JANSONS INSTITUTE OF TECHNOLOGY

(Autonomous)

Accredited by NAAC 'A Grade' and ISO 9001: 2015 Certified Institution
Approved by AICTE and Affiliated to Anna University
Coimbatore – 641 659, Tamil Nadu, India.

B.E. – MECHANICAL ENGINEERING

Curriculum and Syllabi

(Regulations 2024)

Jansons Institute of Technology

(Autonomous)
Regulations 2024
Choice Based Credit System
B.E Mechanical Engineering
Curriculum and Syllabi for Semesters I to VIII (Batch 2024-2028)

Programme Educational Objectives (PEOs)

Graduates of the Programme will

PEO1	Graduates will be practitioners in the design, manufacturing, service, and process industries.
PEO2	Graduates will pursue higher education, be involved in research or become entrepreneurs.
PEO3	Graduates will be ethically and socially responsible and contribute to society and the country.

Program Outcomes (POs)

PO01	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO02	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO03	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO04	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PE05	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO06	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO07	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO08	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO09	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

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

Program Specific Outcomes (PSOs)

On successful completion of the degree programme, the graduates shall exhibit,

PS01	To apply the knowledge gained in Mechanical Engineering for design, development and manufacture of engineering systems.
PS02	To pertain the knowledge acquired to investigate complex problems in mechanical engineering with due consideration for environmental and social impacts.
PS03	To exercise the emerging technologies in the field of mechanical engineering for effective management of multidisciplinary projects.

Summary

Subject Area	I	II	III	IV	V	VI	VII	VIII	Credits
HS	4	3				3			**10**
BS	12	10	4	3					**29**
ES	6	3	4						**13**
EE	2	3	3		1	1	4	7	**21**
PC		2	12	22	12	12			**60**
PE					9	6			**15**
OE						3	12		**15**
Total	**24**	**21**	**23**	**25**	**22**	**25**	**16**	**7**	**163**
Mandatory Course					✓	✓	✓		

Mandatory Induction Programme

Sl. No.	Course Code	Course Title	Category	Periods per Week L	T	P	Contact Hours	Credits
1	U24IP0101	Induction Programme						--

Semester - I

Sl. No.	Course Code	Course Title	Category	Periods per Week L	T	P	Contact Hours	Credits
Theory Courses								
1	U24HS1101	Professional English - I	HS	3	0	0	3	3
2	U24MA2101	Matrices and Calculus	BS	3	1	0	4	4
3	U24PH2101	Engineering Physics	BS	3	0	0	3	3
4	U24CY2101	Engineering Chemistry	BS	3	0	0	3	3
5	U24GE3003	Engineering Graphics	ES	2	2	0	4	4
6	U24GE1101	தமிழர் மரபு /Heritage of Tamils	HS	1	0	0	1	1
Practical Courses								
7	U24GE3004	Engineering Practices Laboratory	ES	0	0	4	4	2
8	U24GE2101	Physics and Chemistry Laboratory	BS	0	0	4	4	2
9	U24HS7101	English Laboratory	EE	0	0	2	2	1
10	U24GE7101	Design Thinking for Innovation	EE	0	0	2	2	1
			Total	**15**	**3**	**12**	**30**	**24**

Semester – II

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24HS1201	Professional English - II	HS	2	0	0	2	2
2	U24MA2202	Transforms and Partial Differential Equations	BS	3	1	0	4	4
3	U24PH2204	Materials Science	BS	3	0	0	3	3
4	U24ME3201	Engineering Mechanics	BS	3	0	0	3	3
5	U24GE1201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	0	0	1	1
Theory cum Laboratory Courses								
6	U24GE3201	Python Programming	ES	2	0	2	4	3
Practical Courses								
7	U24ME4201	Computer Aided Machine Drawing	PC	0	0	4	4	2
8	U24GE7201	Communication Laboratory	EE	0	0	4	4	2
9	U24GE7202	Fundamentals of Entrepreneurship and Startup	EE	0	0	2	2	1
10		Foreign Language^	EE	0	0	2	2	1#
			Total	**14**	**1**	**12**	**27**	**21**

^Japanese / German

 # 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 L	T	P	Contact Hours	Credits
Theory Courses								
1	U24MA2201	Statistics and Numerical Methods	BS	3	1	0	4	4
2	U24ME4301	Engineering Thermodynamics	PC	3	0	0	3	3
3	U24ME4302	Manufacturing Processes	PC	3	0	0	3	3
Theory cum Laboratory Courses								
4	U24ME4303	Fluid Mechanics and Machinery	PC	3	0	2	5	4
5	U24EC3307	Electrical Drives and Controls	ES	3	0	2	5	4
Practical Courses								
6	U24ME4304	Manufacturing Technology Laboratory	PC	0	0	4	4	2
7	U24GE7301	Professional Development	EE	0	0	2	2	1
8	U24GE7302	Product development / Process design	EE	0	0	2	2	1
9	U24ME7301	Technical Seminar	EE	0	0	2	2	1
			Total	**15**	**1**	**14**	**30**	**23**

***Additional courses for lateral entry students**

***Additional Courses**

1	U24GE1101	தமிழர் மரபு /Heritage of Tamils	HS	1	0	0	1	1

Semester – IV

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24ME4401	Theory of Machines	PC	3	0	0	3	3
2	U24ME4402	Thermal Engineering	PC	3	0	0	3	3
3	U24ME4403	Applied Hydraulics and Pneumatics	PC	3	0	0	3	3
4	U24ME4404	Machine Tool Technology	PC	3	0	0	3	3
5	U24CY2401	Environmental Sciences, Climate Change and Sustainability	BS	3	0	0	3	3
Theory cum Laboratory Courses								
6	U24ME4405	Strength of Materials	PC	3	0	2	5	4
Practical Courses								
7	U24ME4406	Kinematics and Dynamics Laboratory	PC	0	0	4	4	2
8	U24ME4407	Thermal Engineering Laboratory	PC	0	0	4	4	2
9	U24ME4408	CAD Modeling and CAM laboratory	PC	0	0	4	4	2
Total				**18**	**0**	**14**	**32**	**25**

***Additional courses for lateral entry students**

***Additional Courses**

1	U24GE1201	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	0	0	1	1

Semester – V

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24ME4501	Design of Machine Elements	PC	3	0	0	3	3
2	U24ME4502	Heat and Mass Transfer	PC	3	0	0	3	3
3		Professional Elective I	PE	3	0	0	3	3
4		Professional Elective II	PE	3	0	0	3	3
5		Professional Elective III	PE	3	0	0	3	3
6		Mandatory Course - I	MC	3	0	0	3	0
Theory cum Laboratory Courses								
7	U24ME4503	Metrology and Measurements	PC	3	0	2	5	4
Practical Courses								
8	U24ME4504	Heat Transfer Laboratory	PC	0	0	4	4	2
9	U24ME7501	Summer Internship - I	EE	-	-	-	-	1
Total				**21**	**0**	**6**	**27**	**22**

Semester – VI

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1	U24ME4601	Design of Transmission Systems	PC	3	0	0	3	3
2	U24ME4602	Mechatronics and IoT	PC	3	0	0	3	3
3	U24GE1601	Professional Ethics	HS	3	0	0	3	3
4		Professional Elective IV	PE	3	0	0	3	3
5		Professional Elective V	PE	3	0	0	3	3
6		Open Elective I	OE	3	0	0	3	3
7		Mandatory Course II	MC	3	0	0	3	0
Theory cum Laboratory Courses								
8	U24ME4603	Finite Element Analysis	PC	3	0	2	5	4
Practical Courses								
9	U24ME4604	Mechatronics and IoT Laboratory	PC	0	0	4	4	2
10	U24ME7601	FABLAB	EE	0	0	2	2	1
Total				**24**	**0**	**8**	**32**	**25**

Semester – VII

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Theory Courses								
1		Open Elective II	OE	3	0	0	3	3
2		Open Elective III	OE	3	0	0	3	3
3		Open Elective IV	OE	3	0	0	3	3
4		Open Elective V	OE	3	0	0	3	3
5		Mandatory Course III	MC	3	0	0	3	0
Practical Courses								
6	U24ME7701	Project Work - Phase I	EE	0	0	6	6	3
7	U24ME7702	Summer Internship - II	EE	-	-	-	-	1
Total				**15**	**0**	**6**	**21**	**16**

Semester – VIII

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
Practical Courses								
1	U24ME7801	Project Work – Phase II / Internship / Apprenticeship	EE	0	0	14	14	7
Total				**0**	**0**	**14**	**14**	**7**

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List of Foreign Language Courses

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1.	U24GE7203	Deutsch – I	EE	0	0	2	2	1*
2.	U24GE7204	Japanese – I	EE	0	0	2	2	1*

* Students can choose either Japanese or German

List of Mandatory Courses

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CY8501	Disaster Risk Reduction and Management	MC	3	0	0	3	0
2	U24GE8506	Industrial Safety	MC	3	0	0	3	0
3	U24HS8501	Elements of Literature	MC	3	0	0	3	0
4	U24GE8503	History of Science and Technology in India	MC	3	0	0	3	0
5	U24GE8502	Well-being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
6	U24GE8505	State, Nation Building and Politics in India	MC	3	0	0	3	0
7	U24GE8501	Introduction to Women and Gender Studies	MC	3	0	0	3	0
8	U24MA8501	Exploring Vedic Mathematics	MC	3	0	0	3	0
9	U24MA8502	Fundamentals of Astrology	MC	3	0	0	3	0

Professional Elective Courses - Verticals

Registration of Professional Elective Courses from Verticals:

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6	VERTICAL 7	VERTICAL 8
PRODUCT AND PROCESS DEVELOPMENT	**ROBOTICS AND SMART SYSTEMS**	**SUSTAINABLE MANUFACTURING**	**MECHANICAL DESIGN**	**ENERGY GENERATION**	**INDUSTRIAL SYSTEMS AND MANAGEMENT**	**DIVERSIFIED COURSES GROUP 1**	**DIVERSIFIED COURSES GROUP 2**
Product Life Cycle Management	Computer Integrated Manufacturing	Green Manufacturing Design and Practices	CAD/CAM	Solar Power System	Operational Research	Automobile Engineering	Precision Engineering
Value Engineering	Robotics	Polymer Composites	Design Codes and Standards	Renewable Energy Production	Maintenance Engineering	Refrigeration and Air Conditioning	NDT Techniques
3D Additive Manufacturing	Smart Mobility and Intelligent Vehicles	Lean Manufacturing	Design Concepts in Engineering	Energy Conservation in Industries	Green Supply Chain Management	Engineering Economics and Financial Account	Principles of Management
Integrated Product Design and Development	Aerial Robotics	Digital Transformations and Digital Twins	Design for X	Hydrogen Energy Generation	Entrepreneurship and Startup Development	Material Handling Equipment	Industrial Management
Process Planning and Cost Estimation	Industrial Automation Systems	Industry 4.0	Design of Pressure Vessels	Bio mass Energy	Industrial Engineering and Tools	Non-traditional Machining Processes	Quality Systems Engineering
Surface Engineering	Intelligent Process Automation	Micro Manufacturing	Ergonomics in Design	Power Plant Engineering	Total Quality Management	Electric Vehicles	Inventory Production Planning and Control

Vertical – 1 : PRODUCT AND PROCESS DEVELOPMENT

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5A01	Product Life Cycle Management	PE	3	0	0	3	3
2	U24ME5A02	Value Engineering	PE	3	0	0	3	3
3	U24ME5A03	3D Additive Manufacturing	PE	3	0	0	3	3
4	U24ME5A04	Integrated Product Design and Development	PE	3	0	0	3	3
5	U24ME5A05	Process Planning and Cost Estimation	PE	3	0	0	3	3
6	U24ME5A06	Surface Engineering	PE	3	0	0	3	3

Vertical – 2 : ROBOTICS AND SMART SYSTEMS

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5B01	Computer Integrated Manufacturing	PE	3	0	0	3	3
2	U24ME5B02	Robotics	PE	3	0	0	3	3
3	U24ME5B03	Smart Mobility and Intelligent Vehicles	PE	3	0	0	3	3
4	U24ME5B04	Aerial Robotics	PE	3	0	0	3	3
5	U24ME5B05	Industrial Automation Systems	PE	3	0	0	3	3
6	U24ME5B06	Intelligent Process Automation	PE	3	0	0	3	3

Vertical – 3 : SUSTAINABLE MANUFACTURING

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5C01	Green Manufacturing Design and Practices	PE	3	0	0	3	3
2	U24ME5C02	Polymer Composites	PE	3	0	0	3	3
3	U24ME5C03	Lean Manufacturing	PE	3	0	0	3	3
4	U24ME5C04	Digital Transformations and Digital Twins	PE	3	0	0	3	3
5	U24ME5C05	Industry 4.0	PE	3	0	0	3	3
6	U24ME5C06	Micro Manufacturing	PE	3	0	0	3	3

Vertical – 4 : MECHANICAL DESIGN

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5D01	CAD/CAM	PE	3	0	0	3	3
2	U24ME5D02	Design Codes and Standards	PE	3	0	0	3	3
3	U24ME5D03	Design Concepts in Engineering	PE	3	0	0	3	3
4	U24ME5D04	Design for X	PE	3	0	0	3	3
5	U24ME5D05	Design of Pressure Vessels	PE	3	0	0	3	3
6	U24ME5D06	Ergonomics in Design	PE	3	0	0	3	3

Vertical – 5 : ENERGY GENERATION

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5E01	Solar Power System	PE	3	0	0	3	3
2	U24ME5E02	Renewable Energy Production	PE	3	0	0	3	3
3	U24ME5E03	Energy Conservation in Industries	PE	3	0	0	3	3
4	U24ME5E04	Hydrogen Energy Generation	PE	3	0	0	3	3
5	U24ME5E05	Bio mass Energy	PE	3	0	0	3	3
6	U24ME5E06	Power Plant Engineering	PE	3	0	0	3	3

Vertical – 6 : INDUSTRIAL SYSTEMS AND MANAGEMENT

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5F01	Operational Research	PE	3	0	0	3	3
2	U24ME5F02	Maintenance Engineering	PE	3	0	0	3	3
3	U24ME5F03	Green Supply Chain Management	PE	3	0	0	3	3
4	U24ME5F04	Entrepreneurship and Startup Development	PE	3	0	0	3	3
5	U24ME5F05	Industrial Engineering and Tools	PE	3	0	0	3	3
6	U24ME5F06	Total Quality Management	PE	3	0	0	3	3

Vertical – 7 : DIVERSIFIED COURSES GROUP 1

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5G01	Automobile Engineering	PE	3	0	0	3	3
2	U24ME5G02	Refrigeration and Air Conditioning	PE	3	0	0	3	3
3	U24ME5G03	Engineering Economics and Financial Account	PE	3	0	0	3	3
4	U24ME5G04	Material Handling Equipment	PE	3	0	0	3	3
5	U24ME5G05	Non-traditional Machining Processes	PE	3	0	0	3	3
6	U24ME5G06	Electric Vehicles	PE	3	0	0	3	3

Vertical – 8 : DIVERSIFIED COURSES GROUP 2

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24ME5H01	Precision Engineering	PE	3	0	0	3	3
2	U24ME5H02	NDT Techniques	PE	3	0	0	3	3
3	U24ME5H03	Principles of Management	PE	3	0	0	3	3
4	U24ME5H04	Industrial Management	PE	3	0	0	3	3
5	U24ME5H05	Quality Systems Engineering	PE	3	0	0	3	3
6	U24ME5H06	Inventory Production Planning and Control	PE	3	0	0	3	3

List of Open Elective Courses

Sl. No.	Course Code	Course Title	Category	Periods per Week L	T	P	Contact Hours	Credits
1.	U24CE6604	Foundation Skills in Integrated product Development	OE	3	0	0	3	3
2.	U24CE6606	Geographical Information System	OE	3	0	0	3	3
3.	U24CE6602	Remote Sensing Concepts	OE	3	0	0	3	3
4.	U24CE6601	Applied Design Thinking	OE	3	0	0	3	3
5.	U24EC6602	Drone Technologies	OE	3	0	0	3	3
6.	U24EC6603	Wearable Technology	OE	3	0	0	3	3
7.	U24EC6604	Medical Informatics	OE	3	0	0	3	3
8.	U24EC6606	Sixth Generation Wireless Technology	OE	3	0	0	3	3
9.	U24EC6607	High speed wireless Communication Networks	OE	3	0	0	3	3
10.	U24EC6605	IoT Concepts and Applications	OE	3	0	0	3	3
11.	U24CY6602	Renewable Energy Systems	OE	3	0	0	3	3
12.	U24GE6601	Intellectual Property Rights	OE	3	0	0	3	3
13.	U24CY6601	Universal Human Values	OE	3	0	0	3	3
14.	U24GE6604	Community Engagement and Social Responsibility	OE	3	0	0	3	3
15.	U24MA6604	Resource Management Techniques	OE	3	0	0	3	3
16.	U24GE6602	IT in Agricultural Systems	OE	3	0	0	3	3
17.	U24PH6602	Nano Technology	OE	3	0	0	3	3
18.	U24AD6603	Augmented Reality /Virtual Reality Technology	OE	3	0	0	3	3
19.	U24AD6602	Artificial Intelligence and Machine Learning Fundamentals	OE	3	0	0	3	3
20.	U24CS6601	Digital Marketing Essentials	OE	3	0	0	3	3

VERTICALS FOR MINOR DEGREE

Registration of Minor Degree Elective Courses from Verticals:

VERTICAL 1	VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management for Business	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

Vertical – 1 : FINTECH AND BLOCK CHAIN

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CB5V01	Financial Management	PE	3	0	0	3	3
2	U24CB5V02	Fundamentals of Investment	PE	3	0	0	3	3
3	U24CB5V03	Banking, Financial Services and Insurance	PE	3	0	0	3	3
4	U24CB5V04	Introduction to Blockchain and its Applications	PE	3	0	0	3	3
5	U24CB5V05	Fintech Personal Finance and Payments	PE	3	0	0	3	3
6	U24CB5V06	Fintech	PE	3	0	0	3	3

Vertical – 2 : ENTREPRENEURSHIP

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CB5W01	Foundations of Entrepreneurship	PE	3	0	0	3	3
2	U24CB5W02	Team Building and Leadership Management for Business	PE	3	0	0	3	3
3	U24CB5W03	Creativity and Innovation in Entrepreneurship	PE	3	0	0	3	3
4	U24CB5W04	Principles of Marketing Management for Business	PE	3	0	0	3	3
5	U24CB5W05	Human Resource Management for Entrepreneurs	PE	3	0	0	3	3
6	U24CB5W06	Financing New Business Ventures	PE	3	0	0	3	3

Vertical – 3 : PUBLIC ADMINISTRATION

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE5X01	Principles of Public Administration	PE	3	0	0	3	3
2	U24GE5X02	Constitution of India	PE	3	0	0	3	3
3	U24GE5X03	Public Personnel Administration	PE	3	0	0	3	3
4	U24GE5X04	Administrative Theories	PE	3	0	0	3	3
5	U24GE5X05	Indian Administrative System	PE	3	0	0	3	3
6	U24GE5X06	Public Policy Administration	PE	3	0	0	3	3

Vertical – 4 : BUSINESS DATA ANALYTICS

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24CB5Y01	Statistics for Management	PE	3	0	0	3	3
2	U24CB5Y02	Data mining for Business Intelligence	PE	3	0	0	3	3
3	U24CB5Y03	Human Resource Analytics	PE	3	0	0	3	3
4	U24CB5Y04	Marketing and Social Media Web Analytics	PE	3	0	0	3	3
5	U24CB5Y05	Operation and Supply Chain Analytics	PE	3	0	0	3	3
6	U24CB5Y06	Financial Analytics	PE	3	0	0	3	3

Vertical – 5 : ENVIRONMENT AND SUSTAINABILITY

Sl. No.	Course Code	Course Title	Category	Periods per Week			Contact Hours	Credits
				L	T	P		
1	U24GE5Z01	Sustainable infrastructure Development	PE	3	0	0	3	3
2	U24GE5Z02	Sustainable Agriculture and Environmental Management	PE	3	0	0	3	3
3	U24GE5Z03	Sustainable Bio Materials	PE	3	0	0	3	3
4	U24GE5Z04	Materials for Energy Sustainability	PE	3	0	0	3	3
5	U24GE5Z05	Green Technology	PE	3	0	0	3	3
6	U24GE5Z06	Environmental Quality Monitoring and Analysis	PE	3	0	0	3	3
7	U24GE5Z07	Integrated Energy Planning for Sustainable Development	PE	3	0	0	3	3
8	U24GE5Z08	Energy Efficiency for Sustainable Development	PE	3	0	0	3	3

U24IP0101 - INDUCTION PROGRAMME

1. Student Induction Programme - Purpose & Concept

This is a 3-week long induction programme for the UG students entering the institution, right at the start. Purpose of the Student Induction Programme is to help new students adjust and feel comfortable in the new environment, inculcate in them the ethos and culture of the institution, help them build bonds with other students and faculty members, and expose them to a sense of larger purpose and self-exploration.

