearable inertial sensors in biomedical fields.
- To know the design of wearable bio-electrodes and physiological monitoring devices for healthcare.
- To understand the use of biochemical and gas sensors as wearable devices.
- To study the wearable devices for safety, navigation, assistive, and diagnostic applications.

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Impedance plethysmography, Wearable ground reaction force sensor.

UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES 9

Wearability issues -physical shape and placement of sensor, Technical challenges – sensor design,

signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS AND SMART TEXTILE 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques. Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques- Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, And Conductive Inks. Case study- smart fabric for monitoring biological parameters - ECG, respiration.

UNIT IV APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

UNIT V WEARABLE CAMERAS AND MICROPHONES FOR NAVIGATION 9

Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for Fingers and Hands, Assistive Devices for wrist, forearm and feet, vests and belts, head-mounted devices.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Describe the concepts of wearable system.

CO2: Analyze the energy harvestings in wearable device.

CO3: Use the concepts of BAN in health care.

CO4: Compare the various wearable devices in healthcare system

CO5: Identify wearable locomotive tools for safety, security, and navigation.

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011 (Unit I, II, IV)
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems,Springer, 2013 (Unit I, III, V)
3. “Wearable and Autonomous Biomedical Devices and Systems for Smart Environment”, by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012 (Unit III)

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
2	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
3	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
4	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1
5	3	2	1	1	2	-	-	1	-	-	-	-	1	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23EC22 INTRODUCTION TO IOT

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Understand the Architectural Overview of IoT.
- To explain the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To elaborate the basics of cloud architecture
- To gain experience in Raspberry PI and experiment simple IoT application on it

UNIT I INTRODUCTION TO IOT **9**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS **9**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics.

UNIT III IoT PROTOCOLS AND TECHNOLOGY **9**

SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP -Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

UNIT IV CLOUD ARCHITECTURE BASICS **9**

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google Appcloud platform in industry

UNIT V CASE STUDIES **9**

Building IOT with RASPBERRY PI/ESP32, Digitalization- Creating the sensor project, Gas Detection and alarm, Distance measurement - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand the various concept of the IoT and their technologies

CO2: Develop the IoT application using different hardware platforms

CO3: Implement the various IoT Protocols

CO4: Understand the basic principles of cloud computing

CO5: Develop and deploy the IoT application into cloud environment

TEXT BOOKS:

1. Honbo Zhou, "Internet of Things in the cloud: A middleware perspective", CRC press, 2012.

REFERENCES:

1. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
4. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd Edition Scitech Publishers, 2014
5. Reese, G.(2009).Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", VPT, 1st Edition, 2014.
3. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
4. Developing IoT Projects with ESP32: Unlock the full Potential of ESP32 in IoT development to create production-grade smart devices, Second Edition.

5. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", VPT, 1st Edition, 2014.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	1	2	1	1	3	-	-	-	-	-	-	3	-	1
2	3	2	1	2	3	2	-	-	-	-	-	-	3	3	-
3	1	1	2	1	3	3	-	-	-	-	-	-	3	3	1
4	2	3	2	1	2	2	-	-	-	-	-	-	3	2	1
5	1	2	1	2	1	1	2	-	2	-	2	-	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23EV21 ELECTRICAL, ELECTRONIC AND MAGNETIC MATERIALS

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To Understand the importance of various materials used in electrical, electronics and magnetic applications
- To acquire knowledge on the properties of electrical, electronics and magnetic materials.
- To gain knowledge on the selection of suitable materials for the given application
- To know the fundamental concepts in Semiconducting materials
- To get equipped with the materials used in optical and optoelectronic applications.

UNIT I DIELECTRIC MATERIALS 9

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II MAGNETIC MATERIALS 9

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT III SEMICONDUCTOR MATERIALS 9

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV MATERIALS FOR ELECTRICAL APPLICATIONS 9

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT V OPTICAL AND OPTOELECTRONIC MATERIALS 9

Principles of photoconductivity - effect of impurities - principles of luminescence-laser principles - He-Ne, injection lasers, LED materials - binary, ternary photoelectronic materials - LCD materials - photo detectors - applications of optoelectronic materials - optical fibres and materials - electro optic modulators - Kerr effect - Pockels effect.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand various types of dielectric materials, their properties in various conditions.
CO2: Evaluate magnetic materials and their behavior.
CO3: Evaluate semiconductor materials and technologies.
CO4: Select suitable materials for electrical engineering applications.
CO5: Identify right material for optical and optoelectronic applications

TEXT BOOKS:

1. Pradeep Fulay, “Electronic, Magnetic and Optical materials”, CRC Press, taylor and Francis, 2 nd illustrated edition, 2017.

REFERENCES:

1. T K Basak, “A course in Electrical Engineering Materials”, New Age Science Publications, 2009
2. TTTI Madras, “Electrical Engineering Materials”, McGraw Hill Education, 2004.
3. Adrianus J. Dekker, “Electrical Engineering Materials”, PHI Publication, 2006.
4. S. P. Seth, P. V. Gupta “A course in Electrical Engineering Materials”, Dhanpat Rai & Sons, 2011.
5. C. Kittel, “Introduction to Solid State Physics”, 7th Edition, John Wiley & Sons, Singapore, (2006).

6. "R K Rajput", "A course in Electrical Engineering Materials", Laxmi Publications, 2009.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	2	2	-	-	-	-	-	-	-	2	2	2	1
2	3	2	2	2	-	-	-	-	-	-	-	2	2	2	1
3	3	2	2	2	2	-	-	-	-	-	-	2	2	2	1
4	3	2	2	2	2	-	-	-	-	-	-	2	2	2	1
5	3	2	2	2	-	-	-	-	-	-	-	2	2	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23MA21 OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To formulate and solve Linear Programming Problems (LPP) using graphical methods and the Simplex Method, addressing resource allocation and optimization challenges.
- To understand the concepts of duality and solve Transportation and Assignment Problems in optimization contexts.
- To solve Integer Programming problems using methods like Branch and Bound and explore dynamic programming techniques.
- To analyse and apply classical optimization methods to solve constrained and unconstrained problems using necessary and sufficient conditions.
- To explore the principles of queuing theory, its operational characteristics, and its applications in system performance analysis.

UNIT I LINEAR PROGRAMMING MODELS 9

Introduction to Linear Programming Problems - Principal components of decision problem - LP formulation and graphical solution –Solving LPP using simplex method – Artificial Variable -Big M method.

UNIT II TRANSPORTATION AND ASSIGNMENT PROBLEMS 9

Introduction- Definitions – North West Corner Rule- Matrix Minima Method-Vogel's Approximation Method-Assignment Problems.

UNIT III INTEGER AND DYNAMIC PROGRAMMING 9

Cutting plane algorithm – Branch and bound methods -Bellman's Principle of Dynamic Programming - Multistage Dynamic programming – Simple Optimization Problems

UNIT IV CLASSICAL OPTIMIZATION THEORY 9

Unconstrained problems– Necessary and Sufficient Conditions –Newton - Raphson method.
Constrained problems with equality / inequality constraints - Kuhn-Tucker conditions.

UNIT V QUEUEING MODELS 9

Introduction to Queueing Theory – Operating characteristics and Constituents of a Queuing system - Service facility - Queue discipline -Kendall's Notation- (M/M/1):(∞/$FIF0$) Single Server with Infinite Capacity-(M/M/1):(k/$FIF0$) Single Server with finite Capacity-(M/M/c):(∞/$FIF0$) Multi Server with Infinite Capacity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Formulate and solve linear programming problems using graphical and simplex methods.

CO2: Apply duality principles and solve transportation and assignment problems.

CO3: Solve optimization problems using integer programming techniques such as Branch and

Bound and dynamic programming.

CO4: Apply classical optimization methods, including Newton-Raphson and Kuhn-Tucker conditions, to analyze and solve constrained and unconstrained problems.

CO5: Analyze and apply queuing models to evaluate system performance and optimize operational efficiency.

TEXTBOOKS:

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.

REFERENCE BOOKS:

1. Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill, 2017.
2. Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming, Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
3. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.
4. J.K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
5. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	1	-	-	-	-	2	1	-	2	-	-	-
2	3	3	2	1	-	-	-	-	2	1	-	2	-	-	-
3	3	3	2	1	-	-	-	-	2	1	-	2	-	-	-
4	3	3	2	1	-	-	-	-	2	1	-	2	-	-	-
5	3	3	2	1	-	-	-	-	2	1	-	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23ME21 **FUNDAMENTALS OF MECHATRONICS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To introduce Mechatronics concepts, system classification, and sensor applications in modern engineering.
- To teach 8085 microprocessor and 8051 microcontroller architecture, programming, and execution concepts.
- To explain 8255 PPI architecture, peripheral interfacing, and real-world control applications.
- To impart knowledge on PLC programming, I/O processing, timers, counters, and selection criteria for automation.
- To equip students gain knowledge in actuator types, selection criteria, and Mechatronic system design with case studies.

UNIT I INTRODUCTION TO MECHATRONICS **9**

Definition and Scope of Mechatronics - Overview of Mechatronics systems, need, and importance. Mechatronics Approach - Systems thinking, interdisciplinary concepts, and components. Emerging Areas - Robotics, IoT-enabled systems, automation, medical Mechatronics. Classification of Mechatronic Systems - Based on application and functionality. Sensors and Transducers - Static and dynamic characteristics. Common Sensors - Potentiometers, LVDT (Linear Variable Differential Transformer), capacitive sensors, strain gauges, eddy current sensors, and Hall effect sensors. Environmental Sensors - Temperature and light sensors and their applications.

UNIT II MICROPROCESSORS AND MICROCONTROLLERS 9

Microprocessor 8085: Architecture, pin configuration, and addressing modes. Instruction Set of 8085: Basics of assembly language programming. Timing Diagram of Instructions: How microprocessors execute instructions. Introduction to Microcontrollers: Architecture and block diagram of 8051. Differences between Microprocessors and Microcontrollers.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE (PPI) 9

Architecture of 8255 PPI: Pin diagram and modes of operation. Interfacing with Peripherals: Keyboard, LED displays, ADC, and DAC. Case Studies: Temperature control systems using microcontrollers. Stepper motor control circuits. Traffic signal control using microprocessors.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS (PLCS) 9

Introduction to PLCs - Basic structure and role in automation, I/O Processing- Input and output handling techniques, Programming of PLCs - Ladder logic programming and mnemonics, Timers, Counters, and Internal Relays - Functionality and applications in automation, Data Handling and Selection of PLCs - Criteria for choosing the right PLC based on application needs.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN 9

Stepper Motors and Servo Motors: Types, construction, and working principles. Actuator Selection: Criteria based on mechanical design needs. Mechatronic System Design: Stages of design, traditional vs. Mechatronics-based design concepts. Case Studies: Pick-and-Place Robots. Engine management systems. Automatic car park barriers.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, the students will be able to

CO1: Explain Mechatronics concepts, system classification, and the role of sensors in engineering applications.

CO2: Demonstrate 8085 and 8051 architectures, programming, and execution methods.

CO3: Apply 8255 PPI concepts to interface microprocessors/microcontrollers with real-world devices.

CO4: Design and program PLCs using ladder logic, timers, and counters for industrial automation.

CO5: Select suitable actuators and design Mechatronic systems for applications like robotics and automation.

TEXT BOOKS :

1 Bolton, W. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering. Prentice Hall, 2008.

REFERENCES:

1 Bradley, D.A., Dawson, D., Burd, N.C., & Loader, A.J. Mechatronics: Principles and Applications. Chapman and Hall, 1993.

2 Ramesh S. Gaonkar, Microprocessor Architecture, Programming, and Applications with 8085. 5th Edition, Prentice Hall, 2008.

3 Clarence W. de Silva, Mechatronics. CRC Press, 2013.

4 Devadas Shetty and Richard A. Kolk, Mechatronics System Design. PWS Publishing, 2007.

5 Krishna Kant, Microprocessors and Microcontrollers. Prentice Hall of India, 2007.

6 Michael B. Histand and Davis G. Alciatore, Introduction to Mechatronics and Measurement Systems. McGraw Hill, 2007.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	1	-	-	-	-	-	-	1	1	-	2
2	3	2	1	-	1	-	-	-	-	-	-	1	1	-	2
3	3	2	1	-	1	-	-	-	-	-	-	1	1	-	2
4	3	2	1	-	1	-	-	-	-	-	-	1	1	-	2
5	3	2	1	-	1	-	-	-	-	-	-	1	1	-	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

OPEN ELECTIVES – III

O23AD31	AI FOR INDUSTRIAL APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explore how Industrial AI is applied in various sectors.
- To learn about Digital Twins, their characteristics, and how they impact predictive maintenance and data-driven decision-making.
- To explore the role of AI in decision-making, software systems, and software engineering processes.
- To study distributed computing, cloud computing, data storage solutions, and information security.
- To examine AI applications across various industries

UNIT I INDUSTRIAL AI 9

Industrial AI- Industrial AI in action- Applying industrial AI- The IMS architecture for industrial AI- Visible and Invisible issues- Building the future with AI- Killer Applications of Industrial AI.

UNIT II DATA ANALYTICS IN INDUSTRY 4.0 9

Digital Twins(DT)- History of DT- Characteristics- Evolution- Data twin - physical world, digital world-Classifications- Level of integration- Characteristics- Modeling digital twins- Smart manufacturing and Applications- Uses of Digital Twin Technology- Digital twins maintenance - predictive maintenance- Planning the digital twin- Digital twin during operation phase- Hybrid analysis and Fleet data- Digital implementation- Digital twin impacts on industry 4.0.- Industry 4.0. Data Analytics - Data driven and model driven approaches-Types - descriptive analytics, diagnostics analytics, maintenance predictive analytics, prescriptive analytics- Data-Driven Decision making- Data quality- Data augmentation- Information logistics- Data driven challenges.