The term induction is a well-planned event to educate the new entrants about the environment in a particular institution, and connect them with the people in it. The Student Induction Programme engages with the new students as soon as they come into the institution; regular classes start only after that.

The time during the Induction Programme is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it. These are included under Proficiency Modules. Its purpose 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.

2. Daily Activity

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

2.1 Physical Activity

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health.

2.2 Creative Arts

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

2.3 Mentoring and Universal Human Values

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and make decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity.

Students are educated in Universal human Values in 3 modules. First module comprises Basic Aspirations and Self-Management and the second module includes Harmony in the Family and Health. The last module preaches Harmony in the Society and Nature. It is best taught through group discussions and real-life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each.

2.4 Introduction to Sustainable Development Goals (SDG)

Students are encouraged to gain knowledge in accepting the need for Sustainable Development Goals. The students are enlightened on the SDGs which give a comprehensive framework of goals and targets with which students understand the complexity of the actions we must take to achieve development that is sustainable across social, environmental, economic aspects and over time.

3. Other Activity

Below activities are not there on a daily basis, but are conducted for 3-4 days.

3.1 Familiarization with College, Department/Branch

The incoming students will be told about the credit and grading system, and about the examinations. They would be informed about how study in college differs from study in school. They shall be taken on a tour of the college and shown important points such as the library, canteen, laboratories, workshops and other facilities.

They would be shown their respective department, and told what it means to get into the branch or department. Students would be described about what role the technology related to their department plays in society and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the department would be carried out which would be very helpful in this regard. The above activity would be done right in the first two days, and then over the afternoons thereafter, as appropriate.

3.2 Department Specific Activities

Activities such as games, quizzes, social interactions, small experiments, design thinking etc., that are relevant to the particular branch of Engineering are introduced to kindle interest in building things in that particular field. For example, CSE, CSBS and AI&DS students would be given activities that kindle computational thinking and ECE students would be introduced to build simple circuits as an extension of their knowledge in science and so on.

3.3 Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

3.4 Proficiency Modules

The induction programme period is used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These activities are run like crash courses, so that when normal courses start after the induction programme, the student would have overcome the lacunas substantially. The problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

3.5 Lectures & Workshops by Eminent People

Lectures by eminent people would be organized, once a week. It would give the students, exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni would be invited as well. Motivational lectures about life, meditation, etc. would be organized.

3.6 Visits in Local Area

A couple of visits to the local landmarks including will be organized which would familiarize the students with the area together with bonding with each other, like in a picnic. Visits would also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

3.7 Extra-Curricular Activities in College

The new students shall be introduced to the extra-curricular activities at the college/university. They would be shown the facilities and informed about activities related to different clubs etc. Selected senior students will be involved in leading these activities by giving presentations, under faculty supervision.

3.8 Feedback and Report on the Programme

Students would be asked to give their mid-programme feedback. They should write their opinions about the programme at the end of the first week or so. The feedback would be used to make any mid-course correction, if any. At the end of the programme, each group (of 20 students) would be asked to prepare a single report on their experiences of the programme. On the second last day, each group should present their report in front of other groups. Immediately after their presentation, they should submit their written report. This will also serve as a closure to the programme. Finally, online anonymous feedback would be collected at the end of the programme.

U24HS1101	PROFESSIONAL ENGLISH - I	L	T	P	C
		3	0	0	3
Course Objectives:	To improve the basic grammar, lexical, communicative competence of learners and develop learners' ability to use language in professional context.				
Unit - I	**INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**	**9**			
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).					
Unit - II	**NARRATION AND SUMMATION**	**9**			
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 –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.					
Unit - III	**DESCRIPTION OF A PROCESS / PRODUCT**	**9**			
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).					
Unit – IV	**CLASSIFICATION AND RECOMMENDATIONS**	**9**			
Reading – Newspaper articles; Journal reports and Nonverbal Communication (tables, pie charts etc). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from nonverbal (chart, graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.					
Unit - V	**EXPRESSION**	**9**			
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Relate appropriate words in a technical context.	K2
CO2	Interpret the fundamentals of basic grammatical structures.	K2
CO3	Infer the denotative and connotative meanings in professional context.	K2
CO4	Explain the information presented in tables, charts and other graphical representations.	K2
CO5	Outline editorials, narrations, and essays on various topics	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**3**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

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. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

Reference Books

1	Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2	A Course Book on Technical English by Lakshminarayanan, 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 Publishing House.
5	Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

U24MA2101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4
Course Objectives:	Integrate matrix algebra, calculus, and multivariable functions to address engineering challenges adeptly. Emphasize practical applications of integration techniques and multiple integrals. Equip students with indispensable mathematical proficiencies vital for engineering analysis.				

Unit - I	**MATRICES**	**9+3**
Types of matrices – System of equations – Characteristic equation – Eigenvalues and Eigenvectors of real matrices – Properties of Eigenvalues 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: Stretching of an elastic membrane.		
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: Hydrostatic force and pressure, moments and centre of mass.		
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 integrals – Applications: Moments and centre of mass, moment of inertia		
	Total Periods:	**60**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Apply the matrix algebra methods for solving real time problems.	K3
CO2	Utilize the differential calculus tools to solve engineering problems.	K3
CO3	Apply the differential calculus ideas in functions of several variables.	K3
CO4	Choose the different methods of integration for solving engineering problems.	K3
CO5	Make use of the multiple integrals in solving real-world issues such as areas and volumes.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3	James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.

Reference Books

1	Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016.
2	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
3	Jain. R. K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4	Narayanan.S. and Manicavachagom 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, 2016.
6	Srimantha Pal and Bhunia. S.C, "Engineering Mathematics", Oxford University Press, 2015.
7	Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

U24PH2101	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3
Course Objectives:	To enhance and apply the fundamental knowledge of Properties of matter, laser, optical fibre, thermal physics, Quantum physics, Optics and Ultrasonics and its applications relevant to various streams of Engineering and Technology.				

Unit - I	PROPERTIES OF MATTER	7
Interatomic Forces & Intermolecular Forces - Solid - Elasticity – Stress & strain diagram and its uses – types of stress & strain - Hooke's Law - Young's modulus, Bulk modulus, modulus of rigidity, Poisson's Ratio, Relation between the Three Moduli of Elasticity– factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple – torsion pendulum: theory and experiment – bending of beams – bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – I-shaped girders.		
Unit - II	**LASER AND FIBRE OPTICS**	**9**
Theory of laser - characteristics – Spontaneous and stimulated emission - Einstein 's A and B coefficients - derivation – resonant cavity, optical amplification (qualitative) – population inversion - CO2 laser, Nd-YAG laser, semiconductor laser – Basic applications of lasers in industry - 3D profiling, laser drilling and laser welding.Principle, numerical aperture and acceptance angle – types of optical fibres (material, refractive index, mode) – losses associated with optical fibres –Fibre optic communication system (Block diagram) - fibre optic sensors: pressure and displacement-Endoscope		
Unit - III	**THERMAL PHYSICS**	**9**
Transfer of heat energy (conduction, convection and radiation) – thermal expansion of solids and liquids – expansion joints – bimetallic strips – thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity – Forbe's method: thermal conductivity of good conductor and Lee's disc method: thermal conductivity of bad conductor : theory and experiment – conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers (qualitative) - refrigerators, ovens and solar water heaters.		
Unit – IV	**QUANTUM PHYSICS**	**11**
Wave particle duality – electron diffraction – Heisenberg's uncertainty principle - wave function and its operators, physical significance of wave function – Schrödinger's wave equation – time independent and time dependent equations – particle in a infinite potential well: 1D, 2D and 3D Boxes – Normalization, probabilities, Expectation values, Eigen values and Eigen functions - tunnelling (qualitative) – Scanning Tunnelling Microscope (STM) - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig -Penney model and origin of energy bands.		
Unit - V	**OPTICS AND ULTRASONICS**	**9**
Optics: Reflection and refraction of light waves - total internal reflection - interference – MichelsonInterferometer: construction and working to determine thickness of the thin transparent material - Theory of air wedge and experiment: determination of the thickness of thin wire.**Ultrasonics:**Production of ultrasonics by Magnetostriction and Piezoelectric method – Acoustic grating: Wavelength of ultrasonic waves – Non-destructive testing – Pulse echo system through transmission and reflection modes – Medical applications – Sonogram.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the basics of properties of matter and its applications.	K2
CO2	Apply the knowledge of laser and fibre optics principle in various fields.	K3
CO3	Illustrate the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.	K2
CO4	Explain the importance of quantum theory and its applications in tunnelling microscopes.	K2
CO5	Apply the concepts of optics in material property and ultrasonics in medical field.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	1	1	-	-
CO2	3	2	1	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	1	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	1	-	-	-	-	1	-	-	-
CO	**3**	**2**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Bhattacharya, D.K. & Poonam, T. —Engineering Physics. Oxford University Press, 2015
2	Gaur, R.K. & Gupta, S.L. —Engineering Physics. Dhanpat Rai Publishers, 2012
3	Pandey, B.K. & Chaturvedi, S. —Engineering Physics. Cengage Learning India,2012
4	Arumugam M. Engineering Physics. Anuradha publishers, 2010
5	Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011.
6	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
7	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw-Hill, 2017.

Reference Books

1	Halliday, D., Resnick, R. & Walker, J. —Principles of Physics. Wiley, 2015.
2	Serway, R.A. & Jewett, J.W. —Physics for Scientists and Engineers. Cengage Learning, 2010.
3	Tipler, P.A. & Mosca, G. —Physics for Scientists and Engineers with Modern Physics.
4	W.H.Freeman, 2007.4. Mani P. Engineering Physics I. Dhanam Publications, 2011.
5	Marikani A. Engineering Physics - PHI Learning Pvt., India, 2009.
6	K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

U24CY2101	ENGINEERING CHEMISTRY	L	T	P	C
		3	0	0	3
Course Objectives:	To understand water quality parameters in water treatment and corrosion prevention methods, outline the phases and significance of alloys, summarize fuels and combustion properties, explore the uses of energy storage devices, and impart knowledge in nanomaterial preparation methods.				

Unit - I	**WATER TECHNOLOGY**	**9**
Sources and impurities, Water quality parameters: Definition and significance of color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). 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 – Ion Exchange Demineralization and Zeolite process. Desalination of brackish water: Reverse Osmosis (RO)- Applications of RO in domestic and industrial purposes.		
Unit - II	**CORROSION AND ITS CONTROL**	**9**
Corrosion: Introduction - Mechanism of Corrosion - Chemical corrosion, Electrochemical corrosion - Differential Aeration corrosion - Pilling Bedworth rule - Factors influencing corrosion. Corrosion control- Cathodic Protection - Sacrificial Anodic Protection method - Impressed Current Cathodic Protection - Use of Inhibitors. **Protective coatings** - Metallic coatings - Anodic and Cathodic coatings - Methods of application of Metal coatings. Organic coatings - Paints, Varnishes, Emulsion paints, Special paints - Luminescent paint, Heat - resistant paint, Fire - retardant paint, Water repellent paint, Antifouling paint.		
Unit - III	**ALLOYS AND PHASE RULE**	**9**
Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – Heat treatment of steel.**Phase rule:** Introduction, definition of terms with examples, One component system -water system - Reduced phase rule - Thermal analysis and Cooling curves - Two Component System - Lead-Silver system – Pattinson's process.		
Unit – IV	**FUELS, COMBUSTION AND ENERGY STORAGE DEVICES**	**9**
Fuels and Combustion: Classification of fuels-Calorific value, units of heat, Gross and Net calorific values, problems on Calorific values. Coal- ranking of coal-Properties of coal- Carbonization-Manufacture of Metallurgical coke -Otto Hoffmann's by-product oven method. Petroleum-Refining of crude oil, Manufacture of Synthetic petrol (Bergius process), Knocking-Octane number and Cetane number. **Energy storage devices:** Types of batteries - Primary battery - dry cell, Secondary battery - Lead acid battery and Lithium-ion battery; Electric vehicles - working principle; Fuel cells: H_2-O_2 fuel cell, Microbial Fuel Cell (MFC).		
Unit - V	**NANOCHEMISTRY**	**9**
Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – Nanoparticle, Nanoclusters, Nanorods, Nanowire and Nanotube. Preparation of nanomaterials: Sol-gel, Solvothermal, Laser ablation, Chemical Vapour Deposition (CVD), Electrochemical deposition and Electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply suitable methodologies for water treatment using water quality parameters.	K3
CO2	Outline the different types of corrosion processes and preventive methods.	K2
CO3	Explain the relationship between phases and the selection of alloy materials.	K2
CO4	Interpret the knowledge of fuels in combustion technology and various energy storage devices.	K2
CO5	Infer the basic concepts of nanotechnology and the synthesis of nanomaterials.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	2	-	-	-	-	2	-	-	-
CO2	3	2	-	-	-	2	-	-	-	-	2	-	-	-
CO3	3	2	-	-	-	2	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	2	-	-	-	-	2	-	-	-
CO5	3	2	-	-	-	2	-	-	-	-	1	-	-	-
CO	**3**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	P. C. Jain and Monica Jain, “Engineering Chemistry”, 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2	Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3	S.S. Dara, “A Textbook of Engineering Chemistry”, S. Chand Publishing, 12th Edition, 2018.
4	O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.

Reference Books

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	T. Pradeep, “Nano: The Essentials: Understanding Nanoscience and Nanotechnology”, (2008) Tata McGraw-Hill Publishing Company Limited, New Delhi.
3	B.R.Puri, L.R.Sharma, M.S.Pathania.,"Principles of Physical Chemistry", Vishal Publishing Company ,2008.
4	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

U24GE3003	ENGINEERING GRAPHICS	L	T	P	C
		2	2	0	4
Course Objectives:	The main learning objective of this course is to prepare the students to acquaint the knowledge on Drawing Standards, projections of points, straight lines, plane surfaces, orthographic projection of solids, section of solids, development of lateral surfaces, isometric and perspective projections of simple solids, engineering curves and freehand sketch of simple objects.				

CONCEPTS AND CONVENTIONS 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	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**12**
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 by rotating object method.		
Unit - II	**PROJECTION OF SOLIDS**	**12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Practicing three-dimensional modeling of simple objects by CAD Software.		
Unit - III	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**12**
Sectioning of solids like prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three-dimensional modeling of simple objects by CAD Software.		
Unit – IV	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**12**
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.		
Unit - V	**PLANE CURVES AND FREEHAND SKETCHING**	**12**
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three-Dimensional objects — Layout of views - Freehand sketching of multiple views from pictorial views of objects.		
	Total Periods:	**60**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret orthographic projections of points, lines and plane surfaces.	K2
CO2	Illustrate the projection of solids placed in first quadrant	K2
CO3	Show the projections of sectioned solids and development of surfaces.	K2
CO4	Show the projections of isometric and perspective sections of simple solids.	K2
CO5	Interpret conic curves, involutes, cycloids and perform freehand sketching	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Natrajan K.V., "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
2	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2018.

Reference Books

1	Bhratt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53 Edition, 2019.
2	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
3	Gopalakrishna K.R., "Engineering Drawing" (Vol. I &II combined), Subhas Publications, Bangalore, 27th Edition, 2017.
4	Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5	Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 5th Edition, 2015.

Publication of Bureau of Indian Standards

1	IS 10711 — 2001: Technical products Documentation — Size and lay out of drawing sheets.
2	IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3	IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4	IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5	IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

U24GE1101	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

Course Objectives:	This course enables the students to provide an insight to the students into the rich culture and heritage of the state, to provide the students detailed information on the engineering techniques to construct architectural marvels practiced in Tamil Nadu and also to make the students connect with their roots, appreciate, and preserve it.

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, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
Unit – IV	**THINAI CONCEPT OF TAMILS**	**3**
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature- Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
Unit - V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		
	Total Periods:	**15**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the human values and rights in Tamil literature.	K2
CO2	Classify the art and culture being practiced by people of Tamil Nadu.	K2
CO3	Outline the various games and dance practices by people of Tamil Nadu.	K2
CO4	Explain the concepts of Sangam Literature and the bravery of Kings	K2
CO5	Summarise the life history of freedom fighters, Vedic herbs and developments in life	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	தமிழகவரலாறு – மக்களும்பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்கல்வியியல்பணிகள்கழகம்).
2	கணினித்தமிழ் – முனைவர். இல. சுந்தரம். (விகடன்பிரசுரம்).
3	கீழடி – வைகைநதிக்கரையில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறை வெளியீடு)
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல்துறைவெளியீடு)
4	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

Reference Books

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

U24GE3004	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.				

Exp. No	Title
GROUP – A (CIVIL & MECHANICAL)	
I - CIVIL ENGINEERING PRACTICE	
1	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) Laying pipe connection to the suction side of a pump d) Laying pipe connection to the delivery side of a pump. e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.
2	WOOD WORK: a) Sawing, b) Planning and c) 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
II - MECHANICAL ENGINEERING PRACTICE	
1	WELDING WORK: a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding b) Practicing gas welding and Basics
2	MACHINING WORK: a) Turning Operation b) Drilling Operation c) Tapping Operation
3	ASSEMBLY WORK: a) Assembling a centrifugal pump b) Assembling a household mixer c) Assembling an air conditioner
4	SHEET METAL WORK: a) Making of a square tray b) Making of a funnel
5	FOUNDRY WORK: a) Demonstrating basic foundry operations.
Total Periods :	**30**
GROUP B (ELECTRICAL & ELECTRONICS)	
III - ELECTRICAL ENGINEERING PRACTICE	
1	a) Residential house wiring using switches, fuse, indicator, lamp and energy meter. b) Fluorescent lamp wiring. c) Stair case wiring d) Measurement of energy using single phase energy meter. e) Measurement of resistance to earth of electrical equipment. f) Study of Iron Box wiring and assembly
IV - ELECTRONICS ENGINEERING PRACTICE	

1	a) Study of Electronic components and equipments – Resistor colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO. b) Study of logic gates AND, OR, EX-OR and NOT. c) Generation of Clock Signal. d) Soldering simple electronic circuits and checking continuity. e) Study the elements of smart phone.
Total Periods:	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Demonstrate various carpentry joints and plumbing connections.	K2
CO2	Identify welding tools, equipment and perform welding joints.	K2
CO3	Demonstrate simple machining process and sheet metal work.	K2
CO4	Demonstrate basic home electrical works, appliances and measure the electrical quantities.	K2
CO5	Infer the electronic components, logic gates, soldering and test simple electronic circuits.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO2	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO3	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO4	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO5	2	1	-	-	-	-	-	2	-	-	2	1	-	-
CO	2	1	-	-	-	-	-	2	-	-	2	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24GE2101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To make students understand and apply the basic concepts of properties of matter, light, sound, thermal properties, semiconductor physics and fibre optics by carrying out experiments. To inculcate experimental skills to test the water and to familiarize with the electro analytical techniques applied for quantitative analysis.				

PHYSICS LABORATORY

Exp. No	Title (Any seven experiments)
1	Torsional pendulum - Determination of rigidity modulus of wire.
2	Non-uniform bending - Determination of Young's modulus of the beam.
3	Uniform bending – Determination of Young's modulus of the beam.
4	Laser- Determination of the wavelength of the laser using grating.
5	Air wedge - Determination of thickness of a thin sheet/wire.
6	Optical fibre -Determination of Numerical Aperture and acceptance angle.
7	Ultrasonic Interferometer - Determination of velocity of ultrasonic waves in liquids.
8	Determination of thermal conductivity of a bad conductor – Lee's Disc method.
9	Determination of wavelength of mercury spectrum – spectrometer grating.
10	Determination of band gap of a semiconductor.
	Total Periods: **30**

CHEMISTRY LABORATORY

Exp. No	Title(Any seven experiments)
1	Determination of Total, Temporary & Permanent Hardness of Water by EDTA method.
2	Determination of Chloride Content of water sample by Argentometric method.
3	Determination of types and amount of Alkalinity in water sample.
4	Preparation of Na_2CO3 as a primary standard and Estimation of Acidity of a water sample using the primary standard solution.
5	Determination of Dissolved Oxygen (DO) content of water sample by Winkler's method.
6	Determination of strength and amount of the given Hydrochloric Acid by pH metric applications.
7	Determination of strength and amount of acids in a Mixture of Acids using Conductivity meter.
8	Conductometric titration of Barium Chloride against Sodium Sulphate (Precipitation Titration).
9	Estimation of Ferrous ion present in Ferrous Ammonium Sulphate (FAS) solution using Potentiometer.
10	Estimation of Iron content of the water sample using Spectrophotometer.
	Total Periods: **30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Extend the principles of elasticity and optics properties in engineering applications.	K2
CO2	Demonstrate the principles of sound in ultrasonic interferometer.	K2
CO3	Explain the thermal properties in engineering applications.	K2
CO4	Apply the knowledge of water quality parameters in water treatment through volumetric analysis.	K2
CO5	Interpret the amount of metal ions present in the solutions through Instrumental analysis.	K2
CO6	Infer the quantity of substances present in the solution by Electro Analytical Techniques.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	2	-	-	2	-	-	-
CO2	3	2	-	-	-	-	-	2	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	2	-	-	1	-	-	-
CO4	3	2	-	-	-	2	-	2	-	-	2	-	-	-
CO5	3	2	-	-	-	2	-	2	-	-	1	-	-	-
CO6	3	2	-	-	-	2	-	2	-	-	1	-	-	-
CO	**3**	**2**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**-**	**1**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Physics Laboratory Manual / Record, Department of Physics.
2	Bhattacharya D K and Poonam Tandon, “Engineering Physics”, 2nd Edition, Oxford University Press, Chennai, 2017
3	Marikani A, “Engineering Physics", 3rd edition, PHI publishers, Chennai, 2021.
4	Dr V.Veeraiyan, Dr L .Devaraj Stephan, “Chemistry Lab Manual “2021.
5	Engineering Chemistry Laboratory Manual / Record, Department of Chemistry.

Reference Books

1	Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", 2nd Edition, Pearson India Education Services Private Limited, Chennai, 2018
2	Avadhanulu M N, Kshirsagar P G, Arun Murthy TVS, “A Text book of Engineering Physics”, 2nd Edition, S Chand Publishing, New delhi, 2018.
3	Thyagaran K, Ajoy Ghatak, “Lasers - Fundamentals and Applications”, 2nd Edition, Laxmi Publications Pvt Limited, New Delhi, 2019.
4	J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, “Vogel’s Textbook of Quantitative Chemical Analysis” (2009).
5	Daniel C. Harris,” Quantitative Chemical Analysis” 2015.

U24HS7101	ENGLISH LABORATORY	L	T	P	C
		0	0	2	1
Course Objectives:	To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.				

Exp. No	Title
1	Telephone communication
2	Self-Introduction
3	Summarising a documentary
4	Mini Presentation
5	Product Description
6	Picture Comprehension
7	Ted Talks Report
8	Travelogue
9	Debates and Discussions
10	Just a Minute
Total Periods:	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Relate the fundamentals of communication.	K2
CO2	Explain different points of view in a discussion on various topics	K2
CO3	Illustrate products and processes based on their purpose	K2
CO4	Explain fluently and accurately in formal and informal communicative contexts	K2
CO5	Interpret their opinions effectively in both formal and informal discussions	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24GE7101	DESIGN THINKING FOR INNOVATION	L	T	P	C
		0	0	2	1
Course Objectives:	To understand innovation, stages involved in design thinking and use the different idea generation techniques in Design Thinking.				

Unit	Title	Periods
Unit - I	**HISTORY OF MODERN DESIGN**	**4**
Introduction to Engineering design, History of Modern design: Early innovations- industrialization, Global Innovation Index- Design Thinking and Innovation.		
Unit - II	**DESIGN THINKING APPROACHES**	**6**
Design thinking as a systematic approach to innovation, Three lenses of Design thinking, design challenges, product development-Case studies.		
Unit - III	**STAGES OF DESIGN THINKING**	**6**
Introduction – Empathize- Define- Ideate- Prototype- Test- Examples, constraints in design- Case studies.		
Unit – IV	**IDEA GENERATION TECHNIQUES**	**6**
Introduction -Creative Thinking-Idea Generation Techniques- brain storming, visual thinking, Mind Mapping- SCAMPER, Story boarding, Questioning Assumptions, Reverse Thinking- Case studies.		
Unit - V	**DESIGN THINKING AND INNOVATION**	**8**
Innovation, User Values and Behaviours-experimental mindset strategies for creativity, teams for innovation, design alternatives, decision making for new design. Concept Poster: Organize all information about an innovation concept to identify critical questions for prototyping. Project: Apply tools to your innovation problem or the provided scenario.		
	Total Periods:	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain early innovations in modern design history	K2
CO2	Classify design thinking approaches and applications.	K2
CO3	Illustrate stages and constraints of design thinking	K2
CO4	Interpret various idea generation techniques and applications	K2
CO5	Demonstrate innovation concepts and creative strategies with suitable techniques	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	1	-	-	-	1	-	2	2	-	2	-	-	-
CO3	2	1	-	-	-	2	-	2	2	-	2	-	-	-
CO4	2	1	-	-	-	1	-	2	2	-	2	-	-	-
CO5	2	1	-	-	-	2	-	2	2	-	2	-	-	-
CO	**2**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**2**	**-**	**2**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2	Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
3	Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.
4	Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Reference Books

1	"Design Thinking - A Primer"By Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras.
2	Design Thinking: A User-Centred Approach to Innovation. (2023). Dr. Harjinthar Singh, Dr. Khairul Anuar Abdul Wahid: Marc & Zed | PUBLISHING.
3	"Design Thinking - A Primer"By Prof. Ashwin Mahalingam, Prof. Bala Ramadurai, IIT Madras. Swayan NPTEL course.
4	Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
5	Handbook of Design Thinking: Tips & Tools for how to design thinking by Christian Mueller Roterberg, Kindle Direct Publishing.

U24HS1201	PROFESSIONAL ENGLISH - II		L	T	P	C
			2	0	0	2
Course Objectives:	To improve the basic grammar with reading, writing and analytical thinking skills in comprehending documents through professional context which demonstrate an understanding of job application, interviews for internship and placements.					
Unit - I	**MAKING COMPARISONS**			**6**		
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases.						
Unit - II	**EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING**			**6**		
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds						
Unit - III	**BUSINESS COMMUNICATION**			**6**		
Technical Synonyms and Antonyms, Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).						
Unit – IV	**REPORTING OF EVENTS AND RESEARCH**			**6**		
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions						
Unit - V	**THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY**			**6**		
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.						
	Total Periods:			**30**		

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Compare the ideas in technical context.	K2
CO2	Interpret the cause and effects in events, industrial processes through writing and speaking skills.	K2
CO3	Relate problems for feasible solutions and communicate it in professional format.	K2
CO4	Explain logical ideas and opinions in technical context.	K2
CO5	Outline professional resume for internships and jobs in an effective manner.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**3**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2	English for Science & Technology Cambridge University Press 2021.
3	Authored by Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr.Deepa Mary Francis, Dr.KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

Reference Books

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, 2001, New Delhi.
3	Learning to Communicate – Dr.V. Chellammal. Allied Publishers, New Delhi, 2003
4	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

U24MA2202	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4
Course Objectives:	Introduce essential PDE concepts and Fourier series analysis for engineering, exploring heat flow solutions and diverse scenarios, while also incorporating Z transform for discrete time systems.				

Unit	Title	Periods
Unit - I	**PARTIAL DIFFERENTIAL EQUATIONS**	**9+3**
Formation of partial differential equations – Classification of linear and nonlinear 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 – Complex form of the Fourier series – Harmonic analysis.		
Unit - III	**APPLICATIONS 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 Periods:	**60**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Identify the various methods to solve the given partial differential equations.	K3
CO2	Construct the functions as a Fourier series.	K3
CO3	Apply the Fourier series techniques to solve the one-dimensional, two-dimensional heat flow problems and one-dimensional wave equations.	K3
CO4	Solve the physical engineering challenges by using Fourier transforms techniques.	K3
CO5	Make use of the Z- transform techniques to solve the ordinary difference equations.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Grewal B.S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2	Kreyszig E, "Advanced Engineering Mathematics", 10th Edition, John Wiley, New Delhi, India, 2018.

Reference Books

1	Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers", SPIE Press, 1999.
2	Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 10th Edition, Laxmi Publications Pvt. Ltd, 2021.
3	James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, New Delhi, 2016.
4	Narayanan. S., ManicavachagomPillay.T.K and Ramanaiah.G, "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2018.
6	Wylie. R.C. and Barrett. L.C., “Advanced Engineering Mathematics “, Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

U24PH2204	MATERIALS SCIENCE	L	T	P	C
		3	0	0	3
Course Objectives:	To make the students understand and apply the electrical properties, quantum mechanical concepts, magnetic properties, semiconductor properties, friction, wear, surface engineering, quantum confinement, diffraction, spectroscopic, microscopic study on different engineering materials. Also, to understand the importance of new engineering materials.				

Unit - I	**ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS**	**9**
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Quantum free electron theory– Fermi- Dirac statistics – Density of energy states –tight binding approximation - Electron effective mass – concept of hole. Magnetic materials: Dia, para and ferromagnetic effects –Ferromagnetism and domain theory- microscopic theory, Magnetic resonance, Magneto resistance – quantum interference devices – GMR devices.		
Unit - II	**SEMICONDUCTORS AND TRANSPORT PHYSICS**	**11**
Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature –Hall effect and devices – Ohmic contacts- Introduction to P-N junction Diode and V-I characteristics, Zener diode and its characteristics, Schottky barrier diode - Varactor diode –Tunnel diode - UJT, LDR.		
Unit - III	**MECHANICAL PROPERTIES OF MATERIALS**	**8**
Friction – Surface Interactions, Normal Force, Coefficient of Friction, Types of Friction. Wear - Mechanisms of Wear, Wear rate, Tribological Factors – Study of friction, wear and lubrication. Energy Dissipation – Surface Engineering – contact mechanics – applications. Propagation of Elastic Waves – Vibrations – Resonance velocity – applications in NVH analysis.		
Unit – IV	**NEW ENGINEERING MATERIALS AND NANOELECTRONIC DEVICES**	**8**
Metallic glasses – types, preparation, properties and applications – Shape memory alloys (SMA) – characteristics, types, properties of NiTi alloy and applications - advantages and disadvantages of SMA. Quantum confinement – Quantum structures – quantum wells, wires and dots – Resonant tunnelling diode: characteristics – Quantum interference effects - Single electron phenomena – Single electron Transistor - Spintronics.		
Unit - V	**MATERIAL CHARACTERIZATION**	**9**
Importance of materials characterization – Powder X-ray diffraction (XRD) – Scanning electron microscope (SEM): Principle, construction and working – Transmission electron microscope (TEM) : Principle, construction and working – Raman spectroscopy: Principle, construction, working and study of polymers – Thermo gravimetric analysis (TGA): principle, construction, working and analysis of conducting polymers - Atomic force microscopy (AFM) - Vibration sample magnetometer (VSM) – Nanoindentation: Hardness testing.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the electrical and magnetic properties of materials.	K2
CO2	Apply the concept of semiconductor physics in electronic devices	K3
CO3	Summarize the mechanical properties of materials.	K2
CO4	Outline the new engineering materials and nanodevices.	K2
CO5	Utilize the microscopic and spectroscopic techniques for material characterization.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSOArticulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	1	1	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	1	-	-
CO3	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	1	-	-
CO	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1	**1**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	V.Raghavan. Materials Science and Engineering: A First Course, Prentice Hall India Learning Private Limited, 2015.
2	S.O. Kasap, Principles of Electronic Materials and Devices, Mc-Graw Hill, 2018.
3	J.A.Belk. Electron Microscopy and Microanalysis of Crystalline Materials. Applied Science Publishers, London, 1979.
4	C.N.Banwell and E.M.McCash. Fundamentals of Molecular Spectroscopy. McGraw-Hill Education, 2017.
5	G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

Reference Books

1	R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2	Wendelin Wright and Donald Askeland, Essentials of Materials Science and Engineering, CL Engineering, 2013.
3	Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006.
4	Pallab Bhattacharya, Semiconductor Optoelectronic Devices, Pearson, 2017.
5	Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.

U24ME3201	ENGINEERING MECHANICS		L	T	P	C
			3	0	0	3
Course Objectives:	Students can understand about concept of equilibrium of particles, principles of equilibrium of rigid bodies, moment of area, mass moment of inertia, various types and laws of frictions and dynamic forces applied in rigid bodies.					

Unit - I	**STATICS OF PARTICLES**	**9**
Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.		
Unit - II	**EQUILIBRIUM OF RIGID BODIES**	**9**
Principle of Transmissibility, Equivalent Forces, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two Dimensions - Reactions at Supports and Connections.		
Unit - III	**GEOMETRY DEPENDENT PROPERTIES**	**9**
Centroids and centre of gravity – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem.		
Unit – IV	**FRICTION**	**9**
The laws of dry friction, Coefficients of Friction, Angles of Friction, Wheel Friction, Rolling Resistance, Ladder friction.		
Unit - V	**DYNAMICS OF PARTICLES**	**9**
Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion - Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force, Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact of bodies.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental concepts in determining the effect of forces on a particle.	K2
CO2	Outline the effect of forces in a rigid body.	K2
CO3	Interpret the geometry dependent properties of solids and sections.	K2
CO4	Explain the concepts and laws of dry friction	K2
CO5	Infer the principles of kinetics involved in dynamic conditions.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	2	2	1	-
CO2	3	2	-	-	-	-	-	-	-	-	2	2	1	-
CO3	3	2	-	-	-	-	-	-	-	-	2	2	1	-
CO4	2	2	-	-	-	-	-	-	-	-	2	2	1	-
CO5	2	2	-	-	-	-	-	-	-	-	2	2	1	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

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 Higher Education.,12thEdition, 2019.
2	Vela Murali, “Engineering Mechanics-Statics and Dynamics”, Oxford University Press, 2018

Reference Books

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, 14th edition, Prentice Hall, 2020.
3	Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4thEdition, Pearson Education Asia Pvt. Ltd., 2014.
4	Bolton J N, Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 9th edition, Wiley student edition, 2020.
5	Timoshenko S, Young D H, Rao J V and SukumarPati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

U24GE1201	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

Course Objectives:	இந்த பாடத்திட்டத்தில், மக்களின் வாழ்க்கைமுறையில் பொருட்களை உருவாக்கும் கலை மற்றும் மேம்பாடுகளை புரிந்து கொள்ளவும், கட்டிடங்கள் கட்டும் பல்வேறு முறைகளை புரிந்து கொள்ளவும், தமிழர்கள் கட்டிடக்கலையில் பயன்படுத்தப்படும் நுட்பங்களை புரிந்து கொள்ளவும், நவீன தொழில்நுட்பத்துடன் தமிழின் கருத்துக்களை புரிந்து கொள்ளவும் பயன்படுத்தவும் உதவுகிறது.

Unit - I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3
சங்க காலத்தில் நெசவுத்தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.		
Unit - II	**வடிவமைப்பு மற்றும் கட்டிடத் தொழில் நுட்பம்**	**3**
சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு - சங்க காலத்தில் கட்டுமான பொருட்களும், நடுகல் லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் –சோழர் காலத்து பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல் , மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந் தோ - சாரோசெனிக் கட்டிடக் கலை.		
Unit - III	**உற் பத்தித் தொழில் நுட்பம்**	**3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம் பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல் மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங் கு மணிகள் – எலும் புத்துண்டுகள் – தொல் லியல் சான் றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
Unit – IV	**வேளாண்மை மற்றும் நீர்ப்பாசனத்தொழில்நுட்பம்**	**3**
அணை, ஏரி, குளங் கள் , மதகு – சோழர் காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன் வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
Unit - V	**அறிவியல் தமிழ் மற்றும் கணித் தமிழ்**	**3**
அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின் பதிப்பு செய் தல் – தமிழ் மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல் விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைக் கிட்டம் .		
	Total Periods:	**15**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	தமிழர்களின் வாழ்க்கை வரலாற்றில் படிப்படியான முன்னேற்றத்தை அறிந்து கொள்ளலாம்.	K2

COs	Statements	K-Level
CO2	கடந்த காலத்தின் தாக்கத்தை நிகழ்காலத்துடன் சேர்த்து வீடுகள் மற்றும் கட்டிடங்களை கட்டலாம்.	K2
CO3	தொழில்நுட்பத்தின் உதவியுடன் குறிப்பிடத்தக்க விஷயங்களை உருவாக்க கற்றுக்கொள்ளலாம்.	K2
CO4	கடல்களின் அளவீடுகளைக் கண்டறிய பண்டைய திறன்களைப் பயன்படுத்தலாம்.	K2
CO5	தமிழின் கருத்துக்களை நவீன தொழில்நுட்பத்துடன் பயன்படுத்தலாம்.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO3	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-
CO	-	-	-	-	-	-	-	1	[illegible]	[illegible]	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

JANSONS INSTITUTE OF TECHNOLOGY JIT (AUTONOMOUS)

Text Books

1	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே. கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித் தமிழ் – முனைவர். இல. சுந்தரம். (விகடன் பிரசுரம்).
3	கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு),
4	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

Reference Books

1	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
2	Historical Heritage of the Tamils (Dr. S. V. Subramanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

3	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
4	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
5	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
6	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
7	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book.

U24GE3201	PYTHON PROGRAMMING	L	T	P	C
		2	0	2	3
Course Objectives:	To understand the basics of algorithmic problem solving and solve problems using python conditionals, loops and functions. To gain knowledge about the concepts of data structures - lists, tuples, dictionaries to represent complex data and input/output with files in python.				

Unit - I	**COMPUTATIONAL THINKING AND PROBLEM SOLVING**	**12**

Introduction – Translators - Compilation and Interpretation - Language Processors - Computer Software –Types of Software – Application Software Packages - Software Development Steps - Fundamentals of Computing – Identification of Computational Problems – Algorithms - Building Blocks of Algorithms - Notation - Algorithmic Problem Solving - Strategies for Developing Algorithms.