UNIT III AI AND SOFTWARE ENGINEERING 9

Fundamentals in AI – Decision Making- Decision Support Systems- Business Intelligence- Database and Knowledge Base in Decision Support Systems- Inference Mechanisms in AI- Knowledge Interpretation- Data, Information Knowledge and Wisdom- AI and Software Engineering- Systems thinking and Systems Engineering- Software Engineering – Overview- System Software- Evolution- Paradigm- Architecture Models- Software Systems and Software Engineering Processes, Component based software engineering- Software maintenance overview- Applications of AI in classical software engineering

UNIT IV DATA STORAGE AND COMPUTING MODELS 9

Distributed Computing, Cloud Computing, Fog and Edge Computing, Data Storage and Information Management, Data Fusion and Integration, Data Quality, Communication, Cognitive Computing, Distributed Ledger, Information Security, Cybersecurity, Block chain Security.

UNIT V CASE STUDIES 9

AI factory for Railway- AI Factory, Mining, Augmented Reality and Virtual Reality, Cyber security, AI Transformation Roadmap, AI in Healthcare, Education, Banking, Retail and E-commerce, Gaming and Entertainment, Chat bots

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand the concepts, principles, and applications of industrial AI in various domains.

CO2: Analyze and apply digital twin technology for smart manufacturing and other industry- specific applications.

CO3: Explore AI algorithms and methodologies in software engineering projects.

CO4: Design and implement various computing models, data storage and management systems and their implications for distributed systems.

CO5: Evaluate and analyze real-world case studies to understand the practical implementation of AI in different industries.

TEXT BOOKS:

1. AI Factory Theories, Applications and case Studies, Ramin Karim, Diego Galar and Uday Kumar, CRC Press, 2023

REFERENCES:

1. Artificial Intelligence and the Fourth Industrial Revolution, Utpal Chakraborty, Amit banerjee, Jayanta Kumar Saha, Niloy Sarkar, Chinmay Chakraborty, 2022.
2. Artificial Intelligence and Industry 4.0, Ella Hassanien, Jyotir Moy Chatterjee and Vishal Jain, Academic press, 2022, Taylor and Francis, CRC Press
3. Artificial Intelligence in Industrial Applications, Stevan Lawrence Fernandes Tarun K.Sharma,Springer, 2022.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	3	2	1	2	2	2	1	2	3	2	3
2	3	2	3	3	3	2	1	2	2	2	2	3	2	3	2
3	3	3	2	3	2	2	2	2	2	2	2	3	3	2	3
4	3	3	3	3	3	2	2	2	3	2	2	3	3	3	2
5	3	3	3	3	3	2	2	2	3	2	2	3	2	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23AL31 INFORMATION TECHNOLOGY ESSENTIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand computer system basics, including components, networking, and server types.
- To learn HTML5, CSS3 fundamentals, and styling techniques for web design.
- To learn JavaScript fundamentals, including variables, functions, objects, and event handling techniques.
- To learn React JS fundamentals, including components, state management, routing, and error handling.
- To explore cellular network generations, information systems, privacy, and social networking applications.

UNIT I HARDWARE AND NETWORK ESSENTIALS 9

Basics of Computer System - Motherboard – Processors – Memory & Storage - Computer Ports - Memory hierarchy - I/O devices – Servers – Types of Servers – Web Server – Database Server – Communication Medium – Fundamentals of Computer Networking – Types of Computer Networks – Network Topologies – Network Standards: OSI Model, TCP/IP Model – Network Components.

UNIT II WEB AND SCRIPTING ESSENTIALS 9

Internet Basics – Browser Fundamentals – Introduction to HTML5 – HTML5 Tags – HTML5 Forms – HTML Graphics - HTML Media - Cascading Style Sheets (CSS3) Fundamentals - CSS Properties - CSS Styling (Background, Text Format, Controlling Fonts) - Working with Lists and Tables - CSS ID and Class – Box Model – Positioning.

UNIT III JAVASCRIPT 9

Introduction to JavaScript – Variables – Datatypes – Type Conversions - Comparisons - Assignments - Conditional Branching – Loops – Arrays - Functions – Built-in functions and methods – Function Expressions – Arrow Functions – Objects – Promises - async/await - Modules – Error Handling – DOM tree – Bubbling and capturing - Event delegation - Capturing - Bubbling - Events.

UNIT IV FRONT – END ESSENTIALS 9

React JS Introduction - React JSX - Understanding Components and Props – Props – React State – Component Lifecycle - React Hooks - Event Delegation - React Forms - React CSS - React Router - State Management with Redex - Fetch API - Handling errors in React applications.

UNIT V MOBILE AND APPLICATION ESSENTIALS 9

Generations of Cellular Networks – GSM - Introduction to Information Systems – Personal Information System – Ethics and Privacy – Information Retrieval System – Relevance feedback – Information retrieval system evaluation - Social Networking Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand the basic concepts of hardware, data communications and networking.
CO2: Create dynamic website/web-based applications using HTML5, and CSS3.
CO3: Understand the syntax, semantics, and dialects of the JavaScript programming language.
CO4: Get familiar with the use of functional components, state components, lifecycle, and routing in React JS
CO5: Identify the fundamental concepts of mobile communications and key issues in the design of commonly used applications.

TEXT BOOKS:

1. James Kurose and Keith Ross, “Computer Networking: A Top-Down Approach”, Eighth Edition, 2021.

REFERENCES:

1. Nabendu Biswas, MERN Projects for Beginners: Create Five Social Web Apps Using MongoDB, Express.js, React, and Node, Apress, 2021.
2. Vasan Subramanian, Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, A Press Publisher, 2019.
3. Niederst Robbins, Jennifer, “Learning Web Design: A Beginner’s Guide to HTML, CSS, Javascript, and Web Graphics”, Fifth Edition, O’Reilly Media, 2018.
4. Greg Lim, Beginning MERN Stack: Build and Deploy a Full Stack MongoDB, Express,

React, Node.js App, 2021.
5. Jochen Schiller, "Mobile Communications", Pearson Education, Second Edition, 2012.
6. R. Kelly Rainer, Casey G. Cegielski, Brad Prince, "Introduction to Information Systems", Fifth Edition, Wiley Publication, 2014.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	2	2	2	-	-	-	-	-	2	2	3	3	3
2	3	3	2	2	3	-	-	-	-	-	-	2	3	3	3
3	3	3	3	2	3	-	-	-	-	-	-	2	3	2	3
4	3	2	3	2	3	-	-	-	2	-	2	2	3	2	3
5	2	2	2	2	3	-	-	-	-	-	2	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23BT31 FORENSIC TECHNOLOGY L T P

3 0 0

COURSE OBJECTIVES:

- To prepare students for entry-level positions in the fields of forensic technology
- To create deeper understanding in forensic science.
- To learn the investigation tools and techniques for biological sample and analysis
- To learn how to define physical evidence, record crime scenes, and search for evidence.
- To render knowledge on how to perform research in interdisciplinary fields like forensic studies.

UNIT I BASICS OF FORENSIC SCIENCE 9

History and Development; Crime Scene Management and Investigation- Collection, preservation, packing and forwarding of physical and trace evidence for analysis; Legal and Court procedure pertaining to Expert Testimony

UNIT II ANALYTICAL INSTRUMENTATION 9

Microscopy-Polarising, Fluorescent and Electron microscopes; Spectrophotometry- UV, Visible, IR atomic absorption; Chromatographic techniques (TLC, GLC, HPLC); Electrophoresis (Gel and Immunoelectrophoresis.)

UNIT III ANALYSIS OF BIOLOGICAL SAMPLES 9

Fresh Blood-Grouping and typing of fresh blood samples; Analysis of stains of blood and allied body fluids for their groups; Cases of disputed paternity and maternity problems; DNA profiling; Identification of hair, determination of species origin, sex, site and individual identification from hair; Examination and identification of saliva, Urine and Faecal matter.

UNIT IV CHARACTERIZATION OF NON BIOLOGICAL SAMPLE 9

Physical analysis - soil, glass, paints, lacquers, cement, inks, paper, tool marks, tyre marks, shoe prints, forensic examination of vehicles in cases of accident; Identification of individuals from bodily features; Examination and identification of deceased from skeletal remains.

UNIT V FORENSIC EXAMINATION 9

Preliminary examination of documents-Identification of hand writing, signatures and detection of forgeries; Reproduction of documents (photographic, mechanical) and their examination; Physical and chemical erasures, obliterations, additions, alterations, indentations, secret writings and charred documents; Inks, papers and their scientific examinations including instrumental analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1 Exhibit proficiency in forensic science and crime investigation process.

CO2 Apply various analytical instruments in forensic analysis.

CO3 Analyze various biological samples for forensic studies.

CO4 Establish the person's identity by analyzing the samples.

CO5 Implement forensic examination in different levels and documentation.

TEXT BOOKS:

1. William G. Eckert, Introduction to Forensic Sciences, 2nd Ed. New York: CRC press, 2000.

REFERENCES:

1. B. D Alberts Bray, J. Lewis, K. Roberts and J.D. Watson. Molecular Biology of Cell., 2nd ed. New York: Garland Publishing, 1989

2. S.H.James, and J.J. Nordby, Forensic Science An Introduction to Scientific and Investigative Techniques. London: CRC Press, 2003.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	-	2	3	1	-	-	-	-	-	-	-	2	-	-
2	2	2	1	2	1	-	-	-	-	-	-	-	1	-	-
3	2	-	1	2	1	-	-	-	-	-	-	-	2	-	-
4	1	2	2	2	3	-	-	-	-	-	-	-	1	-	-
5	1	-	-	2	-	-	-	-	-	-	-	-		-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23CB31 START-UP & INNOVATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of startups, innovation, and entrepreneurial ecosystems.
- To apply lean startup methodologies for idea validation and business model development.
- To explore innovative strategies for scaling and sustaining startups.
- To develop business plans, secure funding, and manage growth effectively.
- To analyze real-world startup case studies and learn from entrepreneurial success and failure.

UNIT I Introduction to Startups & Lean Thinking 9

Understanding startups, types, and characteristics - The Lean Startup methodology and Build-Measure-Learn cycle - Validated learning, experimentation, and iterative development - Minimum Viable Product (MVP) and rapid prototyping - Differences between lean and traditional business planning - Case studies on successful lean startups, highlighting the role of **innovation in minimizing risks and uncertainties.**

UNIT II BUSINESS MODEL INNOVATION AND CUSTOMER DEVELOPMENT 9

Business model components and innovation frameworks - Customer discovery, problem- innovativ solution fit, and market validation - Pivoting strategies and iterative business model evolution - Ke startup metrics: actionable, vanity, and cohort-based insights - Agile product development, A/I testing, and data-driven decision-making - Real-world examples of successful business mode innovation.

UNIT III SCALING, GROWTH, AND LEAN OPERATIONS 9

Growth hacking strategies, user acquisition, and retention - Startup funding sources: bootstrapping angel investors, venture capital - Innovation accounting, performance measurement, and decision making - Lean startup culture, leadership challenges, and managing failures - Legal aspects intellectual property, compliance, and startup policies - Case studies on scaling lean startup innovative strategies.

UNIT IV STRUCTURED ENTREPRENEURSHIP AND GO-TO-MARKET STRATEGY 9

Framework: 24-step disciplined entrepreneurship framework for startup success- Identifying an segmenting target customers effectively, creating innovative solutions- Developing pricing models revenue strategies, and competitive positioning - Sales strategies for B2B and B2C startups Business development, strategic alliances, and networking for growth - Case studies on market entr and commercialization strategies.

UNIT V FINANCIALS, SCALING, AND EXIT STRATEGIES 9

Understanding startup financials: revenue models, cash flow, and cost structures - Managing financial risks, securing investments, and investor relations - Scaling strategies: expansion models, technology adoption, and role of innovation in expanding globally - Exit strategies for startups: acquisitions, IPOs, and strategic partnerships - Case studies on startup failures, recovery strategies, and long-term sustainability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand the startup ecosystem and its significance in economic growth.
CO2: Apply lean methodologies to test, validate, and pivot startup ideas.
CO3: Develop go-to-market strategies, customer engagement plans, and funding proposals.
CO4: Learn practical techniques for growth, scalability, and risk management.
CO5: Gain insights into real-world entrepreneurial successes and challenges.

TEXT BOOKS:

1. **Eric Ries,** *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. First Edition, published by Crown Business in 2011.

REERENCES:

1. Steve Blank, The Four Steps to the Epiphany: Successful Strategies for Products that Win. 2nd Edition, published by K & S Ranch in 2013.
2. **Peter Thiel** – *Zero to One: Notes on Startups, or How to Build the Future*. First Edition, published by Crown Business in 2014.
3. **Bill Aulet,** *Disciplined Entrepreneurship: 24 Steps to a Successful Startup*. Second Edition, published by Wiley in 2024.
4. Michael E. Gerber – The E-Myth Revisited: Why Most Small Businesses Don't Work and What to Do About It. 3rd Edition, published by Harper Business in 2011.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	2	2	3	1	-	2	2	-	3	2	2	2
2	2	3	2	2	2	2	2	-	2	3	2	2	2	2	2
3	2	2	2	2	2	3	1	-	2	2	2	3	2	2	2
4	3	2	3	2	2	3	2	-	2	2	2	2	2	2	2
5	2	2	2	2	2	3	2	-	2	2	-	2	2	2	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23CC31 INTRODUCTION TO R – PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the R programming environment
- To develop proficiency in syntax and functions.
- To enable students to perform data manipulation and visualization using R.
- To teach the application of statistical methods within R.
- To prepare students to write efficient R scripts with models and cluster

UNIT I GETTING STARTED WITH R 9

Installing R – The R environment – R packages – Basics of R – Data Structures – Reading data into R – Graphics in R

UNIT II FUNCTIONS AND STATEMENTS 9

Writing R functions – Control Statements (if and else, switch, if else, compound tests) – Loops in R (for, while, controlling loops) – Applications using the functions and loops.

UNIT III DATA MANIPULATION AND ANALYSIS 9

Group manipulation – Data Reshaping – Manipulating Strings – Basic Statistics using R (Summaries, Correlation, t-tests, ANOVA)

UNIT IV LINEAR MODELS USING R 9

Linear Models – Simple and Multiple regressions, GLM – Logit Regression, Model diagnostics – Residuals, Cross validation, Boot strapping.

UNIT V NON-LINEAR MODELS, TIME SERIES AND CLUSTERING USING R 9

Nonlinear Models – Non-Linear least square, Splines, Generalized Additive Models, Decision trees, Random forests. Time Series – Autoregressive moving average, VAR, GARCH. Clustering – K means, PAM and Hierarchical Clustering.

TOTAL: 45

PERIODS

TEXT BOOK:

1. SandipRakshit, R Programming for Beginners, McGraw Hill Education, 2017

REFERENCES:

1. Jared P.L., R for Everyone – Advanced Analytics and Graphics, Addison Wesley Data and Analytics series, 2015.
2. Chris Brunsdon, Lex Comber, An Introduction to R for Spatial Analysis and Mapping, 1st Edition, Sage Publications Ltd (UK), ISBN: 9781446272954,2nd Edition, 2019.
3. Hamid Reza Pourghasemi, Spatial Modeling in GIS and R for Earth and Environmental Sciences, Elsevier (S&T), ISBN: 9780128152263, 2019

Course Outcomes:

At the end of the course, the students will be able to

CO1: Demonstrate proficiency in using R and R Studio.
CO2**:** Effectively utilize R's syntax for data structures and control flow mechanisms.
CO3: Perform data import, cleaning, transformation, and export operations.
CO4: Apply statistical methods using linear models.
CO5: Efficiency in R scripts using models and clusters.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	2	-	-	-	-	-	-	2	3	2	2
2	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
3	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
4	3	3	3	3	3	-	-	-	-	-	-	2	3	3	2
5	3	3	3	3	3	3	3	3	2	2	2	2	3	3	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23CS31 INTRODUCTION TO BLOCKCHAIN L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the core concepts, types, and components of Block chain technology.
- To learn the role of cryptographic techniques and security protocols in Block chain.
- To explore Smart Contracts and develop decentralized applications (DApps).
- To examine different Block chain platforms and their industry applications.
- To analyze advanced Block chain topics such as scalability, interoperability, and Big Data integration

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Overview of Blockchain Technology: Definition, Importance, and Applications. Types of Blockchains: Public, Private, and Consortium. Key Concepts: Decentralization, Distributed Ledger Technology, Peer-to-Peer Networks. Blockchain Structure: Blocks, Hashing, Digital Signatures. Introduction to Blockchain Use Cases: Cryptocurrencies, Supply Chain, Healthcare, Finance. Tools and Technologies for Blockchain: Introduction to Platforms like Ethereum, Bitcoin, and Hyperledger.

UNIT II BLOCKCHAIN CRYPTOGRAPHY AND SECURITY 9

Cryptography in Blockchain: Symmetric and Asymmetric Encryption, Digital Signatures, Public/Private Key Infrastructure (PKI). Blockchain Security: Hashing Algorithms, Proof of Work, Proof of Stake. Consensus Mechanisms: Introduction to PoW, PoS, Practical Byzantine Fault Tolerance (PBFT), Delegated Proof of Stake (DPoS). Blockchain Vulnerabilities: 51% Attacks, Sybil Attacks, Double-Spending, and Network Security Issues.

UNIT III SMART CONTRACTS AND DECENTRALIZED APPLICATIONS 9

Introduction to Smart Contracts: Definition, Features, and Use Cases. How Smart Contracts Work: Creating, Deploying, and Interacting with Smart Contracts. Introduction to Ethereum and Solidity for Smart Contracts. Developing and Deploying Simple Smart Contracts. Decentralized Applications (DApps): Overview, Architecture, and Benefits. Use Cases of DApps in Finance, Supply Chain, Healthcare.

UNIT IV BLOCKCHAIN PLATFORMS AND FRAMEWORKS 9

Overview of Major Blockchain Platforms: Bitcoin, Ethereum, and Others. Blockchain as a Service (BaaS): Amazon Managed Blockchain, Azure Blockchain Service. Introduction to Hyperledger and Its Frameworks: Fabric, Sawtooth, Indy. Blockchain in Enterprise Use: Real-World Examples in Healthcare, Finance, and Supply Chain. Hands-on Experience with Blockchain Platforms and Tools for Smart Contract Deployment.

UNIT V ADVANCED BLOCKCHAIN TOPICS AND USE CASES 9

Big Data Analytics with Blockchain: Integration with Hadoop, Spark, and Cloud-Based Data Services. Interoperability in Blockchain: Cross-Chain Communication. Blockchain Applications: Use Cases in Voting, Identity Management, and Intellectual Property Protection. Future Trends in Blockchain: Scalability Challenges, Quantum Computing, and Regulatory Considerations. Case Studies: Real-World Blockchain Applications and Developing End-to-End Blockchain Solutions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Describe Blockchain technology, including its architecture and key components.

CO2: Explain the security mechanisms of Blockchain, including cryptography and consensus algorithms.

CO3: Develop and deploy Smart Contracts using Ethereum and Solidity.

CO4: Create and manage Decentralized Applications (DApps) on Blockchain platforms.

CO5: Address real-world Blockchain challenges and implement solutions using advanced Blockchain concepts.

TEXT BOOKS:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

REFERENCES:

1. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction” Princeton University Press, 2016
2. Antonopoulos, Mastering Bitcoin, O’Reilly Publishing, 2014. .
3. Antonopoulos and G. Wood, “Mastering Ethereum: Building Smart Contracts and Dapps”, O’Reilly Publishing, 2018.
4. D. Drescher, Blockchain Basics. Apress, 2017

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	2	1	-	-	-	-	3	2	1
2	3	3	2	2	1	1	3	1	-	-	-	-	3	2	2
3	2	3	3	3	3	2	-	-	-	-	-	-	3	2	2
4	-	2	3	3	3	3	2	1	1	-	-	-	2	3	2
5	1	3	3	2	2	3	3	2	2	1	-	-	3	3	3

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

O23EC31 Batteries and Management System

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the principles of battery technology and its critical performance parameters.
- To learn the design and operational aspects of battery management systems (BMS).
- To explore battery applications across industries like automotive and renewable energy.
- To explore the functions of battery management systems (BMS).
- To address challenges in battery safety, reliability, and sustainability.

UNIT I Fundamentals of Batteries **9**

Basics of electrochemistry: oxidation-reduction, charge-discharge - Battery types: Primary vs. secondary batteries - Key technologies: Lead-acid, Lithium-ion, Nickel-based - Performance metrics: Energy density, power density, cycle life

UNIT II Battery Design and Construction **9**

Core components: Cathode, anode, electrolyte, separator - Battery manufacturing processes: Material selection and assembly - Factors affecting performance: Temperature, depth of discharge, aging - Case study: Lithium-ion battery design

UNIT III Battery Management Systems (BMS) **9**

Functions: Monitoring, protection, optimization -Key concepts: SOC, SOH, SOF estimation - Core components: Sensors, controllers, communication protocols (e.g., CAN bus) - Thermal management: Heat generation and dissipation strategies

UNIT IV Applications of Batteries and BMS **9**

Industry applications: Electric vehicles (EVs), renewable energy storage, electronics - Application-specific requirements: Power density for EVs, long cycle life for grid storage-Case studies: EV battery

failures and mitigation through BMS

UNIT V Challenges and Future Trends in Battery Technology 9

Sustainability: Recycling, second-life battery usage - Emerging technologies: Solid-state batteries, silicon anodes, fast charging- Advances in BMS: AI and IoT integration for optimization-Policies and standards for batteries and energy storage systems.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Explain the fundamental principles of battery operation, types, and performance metrics.

CO2: Assess the factors influencing the performance of batteries by analysing the design and construction of batteries

CO3: Describe the architecture and functions of Battery Management Systems (BMS), including monitoring, control, and safety mechanisms.

CO4: Estimate the applications of batteries and BMS in electric vehicles, renewable energy, and consumer electronics.

CO5: Identify challenges in battery sustainability and discuss emerging trends and solutions for improving energy storage systems.

TEXT BOOKS:

1. Gregory L. Plett, Battery Management Systems: Volume I and II, Artech House Publishers, 2015.

REFERENCES:

1. David Linden, Thomas B. Reddy, Handbook of Batteries, McGraw-Hill, Fourth Edition, 2010.
2. Gregory L. Plett, Battery Management Systems: Volume I and II, Artech House Publishers, 2015.
3. Davide Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Artech House Publishers, 2010.
4. Rachid Yazami, Lithium-Ion Batteries: Fundamentals and Applications, Wiley, 2014.
5. T. R. Crompton, Battery Reference Book, Elsevier, Third Edition, 2000.
6. Mukund R. Patel, Battery Technology Handbook for NASA Engineers, CRC Press, 2004.

COs-POs & PSOs MAPPING

CO	PO												P		
	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3
1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	1	-	-	-	-	-	-	-	-	-	-
5	2	1	1	1	-	3	-	-	-	-	-	-	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23EC32 BASICS OF BIO MEDICAL INSTRUMENTATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To introduce Electrophysiology of bio potentials and electrodes
- To explore Bio signal characteristics and get practical knowledge
- To introduce preamplifiers for Bio signal measurements
- To explore amplifiers for various bio electrical signal measurements
- To understand the principle of various non electrical measurement

UNIT I INTRODUCTION TO ELECTROPHYSIOLOGY 9

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode– skin interface, half-cell potential, impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits, Motion Artifacts.

UNIT II BIOPOTENTIAL MEASUREMENT 9

Bio signal characteristics– frequency and amplitude ranges. ECG – Einthoven 's triangle, standard 12 lead system, block diagram. Measurements of heart sounds - PCG. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Functional block diagram. EMG – unipolar and bipolar mode, block diagram, EOG and ERG.

UNIT III BIOPOTENTIAL AMPLIFIER 9

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Artifacts and removal.

UNIT IV NONELECTRICAL PARAMETER MEASUREMENT 9

Blood Pressure: direct methods - Pressure amplifiers - systolic, diastolic, mean detector circuit, indirect methods - auscultatory method, Oscillo metric method, ultrasonic method. Pulse rate measurements, Plethysmography, Pulse oximetry. Temperature, respiration rate measurement.

UNIT V BLOOD FLOW METER AND BLOOD CELL COUNTER 9

Blood flow - Electromagnetic and ultrasound blood flow measurement. Cardiac output measurement- Indicator dilution, dye dilution and thermodilution method. Blood cell counting- Manual and Automatic Counting of RBC, WBC and Platelets. PRACTICAL Measurement of blood flow velocity using ultrasound transducer.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Recall the Electrophysiology of bio potentials and electrodes for its measurement.
CO2: Describe the Bio signal characteristics and get practical knowledge.
CO3: Design preamplifiers for Bio signal measurements.
CO4: Design and implement amplifiers for various bio electrical signal measurements.
CO5: Describe the principle of various non electrical measurement.

TEXT BOOKS:

1. John G. Webster, “Medical Instrumentation Application and Design,” JohnWiley and Sons, New York, 5 th Edition, 2020.

REFERENCES:

1. L.A Geddes and L. E. Baker, Principles of Applied Biomedical Instrumentation, 3rd Edition, 2008.
2. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill, 2003.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw Hill, New Delhi, 3rd edition, 2014.
4. Richard S. Cobbold, “Transducers for Biomedical Measurements; Principle and applications,” John Wiley and sons, 1992.
5. Joseph Bronzino and Donal R. Peterson, “Handbook of Biomedical Engineering,” 2015, 4 th Edition, CRC Press, Florida.
6. Joseph J. Carr and John M. Brown, “Introduction to Biomedical equipment technology,”Pearson Education, 4 th Edition, 2014.
7. Leslie Cromwell, Biomedical Instrumentation and measurement, Prentice Hall of India, New Delhi, 2nd edition, 2015.

COs-POs & PSOs MAPPING

CO	PO												P		
	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3
1	3	-	-	-		-	-	-	-	-	-	-	-	3	-
2	3	-	-	-		-	-	-	-	-	-	-	-	3	-
3	3	3	3	-	2	-	-	-	2	2	-	2	-	3	-
4	3	3	-	-	2	-	-	-	2	2	-	2	-	3	-
5	3	-	-	-		-	-	-	-	-	-	-	-	3	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

O23EV31 HDL PROGRAMING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the language features of Verilog HDL and the role of HDL in digital logic design.
- To explain the behavioral modeling of combinational and simple sequential circuits.
- To elaborate the behavioral modeling of algorithmic state machines.
- To explain the synthesis of combinational and sequential descriptions.
- To analyze the architectural features of programmable logic devices.

UNIT I Introduction to Logic Design with Verilog 9

Structural models of combination logic, logic simulation, design verification, test methodology, propagation delay, truth table models of combinational and sequential logic with verilog modules, ports, gate types, gate delays, dataflow modeling, continuous assignments delays, expressions, operators, operands, operator types

UNIT II Logic Design With Behavioral Models of Combinational Logic 9

Behavioral modeling, data types for behavioral modeling, behavioral models of combinational logic, propagation delay and continuous assignments, Behavioral models of multiplexers, encoders and decoders

UNIT III Logic Design With Behavioral Models of Sequential Logic 9

lathes and level sensitive circuits in verilog, cyclic behavioral models of flip flops and latches, cyclic behavior and edge detection, a comparison of styles for behavioral modeling. behavioral models of counters, shift registers and register files, switch debounce, metastability, synchronizers for asynchronous signals.