Suggested Activities:
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.

Unit - II	**DATA TYPES, EXPRESSIONS, STATEMENTS**	**12**

Introduction to Python – History & Versions - Importance of Python – Applications - Comparison of Python with C and Java - Installing Python in Windows & Ubuntu - Structure of a Python Program - Standard libraries in Python - Executing Python programs - Python Interpreter and Interactive Mode, Types of Errors – Keywords - Values and Types- Variable Names and Keywords - Type Conversion - Operators and Operands - Precedence of Operators - Expressions – Statements.

Suggested Activities:
1. Install and configure Python IDE
2. Python programming using simple statements and expressions

Unit - III	**CONTROL FLOW, FUNCTIONS, STRINGS**	**12**

Conditionals Statements – Boolean Values and Operators – Conditional: if – Alternative: if-else - Chained Conditional: if-elif-else - Iteration Statements – state – while – for – break – continue -pass - Fruitful Functions: Return Values, Parameters, Local and Global Scope, Function Call, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module - Programs using Decision Making, Loops, Functions and Strings.

Suggested Activities:
1. Scientific problems using Conditionals and Iterative loops.
2. Implementing programs using Functions.
3. Implementing programs using Strings.

Unit – IV	**LISTS, TUPLES, DICTIONARIES**	**12**

Lists: List Operations - List Slices - List Methods and Functions - List Loop, Mutability – Aliasing - Cloning Lists - List Parameters; Tuples: Tuples Operations - Methods and Functions - Tuple Assignment - Tuple as Return Value; Dictionaries: Operations - Methods and Functions - Programs using Lists, Tuples and Dictionaries.

Suggested Activities:
1. Implementing real-time/technical applications using Lists, Tuples.
2. Implementing real-time/technical applications using Sets, Dictionaries.

Unit - V	**FILES, MODULES, PACKAGES**	**12**

Files and Exception: File Types – Text Files – Binary Files - Reading and Writing files - Format Operator - Command Line Arguments - Errors and Exceptions - Handling Exceptions, Modules and Packages.

Suggested Activities:
1. Implementing real-time/technical applications using File & Exception handling.
2. Implementing programs using modules & packages.
3. Exploring Pygame tool and developing a game activity using Pygame like bouncing ball, car race etc.

	Total Periods:	**60**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Outline the algorithmic solutions to solve the simple computational problems.	K2
CO2	Infer and execute simple python programs.	K2
CO3	Explain the simple python program using functions, conditionals and looping.	K2
CO4	Interpret the compound data using python lists, tuples and dictionaries.	K2
CO5	Extend the usage of read and write data from/to files in python programs.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	-	-	-	-	-	1	-	-	1	1	-	-
CO2	2	-	-	-	-	-	-	1	-	-	1	1	-	-
CO3	2	1	-	-	-	-	-	1	-	-	1	1	-	-
CO4	2	1	-	-	-	-	-	1	-	-	1	1	-	-
CO5	2	1	-	-	-	-	-	1	-	-	1	1	-	-
CO	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight   2. Moderate   3. Substantial (High)

Text Books

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	David Amos, Dan Bader, Joanna Jablonski, Fletcher Heisler, “Python Basics: A Practical Introduction to Python 3”, 4th Edition, 2020.
4	Udayan Das, Aubrey Lawson, Chris Mayfield, Narges Norouzi, “Introduction to Python Programming”, OpenStax, Rice University, Texas, 2024.

Reference Books

1	Arockia Mary P, Problem Solving and Python Programming, Shanlax Publications, 2021.
2	G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.

3	Dr. Krishna Kumar Mohbey, Dr. Brijesh Bakariya, “An Introduction to Python Programming: A Practical Approach”, BPB Publications, 2021
4	https://www.python.org/
5	https://realpython.com/python-modules-packages/
6	https://learnpython.com/blog/python-modules-packages-libraries-frameworks/
7	https://www.upgrad.com/tutorials/software-engineering/python-tutorial/module-and-package-in-python/

U24ME4201	COMPUTER AIDED MACHINE DRAWING	L	T	P	C
		0	0	4	2
Course Objectives:	To acquaint the skills and practical experience in handling 2D drafting and 3D modelling software systems, standard drawing practices using fits and tolerances.				

Part	Description
PART I	**DRAWING STANDARDS & FITS AND TOLERANCES** Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits – Tolerancing of individual dimensions IS919- Specification of Fits – Preparation of production drawings and reading of part and assembly drawings, basic principles of Geometric Dimensioning & Tolerancing.
PART II	**2D DRAFTING** Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing. 1. Bearings – Bush Bearing, 2. Valves – Safety and Non-return Valves. 3. Couplings – Flange, Oldham's, Muff, Gear couplings. 4. Joints – Universal, Knuckle, Gib& Cotter, Strap, Sleeve &Cotter joints. 5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch. 6. Machine Components – Screw Jack, Machine Vice, LatheTail Stock, Lathe Chuck, Plummer Block, Vane and Gear pumps.
	Total Periods: 60

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the importance of drawing standards in communication within engineering and design fields.	K2
CO2	Interpret engineering drawings and specifications related to fits and tolerances.	K2
CO3	Apply appropriate tools in drafting software to create 2D technical drawings.	K3
CO4	Utilize editing functions to modify and revise drawing entities according to design requirements.	K3
CO5	Apply block creation and insertion techniques to reuse and standardize frequently used drawing components.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	-	-	-	-	-	2	-	-	2	2	-	-
CO2	3	2	-	-	-	-	-	2	-	-	2	2	-	-
CO3	3	2	1	-	-	-	-	2	-	-	2	2	-	-
CO4	3	2	1	-	-	-	-	2	-	-	2	2	-	-
CO5	3	2	1	-	-	-	-	2	-	-	2	2	-	-
CO	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**2**	**2**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Gopalakrishna K.R., “Machine Drawing”, 17^{th} Edition, Subhas Stores Books Corner, Bangalore, 2018.
2	N. D. Bhatt and V.M. Panchal, “Machine Drawing”, 51^{st} Edition, Charator Publishers, 2022.

Reference Books

1	K. L Narayana, P.Kannaiah, K.Venkata Reddy, Machine Drawing , 15^{th} Edition, New Age International Publication.
2	Goutam Pohit and Goutam Ghosh, “Machine Drawing with AutoCAD”, 1^{st} Edition, Pearson Education, 2014.
3	Junnarkar, N.D., “Machine Drawing”, 1^{st} Edition, Pearson Education, 2014.
4	N. Siddeshwar, P. Kanniah, V.V.S. Sastri,” Machine Drawing”, published by Tata McGrawHill, 2018.
5	S. Trymbaka Murthy, “A Text Book of Computer Aided Machine Drawing”, CBS Publishers, New Delhi, 2016.

U24GE7201	COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To encourage group discussion, effective presentation skills to analyse concepts that are relevant to the context and able to communicate effectively through formal and informal writing.				

Exp. No	Title
1	Speaking Skill.
2	Role Play.
3	Email Writing.
4	Group Discussion.
5	Dialogue writing.
6	Paragraph Writing.
7	Formal / Semi – Formal letters
8	Writing Instructions
9	Short Article Writing
10	Writing Recommendations
	Total Periods: **60**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Relate speaking skills effectively in formal and semi formal context.	K2
CO2	Infer concepts with problems from various perspectives for suitable solutions.	K2
CO3	Interpret the writing skills with technical format.	K2
CO4	Explain the content with the correct format to convey information with clarity.	K2
CO5	Relate recommendations for effective execution of tasks.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO3	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO4	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO5	-	-	-	-	-	-	-	3	3	-	3	-	-	-
CO	-	-	-	-	-	-	-	3	3	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24GE7202	FUNDAMENTALS OF ENTREPRENEURSHIP AND STARTUP	L	T	P	C
		0	0	2	1
Course Objectives:	To familiarize Entrepreneurship and Startups, understand and formulate the Problem Canva, Business model Canva and relate the incubation support with respect to startups.				

Unit - I	FUNDAMENTALS OF ENTREPRENEURSHIP	4
Meaning and importance of Entrepreneurship- Types of entrepreneurial skills – Entrepreneurship in different sectors- Role of entrepreneurship development programmes (EDP).		
Unit - II	**FUNDAMENTALS OF STARTUP**	**6**
Introduction- Features of Startup- Understanding problems and Customer Persona- Problem statement Canva- Empathy map and Value Preposition- Prototyping- Presentation on Problem canva.		
Unit - III	**BUSINESS PLAN AND PITCHING**	**6**
Market Analysis- Business Model Canva- Go to Market Strategy- Cost Analysis and Revenue streams- Presentation on Business model Canva.		
Unit – IV	**INCUBATION SUPPORT TO STARTUPS**	**6**
Commercialisation- Meaning and Definition of Incubation support-Functions of pre incubation and Incubation centres- Registration process.		
Unit - V	**CASE STUDIES ON STARTUP**	**8**
How to Pitch a startup- Pitch deck – Case studies of Successful startups in India- Failure analysis of Startups Pitch deck presentation.		
	Total Periods:	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the types of entrepreneurial skills	K2
CO2	Summarize the problem statement Canva for the identified problem	K2
CO3	Extend a business plan with market analysis and financial projection	K2
CO4	Explain commercialisation and incubation support for startups	K2
CO5	Demonstrate a pitch deck for startup with insights from the case studies	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	1	-	2	2	-	2	-	-	-
CO3	-	-	-	-	-	1	-	2	2	1	2	-	-	-
CO4	1	-	-	-	-	1	2	-	-	-	2	-	-	-
CO5	-	-	-	-	-	1	2	2	3	-	2	-	-	-
CO	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	"Entrepreneurship: Theory, Process, and Practice" Authors: Donald F. Kuratko, Richard M. Hodgetts, and Justin G. Longenecker, Publisher: Cengage Learning Year of Publication: 2021.
2	"Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers".
3	Alexander Osterwalder and Yves Pigneur Publisher: Wiley Year of Publication: 2010.
4	Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012.

Reference Books

1	"Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses" by Eric Ries, Publisher: Currency, Year of Publication: 2011.
2	"The Art of the Start 2.0: The Time-Tested, Battle-Hardened Guide for Anyone Starting Anything" Author: Guy Kawasaki, Publisher: Portfolio, Year of Publication: 2015.

U24MA2201	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4
Course Objectives:	Introduce statistical and numerical methods for engineering problem-solving, crucial for real-world applications, covering hypothesis testing, equation solving, interpolation, and numerical treatment of differential equations.				

Unit	Title	Periods
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 fr 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 - 2^2 factorial design.		
Unit - III	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**9+3**
Solution of algebraic and transcendental equations - Fixed point iteration method – Bisection 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 interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single integrations using Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule and Croute's method.		
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 Periods:	**60**

On completion of the course, the student can

CO	Statements	K-Level
CO1	Identify the types of testing of hypothesis for small and large samples in real life problems.	K3
CO2	Apply the basic concepts of design of experiments.	K3
CO3	Apply the concepts of numerical techniques for solving transcendental equations, eigenvalues and eigenvectors of matrices.	K3
CO4	Utilize the various numerical techniques such as interpolations, differentiation and integrations in solving engineering problems.	K3
CO5	Solve the ordinary differential equations with initial conditions using various single-step and multi-step numerical techniques	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Course Outcomes

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books

1	Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2	Devore. J.L.,"Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis", Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4	Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
6	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

U24ME4301	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a fundamental understanding of thermodynamic principles, including energy conservation, entropy, and thermodynamic cycles, and to apply these concepts to engineering systems for efficient energy conversion and utilization.				

Unit - I	**BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS**	**9**
Basic concepts- concepts of continuum, macroscopic approach, thermodynamic system (closed and open or control volume) -thermodynamic properties and equilibrium; state of a system, state diagram, path and process; different modes of work; Zeroth law of thermodynamics; concept of temperature; heat. First Law of Thermodynamics- Energy, enthalpy, specific heats, first law applied to systems and control volumes, steady and unsteady flow analysis.		
Unit - II	**SECOND LAW OF THERMODYNAMICS & ENTROPY**	**9**
Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for — pure substance, ideal gases — different processes, principle of increase in entropy.		
Unit - III	**PROPERTIES OF PURE SUBSTANCES**	**9**
Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. P-V-T 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**
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.		
Unit - V	**GAS MIXTURES AND PSYCHROMETRY**	**9**
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 Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using charts and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing, Simple Applications.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the fundamental concepts of thermodynamics, including system, surroundings, properties, and state functions.	K3
CO2	Construct the concepts of heat engines, refrigerators, and heat pumps along with their performance parameters	K3
CO3	Develop the concept of pure substances and phase changes.	K3
CO4	Select the interrelation between thermodynamic properties using thermodynamic potentials.	K3

COs	Statements	K-Level
CO5	Construct the psychrometric chart and various processes like humidification, dehumidification, and cooling.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	-	-	-	-	-	2	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	2	1	-	-
CO3	3	2	1	1	-	-	-	-	-	-	2	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	2	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	2	1	-	-
CO	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Nag .P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2	Kavati Venkateswarlu, Engineering Thermodynamics: Fundamental and Advanced Topics, CRC Press in 2021.

Reference Books

1	Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.
2	Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.
3	Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.
4	ClausBorgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.
5	Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007

U24ME4302	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3
Course Objectives:	To illustrate the working principles of various metal casting processes, bulk deformation of metals, sheet metal forming processes, plastic molding methods and metal joining techniques.				
Unit - I	**METAL CASTING PROCESSES**				**9**
Sand Casting – Sand Mould – Type of patterns - Pattern Materials & allowances – Gating Design - 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	**BULK DEFORMATION PROCESSES**				**9**
Hot working and cold working of metals – Forging fundamentals – Open, impression and closed die forging – cold forging- Characteristics of the processes – Typical forging operations – Rolling basic concepts – 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 - III	**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 – IV	**POWDER METALLURGY AND PLASTIC PROCESSING**				**9**
Production of metal powder: Atomization, crushing; Blending; Compacting: Die pressing, iso-static pressing; Sintering: Principle, continuous sintering process; Plastic processing: Injection, blow moulding and rotational moulding. Additive manufacturing – Process, principles, applications					
Unit - V	**METAL JOINING PROCESSES**				**9**
Welding process – fundamentals of welding - 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.					
	Total Periods:				**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the principle of different metal casting processes.	K2
CO2	Illustrate the different bulk deformation processes.	K2
CO3	Outline the various sheet metal forming process.	K2
CO4	Summarize suitable technique for production of metal powders and learn additive manufacturing principles	K2
CO5	Interpret the various metal joining processes.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	-	-	-	-	-	-	-	2	3	1	1
CO2	3	2	1	-	-	-	-	-	-	-	2	3	1	1
CO3	3	2	1	-	-	-	-	-	-	-	2	3	1	1
CO4	3	2	1	-	-	-	-	-	-	-	2	3	1	1
CO5	3	2	1	-	-	-	-	-	-	-	2	3	1	1
CO	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**1**	**1**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India,4th Edition, 2020
2	P.N.Rao Manufacturing Technology Volume 1 Mc Grawhill Education 5th edition,2018.

Reference Books

1	Ian Gibson, David W Rosen, Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", 2nd Edition, Springer, New York, 2015.
2	Jain R K "Production Technology", Khanna Publishers., 2018
3	Paul Degarma E, Black J.T and Ronald A. Kosher, Eligth Edition, Materials and Processes, in Manufacturing, Eight Edition, Prentice – Hall of India, 2015.
4	Hajra Chouldhary S.K and Hajra Choudhury. AK., Elements of workshop Technology, volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2012
5	Sharma, P.C., A Text book of production Technology, S.Chand and Co. Ltd., 2022

U24ME4303	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	2	4
Course Objectives:	To provide students with a comprehensive understanding of fluid properties, behavior under static and dynamic conditions, and the significance of boundary layer theory. Additionally, it aims to explore the fundamental principles of hydraulic machinery design, including various types of turbines and pumps.				

Unit - I	**FLUID PROPERTIES AND FLOW CHARACTERISTICS**	**9+9**

Properties of fluids – mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics - concept of control volume - application of continuity equation, energy equation and momentum equation.

List of Experiments

1. Determination of the Coefficient of discharge of given Venturi meter.
2. Determination of the Coefficient of discharge of given Orifice meter.
3. Calculation of the rate of flow using Rota meter.

Unit - II	**FLOW THROUGH PIPES**	**9+3**

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Pipes in series and parallel.

List of Experiment

1. Determination of friction factor for a given pipe.

Unit - III	**DIMENSIONAL ANALYSIS AND MODEL STUDIES**	**9**

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem-Dimensionless parameters - Similitude and model studies - Distorted and undistorted models – Application in Hydraulic Structures and Machines

Unit – IV	**PUMPS**	**9+9**

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

List of Experiments

1. Conducting experiments and drawing the characteristic curves of Gear pump.
2. Conducting experiments and drawing the characteristic curves of Reciprocating pump.
3. Conducting experiments and drawing the characteristic curves of Centrifugal pump

Unit - V	**TURBINES**	**9+9**

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.

List of Experiments

1. Conducting experiments and drawing the characteristic curves of Pelton wheel.
2. Conducting experiments and drawing the characteristics curves of Francis turbine.
3. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

	Total Periods:	**75**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the mathematical knowledge to predict the properties and characteristics of a fluid in static, kinematics and dynamics.	K3
CO2	Identify the problems on fluid flow through pipes of various sections and its losses.	K3
CO3	Select the nature of physical quantities and formulate equations for model and prototype in various applications.	K2
CO4	Construct the working principles of centrifugal, reciprocating & rotary pumps and infer the performance curves.	K3
CO5	Identify the working principles of various turbines and its performance evaluation.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	1	-	-	-	-	-	-	2	3	1	-
CO2	3	2	1	1	-	-	-	-	-	-	2	3	1	-
CO3	3	2	1	1	-	-	-	-	-	-	2	3	1	-
CO4	3	2	1	1	-	-	-	-	-	-	2	3	1	-
CO5	3	2	1	1	-	-	-	-	-	-	2	3	1	-
CO	**3**	**2**	**1**	**1**	-	-	-	-	-	-	**2**	**3**	**1**	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Bansal R.K., “Fluid Mechanics and Hydraulic Machines”, 10th Edition, Laxmi Publications, New Delhi, 2018
2	Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
3	Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

Reference Books

1	Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2	Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 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.
5	Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.
6	Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.