UNIT IV Introduction to synthesis 9

synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic.

UNIT V Programmable logic devices 9

Programmable logic devices, storage devices, programmable logic array programmable array logic, programmability of PLDs CPLDs.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Demonstrate knowledge on HDL design flow, digital circuits design ,switch de-bouncing, meta-stability, memory devices applications

CO2: Design and develop the combinational and sequential circuits using behavioral modeling

CO3: Solving algorithmic state machines using hardware description language

CO4: Analyze the process of synthesizing the combinational and sequential descriptions

CO5: Memorizing the advantages of programmable logic devices and their description in Verilog

TEXT BOOKS:

1. Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2ND Edition, PHI, 2009.

REFERENCES:

1. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.
2. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.
3. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.

COs-POs & PSOs MAPPING

CO	PO												P		
	1	2	3	4	5	6	7	8	9	1	1	1	1	2	3
1	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
2	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
3	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
4	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
5	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23MA31 MULTIVARIATE DATA ANALYSIS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand data collection, organization, and calculation of averages and measures of spread.
- To explore the relationship between two random variables using correlation and regression techniques.
- To study different types of random processes, including stationary and Markov processes.
- To apply correlation and spectral functions to analyze relationships between processes.
- To analyze relationships between multiple variables and managing residuals in regression.

UNIT I INTRODUCTION TO DATA ANALYTICS 9

Collection of data – Classification and Tabulation of data –Plotting of data - Stem and Leaf Plots – Box Plots - Frequency Distributions and Histograms – Measures of Central Tendency (Mean, Median and Mode) – Measures of Dispersion (Quartile Deviation, Mean Deviation, Standard Deviation)

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9

Discrete and Continuous Joint distributions - Marginal and conditional distributions – Covariance – Correlation and Linear regression.

UNIT III RANDOM PROCESSES 9

Classification – Characterization – Cross correlation and Cross covariance functions - Stationary Random Processes – Markov process - Markov chain.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 9

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

UNIT V MULTIPLE AND PARTIAL CORRELATION 9

Multiple and Partial Correlation -Yule's Notation - Properties of Residuals - Variance of the Residuals - Coefficient of Multiple Correlation -Properties of Multiple Correlation Coefficient - Coefficient of Partial Correlation -Multiple Correlation in terms of Total and Partial Correlations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Collect, organize and analyze data using statistical measures of central tendency and dispersion.

CO2: Analyze relationships between two random variables using correlation, covariance, and regression techniques.

CO3: Understand and classify different types of random processes, including stationary and Markov processes.

CO4: Apply correlation and spectral functions to study and interpret relationships between random processes.

CO5: Develop proficiency in analysing multiple variables and handling residuals in regression models.

TEXT BOOKS:

1. Hogg, R.V., McKean, J.W., & Craig, A.T., Introduction to Mathematical Statistics, Pearson Education, 8th Edition, 2018.

REFERENCES:

1. Anderson, O.D, "Time series Analysis: Theory and Practice", I.North-Holland, Amsterdam, 1982.
2. Walpole, R.E., Myers, R.H., & Myers, S.L., Probability and Statistics for Engineers and Scientists, Pearson, 9th Edition, 2016
3. Sundarapandian, V., "Probability, Statistics and Queueing Theory", PHI Learning Private Ltd., New Delhi, 2009.
4. Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2020.
5. Montgomery, D.C., Jennings, C.L., & Kulahci, M., Introduction to Time Series Analysis and Forecasting, Wiley, 2nd Edition, 2015.
6. Ibe, O.C.," Fundamentals of Applied Probability and Random Processes ", 1st Idian Reprint, Elsevier, 2007.

COs-POs & PSOs MAPPING

	PO												PS		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
2	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
3	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
4	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-
5	3	3	2	2	-	-	-	-	2	1	-	2	-	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

O23ME31 INTRODUCTION TO 3D PRINTING TECHNOLOGIES

L	**T**	**P**	**C**
3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications
- To familiarize the students with various software tools, processes and techniques to create physical objects that satisfy product development/prototyping requirements, using AM.
- To teach the students to understand polymerization and direct energy deposition processes
- To equip the students to be familiar with powder bed fusion and material extrusion processes.
- To impart knowledge on applications of binder jetting, material jetting and sheet lamination processes

UNIT I INTRODUCTION **9**

Overview – History – Need for Additive Manufacturing – Rapid Prototyping – AM Process Chain– Classification –Additive Manufacturing Technology in product development – Benefits –Application – Materials for Additive Manufacturing Technology – Rapid Tooling – Types – Applications– benefits - Economics aspect: Strategic aspect- Operative aspect

UNIT II DESIGN FOR ADDITIVE MANUFACTURING **9**

Concepts and Objectives - AM Unique Capabilities - Part Consolidation – Topology Optimization Generative design - Lattice Structures - Multi-Material Parts and Graded Materials - Data Processing: CAD Model Preparation - AM File formats: STL-Problems with STL- AMF Design for Part Quality Improvement: Part Orientation - Support Structure - Slicing - Tool Path Generation – Design rules for Extrusion based AM.

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION **9**

Photo polymerization: Stereolithography Apparatus (SLA)- Materials -Process – top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Continuous Liquid Interface Production (CLIP)Technology. Directed Energy Deposition: Laser Engineered Net Shaping (LENS)- Process - Material Delivery - Materials -Benefits -Applications.

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION **9**

Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Material Extrusion: Fused Deposition Modeling (FDM)- Process-Materials -Applications and Limitations.

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES **9**

Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits- Limitations - Applications. Material Jetting: Multijet Modeling- Materials - Process - Benefits - Applications. Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding- Materials-Application and Limitation.

TOTAL : 45 PERIODS

COURSE OUTCOMES :

At the end of the course, the students will be able to

CO1 : Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.

CO2 : Explain the process of transforming a concept into the final product in AM technology.

CO3 : Elaborate the vat polymerization and direct energy deposition processes and its applications.

CO4 : Describe the process and applications of powder bed fusion and material extrusion.

CO5 : Analyse the advantages, limitations, and applications of binder jetting, material jetting and sheet lamination processes.

TEXT BOOKS :

1 Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "Additive manufacturing technologies". 3rd edition Springer Cham, Switzerland. (2021). ISBN: 978-3-030-56126-0.

REFERENCES:

1 Milan Brandt, "Laser Additive Manufacturing: Materials, Design, Technologies, and Applications", Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.

2 Amit Bandyopadhyay and Susmita Bose, "Additive Manufacturing", 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.

3 Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer., United States ,2006, ISBN: 978-1-4614-9842-1.

4 Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press., United States, 2011, ISBN: 9780849334092.

5 Andreas Gebhardt and Jan-Steffen Hötter "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.

COs-POs & PSOs MAPPING

	PO												PSO		
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1
2	3	3	1	1	1	-	-	-	-	-	-	-	1	1	1
3	3	3	1	1	1	-	-	-	-	-	-	-	1	1	1
4	3	3	1	1	1	-	-	-	-	-	-	-	1	1	1
5	3	2	1	1	1	-	-	-	-	-	-	-	1	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

VERTICALS FOR MINOR DEGREE

(In addition to all the verticals of other programs)

VERTICAL 1: FINTECH AND BLOCK CHAIN

CS23M01	BANKING, FINANCIAL SERVICES AND INSURANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Understand the Banking system in India
- To Grasp how banks, raise their sources and how they deploy it
- To Understand the development in banking technology
- To Understand the financial services in India
- To Understand the insurance Industry in India

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9

Overview of Banking system – Structure – Functions –Banking system in India - Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts

UNIT II MANAGING BANK FUNDS/ PRODUCTS 9

Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market.

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money – forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT IV FINANCIAL SERVICES 9

Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting –factoring – Merchant Banking.

UNIT V ADVANCED TOPICS IN XR I: AR/VR DISPLAYS TECHNOLOGIES 9

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 –IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able

CO1: To Understand the Structure and Functions of the Indian Banking System

CO2: To Manage Bank Funds and Products Effectively

CO3: To Analyze Technological Developments in Banking

CO4: To Understand the Role of Financial Services in Economic Development

CO5: To Evaluate the Indian Insurance Sector

TEXT BOOKS

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.

REFERENCES

1. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010
2. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2017

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

CS23M02 PRINCIPLES OF FINANCIAL MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

- To acquire the knowledge of the decision areas in finance.
- To learn the various sources of Finance
- To describe about capital budgeting and cost of capital.
- To discuss on how to construct a robust capital structure and dividend policy
- To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts

UNIT II SOURCES OF FINANCE 9

Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III INVESTMENT DECISIONS 9

Investment Decisions: capital budgeting – Need and Importance – Techniques of Capital Budgeting -– Payback -ARR – NPV – IRR –Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Operating Leverage and Financial Leverage- EBIT-EPS analysis. Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - - Determinants of Dividend Policy

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able

CO1: To Understand the Fundamentals of Financial Management

CO2: To Analyze Various Sources of Finance

CO3: To Make Informed Investment Decisions

CO4: To Evaluate Financing and Dividend Decisions

CO5: To Manage Working Capital Effectively

TEXT BOOKS

1. M.Y. Khan and P.K. Jain Financial management, Text, Tata McGraw Hill
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd
3. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2017.

REFERENCES

1. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning,
2. Prasanna Chandra, Financial Management,
3. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

CS23M03	FINTECH PERSONAL FINANCE AND PAYMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To acquire the knowledge of cryptocurrencies, blockchain technology, and various digital payment systems, and their legal and regulatory implications.
- To Analyze the digitization of financial services, including crowdfunding models and initial coin offerings (ICOs).
- To Understand and apply AI, ML, IoT, and risk modeling innovations in insurance technology for fraud detection and claims processing.
- To Evaluate the infrastructure, technology, and business models of P2P lending, crowdfunding, and SME/MSME-specific lending opportunities and its challenges.
- To understand global and domestic regulations in FinTech, assess the evolution of RegTech, apply AI-based solutions and compliance.

UNIT I CURRENCY EXCHANGE AND PAYMENT 9

Understand the concept of Crypto currency- Bitcoin and Applications -Cryptocurrencies and Digital Crypto Wallets -Types of Cryptocurrencies - Cryptocurrencies and Applications, block chain, Artificial Intelligence, machine learning. Fintech users, Individual Payments, RTGS Systems, Immediate Page 54 of 90 Payment Service (IMPS), Unified Payments Interface (UPI). Legal and Regulatory Implications of Crypto currencies, Payment systems and their regulations. Digital Payments Smart Cards, Stored-Value Cards, EC Micropayments, Payment Gateways, Mobile Payments, Digital and Virtual Currencies, Security, Ethical, Legal, Privacy, and Technology Issues

UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE 9

A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity, Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH 9

InsurTech Introduction, Business model disruption AI/ML in InsurTech - IoT and InsurTech, Risk Modeling, Fraud Detection Processing claims and Underwriting Innovations in Insurance Services.

UNIT IV PEER TO PEER LENDING 9

P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies, Concept of Crowdfunding Crowd Funding Architecture and Technology, P2P and Crowdfunding unicorns and business models, SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations.

UNIT V REGULATORY ISSUES 9

FinTech Regulations: Global Regulations and Domestic Regulations, Evolution of RegTech, RegTech Ecosystem: Financial Institutions, RegTech Ecosystem: Startups RegTech, Startups: Challenges, RegTech Ecosystem: Regulators, Use of AI in regulation and Fraud detection.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able

CO1: To Understand Cryptocurrency and Digital Payments

CO2: To Evaluate Digital Finance Trends

CO3: To Apply Advanced Technologies in InsurTech

CO4: To Explore Peer-to-Peer Lending Models

CO5: To Analyze Regulatory Frameworks and RegTech

TEXT BOOKS

1. Swanson Seth, Fintech for Beginners: Understanding and Utilizing the power of technology, Createspace Independent Publishing Platform,2016. (Unit I, II)
2. Models Au Tanda, Fintech Bigtech and Banks Digitalization and Its Impact On Banking Business, Springer, 2019. (Unit III)
3. Henning Diedrich, Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations, Wildfire Publishing, 2016(Unit IV & V)

REFERENCES

1. Jacob William, FinTech: The Beginner's Guide to Financial Technology, Createspace Independent Publishing Platform, 2016.
2. IIBF, Digital Banking, Taxmann Publication, 2016.
3. Jacob William, Financial Technology, Create space Independent Pub, 2016.
   Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

CS23M04 FUNDAMENTALS OF INVESTMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

- Describe the investment environment in which investment decisions are taken.
- Explain how to Value bonds and equities
- Explain the various approaches to value securities
- Describe how to create efficient portfolios through diversification
- Discuss the mechanism of investor protection in India.

UNIT I THE INVESTMENT ENVIRONMENT **9**

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return

UNIT II FIXED INCOME SECURITIES **9**

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS **9**

Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES **9**

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT V INVESTOR PROTECTION **9**

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able

CO1: Understand the Investment Environment

CO2: Evaluate Fixed Income Securities

CO3: Apply Approaches to Equity Analysis

CO4: Analyze Portfolios and Financial Derivatives

CO5: Promote Investor Protection and Awareness

TEXT BOOKS

1. Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.

2. Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.

REFERENCES

1.Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.

2.ZviBodie, Alex Kane, Alan J Marcus, Pitabus Mohanty, Investments, McGraw Hill Education (India), 11 Edition(SIE), 2019.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

CS23M05 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of blockchain technology and its evolution.
- To understand the applications of blockchain technology in decentralized systems.
- To Focus on the foundational concepts of blockchain, cryptocurrency, Ethereum, Web3 frameworks, and emerging blockchain trends.
- To gain practical knowledge of blockchain ecosystems, smart contracts and consensus mechanisms of decentralized applications.
- To understand the development of decentralized applications (DApps).

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts- Deploying smart contracts on a blockchain.

UNIT III ETHEREUM 9

Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network.