U24EC3307	ELECTRICAL DRIVES AND CONTROL		L	T	P	C
			3	0	2	4
Course Objectives:	To learn the fundamental concepts of electrical machines, its characteristics, starting methods, speed control and application of power electronics for speed control					

Unit - I	**FUNDAMENTALS OF ELECTRICAL MACHINES**	**9+2**
Basic circuit elements and definitions- Faraday's law of Electromagnetic Induction- Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Stepper motor **Practical Exercises:** 1.Experimentation on different types of transformer		
Unit - II	**DRIVE MOTOR CHARACTERISTICS**	**11+10**
Mechanical characteristics – Speed-Torque characteristics of DC motors: Shunt, series, and compound - single phase and three phase induction motor – Braking of Electrical motor –. Types of Electric Drives - factors influencing the choice of electrical drives–classes of duty – Selection of power rating for drive motor **Practical Exercises:** 1.Load Test and determination of performance characteristics of DC shunt motor 2.Load Test and determination of performance characteristics of DC series motor 3.Load test and determination of performance characteristics of three phase Induction motor		
Unit - III	**STARTING METHODS OF MOTORS**	**7+2**
Types of D.C Motor starters – Typical starters for shunt and series motors – starting methods for three phase Squirrel cage and slip ring induction motor. **Practical Exercises:** 1.Experimentation on two point, three point and four point starters		
Unit – IV	**CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF D.C. DRIVES**	**9+10**
Speed control of DC series and shunt motor – Armature and field control, Ward-Leonard control system – speed control using controlled rectifier and DC chopper –applications. **Practical Exercises:** 1.Field Control and Armature control of DC shunt motor 2.Experimental study of single phase controlled rectifier 3.Experimentation on chopper fed control of DC motor		
Unit - V	**CONVENTIONAL AND SOLID-STATE SPEED CONTROL OF A.C. DRIVES**	**9+6**
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – speed control Using inverters and AC voltage regulators – applications **Practical Exercises:** 1.Experimentation on single phase Inverter and its voltage control 2.Experimentation on AC voltage regulator		
	Total Periods:	**45+30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the construction and operation of different types of DC and AC motor	K2
CO2	Compare the mechanical characteristics of different types of DC and AC motor	K4
CO3	Interpret the need for starting methods and different types of starters for motor	K2
CO4	Experiment the different types of conventional and static speed control techniques for DC drives	K3
CO5	Apply the static speed control schemes for voltage and frequency control of AC drives	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	1	1	-	-
CO5	3	2	2	-	-	-	-	-	-	-	1	1	-	-
CO	**3**	**2**	**2**	**-**	**-**	**--**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kothari D.P., Rakesh Singh Lodhi, "Electric Drives", 2016, ISBN 9789384588120
2	Pillai.S.K "A First Course on Electric Drives", Wiley Eastern Limited, 2012,ISBN 978-8122433616
3	Vedam Subrahmaniam, "Electric Drives: Concept and Application", Tata McGrawhill, 2nd Edition, 2017, ISBN 978-0070701991

Reference Books

1	Singh. M.D., K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 2017, ISBN 978-0070583894
2	B.R. Gupta and V. Singhal, Fundamentals Of Electric Drives And Control, 2013, S.K. Kataria & Sons, ISBN 978-93-5014-381-0
3	Nagrath .I.J. & Kothari .D.P, "Electrical Machines", Tata McGraw-Hill, 2017, 5th Edition, ISBN 978-9352606405
4	Bimal K.Bose, "Power Electronics and Motor Drives: Advances and Trends", 2nd edition, 2020, ISBN: 9780128213605

Online Content

1	Prof. Shyama Prasad Das, Fundamentals of Electric Drives, IIT Kanpur, NPTEL

U24ME4304	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To select and operate appropriate tools, equipment, and machines for welding (GMAW), gear fabrication, and machining processes (rolling, drawing, turning, shaping, drilling, milling), while also analyzing defects in cast and machined components.				

Exp. No	Title
1.	Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2.	Preparing green sand moulds with cast patterns.
3.	Taper Turning and Eccentric Turning on circular parts using lathe machine.
4.	Knurling, external and internal thread cutting on circular parts using lathe machine
5.	Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
6.	Drilling and Reaming using vertical drilling machine.
7.	Milling contours on plates using vertical milling machine.
8.	Cutting spur and helical gear using milling machine.
9.	Generating gears using gear hobbing machine.
10	Grinding components using surface grinding machine.
11	Cutting force calculation using dynamometer in turning machines
Total Periods :	**60**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW	K3
CO2	Model and make the work piece as per given size and shape using turning, shaping machines	K3
CO3	Model and make the work piece as per given size and shape using drilling and milling machines	K3
CO4	Model and make the work piece as per given size and shape using grinding machines	K3
CO5	Make the gears as per given dimension using gear shaping machines	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	-	-	2	1	-	2	2	1	-
CO2	3	2	1	1	-	-	-	2	1	-	2	2	1	-
CO3	3	2	1	1	-	-	-	2	1	-	2	2	1	-
CO4	3	2	1	1	-	-	-	2	1	-	2	2	1	-
CO5	3	2	1	1	-	-	-	2	1	-	2	2	1	-
CO	3	2	1	1	-	-	-	2	1	-	2	2	1	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24GE7301	PROFESSIONAL DEVELOPMENT	L	T	P	C
		0	0	2	1
Course Objectives:	Apply MS Word, MS Excel, and MS PowerPoint effectively for professional tasks while developing emotional intelligence, change management strategies, and essential professional skills for workplace success				

Exp. No	Title
1	MS WORD: 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
2	MS EXCEL 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
3	MS POWERPOINT 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
4.	Emotional Intelligence and Meta Communication Learn how to manage emotions and develop self-awareness to enhance communication and collaboration at work.
5	What is Lateral Thinking? – Origin and History – Importance of Lateral Thinking – How to use it in Life- How to use it at Work?

6	Professional Skills Communication Skills - Nonverbal Communication, Writing and Different Modes of Writing Career Skills - Resume Skills, Interview Skills, Group Discussion Skills, Exploring Career Opportunities Team Skills - Presentation Skills, Trust and Collaboration, Internal Communication Management Skills – Leadership, Managerial and Entrepreneurial Skills
7	Career Planning and Goal Setting, Knowledge about SDG, COGNITIVE AND NON-COGNITIVE SKILLS SELF-AWARENESS: Assessing personal strengths and weaknesses - Goal setting: SMART goals framework - Building a growth mindset for continuous learning, Decision Making Engineering AI Assistants: Enhancing productivity, Design & simulation assistance, Problem-Solving & Decision Support, Coding & Automation, Manufacturing & Process Optimization, Project Management & Documentation.
Total Periods:	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the fundamental features and functionalities of MS Word, MS Excel, and MS PowerPoint	K2
CO2	Interpret the emotional intelligence and their impact on personal and professional interactions.	K2
CO3	Infer the principles of change management and its impact on organizations and individuals.	K2
CO4	Describe the essential professional skills required for effective communication, teamwork, and workplace success.	K2
CO5	Explain the role of career planning, goal setting, SDGs, skills, and self-awareness in growth.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO	-	-	-	-	-	-	-	-	3	-	2	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Textbooks

1	"Microsoft Office 2019 Beginner: Learn The Basics of Microsoft Word, Excel, and PowerPoint" by M.L.Humphrey
2	"Emotional Intelligence" by Daniel Goleman was published by Bantam Books in 1995.
3	"Lateral Thinking: Creativity Step by Step" by Edward de Bono

Reference Books

1	Placement Interviews Skills for Success by Ananda murugan.S – 1st edition2011
2	SOFT SKILLS: Personality, Body language and Communication skills Development GD, Interview Preparation & Questions by N.S. REDDY and NEO –2016
3	Communication Skills: Stepladders to Success for the Professional by Richard Ellis

U24GE7302	PRODUCT DEVELOPMENT / PROCESS DESIGN	L	T	P	C
		0	0	2	1
Course Objectives:	To equip students with hands-on experience in prototyping, understanding the entrepreneurial ecosystem, and leveraging resources for startup success.				

1	ENTREPRENEURIAL ECOSYSTEM	10

Understanding the Entrepreneurial Ecosystem – Components: Angels, Venture Capitalists, Maker Spaces, Incubators, Accelerators, Investors. Financing models – equity, debt, crowdfunding, etc, Support from the government and corporates. Navigating Ecosystem Support: Searching & Identifying the Right Ecosystem Partner – Leveraging the Ecosystem - Building the right stakeholder network

ACTIVITY

- Arrangement of Guest Speaker Sessions by successful entrepreneurs and entrepreneurial ecosystem leaders (incubation managers; angels; etc),
- Visit one or two entrepreneurial ecosystem players (Travel and visit a research park or incubator or makerspace or interact with startup founders).

2	PROTOTYPING	20

Prototyping – Importance in entrepreneurial process – Types of Prototypes – Different methods – Tools & Techniques. Hands-on sessions on prototyping tools (3D printing, electronics, software), Develop a prototype based on identified opportunities; Receive feedback and iterate on the prototypes.

ACTIVITY

Students should for a team of maximum 4 members and make a Final Presentation of the prototype they have innovated.

Total Periods:	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the significance of prototyping in the entrepreneurial process and identify different types, methods, and tools.	K2
CO2	Apply various prototyping techniques, including 3D printing, electronics, and software, to develop a functional prototype	K4
CO3	Analyze the components of the entrepreneurial ecosystem and evaluate different financing models.	K4
CO4	Engage with ecosystem partners such as incubators, investors, and accelerators to navigate startup support mechanisms.	K3
CO5	Develop a stakeholder network by interacting with successful entrepreneurs and reflect on real-world entrepreneurial experiences.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	2	2	3		3			3	2	2	2
CO2	3	3	3	2	2	3		3			3	2	2	2
CO3	3	3	3	2	2	3		3			3	2	2	2
CO4	3	3	3	2	2	3		3			3	2	2	2
CO5	3	3	3	2	2	3		3			3	2	2	2
CO	**3**	**3**	**3**	**2**	**2**	**3**		**3**			**3**	**2**	**2**	**2**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S.S. Khanka – Entrepreneurial Development, S. Chand Publishing, 2021.
2	P.C. Jain – Handbook for New Entrepreneurs, Oxford University Press, 2017.
3	Poornima M. Charantimath – Entrepreneurship Development and Small Business Enterprises, Pearson India, 2022.

Reference Books

1	Ramachandran K. – Entrepreneurship: Theory and Practice, McGraw Hill, 2021.
2	Reddy K. Sudarsanam – Essentials of Entrepreneurship Development, Himalaya Publishing House, 2017.
3	Kelley, Tom & Littman, Jonathan – The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm, Crown Business, 2001.
4	Ries, Eric – The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Crown Business, 2011.

U24ME7301	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1
Course Objectives:	To enhance self-study abilities, improve presentation and communication skills, and broaden knowledge base.				

DESCRIPTION	
10.	1. The student is expected to present a seminar in one of the current topics in the field of Engineering related issues / technology. 2. The seminar shall be of 30 minutes duration and give presentation to the committee. 3. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. 4. In a session of two periods per week, 4 students are expected to present the seminar. 5. Students are encouraged to use various teaching aids such as ICT tools and demonstrative models. 6. Students are required to prepare a seminar report in the prescribed format given by the committee.
11.	**EVALUATION** ▪ To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present three Technical papers or recent advances in engineering/technology ▪ Technical Seminar will be evaluated by a committee constituted by the Head of the Department.
Total Periods :	**30**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify and choose appropriate topic of relevance	K2
CO2	Compare literature on technical articles of specified topic and develop comprehension	K2
CO3	Make use of and prepare technical report	K2
CO4	Design, develop and deliver presentation on specified technical topic	K3
CO5	Interpret and present the Technical papers on recent advances in Engineering and Technology	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	-	-	-	1	2	3	-	2	2	1	-
CO2	3	2	1	-	-	-	1	2	3	-	2	2	1	-
CO3	3	2	1	-	-	-	1	2	3	-	2	2	1	-
CO4	3	2	1	1	-	-	1	2	3	-	2	2	1	-
CO5	3	2	1	-	-	-	1	2	3	-	2	2	1	-
CO	3	2	1	1	-	-	1	2	3	-	2	2	1	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24ME4401	THEORY OF MACHINES	L	T	P	C
		3	0	0	3
Course Objectives:	To develop an understanding of kinematic and dynamic analysis of mechanical systems, including mechanisms, cams, gears, flywheels, and governors.				

Unit - I	MECHANISMS	9
Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms. Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions. Machine learning applications in kinematics and dynamics		
Unit - II	**KINEMATIC ANALYSIS OF MECHANISMS**	**9**
Displacement, velocity, and acceleration analysis of planar mechanisms; Kinematic chains and inversion Graphical and analytical methods for velocity and acceleration analysis; Instantaneous center of rotation Relative motion and Coriolis acceleration.		
Unit - III	**CAMS**	**9**
Cams, Classification and terminology; Displacement, velocity, acceleration and jerk diagrams; Uniform velocity, parabolic, simple harmonic and cycloidal motions; Derivatives of follower motions; Circular and tangent cams; Pressure angle and undercutting; Graphical and analytical disc cam profile synthesis for roller and flat face followers.		
Unit – IV	**GEARS**	**9**
Spur gear, law of toothed gearing, involute gearing, Interchangeable gears, Gear tooth action interference and undercutting, nonstandard teeth. Gear trains, parallel axis gears trains, epicyclic gear trains, automotive transmission gear trains.		
Unit - V	**DYNAMIC ANALYSIS OF MECHANISMS**	**9**
Dynamic force analysis of linkages; Inertia forces in mechanisms; D'Alembert's principle and its application; Energy methods in mechanism dynamics; Dynamic balancing of a single and Multi-cylinder engine and reciprocating masses, Inertia effect of connecting rod, Bearing loads, Crank shaft torque, Turning moment diagrams, Fly Wheels		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental concepts of mechanism and their principles.	K2
CO2	Apply graphical and analytical methods to determine displacement, velocity, and acceleration.	K3
CO3	Solve problems related to cam and gear mechanisms by analyzing motion characteristics.	K3
CO4	Select the suitable gear train by analyzing motion characteristics.	K3
CO5	Make use of dynamic force analysis methods to evaluate inertia forces reciprocating masses and assess flywheel	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	2	2	1	-
CO2	3	2	2	1	-	-	-	-	-	-	2	2	1	-
CO3	3	2	2	1	-	-	-	-	-	-	2	2	1	-
CO4	2	2	2	1	-	-	-	-	-	-	2	2	1	-
CO5	2	2	2	1	-	-	-	-	-	-	2	2	1	-
CO	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Rattan, S.S, "Theory of Machines", McGraw-Hill Education Pvt. Ltd., 5th edition 2019.
2	Ramamurthi. V, "Mechanics of Machines", Narosa Publishing House, 3rd edition 2019
3	Thomas Bevan, "Theory of Machines," CBS Publishers & Distributors, 2005.

Reference Books

1	Rao.J.S. and Dukkipati.R.V. "Mechanism and Machine Theory", New Age International Pvt. Ltd., 2nd edition,2014
2	W. L. Cleghorn, "Mechanisms of Machines," Oxford University Press, 2005.
3	R. L. Norton, "Kinematics and Dynamics of Machinery," Tata McGraw Hill, 2009
4	Uick er, 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.

Online Resources

1. https://nptel.ac.in/courses/112105268

U24ME4402	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:	Students can understand the fundamental principles of thermodynamic cycles, steam flow through nozzles, steam and gas turbines, internal combustion engines, and psychrometric processes. They will gain knowledge of energy conversion processes, performance analysis of the thermal systems.

Unit - I	**THERMODYNAMIC CYCLES**	**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 flow rate with pressure ratio. Effect of friction. Metastable flow		
Unit - III	**STEAM AND GAS TURBINES**	**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**
Classification: SI vs. CI engines, Two-stroke vs. Four-stroke Working principle, components, and their functions Valve and port timing diagrams p-v diagrams for Two-stroke & Four-stroke engines, Fuel, Combustion, and Air-Fuel Ratio. Fuel Injection and Ignition Systems Lubrication, Cooling, and Performance Testing.		
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.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Calculate the performance parameters of thermodynamic cycles,	K2
CO2	To solve problems in steam nozzle and calculate critical pressure ratio	K2
CO3	Explain the flow in steam turbines, draw velocity diagrams, flow in Gas turbines and solve problems..	K2
CO4	Explain the functioning and features of IC engines, and describe the calculation of their performance parameters.	K2
CO5	Interpret Refrigerant properties, cycles , and chart applications in air conditioning system.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	1	-	-	-	-	-	-	1	2	1	-
CO2	3	2	2	1	-	-	-	-	-	-	1	2	1	-
CO3	3	2	2	1	-	-	-	-	-	-	1	2	1	-
CO4	2	2	1	1	-	-	-	-	-	-	1	2	1	-
CO5	2	2	1	1	-	-	-	-	-	-	1	2	1	-
CO	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**2**	**1**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010..
2	Ganesan.V, " Internal Combustion Engines" 4th Edition, Tata McGraw Hill, 2012.

Reference Books

1	Ballaney. P, “Thermal Engineering”, 25th Edition, Khanna Publishers, 2017..
2	Domkundwar, Kothandaraman, & Domkundwar, “A Course in Thermal Engineering”, 6th Edition, DhanpatRai& 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..
5	Arora, C.P., “Refrigeration and Air conditioning”, Tata McGraw-Hill Publishers,2017.

U24ME4403	APPLIED HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the basics of fluid power systems, including Working Principle of their components, circuit design, basic troubleshooting and their applications.				

Unit	Title	Periods
Unit - I	**FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS**	**9**
Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law, Sources of Hydraulic power, Pump Classification – Construction, Working, Design, Advantages, and Disadvantages, Symbols.		
Unit - II	**HYDRAULIC AND PNEUMATICS COMPONENTS**	**9**
Hydraulic Actuators: Cylinders – Types and construction, Application, Symbols, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves - Types and constructional details, Symbols, Accumulators, Intensifiers, Symbols Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators symbol		
Unit - III	**INDUSTRIAL HYDRAULIC CIRCUITS AND SYSTEMS**	**9**
Industrial hydraulic circuits – Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission		
Unit – IV	**CIRCUITS DESIGNING AND APPLICATIONS**	**9**
Design of sequential multi-actuator circuits: Intuitive, cascade and step counter methods; Integration of start selection, start restriction and emergency stop modules using Hydraulic and Pneumatic Power - Design of Pneumatic circuits for Pick and Place applications - Design of hydraulic circuits for Drilling applications		
Unit - V	**SERVO SYSTEMS AND TROUBLE SHOOTING**	**9**
Servo and proportional valves: Construction, types and applications - Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain about the fluid power principles and hydraulic pumps used	K2
CO2	Identify hydraulic and pneumatic components and its symbol and usage	K2
CO3	Classify the functionality of industrial hydraulic circuits	K2
CO4	Explain about the design of hydraulic and pneumatic circuits	K2
CO5	Summarize the trouble and remedies for the trouble	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	-	-	-	-	-	-	-	1	3	1	1
CO2	3	2	1	-	-	-	-	-	-	-	1	3	1	1
CO3	3	2	1	-	-	-	-	-	-	-	1	3	1	1
CO4	3	2	1	-	-	-	-	-	-	-	1	3	1	1
CO5	3	2	1	-	-	-	-	-	-	-	1	3	1	1
CO	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**1**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

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.

Reference Books

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.

U24ME4404	MACHINE TOOL TECHNOLOGY		L	T	P	C
			3	0	0	3
Course Objectives:	This course covers the fundamentals of metal cutting, machinability factors, and the working principles of conventional and advanced machine tools, including CNC. It also introduces CNC programming concepts for machining and turning centers with machine learning applications.					
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	**TURNING MACHINES**		**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						
Unit - III	**RECIPROCATING MACHINE TOOLS**		**9**			
Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, tapping, type of milling operations-attachments- types of milling cutters– machining time calculation - Gear cutting, 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 MACHINES**		**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, Safety features.						
Unit - V	**SPECIAL PURPOSE MACHINE TOOLS**		**9**			
Principles and classification of jigs and fixtures-applications in machine tools, Application of laser in micro and nano fabrication, Additive Manufacturing machines – polymer, and metal. Machine learning applications in CNC Machine Tools.						
		Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the mechanism of metal removal process and to identify the factors involved in improving machinability.	K2
CO2	Summarize the constructional and operational features of centre lathe and other special purpose lathes.	K2
CO3	Outline the constructional and operational features of reciprocating machine tools.	K2
CO4	Summarize the constructional features and working principles of CNC machine tools	K2
CO5	Extend the design procedures in fixtrure design and predictive maintenance using machine learning techniques.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	-	-	-	-	-	-	-	2	2	-	-
CO2	3	2	1	-	-	-	-	-	-	-	2	2	-	-
CO3	3	2	1	-	-	-	-	-	-	-	2	2	-	-
CO4	3	2	1	-	-	-	-	-	-	-	2	2	-	-
CO5	3	2	1	-	-	-	-	-	-	-	2	2	-	-
CO	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India,7th Edition, 2018.
2	Michael Fitzpatrick, Machining and CNC Technology, McGraw-Hill Education; 4th edition, 2018.

Reference Books

1	Roy. A. Lindberg, Processes and materials of manufacture, PHI / Pearson education, 2006.
2	Geofrey Boothroyd, “Fundamentals of Metal Machining and Machine Tools”, McGraw Hill, 1984.
3	Rao. P.N “Manufacturing Technology,” Metal Cutting and Machine Tools, Tata McGraw- Hill, New Delhi, 2009.
4	A. B. Chattopadhyay, Machining and Machine Tools, Wiley, 2nd edition, 2017.
5	Machine Learning in CNC Machining: Best Practices, by T von Hahn · 2022.

U24CY2401	ENVIRONMENTAL SCIENCES, CLIMATE CHANGE AND SUSTAINABILITY	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the environmental issues, impacts of climate change, promoting sustainable practices, social responsibility, and conservation of natural resources.				

Unit - I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9
Great ancient civilizations and the environment, Industrial revolution and its impact on the environment. Definition, Scope and importance of Environmental Education; Ecosystem: components, energy flow; Ecosystem services: classification and their significance, Economic value of ecosystem services. Biodiversity: Biodiversity as a natural resource; Levels of biodiversity; Biodiversity in India and the world; values of biodiversity; hot-spots of biodiversity; Threats to biodiversity and ecosystems; conservation of biodiversity: In-situ and ex-situ; the role of traditional knowledge, community-based conservation. International Union for Conservation of Nation (IUCN) red list criteria and categories.		
Unit - II	**ENVIRONMENTAL ISSUES, POLLUTION AND HEALTH**	**9**
Environmental issues and scales: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. Definition of pollution; Point and non-point sources of pollution; Types, sources, environmental impacts and control methods of Air, Water, Soil, Noise and Radioactive Pollution; adverse impacts of various pollution on human health.Solid waste management: causes, effects, control measures and management of municipal solid wastes; E-waste Management; role of an individual in prevention of pollution; Occupational Health and Safety Management system (OHASMS) and its case studies.		
Unit - III	**CLIMATE CHANGE: IMPACTS, ADAPTATION AND MITIGATION**	**9**
Understanding climate change: Anthropogenic climate change from greenhouse gas emissions: past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Impacts, vulnerability and adaptation to climate change: Sea level rise, Ecosystems, animal species, agriculture, and Health. Climate change mitigation and adaptation strategies. Major International Environmental Agreements: Convention on Biological Diversity (CBD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment, United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; Conference of the Parties (COP). United Nations Environment Programme (UNEP) and Governance policy.		
Unit – IV	**ENVIRONMENTAL MANAGEMENT AND SUSTAINABLE PRACTICES**	**9**
Development, Effects of unplanned development - case studies. Economic growth - Gross Domestic Product (GDP), Sustainability: concept, needs and challenges; economic, social and aspects of sustainability; from unsustainability to sustainability; Sustainable Development: Goals, targets, Nation missions and environmental policy, indicators and intervention areas. Concept of Carbon Credit; Carbon Footprint; ISO14001; Environmental management in industry with case studies. Practices: Eco labelling; Circular economy; Material Life cycle assessment; Environmental Impact Assessment; Sustainable habitat: Green buildings, Green materials, Energy efficiency. Sustainable transports; Sustainable urbanization; Need of the Hour: Sustainable Industry, Innovation, and resilient Infrastructure. Significance of holistic value-based education for true sustainability.		
Unit - V	**NATURAL RESOURCES AND ENVIRONMENTAL ACTS**	**9**
Definition of resource; Classification of natural resources: biotic and abiotic, renewable and non-renewable; Significance and challenges of biotic resources: forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine). Significance, over exploitation and conservation: Water resources, Soil and mineral resources. Principle and applications of (a) Solar energy, (b) Wind energy (c) Hydrogen energy (d) Tidal energy (e) Geothermal energy and (f) Biomass energy. Significance of major Indian Environmental Legislation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; Wetlands (Conservation and Management Rules) 2017.		

Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the functions of environment, ecosystems, biodiversity and the impact of human activities on their conservation.	K2
CO2	Outline the causes, effects of environmental pollution and contribution to the preventive measures in the society.	K2
CO3	Understand the climate change, its impacts, and mitigation measures.	K2
CO4	Interpret the significance of sustainable development in reducing environmental degradation, fostering economic prosperity, and propose innovative solutions for a more sustainable future.	K2
CO5	Summarize the importance of natural resources and various environmental acts.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 - Apply

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	-	-	-	2	3	-	-	-	2	-	-	-
CO2	2	1	-	-	-	2	3	-	-	-	2	-	-	-
CO3	2	1	-	-	-	2	3	-	-	-	2	-	-	-
CO4	2	1	-	-	-	2	3	2	-	-	2	-	-	-
CO5	2	-	-	-	-	2	3	2	-	-	2	-	-	-
CO	2	1	-	-	-	2	3	2	-	-	2	-	-	-

Text Books

1	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2	S S Dara and D D Mishra, "A Textbook of Environmental Chemistry and Pollution Control", Ninth revised and enlarged edition, 2011, S Chand publishing New Delhi.
3	Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4	Singh, J.S., Singh, S.P. and Gupta, S.R. (2017). Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
5	R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 .edition 2010.
6	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.
7	Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.

Reference Books

1	Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
3	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
4	Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
5	Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
6	Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
7	Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.

U24ME4405	STRENGTH OF MATERIALS	L	T	P	C
		3	0	2	4
Course Objectives:	Explore the fundamental concepts of stress, strain, principal stresses, and principal planes; examine shearing force and bending moment in beams; determine stresses and deformations in torsional elements like circular shafts and helical springs. Compute slopes and deflections in beams and analyze stresses and deformations in thin and thick shells.				

Unit - I	STRESS, STRAIN AND DEFORMATION OF SOLIDS	9+9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumertric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress

List of Experiments

1. Tension test on a mild steel rod
2. Strain Measurement using Rosette strain gauge
3. Hardness test on metals - Brinnell and Rockwell Hardness Number

Unit - II	TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM	9

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams –Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution

Unit - III	DEFLECTION OF BEAMS	9+3

Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.

List of Experiment

1. Deflection test on beam

Unit – IV	TORSION	9+15

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

List of Experiments

1. Double shear test on Mild steel and Aluminium rod
2. Torsion test on a mild steel rod
3. Impact test on metal specimen
4. Compression test on helical springs
5. Deflection test on carriage spring

Unit - V	THIN CYLINDERS, SPHERES AND THICK CYLINDERS	9+3

Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.

List of Experiments

1. Effect of hardening- Improvement in hardness and impact resistance of steels

Total Periods:	**75**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Illustrate the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes	K3
CO2	Interpret the load transferring mechanism in beams and stress distribution due to shearing force and bending moment	K3
CO3	Apply basic equation of torsion in designing of shafts and helical springs	K2
CO4	Apply different methods to compute slope and deflection in beams.	K3
CO5	Solve thin and thick shells for applied pressures.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	3	2	1	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	3	-	-
CO	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

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

Reference Books

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

U24ME4406	KINEMATICS AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To provide students with practical experience in analyzing and experimenting with the principles of kinematics and dynamics, enhancing their understanding of mechanical system behavior through hands-on experiments				

Exp. No	Title	
1	Study of gear parameters	
2	Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.	
3	Determination of Mass moment of inertia of Fly wheel and Axle system and compound pendulum	
4	Motorized gyroscope – Study of gyroscopic effect and couple	
5	Governor - Determination of characteristics for Watts, Porter, Proell, and Hartnell Governors.	
6	Cams – Cam profile drawing, Motion curves and study of jump phenomenon	
7	Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination	
8	Transverse vibration of Free-Free beam – with and without concentrated masses.	
9	Determination of torsional natural frequency of single Rotor systems .- Undammed and Damped Natural frequencies	
10	Whirling of shafts – Determination of critical speeds of shafts with concentrated load	
11	Balancing of rotating masses and reciprocating masses	
	Total Periods :	**60**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Understand the fundamental concepts of gear parameters and their significance in mechanical systems.	K2
CO2	Demonstrate the gyroscopic effect and determine the mass moment of inertia of a flywheel and axle system, and compound pendulum	K2
CO3	Apply the principles of governor characteristics to determine the performance governors, and study the cam jump phenomena	K3
CO4	Determine the natural frequency of freedom spring-mass system, single rotor system and free - free beam.	K3
CO5	Demonstrate the balancing of rotating and reciprocating masses to minimize vibration and also determine the critical speeds of shafts with concentrated loads	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	-	-	-	-	2	-	-	-	1	-	-
CO2	3	2	1	-	-	-	-	2	-	-	-	1	-	-
CO3	3	2	1	-	-	-	-	2	-	-	-	1	-	-
CO4	3	2	1	-	-	-	-	2	-	-	-	1	-	-
CO5	3	2	1	-	-	-	-	2	-	-	-	1	-	-
CO	3	2	1	-	-	-	-	2	-	-	-	1	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24ME4407	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	The objective is to develop hands-on experience with IC engines, steam systems, and refrigeration & air conditioning systems through performance testing and analysis. It includes experiments on engine efficiency, fuel properties, energy balance, and thermodynamic cycles to enhance practical understanding of thermal systems				

Exp. No	Title
	IC ENGINES LABORATORY
1.	Valve Timing and Port Timing diagrams.
2.	Actual p-v diagrams of IC engines
3.	Performance Test on four – stroke Diesel Engine.
4.	Heat Balance Test on 4 – stroke Diesel Engine.
5.	Retardation Test on a Diesel Engine.
6.	Morse Test on Multi-Cylinder Petrol Engine.
7.	Determination of p-θ diagram and heat release characteristics of an IC engine.
8.	Determination of Flash Point and Fire Point of various fuels / lubricants
9.	Performance test on a two stage Reciprocating Air compressor
	REFRIGERATION AND AIR CONDITIONING SYSTEM
1	Determination of COP of a Refrigeration system
2	Determination of COP of an Air conditioning Test rig
	STEAM LABORATORY
1	Study of Steam Generators and Turbines.
2	Performance and Energy Balance Test on a Steam Generator.
3	Performance and Energy Balance Test on Steam Turbine.
	Total Periods : 60

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Demonstrate valve timing, port timing, and actual p-v diagrams of IC engines.	K2
CO2	Illustrate performance, heat balance, and Morse tests for SI and CI engines.	K2
CO3	Interpret fuel properties, and efficiency of IC engines.	K2
CO4	Explain steam generator and turbine operations, including performance and energy balance.	K2
CO5	Compare the performance of refrigeration and air conditioning systems using COP analysis.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	-	-	-	-	-	1	2	1	-
CO2	3	2	1	1	-	-	-	-	-	-	1	2	1	-
CO3	3	2	1	1	-	-	-	-	-	-	1	2	1	-
CO4	3	2	1	1	-	-	-	-	-	-	1	2	1	-
CO5	3	2	1	1	-	-	-	-	-	-	1	2	1	-
CO	3	2	1	1	-	-	-	-	-	-	1	2	1	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24ME4408	CAD MODELING AND CAM LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	The objective is to develop hands-on experience with 2D drafting and 3D modeling software for designing parts, sub-assemblies, and assemblies. It also covers G&M code programming, CNC simulation, and generating part programming data via CAM software.				

Exp. No	Title
	3D GEOMETRIC MODELLING
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, History operations. Assembly: Constraints, Exploded Views, Interference check Drafting: Layouts, Standard & Sectional Views, Detailing & Plotting
2	Creation of 3D assembly model of following machine elements using 3D modeling software 1. Flange Coupling 2. Plummer Block 3. Screw Jack 4. Lathe Tailstock 5. Universal Joint 6. Machine Vice 7. Stuffing box 8. Crosshead 9. Safety Valves 10. Non-return valves 11. Connecting rod 12. Piston 13. Crankshaft * Students may also be trained in manual and CAD drawing of some of the above components (specify the number – progressive arrangement of 3D)
	MANUAL PART PROGRAMMING
3	CNC Machining Centre i) Linear Cutting. ii) Circular cutting. iii) Cutter Radius Compensation. iv) Canned Cycle Operations.
4	CNC Turning Centre i) Straight, Taper and Radial Turning. ii) Thread Cutting. iii) Rough and Finish Turning Cycle. iv) Drilling and Tapping Cycle.
5	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
	Total Periods : 60

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Relate the creating and manipulating 3D models, assemblies, and 2D drawings using CAD software.	K2
CO2	Outline the detailed 3D assembly models of various machine elements using advanced 3D modeling software	K2
CO3	Infer the ability to program and operate CNC machining centers for different operations	K2

CO4	Show the skills in programming and operating CNC turning centers for various operations	K2
CO5	Summarize the CL data generate, post-process data using CAM and techniques in machining and turning operations.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	-	1	-	-	-	-	1	1	2	1	1
CO2	3	2	1	-	1	-	-	-	-	1	1	2	1	1
CO3	3	2	1	-	1	-	-	-	-	1	1	2	1	1
CO4	3	2	1	-	1	-	-	-	-	1	1	2	1	1
CO5	3	2	1	-	1	-	-	-	-	1	1	2	1	1
CO	3	2	1	-	1	-	-	-	-	1	1	2	1	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24ME4501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a thorough understanding of the design process for mechanical components, including the various steps involved in the generic design methodology, with a focus on shafts, couplings, temporary joints, and permanent joints. It emphasizes the design of essential machine elements such as springs, flywheels, connecting rods, and crankshafts for diverse applications, while also covering the design of bearings, seals, and gaskets. Students are encouraged to utilize reference tools, such as the PSG Design Data Book, to support accurate and practical design solutions.				

Unit - I	**STATIC AND VARIABLE LOADING**	**9**
Machine Design: Definition, design process, machine element design, standards and codes in design, types of stress including buckling stress, contact stress and impact stress; Design for static loading: Modes of failure, factor of safety, eccentric loading, theories of failure, problems; Design for variable loading: Stress concentration, fatigue failure, endurance limit, design equations - Soderberg, Goodman and Gerber equations, combined stresses.		
Unit - II	**SHAFTS AND COUPLINGS**	**9**
Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.		
Unit - III	**TEMPORARY AND PERMANENT JOINTS**	**9**
Threaded fasteners - Bolted joints - axial loading and eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures.		
Unit – IV	**ENERGY STORING ELEMENTS AND ENGINE COMPONENTS**	**9**
Helical springs: Stresses and deflection in round wire helical springs accounting for variable loading, concentric springs; Design of leaf springs- stress and deflection equation, nipping; Overview of the design of helical and leaf springs in automobile suspension system.		
Unit - V	**BEARINGS AND MISCELLANEOUS ELEMENTS**	**9**
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 Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the design of machine members subjected to static and variable loads.	K2
CO2	Apply the concepts to design shafts, key and couplings.	K3
CO3	Apply the concepts to design bolted, Knuckle, Cotter, riveted and welded joints.	K3
CO4	Apply the concept to design helical, leaf springs.	K3
CO5	Apply the concepts to design and select sliding and rolling contact bearings, seals and gaskets.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	-	-	-	-	1	1	-	-	3	2	2
CO2	2	2	3	-	-	-	-	1	1	-	-	3	2	2
CO3	2	2	3	-	-	-	-	1	1	-	-	3	2	2
CO4	2	2	3	-	-	-	-	1	1	-	-	3	2	2
CO5	2	2	3	-	-	-	-	1	1	-	-	3	2	2
CO	2	2	3	-	-	-	-	1	1	-	-	3	2	2

Text Books

1	Bhandari V B, "Design of Machine Elements", 4th Edition , Tata McGraw-Hill Book Co, 2016
2	Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015.
3	Machine Design by R.S Khurmi and J.K.Gupta, S.Chand Publishers, New Delhi.
4	Machine Design, S MD Jalaludin, Anuradha Publishers.

Reference Books

1	Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
2	Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004.
3	Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.
4	Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
5	Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup, et al. | 25 March 2019

U24ME4502	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3
Course Objectives:	The main objectives of this course is, enable the students to understand the mechanism of heat transfer, thermal analysis, design of heat exchangers, principles in radiation heat transfer and the basic concepts of mass transfer.				

Unit - I	**CONDUCTION**	**9**
General Differential equation – Cartesian, Cylindrical and Spherical 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 – Methods of enhanced thermal conduction-Basic laws governing heat transfer.		
Unit - II	**CONVECTION**	**9**
Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection-Simplified free convection relations for air.		
Unit - III	**PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**	**9**
Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications-LMTD correction factors (F-Charts).		
Unit – IV	**RADIATION**	**9**
Introduction to Thermal Radiation - Radiation laws and Radiative properties - Black Body and Gray body Radiation - Radiosity - View Factor Relations. Electrical Analogy. Radiation Shields-Coefficient of Radiant Heat Transfer and Radiation combined with convection.		
Unit - V	**MASS TRANSFER**	**9**
Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state and Transient Diffusion -Stefan flow –Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations- Reynolds Analogy		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the mechanism of steady and unsteady conductive heat transfer and compare convective heat transfer in natural with forced convection.	K3
CO2	Relate the phase change in heat transfer coefficient for Natural convection and Forced convection	K3
CO3	Calculate the effectiveness of heat exchangers by LMTD & NTD method.	K3
CO4	Summarize the concept of heat transfer between black body and gray body surfaces.	K3
CO5	Explain the basic concept of diffusive and convective mass transfer.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	1	-	-	-	-	-	-	-	-	2	2	1
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2	1
CO3	3	3	2	-	-	-	-	-	-	-	-	2	2	1
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2	1
CO5	3	3	2	-	-	-	-	-	-	-	-	2	2	1
CO	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**2**	**2**	**1**

Text Books

1	R.C. Sachdeva, “Fundamentals of Engineering Heat & Mass transfer”, New Age International Publishers, 2009.
2	Yunus A. Cengel, “Heat Transfer A Practical Approach” – Tata McGraw Hill, 5thEdition – 2013.

Reference Books

1	Frank P. Incropera and David P. Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons, 7th Edition, 2014.
2	Holman, J.P., “Heat and Mass Transfer”, Tata McGraw Hill, 2010
3	Kothandaraman, C.P., “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2012
4	Ozisik, M.N., “Heat Transfer”, McGraw Hill Book Co., 1994.
5	S.P. Venkateshan, “Heat Transfer”, Ane Books, New Delhi, 2014

U24ME4503	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	2	4
Course Objectives:	To develop a comprehensive understanding of metrology and its critical role in manufacturing. The course aims to equip learners with knowledge of dimensional measurement techniques, tolerance analysis, GD&T, surface metrology, and advanced inspection methods for effective quality control.				

Unit - I	BASICS OF METROLOGY	9+12
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, Design of plug and ring gauges, ISO standards, Abbe's principle. **List of Experiments** Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, and Comparators.		
Unit - II	MEASUREMENT OF LINEAR DIMENSIONS	9
Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector		
Unit - III	MEASUREMENT OF ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS	9+14
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, Profile errors, and total composite errors of gears. **List of Experiments** Measurement of angles using bevel protractor, sine bar, autocollimator, precision level. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope. Measurement of gear parameters – Micrometers, Vernier caliper.		
Unit – IV	METROLOGY OF SURFACES	9+4
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, Integration of surface metrology with CAD/CAM systems. **List of Experiments** Surface metrology - Measurement of form parameters – Straightness, Flatness using Autocollimator		
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, Introduction to Nano metrology.		
	Total Periods:	**75**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Interpret the basic principles of measurement, sources of errors, uncertainty estimation, statistical analysis, calibration practices, and metrology standards.	K2

CO2	Illustrate the operating principles and uses of linear, angular, and gear measuring instruments for dimensional and assembly inspection.	K2
CO3	Summarize the concepts of tolerancing, limits and fits, gauge design, and tolerance analysis in manufacturing processes.	K2
CO4	Differentiate geometric dimensioning concepts, inspection of form deviations, and surface texture measurement methods.	K2
CO5	Outline the principles and industrial applications of advanced metrology tools such as lasers, CMMs, machine vision, and non-contact measurement systems.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	-	2	1	-	-	2	-	-	2	1	1
CO2	3	2	2	-	2	1	-	-	2	-	-	2	1	1
CO3	3	2	2	-	2	1	-	-	2	-	-	2	1	1
CO4	3	2	2	-	2	1	-	-	2	-	-	2	1	1
CO5	3	2	2	-	2	1	-	-	2	-	-	2	1	1
CO	3	2	2	-	2	1	-	-	2	-	-	2	1	1

Text Books

1	Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2012.
2	Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2013.