UNIT IV WEB3 AND HYPERLEDGE 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able

CO1: To Understand the Basics of Blockchain:

CO2: To Explain Cryptocurrencies and Smart Contracts

CO3: To Work with the Ethereum Ecosystem

CO4: To Explore Web3 and Hyperledger Frameworks

CO5: To Evaluate Emerging Blockchain Trends and Challenges

TEXT BOOK

1. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018

REFERENCES

1. Peter Borovykh, Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018
2. ArshdeepBahga, Vijay Madisetti, "Blockchain Applications: A Hands On Approach", VPT, 2017.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

CS23M06 INTRODUCTION TO FINTECH L T P C

3 0 0 3

COURSE OBJECTIVES:

- To learn about history, importance and evolution of Fintech
- To acquire the knowledge of Fintech in payment industry
- To acquire the knowledge of Fintech in insurance industry
- To learn the Fintech developments around the world
- To know about the future of Fintech

UNIT I INTRODUCTION 9

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY 9

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY 9

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy

servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE **9**

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH **9**

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able

CO1: To Understand the Fundamentals of FinTech

CO2: To Explore the Payment and Lending Sectors in FinTech

CO3: To Examine the Wealth and Insurance Management Innovations

CO4: To Evaluate Global FinTech Trends and Regulatory Challenges

CO5: To Forecast the Future of FinTech and Emerging Trends

TEXT BOOKS

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015(Unit I, II)

2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016. (Unit III, IV & V)

REFERENCES

1.Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016

2.Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018

3.Sanjay Phadke, Fintech Future: The Digital DNA of Finance Paperback. Sage Publications, 2020

4.Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	-	3	-	-	-	2	2	1	2	2	1	2
2	3	2	2	1	3	-	-	-	3	2	2	3	3	1	2
3	3	3	2	2	3	-	-	-	3	2	1	2	3	2	2
4	3	3	3	2	3	-	-	-	3	2	2	3	3	2	2
5	3	3	3	3	3	-	-	-	3	3	3	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

VERTICAL 2: ENTREPRENEURSHIP

ME23M01	FOUNDATION OF ENTREPRENEURSHIP	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the fundamentals of entrepreneurship and its role in economic development.
- To explore the business ownership and environmental factors.
- To learn about government initiatives and schemes for startups.
- To develop business plans and understand the legal aspects of entrepreneurship.
- To gain insights into social entrepreneurship and the responsibilities of entrepreneurs.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship Meaning- Characteristics- Functions- Traits- Types - Women Entrepreneurship- Rural Entrepreneurship- Role of Entrepreneurship in Economic Development – Factors affecting entrepreneurial growth.

UNIT II BUSINESS OWNERSHIP & ENVIRONMENT 9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological-Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration.

UNIT III GOVERNMENT INITIATIVES FOR STARTUPS 9

SAMRIDH Scheme, MSME Market Development Assistance (MDA), NIDHI Scheme (National Initiative for Development and Harnessing Innovations), Credit Linked Subsidy Scheme (CLCSS), Digital India GENESIS, MSME Sustainable (ZED) Certification, The Multiplier Grants Scheme (MGS), Startup Leadership Program (SLP), ASPIRE (A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship), Startup India Initiative, Startup India Seed Fund Scheme, Pradhan Mantri Mudhra Yojna, Atal Innovation Mission, Credit Guarantee Trust Fund, Venture Capital Assistance Scheme, The Standup India Scheme, Raw Material Assistance Scheme, Single Point Registration Scheme.

UNIT IV BUSINESS PLAN AND LEGAL ASPECTS 9

Development of Business Plan and starting venture- Registration Formalities- IPR Incentives and Subsidies- Need for Incentives and Subsidies- Tax benefits for SSI Units- Sickness in Small Industries- Causes and Remedies and Revival.

UNIT V SOCIAL ENTREPRENEURSHIP AND SOCIAL RESPONSIBILITIES OF ENTREPRENEURS 9

Social Entrepreneurship i) Meaning and Definition ii) Importance of Social Entrepreneurship iii) Ethics in Social Entrepreneurship iv) Forms/Types of Social Entrepreneurship B) Social Responsibility of Entrepreneurs towards consumers, Employees, Investors, Local Public, The Nation

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of course students will be able

CO1: To Discern distinct entrepreneurial traits.

CO2: To Understand the business ownership patterns and environment.

CO3: To Design strategies for successful implementation of innovative business ideas.

CO4: To Write a business plan.

CO5: To Understand social entrepreneurship and its responsibilities.

TEXTBOOKS :

1. Khanka SS - Entrepreneurial Development - S.Chand & Co. Ltd 2010.
2. Startup India Website: https://www.startupindia.gov.in/content/sih/en/government-schemes.html

REFERENCES:

1. Gupta CB and Srinivasan NP - Entrepreneurship Development in India - S.Chand & Co. Ltd
2. Robert D Hisrich et al - Entrepreneurship Development - Tata McGraw- Hill publishing company Ltd 2007
3. Prasanna Chandra - Projects- Planning, Analysis, Financing, Implementation & Review - Tata McGraw- Hill publishing company Ltd 2006.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	1
2	3	1	1	-	2	-	-	-	-	-	-	2	-	-	1
3	3	2	2		-	-	-	-	-	-	-	-	-	-	1
4	3	1	1	1	2	-	-	-	-	-	-	2	-	-	1
5	3	2	3	2	2	1	1	-	-	-	-	2	-	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

ME23M02 TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of team building processes, including the distinctions between groups and teams, and various types of teams.
- To develop skills for evaluating team performance, setting goals, defining roles, and understanding factors influencing team dynamics.
- To explore the fundamental concepts of leadership, including its components, skills, and the process of building high-performance teams.
- To introduce the concept of personality, its determinants, and the methodologies for evaluating personality traits.
- To examine the formation, structure, roles, and characteristics of effective groups within organizational settings.

UNIT I TEAM BUILDING PROCESS 9

Team Building Process: Overview of team; Difference between Groups and Teams. Types of Teams- Problem-solving Teams, Self-Managed Teams, Cross-functional teams, Virtual Teams.

UNIT II EVALUATING TEAM PERFORMANCE 9

Evaluating team performance, Goal Setting of Team, Defining roles and Responsibility of team members; External and Internal factors affecting team building.

UNIT III LEADERSHIP 9

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership, Leadership Skills – Basic Leadership Skills, Building Technical Competency, Advanced Leadership Skills, Building High Performance Teams.

UNIT IV PERSONALITY 9

Personality: Meaning & Concept of Personality; Types of personality; Personality Determinants; Evaluation of Personality.

UNIT V GROUPS 9

Meaning of Group; Formation of group; Roles, Structure, and Size of Group; Types of Group; Characteristics of an Effective Group.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Differentiate between groups and teams and identify various types of teams and their applicability in organizational contexts.
CO2: Evaluate team performance effectively by setting clear goals, defining roles, and understanding internal and external factors affecting team building.
CO3: Demonstrate a strong grasp of leadership concepts, debunk common myths, and develop key leadership skills to manage and inspire teams.
CO4: Analyze personality traits and determinants and apply evaluation tools to understand individual differences in workplace behaviour.
CO5: Describe the formation and functioning of groups, including their roles, structure, and the characteristics that make groups effective.

REFERENCES:

1. Rao, V.S.P. Human Resource Management, New Delhi. 2nd edition, Excel Books.
2. Janaki raman- Training & Development, Biztantra.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	-	-	-	1	3	-	-	3	-	-	1
2	3	3	1	1	-	-	-	1	3	-	-	3	-	-	1
3	3	3	1	1	-	-	-	1	3	-	-	3	-	-	1
4	3	3	1	1	-	-	-	1	3	-	-	3	-	-	1
5	3	3	1	1	-	-	-	1	3	-	-	3	-	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

ME23M03	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explore the phenomenon of creativity, including its origins, qualities, and applications in personal and entrepreneurial contexts.
- To provide students with tools and techniques for mastering creative problem-solving and enhancing divergent and convergent thinking.
- To understand the role of creative intelligence, personality traits, and motivation in fostering and sustaining creativity.
- To develop a comprehensive understanding of innovation management, including theories, levels of innovation, and methods for ideation.
- To analyze innovation from micro and macro perspectives, focusing on leadership, open innovation frameworks, and innovation within emerging economies.

UNIT I CREATIVITY **9**

The Creativity Phenomenon: Creative Cerebration- Creative Personality and Motivation – Creative Environment- Creative Technology- Creativity Training- Puzzles of Creativity- Spiritual and social roots of creativity- Essence, Elaborative and Expressive Creativities- Quality of Creativity- Existential, Entrepreneurial and Empowerment Creativities – Criteria for evaluating Creativity- Credible Evaluation- Improving the quality of our creativity.

UNIT II CREATIVE PROBLEM SOLVING **9**

Mastering Creative Problem Solving: Structuring of ill- defined problems- Creative Problem solving Models of Creative problem solving- Mechanisms of Divergent thinking- Useful mechanisms of convergent thinking- Techniques of Creativity Problem solving.

UNIT III CREATIVE INTELLIGENCE **9**

Creative Intelligence: Creative Intelligence abilities - A model of Creative Intelligence – Convergent thinking ability - Traits Congenial to creativity - Creative Personality and forms of creativity- Motivation and Creativity- Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Energy for your creativity- Designing Creative Environment.

UNIT IV INNOVATION MANAGEMENT **9**

Innovation Management: Concept of Innovation- Levels of Innovation- Incremental Vs Radical Innovation-Inbound and Outbound Ideation- Open and Other Innovative Ideation Methods- Theories of outsourcing New Product Development: Transaction Cost, Resource Based, Resource Dependence, Knowledge Based Theories.

UNIT V LEADERSHIP AND INNOVATIONS **9**

Micro and Macro perspectives of Innovation: Systems Approach to Innovation- Innovation in the context of Emerging Economies- Organizational factors affecting innovation at the firm level Leadership and Innovations- Open Innovation- Innovation Framework- Innovations developed by Open Technology Communities.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able

CO1: To Explain the essence, components, and various dimensions of creativity and evaluate its quality using credible frameworks.

CO2: To Apply structured models and techniques for creative problem-solving to address ill-defined challenges effectively.

CO3: To Analyze creative intelligence and identify strategies to overcome blocks to creativity and design conducive environments for innovation.

CO4: To Demonstrate knowledge of innovation management concepts, distinguishing between incremental and radical innovations, and utilize relevant theories for outsourcing product development.

CO5: To Evaluate organizational and systemic factors affecting innovation, emphasizing leadership roles and frameworks like open innovation and technology community contributions.

TEXT BOOKS:

1. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata McGraw Hill, 2004.

2. Vinnie Jauhari, Sudanshu Bhushan, Innovation Management, Oxford Higher Education, 2014.

3. Innovation Management, C. S. G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2010.

REFERENCES:

1. A.Dale TimSE, Creativity, Jaico Publishing House, 2003.

2. P. N. Rastogi, Managing Creativity for Corporate Excellence, Macmillan 2009.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	1	-	-	-	-	-	3	1	-	2
2	3	3	2	2	-	1	-	-	-	-	-	3	1	-	2
3	3	3	2	2	-	1	-	-	-	-	-	3	1	-	2
4	3	3	2	2	-	1	-	-	-	-	-	3	1	-	2
5	3	3	2	2	-	1	-	-	-	-	-	3	1	-	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

ME23M04 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To provide a comprehensive understanding of the fundamental concepts and principles of marketing and their evolution.
- To analyze internal and external business environments using tools like SWOT, PESTEL, and value chain analysis for marketing planning and decision-making.
- To develop strategic marketing approaches for industrial, consumer, and services marketing, considering economic and behavioural factors.

- To explore marketing mix components, including product development, pricing strategies, brand positioning, and integrated channel management.
- To understand consumer and industrial buyer behaviour models and their implications for customer satisfaction, retention, and loyalty.

UNIT I INTRODUCTION 9

Defining Marketing – Core concepts in Marketing Evolution of Marketing – Marketing Planning Process – Scanning Business environment Internal and External – Value chain – Core Competencies – PESTEL – SWOT Analysis – Marketing interface with other functional areas - Production, Finance, Human Relations Management, Information System – Marketing in global environment –International Marketing – Rural Marketing – Prospects and Challenges.

UNIT II MARKETING STRATEGY 9

Marketing strategy formulations – Key Drivers of Marketing Strategies – Strategies for Industrial Marketing – Consumer Marketing – Services marketing–Competition Analysis – Analysis of consumer and industrial markets – Influence of Economic and Behavioural Factors – Strategic Marketing Mix components.

UNIT III MARKETING MIX DECISIONS 9

Product planning and development– Product life cycle – New product Development and Management - Defining Market Segmentation – Targeting and Positioning – Brand Positioning and Differentiation – Channel Management Managing Integrated Marketing Channels – Managing Retailing, Wholesaling and Logistics – Advertising and Sales Promotions – Pricing OBJECTIVE, Policies and Methods.

UNIT IV BUYER BEHAVIOUR 9

Understanding Industrial and Consumer Buyer Behaviour – Influencing factors –Buyer Behaviour Models – Online buyer behaviour – Building and measuring customer satisfaction–Customer relationships management– Customer acquisition, Retaining, Defection – Creating Long Term Loyalty Relationships.

UNIT V MARKETING RESEARCH & TRENDS IN MARKETING 9

Marketing Information System – Marketing Research Process – Concepts and applications: Product – Advertising – Promotion – Consumer Behaviour – Retail research – Customer-driven organizations - Cause related marketing – Ethics in marketing – Online marketing trends - social media and digital marketing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: To Explain core marketing concepts and the evolution of marketing in different environments, including rural and international contexts.

CO2: To Conduct business environment analysis using frameworks like PESTEL, SWOT, and core competency analysis for strategic marketing planning.