Reference Books

1	AmmarGrous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.
2	Galyer, J.F.W. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA; 5th revised edition, 1990.
3	National Physical Laboratory Guide No. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk.
4	Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5	Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley &Sons, 2015.

U24ME4504	HEAT TRANSFER LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	The main objective of this course is to gain experimental knowledge of Predicting the thermal conductivity of solids and liquids, estimating the heat transfer coefficient values of various fluids & testing the performance of tubes in tube heat exchangers				

Exp. No.	Experiment Title	
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 and forced convection.	
4	Heat transfer from pin-fin under natural and forced convection.	
5	Determination of heat flux under pool boiling and flow boiling in various regimes.	
6	Determination of heat transfer coefficient in film-wise and drop-wise condensation.	
7	Determination of friction factor, heat transfer coefficient of cold/hot fluid and effectiveness of 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 Periods	**60**

On completion of the course, the student can

Course Outcomes

COs	Statements	K-Level
CO1	Conduct experiment on Predict the thermal conductivity of solids and liquids	K3
CO2	Conduct experiment on Estimate the heat transfer coefficient values of various fluids	K3
CO3	Conduct experiment on Test the performance of tubes in tube heat exchangers	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

POs / COs	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	-	-	-	-	1	-	1	1	1	1
CO2	3	2	2	2	-	-	-	-	1	-	1	1	1	1
CO3	3	2	2	2	-	-	-	-	1	-	1	1	1	1
CO	**3**	**2**	**2**	**2**	-	-	-	-	**1**	-	**1**	**1**	**1**	**1**

U24ME7501	SUMMER INTERNSHIP - I	L	T	P	C
		0	0	0	1
Course Objectives	To provide experiential learning through internships in reputed industries, research organizations, startups, or academic institutions, the course enables students to apply theoretical knowledge to real-world problems, understand industrial workflows, and develop technical, analytical, communication, and teamwork skills aligned with emerging technologies, automation, and digital transformation practices.				
Students shall undergo internship training for the prescribed duration in domains such as software development, system design, testing, analytics, product development, research practices, business processes, automation tools, and digital platforms. Students are expected to participate in assigned tasks actively, maintain professional ethics, and enhance problem-solving and project execution skills. Upon completion, students shall submit a detailed internship report within a week of the commencement of the next semester. Evaluation shall be based on the quality of the report, presentation, and viva-voce examination as per institutional regulations.					
	No. of Weeks:			**02**	

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify industry practices, processes, tools, technologies, automation methods, and professional standards followed in real-world software and technology environments.	K3
CO2	Analyze complex business or technical problems encountered during the internship and propose appropriate solution strategies considering practical constraints.	K4
CO3	Utilize domain knowledge to build, develop, and deploy solutions or prototypes for the target platform using appropriate tools and technologies.	K3
CO4	Analyze and evaluate internship outcomes and prepare a comprehensive technical report and presentation reflecting the work carried out and learning achieved.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

U24ME4601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a comprehensive understanding of the principles and standard procedures involved in designing mechanical power transmission components, including spur and helical gears. It covers the design methodology for bevel, worm, and cross-helical gears, as well as the development of multi-speed and variable-speed gearboxes for machine tool applications. Additionally, students will acquire knowledge in the design and analysis of cams, brakes, and clutches used in mechanical transmission systems, enabling them to develop efficient and reliable power transmission solutions.				

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 teeth-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 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 gear box, Fluid Couplings, Torque Converters for automotive applications.		
Unit - V	**CLUTCHES AND BRAKES**	**9**
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 Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply the concepts of design to belts, chains and rope drives.	K3
CO2	Apply the concepts of design to spur, helical gears.	K3
CO3	Apply the concepts of design to worm and bevel gears.	K3
CO4	Apply the concepts of design to gear boxes.	K3

CO5	Apply the concepts of design to brakes and clutches	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	3	1	-	-	-	-	1	-	-	2	3	2
CO2	3	2	3	1	-	-	-	-	1	-	-	2	3	2
CO3	3	2	3	1	-	-	-	-	1	-	-	2	3	2
CO4	3	2	3	1	-	-	-	-	1	-	-	2	3	2
CO5	3	2	3	1	-	-	-	-	1	-	-	2	3	2
CO	3	2	3	1	-	-	-	-	1	-	-	2	3	2

Text Books

1	Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
2	Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, 2008.

Reference Books

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.

U24ME4602	MECHATRONICS AND IoT	L	T	P	C
		3	0	0	3
Course Objectives:	To familiarize students with sensors and actuators commonly used in mechatronics systems; to provide insight into signal conditioning circuits and develop competency in PLC programming and control; to introduce the fundamentals of IoT and embedded systems; to impart knowledge of platforms such as Arduino and Raspberry Pi; and to inculcate skills in the design and development of mechatronics and IoT-based systems.				

Unit - I	SENSORS AND ACTUATORS	9
Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors –Photo detectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezo-electrical and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors		
Unit - II	**SIGNAL CONDITIONING CIRCUITS AND PLC**	**9**
Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge Amplifier – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System – Relays. PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.		
Unit - III	**FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS**	**9**
The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals - Software Considerations		
Unit – IV	**CONTROLLERS**	**9**
Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.		
Unit - V	**MECHATRONICS AND IoT CASE STUDIES**	**9**
Mechatronics systems: Drone actuation and Control -Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain Select suitable sensors and actuators to develop mechatronics systems.	K2
CO2	Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.	K2
CO3	Elucidate the fundamentals of Iot and Embedded Systems	K2
CO4	Discuss Control I/O devices through Arduino and Raspberry Pi.	K2
CO5	Design and develop an apt mechatronics/IoT based system for the given real-time application.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	2	-	-	-	-	-	-	-	1	2	-	1
CO2	2	2	2	-	3	-	-	-	-	-	1	2	-	3
CO3	2	-	0	-	-	-	-	-	-	-	2	1	-	2
CO4	2	-	2	-	3	-	-	-	-	-	2	2	-	3
CO5	3	3	3	2	3	2	-	2	2	2	2	3	2	3
CO	2	1	2	2	2	2	-	2	2	2	2	2	2	2

Text Books

1	Bradley D.A., Burd N.C., Dawson D., Loader A.J., “Mechatronics: Electronics in Products andProcesses”, Routledge, 2017.
2	Sami S.H and Kisheen Rao G “The Internet of Mechanical Things: The IoT Framework forMechanical Engineers”, CRC Press, 2022.

Reference Books

1	John Billingsley, “Essentials of Mechatronics”, Wiley, 2006
2	David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,“IoT Fundamentals: NetworkingTechnologies, Protocols, and Use Cases for the Internet of Things”, Pearson Education, 2018.
3	Nitin G and Sharad S, “Internet of Things: Robotic and Drone Technology”, CRC Press, 2022
4	Newton C. Braga, “Mechatronics for The Evil Genius”, McGrawHill, 2005.
5	Bell C., “Beginning Sensor Networks with Arduino and Raspberry Pi”, Apress, 2013

U24GE1601	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3
Course Objectives:	Develop ethical awareness in engineering, fostering human values, professional responsibility, safety, rights, and global perspective, enabling sustainable, socially conscious, and accountable decision-making throughout professional life.				

Unit - I	HUMAN VALUES, ETHICS AND PROFESSIONAL EXCELLENCE	9

Introduction to Morals, Values and Ethics – Integrity, Honesty , Work ethic – Service learning , Civic virtue – Respect for others , Living peacefully, Caring and Sharing — Courage, Commitment , Cooperation – Valuing time & Professional Discipline - Empathy , Self Confidence , Character Building – Spirituality and Inner Development – Introduction to Yoga and meditation for professional excellence and stress management.

Unit - II	ENGINEERING ETHICS	9

Introduction to Engineering Ethics – Senses, Scope, and Importance in Professional Life - Variety of Moral Issues – Understanding Ethical Challenges in Engineering Practice - Types of Inquiry – Moral Dilemmas and Decision-Making Frameworks - Moral Autonomy – Kohlberg's Theory of Moral Development - Gilligan's Ethics of Care – Consensus, Controversy, and Ethical Reasoning- Models of Professional Roles – Responsibilities and Expectations in Engineering- Theories about Right Action – Utilitarianism, Deontology, Virtue Ethics- Influence of Self-Interest, Customs, and Religion on Ethical Decision-Making- Applications and Uses of Ethical Theories – Case Studies.

Unit - III	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as Experimentation – Differences between laboratory experiments and engineering projects , Uncertainty, risk, and complexity in engineering experiments - Role of engineering in society and public welfare - Engineers as responsible Experimenters – Moral and Professional responsibilities of engineers - Codes of Ethics – Fundamental principles and Ethical dilemmas in engineering practice - A Balanced Outlook on Law – Case Studies.

Unit – IV	OCCUPATIONAL SAFETY, PROFESSIONAL RESPONSIBILITIES AND LEGAL RIGHTS	9

Introduction to Safety and Risk – Concepts, Importance, and Types of Workplace Hazards-Assessment of Safety and Risk – Methods and Tools for Identifying Risks-Risk–Benefit Analysis and Risk Reduction Strategies – Preventive Measures and Safety Planning-Respect for Authority and Ethical Workplace Conduct – Roles and Responsibilities-Collective Bargaining and Confidentiality- Conflicts of Interest and Occupational Crime – Identification and Mitigation Strategies-Professional Rights and Employee Rights-ntellectual Property Rights (IPR) – Importance, Types, and Professional Compliance-Discrimination and Equal Opportunity.

Unit - V	GLOBAL AND PROFESSIONAL ISSUES	9

Global Issues in Engineering – Overview and Relevance- Multinational Corporations- Environmental Ethics – Sustainable Practices and Impact Assessment- Computer Ethics – Cyber security, Privacy, and Professional Responsibility- Weapons Development – Ethical Considerations and Social Implications- Engineers as Managers, Consultants, and Advisors - Engineers as Expert Witnesses – Legal and Ethical Accountability- Moral Leadership and Code of Conduct- Corporate Social Responsibility – Ethics, Sustainability, and Societal Impact.

Total Periods:	45

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply ethical principles, honesty, cooperation, time management, and service learning in real-life academic and professional contexts.	K3
CO2	Analyze engineering ethical issues and moral dilemmas using ethical theories, moral development models, and professional role frameworks for responsible decision-making.	K4
CO3	Analyze engineering practice as experimentation, addressing risk, uncertainty, public welfare, professional responsibilities, codes of ethics, law, and ethical case studies.	K4
CO4	Apply safety, risk, rights, confidentiality, conflicts, ethics, and intellectual property principles in professional workplace contexts.	K3
CO5	Apply ethical principles to multinational corporations, environmental and computer ethics, corporate social responsibility, leadership, and engineering practice.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	-	-	-	-	-	3	3	-	-	-	2	-	-	-
CO02	-	-	-	-	-	3	3	-	-	-	2	-	-	-
CO03	-	-	-	-	-	3	3	-	-	2	2	-	-	-
CO04	-	-	-	-	-	3	3	2	-	2	2	-	-	-
CO05	-	-	-	-	-	3	3	2	-	2	3	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**-**	**2**	**2**	**-**	**-**	**-**

Text Books

1	Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York, 2012.
2	Charles E Harris, Michael S Pritchard and Michael J Rabins, “Engineering Ethics – Concepts and Cases”, Ray James, Elian Englehardt Wadsworth publishing co, 6/e, 2013
3	Professional Ethics by R. Subramanian (OUP India) , Oxford University Press (India), ISBN-13: 978-9367256060, 3rd edition 2025.

Reference Books

1	Charles D Fleddermann, ‘Engineering Ethics’, Prentice Hall, New Mexico, 2012.
2	John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, 2013.
3	Edmund G Seebauer and Robert L Barry, ‘Fundamentals of Ethics for Scientists and Engineers’, Oxford University Press, 2013.
4	David Erman & Michele Shauf, ‘Computers, Ethics and Society, Oxford University Press, 2012.

U24ME4603	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	2	4
Course Objectives:	To introduce the concepts of Mathematical Modeling of Engineering Problems and to appreciate the use of FEM to a range of Engineering Problems. And to enable students to formulate and analyze structural, thermal, and dynamic problems using finite element techniques.				

Unit - I	**INTRODUCTION**	**9+6**
Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Weighted Residual Methods – Ritz Technique – Basic concepts of the Finite Element Method – Gauss Elimination method **List of Experiments** 1. SCILAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables. 2. Use of SCILAB to solve simple physical problems.		
Unit - II	**ONE - DIMENSIONAL PROBLEMS**	**9+6**
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 structural (Bar, Truss, Beam element) and heat transfer. **List of Experiments** 1. Stress and deflection analysis in beams with different support conditions 2. Force and stress analysis using Truss element		
Unit - III	**TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS**	**9+6**
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 - Serendipity elements **List of Experiments** 1. Stress analysis of 2D components 2. Thermal analysis of Simple 2D components.		
Unit – IV	**TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS**	**9+6**
Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements **List of Experiments** 1. Stress analysis of axi–symmetric components. 2. Stress analysis of simple shell element		
Unit - V	**ISOPARAMETRIC FORMULATION & SOLUTION TECHNIQUES**	**9+6**
Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Numerical integration and application to plane stress problems - Matrix solution techniques – Dynamic problems – natural frequencies and mode shapes (Basic bar & beam element). **List of Experiments** 1. Model analysis of beams. 2. Harmonic and transient analysis of simple systems.		
	Total Periods:	**75**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply the fundamental concepts of finite element methods to formulate governing equations and mathematical models for engineering field problems using numerical techniques.	K3
CO2	Develop finite element procedures to solve one-dimensional engineering problems by developing shape functions, stiffness matrices, and assembling global matrices for structural and heat transfer applications.	K3
CO3	Identify finite element formulations to analyze two-dimensional scalar field problems using triangular and higher-order elements for thermal and engineering applications.	K3
CO4	Apply finite element methods to analyze two-dimensional vector field problems involving plane stress, plane strain, and axisymmetric conditions in structural components.	K3
CO5	Select isoparametric formulation and numerical integration techniques to evaluate element stiffness matrices for structural and continuum problems. And develop dynamic responses such as longitudinal vibration frequencies and mode shapes of structural elements.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	1	3	-	-
CO3	3	3	2	1	-	-	-	-	-	-	1	3	1	-
CO4	2	3	2	2	1	-	-	-	-	-	1	3	2	-
CO5	2	3	3	3	2	-	-	-	-	1	2	3	3	-
CO	**3**	**3**	**2**	**2**	**1**	-	-	-	-	**1**	**2**	**3**	**2**	-

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.

Reference Books

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.

U24ME4604	MECHATRONICS AND IoT LABORATORY	L	T	P	C
		0	0	4	2
Course Objectives:	To understand the principles and applications of various transducers and implement speed and direction control of electrical motors such as DC, AC servo, and induction motors; to develop programming skills using 8051 microcontrollers/PLC for arithmetic operations and interfacing motors, traffic light systems, and other control applications; to understand the sequencing and control of hydraulic, pneumatic, and electro-pneumatic systems using PLC and simulation software; to gain knowledge of IoT fundamentals and develop programs for sensor interfacing and remote monitoring/control of devices through the Internet; and to interface sensors with microcontrollers/SBCs for IoT-based control of actuators such as solenoid valves and linear/rotary systems, along with wireless data transmission using Bluetooth/Wi-Fi.				

Exp. No.	Experiment Title
MECHATRONICS - LIST OF EXPERIMENTS:	
1.	Measurement of Linear/Angular of Position, Direction and Speed using Transducers.
2.	Measurement of Pressure, Temperature and Force using Transducers.
3.	Speed and Direction control of DC Servomotor, AC Servomotor and Induction motors.
4.	Addition, Subtraction and Multiplication Programming in 8051.
5.	Programming and Interfacing of Stepper motor and DC motor using 8051/PLC.
6.	Programming and Interfacing of Traffic Light Interface using 8051.
7.	Sequencing of Hydraulic and Pneumatic circuits.
8.	Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.
9.	Electro-pneumatic/hydraulic control using PLC.
10.	Vision based image acquisition and processing technique for inspection and classification.
INTERNET OF THINGS - LIST OF EXPERIMENTS:	
11.	Familiarization with concept of IoT and its open source microcontroller/SBC
12.	Write a program to turn ON/OFF motor using microcontroller/SBC through internet.
13.	Write a program to interface sensors to display the data on the screen through internet.
14.	Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.
15.	To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear /Rotary Actuator through IoT when sensor data is detected.
16.	To interface Bluetooth/ Wifi with microcontroller/SBC and write a program to send sensor data to smart phone using Bluetooth/ wifi.
Total Periods	**60**

On completion of the course, the student can

COs	Statements	K-Level
CO1	Measure physical parameters, control motor operations, and develop programming and interfacing solutions using 8051.	K2
CO2	Design and Demonstrate sequencing of hydraulic, pneumatic, and electro-pneumatic circuits, PLC control, and vision-based inspection and classification.	K3
CO3	Apply the IoT concepts, and demonstrate controlling a motor remotely using an open-source microcontroller/SBC through the internet.	K3
CO4	Choose a sensor to Interface with microcontrollers, display data online, and control devices remotely.	K3
CO5	Select sensors and Bluetooth/WiFi with microcontrollers/SBCs, and develop programs to control actuators and send sensor data to smartphones through IoT.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

POs / COs	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	-	-	-	-	-	-	2	1	1
CO2	3	2	1	1	-	-	-	-	-	-	-	2	1	1
CO3	3	2	1	1	-	-	-	-	-	-	-	2	1	1
CO4	3	2	1	1	-	-	-	-	-	-	-	2	1	1
CO5	3	2	1	1	-	-	-	-	-	-	-	2	1	1
CO	3	2	1	1	-	-	-	-	-	-	-	2	1	1

Text Books

1	Bradley D.A., Burd N.C., Dawson D., Loader A.J., “Mechatronics: Electronics in Products andProcesses”, Routledge, 2017.
2	Sami S.H and Kisheen Rao G “The Internet of Mechanical Things: The IoT Framework forMechanical Engineers”, CRC Press, 2022.