CO3: To Formulate and evaluate marketing strategies for industrial, consumer, and ervices marketing, integrating competitive and behavioral analysis.

CO4: To Develop marketing mix strategies, including product development, brand positioning, channel management, pricing policies, and promotional techniques.

CO5: To Analyze buyer behavior in industrial and consumer markets and apply CRM practices to build and sustain long-term customer relationships.

TEXT BOOKS:

1. Philip T. Kotler and Kevin Lane Keller Marketing Management, Prentice Hall India, 14th Edition, 2012.
2. K S Chandrasekar, "Marketing management – Text and Cases", Tata McGraw Hill Education,2012.
3. Lamb, Hair, Sharma, McDaniel–Marketing–An Innovative approach to learning and teaching - A south Asian perspective, Cengage Learning, 2012.

REFERENCES:

1. Paul Baines, Chris Fill, Kelly Page, Marketing, Asian edition, Oxford University Press, 2013.
2. Ramasamy, V.S, Namakumari, S, Marketing Management: Global Perspective Indian Context, 5th Edition, Macmillan Education, New Delhi, 2014.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	1	1	-	-	-	-	-	-	-	3	1	-	1
2	3	3	1	1	-	-	-	-	-	-	-	3	1	-	1
3	3	3	1	1	-	-	-	-	-	-	-	3	1	-	1
4	3	3	1	1	-	-	-	-	-	-	-	3	1	-	1
5	3	3	1	1	-	-	-	-	-	-	-	3	1	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

ME23M05	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To equip students with foundational knowledge of human resource management (HRM) by explaining its importance, scope, and challenges in entrepreneurial ventures.
- To guide learners in designing effective recruitment and workforce planning strategies, focusing on the unique needs of startups.
- To familiarize students with performance management systems, employee retention techniques, and motivation strategies suitable for resource-constrained environments.
- To develop leadership and team-building skills essential for managing diverse teams and resolving conflicts in entrepreneurial settings.
- To demonstrate practical HRM practices by exploring legal and ethical dimensions, including compliance with employment laws and ethical dilemmas.

UNIT I INTRODUCTION TO HRM FOR ENTREPRENEURS 9

Overview of HRM: Definition, scope, and functions-Importance of HRM in entrepreneurial ventures- Key challenges in managing HR for startups- Difference between corporate HR and startup HR practices

UNIT II WORKFORCE PLANNING AND TALENT ACQUISITION 9

Strategic workforce planning for startups-Recruitment methods and employer branding Interviewing and selection techniques tailored for small businesses- Outsourcing and hiring freelancer.

UNIT III PERFORMANCE MANAGEMENT AND EMPLOYEE RETENTION 9

Setting performance goals and Key Performance Indicators (KPIs) - Conducting performance reviews and feedback sessions - Employee engagement and motivation strategies - Retention strategies: Competitive benefits and work culture - Managing employee turnover in startups.

UNIT IV LEADERSHIP, TEAM BUILDING, AND CONFLICT RESOLUTION 9

Leadership styles for entrepreneurs - Building high-performing teams - Managing diversity and inclusion in startups - Conflict resolution techniques for small teams - Creating a collaborative work environment.

UNIT V LEGAL AND ETHICAL HRM PRACTICES FOR ENTREPRENEURS 9

Overview of employment laws and labor regulations - Legal compliance for startups - Ethical dilemmas in HRM and strategies for resolution - Case studies: Real-world HR challenges and solutions in entrepreneurial ventures.

TOTAL: 40 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: To Demonstrate an understanding of HRM concepts and their strategic importance in entrepreneurial ventures

CO2: To Develop and implement effective workforce planning, recruitment, and talent acquisition strategies for startups

CO3: To Create performance management systems and employee retention strategies tailored to small business environments

CO4: To Exhibit leadership, teamwork, and conflict resolution skills essential for managing diverse teams in startups

CO5: To Apply legal and ethical principles in HR practices to ensure compliance and organizational integrity

TEXT BOOKS:

1. Dessler, G., Human Resource Management, Pearson, 16th Edition, 2022.

2. Bohlander, G. W., and Snell, S., Principles of Human Resource Management, Cengage Learning, 2023.

REFERENCES:

1. Tushman, M. L., Managing People for Competitive Advantage, Harvard Business Review Press, 2022

2. Storey, D. J., Understanding the Small Business Sector, Routledge, 2021

3. Armstrong, M., Handbook of Human Resource Management Practice, Kogan Page, 2023.

4. Rao, T. V., HRD in Startups and SMEs, Sage Publications, 2023.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
2	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
3	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
4	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
5	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

ME23M06 FINANCING NEW BUSINESS VENTURES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To equip students with knowledge of financial concepts and strategies crucial for new business ventures.
- To familiarize learners with various sources of funding, including traditional, venture capital, and crowdfunding.
- To guide students in developing financial projections, understanding valuation methods, and assessing risks in startups.
- To provide practical insights into managing working capital and structuring financial deals.
- To explore regulatory and compliance aspects of financing entrepreneurial ventures.

UNIT I FUNDAMENTALS OF BUSINESS FINANCING 9

Overview of financing for new ventures - Importance of financial planning - Key financial metrics - Bootstrapping techniques - Role of personal savings and family funding in startups.

UNIT II SOURCES OF FUNDING FOR ENTREPRENEURS 9

Equity financing: Venture capital, angel investors, and private equity - Debt financing: Bank loans, microloans, and trade credit - Alternative financing: Crowdfunding, government grants, and incubators - Hybrid models of funding

UNIT III FINANCIAL FORECASTING AND VALUATION 9

Developing financial projections for startups - Break-even analysis and profit planning - Business valuation methods: Discounted Cash Flow (DCF), market comparables, and asset-based valuation - Role of financial models in investor decision-making

UNIT IV MANAGING WORKING CAPITAL AND FINANCIAL DEALS 9

Components of working capital management - Cash flow management for startups - Negotiating and structuring financial deals - Common terms in term sheets and shareholder agreements.

UNIT V LEGAL AND REGULATORY ASPECTS OF FINANCIAL MANAGEMENT 9

Compliance with financial regulations - Taxation and incentives for startups - Intellectual property valuation for funding - Ethical considerations in fundraising - Case studies on successful funding strategies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

CO1: To Explain the fundamental principles of financing new ventures, including the iimportance of financial planning, key metrics, and the role of personal savings and bootstrapping techniques in entrepreneurial finance.

CO2: To Demonstrate knowledge of various funding sources such as equity financing (venture apital, angel investors), debt financing (bank loans, microloans), and alternative financing options like crowdfunding and government grants.

CO3: To Apply financial forecasting and valuation techniques to develop financial models, conduct break-even analysis, and use valuation methods such as Discounted Cash Flow (DCF), market comparables, and asset-based valuation for startup decision- making.

CO4: To Analyze and structure financial deals, including cash flow management, working capital strategies, and negotiating term sheets and shareholder agreements to secure funding and support business growth

CO5: To Identify and evaluate the regulatory and compliance aspects of entrepreneurial finance, including taxation, financial incentives, and ethical considerations, along with analyzing real-world case studies of successful funding strategies

TEXT BOOKS:

1. Leach, J., & Melicher, R., Entrepreneurial Finance, Cengage Learning, 7th Edition, 2023.
2. Damodaran, A., The Little Book of Valuation, Wiley, 2023

REFERENCES:

3. Klonowski, D., Venture Capital and Entrepreneurial Finance, Routledge, 2022
4. Kaplan, S., Financial Models for Startups, Harvard Business Review Press, 2022.
5. Sahlman, W., How to Write a Great Business Plan, Harvard Business Review Press, 2023
6. Blank, S., The Startup Owner's Manual, K&S Ranch Publishing, 2022.

CO's-PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
2	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
3	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
4	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
5	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2
Avg.	1	2	2	1	-	1	-	2	3	2	3	2	1	-	2

1 - low, 2 - medium, 3 - high, '-' - no correlation

VERTICAL 3: BUSINESS DATA ANALYTICS

CB23M01	DATA MINING FOR BUSINESS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explore various data mining techniques and their applications in business intelligence.
- To develop skills in data pre-processing, feature selection, and data transformation for effective mining.
- To understand and apply classification, clustering, and prediction techniques for business decision-making.
- To evaluate different machine learning approaches and optimization techniques in data mining.
- To analyze real-world business problems and propose data-driven solutions using data mining models.

UNIT I INTRODUCTION **9**

Data mining, Text mining, Web mining, Spatial mining, Process mining, Data ware house and DataMart

UNIT II DATA MINING PROCESS **9**

Data mining process KDD, CRISP-DM, SEMMA and Domain-Specific, Classification and Prediction performance measures -RSME, MAD, MAP, MAPE, Confusion matrix, Receiver Operating Characteristic curve & AUC; Validation Techniques - hold-out, k-fold cross-validation, LOOCV, random subsampling, and bootstrapping.

UNIT III PREDICTION TECHNIQUES **9**

Data visualization, Time series ARIMA, Winter Holts, Vector Autoregressive analysis, Multivariate regression analysis.

UNIT IV CLASSIFICATION AND CLUSTERING TECHNIQUES **9**

Classification- Decision trees, k nearest neighbor, Logistic regression, Discriminant analysis; Clustering; Market basket analysis;

UNIT V MACHINE LEARNING AND AI **9**

Genetic algorithms, Neural network, Fuzzy logic, Support Vector Machine, Optimization techniques Ant Colony, Particle Swarm, DEA.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: To Demonstrate an understanding of fundamental data mining concepts and techniques.

CO2: To Apply appropriate data mining models for classification, clustering, and prediction problems.

CO3: To Assess the effectiveness of data mining algorithms using various performance evaluation metrics.

CO4: To Integrate machine learning and AI techniques to enhance business decision-making processes.

CO5: To Design and implement data mining solutions to solve complex business challenges.

TEXT BOOKS:

1. Jiawei Han, Micheline Kamber, and Jian Pei, Data Mining: Concepts and Techniques, 3rd Edition, Morgan Kaufmann, 2011. (Units: I, II, & IV)
2. Pang-Ning Tan, Michael Steinbach, Anuj Karpatne, and Vipin Kumar, Introduction to Data Mining, 2nd Edition, Pearson, 2018. (Units: III, V)

REFERENCES:

1. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 2011
2. G. K. Gupta, Ïntroduction to Data mining with Case Studies, Prentice hall of India, 2011
3. Giudici, Applied Data mining Statistical Methods for Business and Industry, John Wiley. 2009
4. Elizabeth Vitt, Michael LuckevichStaciaMisner, Business Intelligence, Microsoft, 2011
5. Michalewicz Z., Schmidt M. Michalewicz M and Chiriac C, Adaptive Business Intelligence, Springer Verlag, 2007

Os-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	-	-	-	-	-	-	-	2	-	3	3	-	-
2	3	3	2	-	-	-	-	-	-	2	-	3	3	2	-
3	3	3	3	3	3	-	-	-	-	-	-	3	3	3	3
4	-	3	3	3	3	-	-	-	-	-	2	3	-	3	3
5	3	3	3	3	3	-	-	-	-	2	2	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

CB23M02	FINANCIAL ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand modern analytical tools that specifically target finance applications
- To understand different management aspects
- To learn financial analysis for decision making
- To understand human resource management
- To learn different business strategy

UNIT I CORPORATE FINANCE ANALYSIS **9**

Basic corporate financial predictive modelling- Project analysis- cash flow analysis- cost of capital, Financial Break even modelling, Capital Budget model-Payback, NPV, IRR.

UNIT II FINANCIAL MARKET ANALYSIS **9**

Estimation and prediction of risk and return (bond investment and stock investment) –Time series- examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III PORTFOLIO ANALYSIS 9

Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models- binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV TECHNICAL ANALYSIS 9

Prediction using charts and fundamentals – RSI, ROC, MACD, moving average and candle charts, simulating trading strategies. Prediction of share prices.

UNIT V CONTROLLING 9

Credit Risk analysis- Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: Understand different management techniques

CO2: Apply analytical tools that specifically target finance applications.

CO3: Describe financial analysis for decision making

CO4: Understand human resource management

CO5: Adopt different business strategy

TEXT BOOKS

1. Financial analytics with R by Mark J. Bennett, Dirk L. Hugen, Cambridge university press. (Units: I, II & III)

2. Haskell Financial Data Modeling and Predictive Analytics Paperback – Import, 25 Oct 2013 by Pavel Ryzhov. (Units: IV & V)

REFERENCES:

1. Quantitative Financial Analytics: The Path to Investment Profits Paperback –Import, 11 Sep 2017 by Edward E Williams (Author), John A Dobelman.

2. Python for Finance - Paperback – Import, 30 Jun 2017 by Yuxing Yan (Author).

3. Mastering Python for Finance Paperback – Import, 29 Apr 2015 by James Ma Weiming.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	1	1	-	2	-	-	2	-	3	2	2
2	3	3	2	3	3	1	-	2	-	-	2	-	3	2	2
3	3	3	3	3	1	1	-	3	-	-	2	-	3	3	2
4	3	2	2	2	2	1	-	3	-	-	2	-	3	2	2
5	3	3	3	3	2	1	-	3	-	-	2	-	3	3	2

1 -low,2-medium, 3-high, '-'-no correlation

CB23M03	HUMAN RESOURCE ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain insights into data-driven decision-making in human resource management.
- To explore predictive analytics and its role in HR decision-making.
- To analyze HR data for improving organizational performance.
- To leverage workforce data for strategic HR planning.
- To implement advanced analytics techniques for workforce optimization.

UNIT I INTRODUCTION TO HR ANALYTICS 9

HR analytics - People Analytics: Definition- context - stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HRMetrics – HR metrics and KPIs

UNIT II HR ANALYTICS I: RECRUITMENT 9

Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover -Employee referral hires - Agency hires - Lateral hires - Fulfilment ratio- Quality of hire- Recruitment to HR cost - Recruitment analysis.

UNIT III HR ANALYTICS II : TRAINING AND DEVELOPMENT 9

Training & Development Metrics: Percentage of employee trained- Internally and externally trained - Training hours and cost per employee - ROI -Optimizing the ROI of HR Programs - Training and Development analysis.

UNIT IV HR ANALYTICS III : EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics: Talent Retention - Retention index – Voluntary an dinvoluntary turnover- Turnover by department, grades, performance, and service tenure -
Internal hired index - Engagement Survey Analysis. Career Progression Metrics : Promotion index - Rotation index - Career path index - Level wise succession readiness index.

UNIT V HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics : Employees per manager - Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix - Differently abled index- Revenue per employee - Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance - Compensation to HR cost.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: To The learners will be conversant about HR metrics and ready to apply at work settings.
CO2: The learners will be able to resolve HR issues using people analytics.
CO3: To The learners will gain knowledge about analytics of training and development.
CO4: To The learners will know about the analytics of employee engagement and career progression
CO5: To The learners are competent in the anaytics of workforce diversity and development.

TEXT BOOKS:

1. JacFitzenz, The New HR Analytics, AMACOM, 2010. (Units: I,II & III)
2. Dipak Kumar Bhattacharyya, HR Analytics, Understanding Theories and Applications, SAGE Publications India ,2017. (Units: IV & V)

REFERENCES:

1. Ramaz Elmasri, A. Gil Carrick, David Levine, —Operating Systems – A Spiral Approach||, Tata McGraw Hill Edition, 2010.
2. Edwards M. R., & Edwards K, Predictive HR Analytics: Mastering the HR Metric. Lond n: Kogan Page.2016.
3. Human Resources kit for Dummies – 3 rd edition – Max Messmer, 2012

CO's- PO's & PSO's MAPPING

CO's	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	1	2	1	-	-	-	3	1	3	3	2	1
2	3	3	3	2	2	-	-	-	-	3	1	3	3	3	2
3	2	3	3	3	3	1	1	-	1	2	2	3	2	3	3
4	3	2	3	3	2	2	1	1	3	3	2	3	3	2	3
5	3	3	3	3	2	2	2	2	3	3	2	3	3	3	3

1 -low,2-medium, 3-high, '-'-no correlation

CB23M04 MARKETING AND SOCIAL MEDIA WEB ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of marketing analytics and its role in business decision-making.
- To explore the impact of social media and web analytics on consumer behavior and market trends.
- To develop analytical skills for evaluating marketing strategies and measuring their effectiveness.
- To learn best practices for managing social media communities and campaigns.
- To apply search engine optimization (SEO) and search analytics for digital marketing success.

UNIT I MARKETING ANALYTICS 9

Introduction to Marketing Analytics-Marketing Budget and Marketing Performance Measure, Marketing Metrics and its application- Financial Implications of various Marketing Strategies-Geographical Mapping, Data Exploration, Market Basket Analysis.

UNIT II COMMUNITY BUILDING AND MANAGEMENT 9

History and Evolution of Social Media-Understanding Science of Social Media -Goals for using Social Media- Social Media Audience and Influencers-Social theory and social media - technological determinism-Keys to Community Building - Promoting Social Media Pages- Linking Social Media Accounts-The Viral Impact of Social Media-Digital PR-Encourage Positive Chatter in Social Media - Identity in social media: formation of identities, communities, activist movements, and consumer markets - Social Media as business.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS 9

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The road ahead in social media- The Basics of Tracking Social Media - social media analytics- Insights Gained From Social Media- Customized Campaign Performance Reports - Observations of social media use.

UNIT IV WEB ANALYTICS 9

Web Analytics - Present and Future, Data Collection - Importance and Options, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS 9

Search engine optimization (SEO), non-linear media consumption, user engagement, user generated content, web traffic analysis, navigation, usability, eye tracking, online security, online ethics, content management system, data visualization, RSS feeds, Mobile platforms, User centered design, Understanding search behaviours.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: To Understand the role and significance of marketing and web analytics in business strategies.

CO2: To Develop skills to analyze and interpret social media data for decision-making. CO3: To Utilize key performance indicators (KPIs) to measure marketing effectiveness.

CO4: To Apply analytical techniques to optimize digital marketing and social media campaigns.

CO5: To Implement SEO and search analytics to improve online visibility and user engagement.

TEXT BOOKS:

1. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014 (Units I,II & III)

2. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007 (Units: IV & V)

REFERENCES:

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013 .

2. T. Peterson, Web Analytics Demystified, Celilo Group Media and CafePress, 2004.

3. Takeshi Moriguchi, Web Analytics Consultant Official Textbook, 7th Edition, 2016.

CO's- PO's & PSO's MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	1	2	1	-	-	2	1	1	2	3	2	1
2	3	3	3	2	2	2	1	1	2	2	2	2	3	3	2
3	3	3	3	3	2	2	1	1	2	2	2	2	3	3	3
4	2	2	3	3	3	2	2	1	3	3	2	3	3	3	3
5	3	2	3	3	3	3	2	2	3	3	3	3	3	3	3

1 -low,2-medium, 3-high, '-'-no correlation

CB23M05	OPERATION AND SUPPLY CHAIN ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of analytics in operations and supply chain management.
- To apply quantitative models for optimizing warehousing, transportation, and inventory decisions.
- To understand risk analysis and mitigation strategies in supply chain operations.
- To analyze decision-making models such as AHP, DEA, and fuzzy logic in supply chain management.
- To implement data-driven approaches for improving supply chain efficiency and performance.

UNIT I INTRODUCTION **9**

Introduction to analytics – descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains, Barriers to implementation, Road Map.

UNIT II WAREHOUSING DECISIONS **9**

Mathematical Programming Models - P-Median Methods - Guided LP Approach - Balmer – Wolfe Method, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods

UNIT III INVENTORY MANAGEMENT **9**

Inventory aggregation Models, Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain - Measuring transit risks, supply risks, delivering risks, Risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS **9**

Notion of Graphs, Minimal Spanning Tree, Shortest Path Algorithms, Maximal Flow Problems, Multistage Transhipment and Transportation Problems, Set covering and Set Partitioning Problems, Traveling Salesman Algorithms, Advanced Vehicle Routing Problem Heuristics,
Scheduling Algorithms-Deficit function Approach and Linking Algorithms.

UNIT V MCDM MODELS **9**

Analytic Hierarchy Process(AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS-Application in SCM

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able

CO1: To Apply analytical methods to solve supply chain and logistics problems.

CO2: To Design and optimize warehouse and inventory management systems.

CO3: To Assess and mitigate risks in supply chain operations.

CO4: To Implement mathematical and heuristic models for transportation and network optimization.

CO5: To Utilize Multi-Criteria Decision-Making (MCDM) techniques in supply chain analytics.

TEXT BOOKS:

1. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013. (Units: I, III, IV)
2. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016. (Units: II, V)

REFERENCES:

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
3. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

CO's- PO's & PSO's MAPPING

CO	PO's												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	2	2	-	-	-	-	-	-	-	2	3	2	-
2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	-
3	3	3	2	-	2	2	2	-	-	-	-	-	3	2	2
4	3	3	3	2	3	-	2	-	-	2	-	2	3	2	2
5	3	3	2	-	3	-	2	2	2	2	2	2	3	2	2

1 -low,2-medium, 3-high, '-'-no correlation

CB23M06 STATISTICS FOR MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide a foundational understanding of statistical methods in business decision- making.
- To equip students with knowledge of probability distributions and their applications.
- To develop skills in hypothesis testing and statistical inference.
- To enable students to use non-parametric tests for real-world business problems.
- To apply correlation and regression techniques for business analysis.

UNIT I INTRODUCTION 9

Basic definitions and rules for probability, conditional probability independence of events, Baye's theorem, and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION 9

Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

UNIT III TESTING OF HYPOTHESIS - PARAMETIRC TESTS 9

Hypothesis testing: one sample and two sample tests for means and proportions of large samples (ztest), one sample and two sample tests for means of small samples (t-test), F-test for two sample standard deviations. ANOVA one and two way

UNIT IV NON-PARAMETRIC TESTS 9

Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Kolmogorov-Smirnov – test for goodness of fit, comparing two populations. Mann – Whitney U test and Kruskal Wallis test. One sample run test.

UNIT V CORRELATION AND REGRESSION 9

Correlation – Coefficient of Determination – Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able

CO1: To Apply probability concepts and distributions in decision-making.

CO2: To Understand and use sampling techniques and estimation methods.

CO3: To Conduct hypothesis testing using parametric methods.

CO4: To Implement non-parametric statistical methods for real-world problems.

CO5: To Analyze business data using correlation and regression techniques.

TEXT BOOKS:

1. Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017. (Units : I,III,IV, V)

2. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015. (I, II, III)

REFERENCES:

1. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.

2. David R. Anderson, Dennis J. Sweeney, Thomas A.Williams, Jeffrey D.Camm, James J.Cochran, Statistics for business and economics, 13th edition, Thomson (South – Western) Asia, Singapore, 2016.

3. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.

CO's- PO's & PSO's MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
3	3	3	2	2	2	1	-	-	-	-	1	2	3	2	1
3	3	3	3	3	2	1	-	-	-	1	1	2	3	2	1
3	3	3	3	3	3	2	1	-	-	1	1	2	3	3	2
3	3	3	3	3	3	2	1	-	-	1	1	2	3	3	2
3	3	3	3	3	3	2	1	1	1	2	2	3	3	3	3

1 -low,2-medium, 3-high, '-'-no correlation

VERTICAL 4: IoT

EC23M01	IOT ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the overview of architecture in IoT.
- To learn about the IoT Reference model.
- To learn about IoT devices and event driven analysis.
- To understand and analyze IIoT.
- To understand Safety and security testing of IoT Systems.

UNIT I IOT SYSTEM ARCHITECTURE 9

IoT An Architectural Overview 9 Building architecture- Main design principles and needed capabilities- An IoT architecture outline- Standards considerations- Devices and gateways-Local 112 Syllabus IOT and wide area networking- Data management- Business processes in IoT Everything as a service (XaaS).

UNIT II IOT ARCHITECTURE - REFERENCE MODEL 9

State of the art- European Telecommunications Standards Institute M2M/oneM2M, International Telecommunication Union Telecommunication sector view- Reference model and architecture- IoT reference model, Information model- Functional model- Communication model- Safety, privacy, trust, security model.

UNIT III IOT DEVICES AND EVENT-DRIVEN SYSTEM ANALYSIS 9

The IoT Device Design Space, Cost of Ownership and Power Consumption, Cost per Transistor and Chip Size, Duty Cycle and Power Consumption, Platform Design. Event-Driven System Analysis: Introduction, Motivating Example, IoT Network Model, Events, Networks, Devices and Hubs, Single-Hub Networks, Multi-hub Networks, Network Models and Physical Networks, IoT Event Analysis, Event Populations, Stochastic Event Populations, Environmental Interaction Modeling, Event Transport and Migration.

UNIT IV INDUSTRIAL INTERNET OF THINGS 9

Introduction, Industry 4.0, Industrial Internet of Things (IIoT), IIoT Architecture, Basic Technologies, Applications and Challenges.

UNIT V SECURITY AND SAFETY 9

Introduction, Systems Security, Network Security, Generic Application Security, Application Process Security and Safety, Reliable-and-Secure-by-Design IoT Applications, Run-Time Monitoring, The ARMET Approach, Privacy and Dependability.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course the student will be able

CO1: To Understand the basic architecture of the Internet of Things.

CO2: To Understand the IoT Reference Architecture and Real World Design Constraints.

CO3: To Learn about IoT devices and event driven analysis.

CO4: To Analyze IIoT and relate with real time applications.

CO5: To Understand safety and security testing of IoT systems.

TEXTBOOKS:

1. Dimitrios Serpanos, Marilyn Wol, Internet-of-Things (IoT) Systems Architectures, Algorithms, Methodologies, ISBN 978-3-319-69714-7. (Unit – I, II, III, V).
2. R. Anandan, Suseendran Gopalakrishnan, Souvik Pal, Noor Zaman – "Industrial Internet of Things (IIoT)" , Wiley Publications. ISBN: 9781119768777. (Unit- IV)

REFERENCE BOOKS:

1.Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015.
2.The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012.
3."From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
4. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	1
3	2	-	3	-	-	-	-	-	2	-	-	-	3	2	-
3	2	3	-	2	3	-	-	-	2	-	-	-	-	-	1
3	2	-	2	-	3	-	-	-	2	-	-	2	-	-	1
3	3	2	3	3	3	-	-	-	2	-	2	2	3	-	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

EC23M02	IOT DEVICE PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To explore the role of IoT device programming.
- To introduce the solution of different real time problems in Healthcare.
- To explore smart cities.
- To explore the smart sensing healthcare and power challenge.
- To explore the working principles of IoT systems and their role in urban environments.

UNIT I ARDUINO PROGRAMMING 9

Basic commands for Arduino , Integration of Sensors and Actuators with Arduino, Raspberry Pi, interfacing relay with Raspberry Pi, interfacing DC motor with Raspberry Pi.

UNIT II INTRODUCTION TO IOT BASED HEALTH CARE 9

Introduction to IoT applications in smart healthcare& their distinctive advantages – Patient Health Monitoring System (PHMS), Tele-Health, Tele Medicine, Tele-Monitoring, Mobile Health Things (m-health).

UNIT III IOT SMART SENSING HEATH CARE AND POWER CHALLENGE 9

Concept of Generic Biomedical sensors, Smart Sensors: Monitor health parameters, Wearable ECG sensors, IoT Data Acquisition System, Energy harvesting, Battery based systems, Power management.

UNIT IV INTEROPERABILITY FOR SMART CITY IOT 9

Systems Wireless communication modules and topology such as Zigbee, Bluetooth, GSM module, Wi-fi module &Things speak (IoT Platform) cloud, Ethernet, M2M Wireless Sensor Network(WSN).

UNIT V APPLICATION AREA OF SMART CITIES IOT 9

Systems Working principle & Use of Geographical Information System (GIS), GPS module for vehicle speed measurement. Connected Parking - LoRaWAN private network.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: Implement Arduino and Raspberry Pi Programming.

CO2: Apply Introduction to IoT based Health Care.

CO3: Recognize IoT Smart Sensing Heath Care and Power challenge.

CO4: Explain the need of Interoperability for Smart City IoT.

CO5: Apply application of IOT in Smart cities.

TEXTBOOKS:

1. Internet of Things: Projects and Real-World Applications" by Rajesh Singh, Anita Gehlot, and Lovi Raj Gupta. (Unit I).

2. Designing, Developing, and Facilitating Smart Cities Urban Design to IoT Solutions, Vangelis Angelakis Springer, 2019. (Unit II-V).

REFERENCE BOOKS:

1. Introduction to IoT", S. Misra, A. Mukherjee, and A. Roy, Cambridge University Press,2018.

2. Industry 4.0: The Industrial Internet of Things", Alasdair Gilchrist, Apress, 2016.

3. Introduction to Industrial Internet of Things and Industry 4.0", Sudip Misra, Chandana Roy, Anadarup Mukherjee, CRCPress, 2021.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
3	3	-	-	-	-	-	-	-	-	-	2	-	3	2	3
3	3	3	1	3	-	-	-	-	3	-	2	-	2	2	3
3	3	3	3	3	-	-	-	-	3	-	2	2	3	2	3
3	3	3	3	3	-	-	-	-	-	-	2	-	3	2	3
3	3	3	3	3	-	-	-	-	2	-	2	2	3	2	3

1 - low, 2 - medium, 3 - high, '-' - no correlation

EC23M03 IOT FOUNDATION L T P C

3 0 0 3

COURSE OBJECTIVE

- To study fundamental concepts of IoT.
- To understand roles of sensors in IoT.
- To Learn different protocols used for IoT design.
- To be familiar with data handling and analytics tools in IoT.
- To Appreciate the role of big data, cloud computing and data analytics in a typical IoT system.

UNIT I FUNDAMENTALS OF IOT 9

Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

UNIT II SENSOR NETWORKS 9

Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, Raspberri Pi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

UNIT III IOT PROTOCOLS 9

Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols.

UNIT IV DATA HANDLING AND ANALYTICS 9

Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications.

UNIT V APPLICATIONS OF IOT 9

Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and ifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course the student will be able

CO1: To Understand the various concepts, terminologies and architecture of IoT systems.

CO2: To Use sensors and actuators for design of IoT.

CO3: To Apply various protocols for design of IoT systems.

CO4: To Use various techniques of data storage and analytics in IoT.

CO5: To Understand various applications of IoT.

TEXTBOOKS:

1. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016. (Unit – I, IV, V).

2. Olivier Hersent, David Boswarthick, and Omar Elloumi, — "The Internet of Things: Key Applications and Protocols", Wiley Publications. (Unit – II, III).

REFERENCE BOOKS:

1. Hakima Chaouchi, — "The Internet of Things Connecting Objects to the Web" ISBN: 978-1-84821-140-7, Wiley Publications.
2. Daniel Minoli, — "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press.
4. Vijay Madisetti and ArshdeepBahga, — "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 201.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	1	1	-	-	-	-	-	-	-	-	-	3	-	1
2	2	2	1	-	-	-	-	-	-	-	-	-	3	2	-
3	3	1	1	2	2	-	-	-	-	-	-	-	3	3	1
4	3	3	3	3	3	-	-	-	-	-	-	-	3	2	1
5	3	2	2	3	3	1	2		2		2		3	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

EC23M04 INDUSTRIAL INTERNET OF THINGS L T P C

3 0 0 3

COURSE OBJECTIVE

- To focus on basics of Industrial Internet.
- To modify the various existing industrial systems.
- To get an idea about IIoT Architectures.
- To acquire the knowledge about various Network Protocols.
- To extract the backend Middleware Protocols.

UNIT I INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS 9

The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Support System for Industry 4.0, Intelligent Devices – Industrial Internet.

UNIT II IMPLEMENTATION SYSTEM FOR IIoT 9

Various types of Sensors and Actuators in Industries, IoT Sensors, Cyber Physical Systems – Wireless technology – IP Mobility, Cloud and Fog - Big Data and Analytics – M2M, SCADA, RFID, Cypher

Physical Systems and Artificial Intelligence., Wireless sensor nodes with Bluetooth, Wi-Fi and LoRa Protocols, CoAP –Wireless.

UNIT III IOT MONITORING, CONTROL AND ARCHITECTURE 9

Industrial Internet architecture , Industrial IoT Gateway, IoT Edge System and its programming, Cloud Computing, Dashboard for data monitoring, Data analytics.

UNIT IV MIDDLEWARE, CLOUD AND TRANSPORT PROTOCOLS 9

The Cloud types; IaaS, PaaS, SaaS, TCP/IP, UDP, RTP, CoAP –Middleware Software patterns –Software Design patterns – Application Programming Interface (API), Web Services – Middleware IIoT.

UNIT V INDUSTRIAL IOT APPLICATION 9

Healthcare, Drug delivery systems, Fleet management application, Smart Building, Industrial quality control, Plant maintenance, safety and security.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able

CO1: To Know about the concepts of Industrial IoT.

CO2: To Understand about implementation of IIoT.

CO3: To Monitor and control the IIoT architecture and its application.

CO4: To Understand the middleware of IIoT.

CO5: To Understand the Concepts of IIoT.

TEXTBOOKS:

1. Honbo Zhou, “Internet of Things in the cloud: A middleware perspective”, CRC press, 2012. (Unit I, II, III).

2. Industry 4.0: The Industrial Internet of Things Alasdair GilchristPublications: Apress. (Unit I).

3. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015(Unit III, IV, V).

4. S. Misra, A. Mukherjee, and A. Roy, Introduction to IoT. Cambridge University Press, 2020. (Unit III, IV, V).

REFERENCE BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020.

2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011.

3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.

4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014.

5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd EditionScitech Publishers, 2014.

6. The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	1	2	-	-	-	-	-	2	3	1	1
2	3	2	2	2	1	2	-	-	-	-	-	2	3	1	1
3	3	2	2	2	2	2	-	-	-	-	-	2	3	1	1
4	3	2	3	2	3	2	-	-	-	-	-	2	3	1	1
5	3	3	3	3	3	3	-	-	-	-	-	1	3	1	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

EC23M05 IOT PROTOCOLS L T P C

3 0 0 3

COURSE OBJECTIVE

- To familiarize the basic concepts of IoT and its comparison with related paradigms.
- To gain Knowledge of IoT Connectivity Technologies.
- To Understand IoT Communication technologies.
- To develop Insights into IoT Interoperability.
- To explore Cloud Computing in IoT Ecosystems.

UNIT I EMERGENCE OF IOT 9

Introduction, Evaluation of IoT – IoT Versus M2M, IoT versus CPS, IoT versus WoT, Enabling IoT and complex interdependence of technologies, IoT networking components, Addressing strategies in IoT.

UNIT II IOT CONNECTIVITY TECHNOLOGIES 9

RFID , NFC, Wi-Fi, Bluetooth low energy, IEEE 802.15.4, Zigbee, Thread, Wireless HART, Z-Wave, LoRa, NB-IoT.

UNIT III IOT COMMUNICATION TECHNOLOGIES 9

Introduction, Constrained nodes, Constrained networks, Types of constrained devices, Low power and lossy networks, Infrastructure protocols, Internet protocol version 6 (IPv6), RPL,6LoWPAN, Content-centric networking (CCN), Discovery Protocols, Physical web, Multicast DNS (mDNS), Universal plug and play (UPnP), Data Protocols, MQTT, CoAP, AMQP, XMPP, REST, WebSocket, Identification Protocols, EPC, URIs, Device Management, Semantic Protocols, JSON-LD, Web thing model.

UNIT IV IOT INTEROPERABILITY 9

Introduction, Taxonomy of interoperability, Standards, DLNA, Konnex, UPnP, Frameworks, universal, IoTivity, HomeKit.

UNIT V CLOUD COMPUTING 9

IOT Associated Technologies: Introduction, Virtualization, Advantages of virtualization, Types of virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Importance of SLA, Metrics for SLA, Cloud Implementation, Cloud simulation, An open-source cloud: OpenStack, A commercial cloud: Amazon web services(AWS), Sensor-Cloud: Sensors-as-a-Service, Importance of sensor-cloud, Architecture of a sensor-cloud platform.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able

CO1: To Understand the Evolution and Concepts of IoT.

CO2: To Comprehend IoT Networking and Connectivity Technologies.

CO3: To Evaluate IoT Communication Technologies.

CO4: To Address IoT Interoperability Challenges.

CO5: To Explore Cloud Computing in the Context of IoT.

TEXTBOOK:

1. Sudip Mishra, Anandarup Mukherjee, Arijit Roy: Introduction to IOT, Cambridge University Press. (Unit I-V).

REFERENCE BOOKS:

1. Hanes et al "IoT Fundamentals", Cisco Press.
2. Rahul Dubey, "An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications", Cengage India Publication.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012.
4. RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, Internet of Things, John Wiley and Sons.
5. Klaus Elk, "Embedded Software for the IoT".
6. Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed". Elizabeth Gootman et. al, "Designing Connected Products", Shroff Publisher/O"Reilly Publisher.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	2	2	2	2	2	-	-	1	-	-	-	1	1	1	1
2	3	3	2	2	3	-	-	1	-	-	-	2	1	2	1
3	3	3	3	2	3	-	-	2	-	-	-	2	2	2	1
4	3	3	3	3	3	-	-	2	-	-	-	2	2	2	1
5	3	3	3	3	3	-	-	2	-	-	-	2	1	2	1

1 - low, 2 - medium, 3 - high, '-' - no correlation

EC23M06	SENSOR TECHNOLOGIES AND IOT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

- To understand the fundamental concepts of sensors and their working principles.
- To explore different sensor technologies and their integration into IoT systems.
- To gain knowledge of IoT architecture, protocols, and communication technologies.
- To learn about real-world IoT applications in various domains.
- To address challenges in IoT deployment, including security, scalability, and energy efficiency.

UNIT I INTRODUCTION TO SENSOR TECHNOLOGY 9

Definition and classification of sensors – Working principles: Mechanical, thermal, optical, chemical, and biological sensors – Sensor specifications: Sensitivity, accuracy, resolution, range – Signal conditioning techniques: Amplification, filtering, and analog-to-digital conversion – Interfacing sensors with microcontrollers and IoT platforms – Latest advancements in sensor technology.

UNIT II IOT FUNDAMENTALS AND ARCHITECTURE 9

IoT characteristics and ecosystem – IoT enabling technologies: Cloud computing, big data, and artificial intelligence – IoT architecture layers: Perception, network, and application layers – Communication protocols for IoT: MQTT, CoAP, HTTP, and WebSocket – Edge and fog computing concepts in IoT – Introduction to interoperability and standardization in IoT systems.

UNIT III SENSORS IN IOT SYSTEMS 9

Integration of sensors with IoT platforms – Sensor networks and data acquisition – Wireless sensor networks (WSNs): Architecture and protocols – Low-power wireless communication technologies: Zigbee, LoRa, BLE, NB-IoT – Power management techniques for sensor nodes – Examples of sensor-enabled IoT applications: Smart homes, environmental monitoring, and healthcare.

UNIT IV IOT APPLICATIONS AND CHALLENGES 9

Applications of IoT: Industrial IoT (IIoT), smart cities, agriculture, healthcare, and transportation – Design and deployment of IoT systems for specific use cases – Challenges in IoT: Scalability, interoperability, and energy efficiency – Security in IoT: Threats, vulnerabilities, and solutions – Emerging trends in IoT: Blockchain, AI integration, and digital twins.

UNIT V IOT TOOLS AND PLATFORMS 9

Overview of IoT development platforms: Arduino, Raspberry Pi, and ESP32 – Sensor interfacing and data acquisition using IoT platforms – Cloud platforms for IoT: AWS IoT, Google Cloud IoT, and Microsoft Azure IoT Hub – Programming techniques and libraries for IoT development – Integration of cloud services with IoT platforms for data visualization and analytics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able

CO1: To Understand the working principles and characteristics of various sensors.

CO2: To Explain IoT architecture and protocols for communication and data handling.

CO3: To Design and implement sensor-based IoT systems for diverse applications.

CO4: To Analyze challenges in IoT deployment, including security and scalability.

CO5: To Utilize IoT development platforms and tools to build practical solutions.

TEXTBOOKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things: A Hands-On Approach," Universities Press, 2014. (UNIT I-V).
2. "Wireless Sensor Networks: Technology, Protocols, and Applications" by K. Akkaya and M. Younis (2005).(UNIT I,III).

REFERENCE BOOKS:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles," McGraw Hill, 2017.
2. Ovidiu Vermesan and Peter Friess, "Internet of Things – From Research and Innovation to Market Deployment," River Publishers, 2014.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications," Wiley, 2013.
4. Jan Holler et al., "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence," Academic Press, 2014.
5. Cuno Pfister, "Getting Started with the Internet of Things," O'Reilly Media, 2011.

COs-POs & PSOs MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
1	3	2	1	-	1	-	-	-	-	-	-	2	3	2	1
2	3	3	2	2	2	-	-	-	-	-	-	2	3	3	2
3	3	3	3	3	2	-	-	-	-	-	-	2	3	3	3
4	3	3	2	3	3	2	2	-	-	-	-	3	3	3	3
5	3	2	3	3	3	-	-	-	2	2	1	3	3	3	3

1 - low, 2 - medium, 3 - high, '-' - no correlation