Reference Books

1	John Billingsley, “Essentials of Mechatronics”, Wiley, 2006
2	David H., Gonzalo S., Patrick G.,Rob B. and Jerome H.,“IoT Fundamentals: NetworkingTechnologies, Protocols, and Use Cases for the Internet of Things”, Pearson Education, 2018.
3	Nitin G and Sharad S, “Internet of Things: Robotic and Drone Technology”, CRC Press, 2022
4	Newton C. Braga, “Mechatronics for The Evil Genius”, McGrawHill, 2005.
5	Bell C., “Beginning Sensor Networks with Arduino and Raspberry Pi”, Apress, 2013

U24ME7601	FABLAB	L	T	P	C
		0	0	2	1
Course Objectives:	To help the students look into the functioning of simple to complex devices and systems, enable the students to design and build simple systems on their own, experiment with innovative ideas in design and team work, create an engaging and challenging environment in the engineering lab				

Description	
The course will provide mechanical engineering students with an opportunity to gain a foundational understanding of computer-controlled systems and electronic devices, and apply these concepts to design and develop mechanically integrated systems. As a practical, project-based embedded systems course, students will learn through a variety of publicly available reference materials. While initial instruction will cover relevant hardware, programming, and system integration, the major portion of the course will emphasize innovation in designing and building mechanically interactive devices, such as automated mechanisms, robotic arms, drones, and other electromechanical systems. In the final semester, students will focus primarily on the design, integration, and development of a functional prototype combining mechanical and interdisciplinary components.	
Total Periods	**30**

On completion of the course, the student can

Course Outcomes

COs	Statements	K-Level
CO1	Identify practical problems and develop effective solutions	K3
CO2	Understand and apply project management techniques	K3
CO3	Apply interdisciplinary knowledge to design and implement electromechanical solutions	K3
CO4	Collaborate effectively in teams to execute project-based engineering tasks	K3
CO5	Demonstrate technical report writing and presentation skills	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

POs / COs	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	1	1				1		1	1	1	1	1
CO2	3	1	2	1	1			1		1	1	2	1	1
CO3	3	3	3	1	2			1		1	2	2	1	1
CO4	3	1	1		1			2		1	1	1	1	1
CO5	3	1	1		1			1				1	1	1
CO	3	2	2	1	1			2		1	1	2	1	1

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

U24ME7701	PROJECT WORK – PHASE I	L	T	P	C
		0	0	6	3
Course Objectives:	To enable students to identify and define a relevant business or research problem, conduct a preliminary literature review, and formulate clear objectives and an appropriate methodology, while initiating the project through planning or a pilot implementation.				
The students shall undertake a project individually or in groups on a business or research problem relevant to their programme specialization and approved by the department. In this phase, students shall identify the problem, finalize the title and objectives, conduct a brief literature review, and design the methodology. The project shall be developed and implemented with core modules integrated, tested, and maintained using version control practices in line with industry standards. A working prototype or functional system must be demonstrated. A Phase 1 project report shall be submitted as per the prescribed guidelines and presented for evaluation.					
	Total Periods:			**90**	

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply problem identification techniques to select and define a relevant business or research problem aligned with the programme specialization.	K3
CO2	Analyze existing literature to identify research gaps, theoretical foundations, and current practices related to the defined problem.	K4
CO3	Apply project planning principles to design clear objectives, scope, and an appropriate methodology for addressing the identified problem.	K3
CO4	Analyze initial implementation results or pilot outcomes to validate the feasibility and direction of the proposed project approach.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

U24ME7702	SUMMER INTERNSHIP - II	L	T	P	C
		0	0	0	1
Course Objectives:	To enable students to gain exposure to reputed industry, academia, or research organizations and acquire practical knowledge in product development, software design, testing, analytics, and related domains. The course also aims to develop technical, soft, and teamwork skills aligned with industry practices, automation, and digitalization to effectively solve real-world problems.				
The students shall individually undergo training in reputed industries, research institutes, laboratories, startups, or academic organizations for the specified duration. During the internship, students are expected to gain hands-on experience in relevant domains such as product development, software design and development, testing, analytics, research practices, business processes, professionalism, automation, and digitalization. Upon completion of the training, the student shall prepare and submit a detailed internship report within a week of the commencement of the next semester. The report shall document the organization profile, problem domain, nature of work carried out, methodologies adopted, tools and technologies used, learning outcomes, and conclusions. The students shall be evaluated based on the submitted report and assessment as per the regulations.					
	No. of Weeks:	02			

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify industry practices, processes, tools, technologies, automation methods, and professional standards followed in real-world software and technology environments.	K3
CO2	Analyze complex business or technical problems encountered during the internship and propose suitable solution approaches.	K4
CO3	Develop and deploy solutions or prototypes for the target platform by applying acquired domain knowledge and technical skills.	K3
CO4	Evaluate the internship outcomes and prepare a comprehensive technical report and presentation reflecting the work carried out and learning achieved.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

U24ME7801	PROJECT WORK - PHASE II / INTERNSHIP / APPRENTICESHIP	L	T	P	C
		0	0	14	7
Course Objectives:	To enable students to complete the project as per the approved methodology, analyze and interpret results, and effectively present the outcomes through a comprehensive report and viva-voce examination.				
The students shall continue and enhance the project completed in Phase 1 by implementing additional features, improvements, or advanced analysis. Alternatively, students may undertake a new project, internship, or apprenticeship related to their programme specialization with prior departmental approval. In the case of an internship or apprenticeship, students shall carry out the assigned industry or organization-based tasks and submit a detailed report as per the prescribed guidelines. Students shall submit a comprehensive final report and appear for a viva-voce examination conducted as per regulations.					
	Total Periods:	210			

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply the approved methodology to implement and complete the project in accordance with defined objectives and scope.	K3
CO2	Analyze project data or system outputs using appropriate analytical tools and techniques to obtain meaningful results.	K4
CO3	Analyze and interpret project outcomes in relation to stated objectives and existing literature to assess effectiveness.	K4
CO4	Apply technical documentation and presentation skills to develop a comprehensive project report and present the work through viva-voce examination.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

U24GE7203	Deutsch - I	L	T	P	C
		0	0	2	1
Course Objectives:	In this course equip the students with foundational proficiency in the German language by developing their basic grammar, vocabulary, pronunciation, and conversational skills, enabling them to communicate effectively in everyday, workplace, travel, and social contexts.				

Unit	Title	Periods
Unit - I	**INTRODUCTION TO GERMAN SOUNDS AND BASIC WORDS**	**9**
Die Satzmelodie - Das Alphabet - Die Laute sch [S] und sp [Sp] - Diphthonge: ei [ai] - Begrüßen - Sich und andere vorstellen - Buchstabieren - Zählen		
Unit - II	**FAMILY**	**9**
Angaben zur Person: Name, Alter, Familie - Länder - Städte - Berufe - Sprachen - Hobbys - Zahlen Personalpronomen und Verben im Präsens - Personalpronomen - Aussagesätze - Fragesätze - Bestimmter Artikel - Possessivartikel		
Unit - III	**FIRST CONVERSATION AT WORKPLACE**	**9**
Gespräche mit Kollegen - Die Büroeinrichtung und die Abteilungen beschreiben - Nach Preisen fragen - Über Freizeitaktivitäten sprechen - Nomengruppe im Nominativ: bestimmter und unbestimmter Artikel - Possessivartikel - Pronomen - Verben im Präsens - Modalverb: können - Negation - Lokale Präpositionen: aus, in, bei, nach		
Unit – IV	**TRAVEL**	**9**
Ein Hotelzimmer reservieren - Sich im Hotel anmelden - Probleme im Hotelzimmer benennen - Sich in einer Stadt orientieren - Informationen über Museen erfragen (Öffnungszeiten/Eintrittspreise) - Nomengruppe im Akkusativ - Komposita - Verben im Präsens - Verben mit Akkusativ - Modalverb: möchte(n) - Temporale und lokale Präpositionen		
Unit - V	**FOOD AND DRINK**	**9**
Essen und Trinken bestellen - Nahrungsmittel einkaufen - Einfache Rezepte lesen Informationen über Essgewohnheiten geben und erfragen - Nomengruppe im Akkusativ - Plural der Nomen - Modalverb: mögen - Präteritum von sein und haben - Personalpronomen im Akkusativ		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Explain basic German sounds, alphabet patterns, pronunciation rules, and commonly used introductory expressions in everyday communication.	K2
CO2	Describe personal information, family details, professions, and hobbies using appropriate personal pronouns, articles, and present tense verb forms.	K2

COs	STATEMENTS	K-Level
CO3	Interpret and respond to simple workplace conversations using correct grammatical structures such as modal verbs, negation, and prepositions	K2
CO4	Explain travel-related interactions including hotel reservations, city navigation, and museum inquiries using appropriate accusative forms and modal verbs	K2
CO5	Discuss food and drink preferences, ordering processes, and basic shopping conversations using plural forms, accusative pronouns, and simple past forms of *sein* and *haben*.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO2	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO3	-	-	-	-	-	2	-	3	3	1	2	1	1	2
CO4	-	-	-	-	-	2	-	2	3	1	2	-	1	2
CO5	-	-	-	-	-	1	-	2	3	-	2	-	1	1
CO	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**3**	**0**	**2**	**-**	**1**	**1**

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Dengler, Stefanie, et al. *Netzwerk A1: Kursbuch*. Ernst Klett Sprachen, 2017.
2	Funk, Hermann, et al. *Menschen A1: Kursbuch*. Hueber Verlag, 2012.
3	Funk, Hermann, et al. *Menschen A1: Arbeitsbuch*. Hueber Verlag, 2012.
4	Koithan, Ute, et al. *Aspekte neu A1 Plus*. Klett Sprachen, 2016.

Reference Books:

1	Dreyer, Hilke, and Richard Schmitt. *Lehr- und Übungsbuch der deutschen Grammatik*. Hueber Verlag, 2015.
2	Reimann, Monika. *Grundstufen-Grammatik für Deutsch als Fremdsprache*. Hueber Verlag, 2010.
3	Lemcke, Christiane, et al. *Berliner Platz 1 NEU*. Langenscheidt, 2016.
4	Hall, Karin, and Barbara Scheiner. *Übungsgrammatik für die Grundstufe*. Hueber Verlag, 2014.
5	Di Donato, Robert, et al. *Deutsch Na Klar! An Introductory German Course*. McGraw-Hill Education, 2014.

U24GE7204	JAPANESE - I	L	T	P	C
		0	0	2	1
Course Objectives:	To develop foundational proficiency in the Japanese language by enabling students to understand the Japanese writing system (Hiragana, Katakana, and basic Kanji), acquire essential grammar and vocabulary, and communicate effectively in everyday, workplace, travel, and social situations.				

Unit - I	INTRODUCTION TO JAPANESE	9
Japanese written system - Japanese sounds - Hiragana (あ、い、う、え、お...) -Hiragana variations - Katakana - Katakana variations		
Unit - II	**MYSELF**	**9**
Countries - Languages - Occupations - Self-introduction - Family - People - Numbers - My family - wa...desu - mo particle- to particle - ni particle - no particle.		
Unit - III	**FIRST CONVERSATION AT WORKPLACE**	**9**
Food - Drinks - 7 Kanji - Food for lunch - Eating places - ga suki desu - sukijanai - o particle - de particle - My breakfast - My lunch		
Unit – IV	**TRAVEL**	**9**
Home - Furniture - 4 kanjis - Places to visit nearby - Rooms - Things in the room - ni + ga + arimasu - ni + ga + imasu - general counter - My home - My room		
Unit - V	**FOOD AND DRINK**	**9**
Daily routines - Time - 10 kanjis - Free-time activities - Places - Calendar - telling time - ni particle - kara... made... - time expression - ii adjective		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Explain the Japanese writing system including Hiragana, Katakana, basic Kanji, and fundamental pronunciation patterns.	K2
CO2	Describe personal information, family details, occupations, and nationalities using basic Japanese sentence structures and particles (wa, mo, to, ni, no).	K2
CO3	Interpret and respond to simple workplace and daily-life conversations related to food, preferences, and common expressions using appropriate particles (ga, o, de).	K2
CO4	Explain travel-related and home-based conversations using sentence patterns such as *ni + ga + arimasu/imasu* and basic counters.	K2
CO5	Discuss daily routines, time expressions, free-time activities, and calendar-related conversations using correct particles and adjective forms.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO2	-	-	-	-	-	1	-	2	3	-	2	-	-	1
CO3	-	-	-	-	-	2	-	3	3	1	2	1	1	2
CO4	-	-	-	-	-	2	-	2	3	1	2	-	1	2
CO5	-	-	-	-	-	1	-	2	3	-	2	-	1	1
CO	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**3**	**0**	**2**	**-**	**1**	**1**

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Banno, Eri, et al. *Genki I: An Integrated Course in Elementary Japanese*. 3rd ed., The Japan Times Publishing, 2020.
2	The Japan Foundation. *Marugoto: Japanese Language and Culture Starter A1 – Katsudoo (Coursebook for Communicative Language Activities)*. Sanshusha Publishing, 2014.
3	The Japan Foundation. *Marugoto: Japanese Language and Culture Starter A1 – Rikai (Coursebook for Communicative Language Competences)*. Sanshusha Publishing, 2014.
4	Tohsaku, Yookoso! Yasu-Hiko. *Yookoso! An Invitation to Contemporary Japanese, Book 1*. 3rd ed., McGraw-Hill Education, 2014.
5	Nakama, Yukiko Abe Hatasa, et al. *Nakama 1: Japanese Communication, Culture, Context*. 3rd ed., Cengage Learning, 2017.

Reference Books:

1	Makino, Seiichi, and Michio Tsutsui. *A Dictionary of Basic Japanese Grammar*. The Japan Times Publishing, 1989.
2	Hadamitzky, Wolfgang, and Mark Spahn. *Japanese Kanji and Kana: A Complete Guide to the Japanese Writing System*. Tuttle Publishing, 2011.
3	Miura, Akira. *Essential Japanese Grammar: A Comprehensive Guide to Contemporary Usage*. Tuttle Publishing, 1998.
4	Henshall, Kenneth G. *A Guide to Remembering Japanese Characters*. Tuttle Publishing, 2015.
5	Sasaki, Isami, et al. *Minna no Nihongo I: Main Textbook*. 2nd ed., 3A Corporation, 2012.

U24CY8501	DISASTER RISK REDUCTION AND MANAGEMENT	L	T	P	C
		3	0	0	0
Course Objectives:	To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management and acquaint with the skills for planning and organizing disaster response				

Unit - I	**HAZARDS, 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 Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental concepts of hazards, vulnerability, and risks, and describe the diverse impacts of natural and human-induced disasters on society and the environment.	K2
CO2	Summarize the disaster risk reduction (DRR) framework and the roles of various stakeholders in implementing prevention, mitigation, and early warning strategies	K2
CO3	Outline the institutional frameworks, legislative acts, and policies governing disaster management and post-disaster recovery in the Indian context.	K2
CO4	Describe the integration of modern tools like GIS and IT in disaster response, and discuss the essential components of climate-resilient infrastructure and	K2

COs	Statements	K-Level
	relief operations.	
CO5	Interpret real-world disaster scenarios through case studies to understand the effectiveness of mitigation strategies and the importance of field-based preparedness like mock drills.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**01**	**02**	**03**
CO1	2	2	-	-	-	3	1	-	-	-	2	2	1	2	2
CO2	1	-	3	-	-	3	2	2	1	-	2	1	1	3	1
CO3	-	-	-	-	-	3	3	-	2	2	1	1	2	2	-
CO4	2	2	3	2	3	3	-	-	2	2	3	3	2	3	2
CO5	1	3	3	3	2	3	2	3	3	1	3	2	3	3	1
CO	**1.5**	**2**	**3**	**2.5**	**2.5**	**3**	**2**	**2.5**	**2**	**2**	**2**	**2**	**2**	**2.5**	**1.5**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

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
3	Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.
4	Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.

Reference Books

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

Website Link

1. **https://onlinecourses.swayam2.ac.in/ini25_hs32/preview**

U24GE8506	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	0
Course Objectives:	It enables students to understand workplace exposures and hazards, and to conduct and participate in various industrial safety activities. The course also equips learners to assess hazards and their consequences using appropriate 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 - Safety Culture and Safety Climate.		
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 – Behaviour -Based Safety (BBS) and Legal Compliance.		
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 - Digital Safety Management Systems (E-Safety Reporting).		
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 - Industrial Hygiene Monitoring and Control		
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 - Bow-Tie Risk Analysis Method.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the basic concepts of safety.	K2
CO2	Describe statutory regulations and safety standards.	K2
CO3	Outline workplace safety activities.	K2
CO4	Interpret the impact of occupational exposures and their remedies.	K2
CO5	Summarize risk assessment techniques.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	3	1	-	-	-	-	-	-	-	2	-	1
CO2	2	3	2	2	-	-	-	-	-	-	-	-	3	1
CO3	2	3	2	3	-	-	-	-	-	-	-	2	2	-
CO4	2	2	3	2	-	-	-	-	-	-	-	-	2	1
CO5	2	2	3	2	-	-	-	-	-	-	-	2	3	1
CO	2	2	3	2	-	-	-	-	-	-	-	2	3	1

Text Books

1	R.K. Jain and Prof. Sunil S. Rao,(2019) Industrial Safety, Health and Environment Management Systems KHANNA PUBLISHER
2	L. M. Deshmukh (2021) Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

Reference Books

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 (2020) , USA

U24HS8501	ELEMENTS OF LITERATURE	L	T	P	C
		3	0	0	0
Course Objectives:	This course introduces the relevance of literature in developing reading, thinking, discussion, and writing skills while nurturing human sensibility. It provides basic knowledge of fiction, poetry, and drama and their key elements and techniques. It also presents major approaches to literary criticism and interpretation. Overall, it trains students to read and analyze literary texts with clarity and critical insight.				

Unit - I	**RELEVANCE OF LITERATURE**	**9**
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 – Narrative Techniques (Stream of Consciousness, Unreliable Narrator) fact, and literary truth, - Fictional modes and patterns, - Plot character and perspective - Characterization in Fiction - Narrative Perspective and Point of View - Time and Structure in Narrative - Setting and Atmosphere in Fiction		
Unit - III	**ELEMENTS OF POETRY**	**9**
Poetry – Prosody (Meter, Rhyme, Rhythm) - Emotions and imaginations, - Figurative language, (Simile, metaphor, conceit, symbol, pun, and irony), - Personification and animation, - Rhetoric and trend - Imagery and Sensory Language - Tone, Mood, and Voice in Poetry - Sound Devices in Poetry - Symbolism and Allegory in Poetry - Forms and Structures of Poetry.		
Unit – IV	**ELEMENTS OF DRAMA**	**9**
Drama as representational art (Modern Forms like Absurdist theatre, Postcolonial Drama beyond Tragedy/Comedy/ Satire) - Content mode and elements, - Theatrical performance, - Drama as narration, mediation, and persuasion, - Features of tragedy, comedy, and satire.		
Unit - V	**LITERARY CRITICISM AND INTERPRETATION**	**9**
Approaches to Literary Criticism, - Modern Critical Theories, - Methods of Literary Interpretation, - Practical Literary Analysis - Historical and Biographical Criticism - Reader-Response Criticism - Feminist and Gender Criticism - Postcolonial Criticism - Structuralism and Post-Structuralism - Comparative and Interdisciplinary Approaches.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	STATEMENTS	K-Level
CO1	Recall and explain the relevance of literature in enhancing reading, thinking, discussion, and writing skills and in developing human sensibility and unbiased understanding.	K2
CO2	Identify and explain the elements of fiction such as literary truth, fictional modes, plot, character, and narrative perspective.	K2/K3
CO3	Describe and illustrate poetic elements including figurative language, imagery, rhetoric, and poetic devices like simile, metaphor, symbol, and irony.	K2/K4

COs	STATEMENTS	K-Level
CO4	Explain and apply the elements of drama, theatrical modes, and the features of tragedy, comedy, and satire while reading dramatic texts.	K2
CO5	Summarize and apply major approaches to literary criticism and interpretation in practical literary analysis.	K2/K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	1	-	-	-	2	2	1	2	-	1	1	2	1
CO2	-	2	-	-	-	1	-	-	2	-	1	1	1	1
CO3	-	2	-	1	-	1	-	-	3	-	1	1	1	2
CO4	-	2	-	1	-	2	1	1	3	-	1	1	2	1
CO5	-	2	-	2	-	2	1	-	3	-	1	1	2	2
CO	**-**	**2**	**-**	**1**	**-**	**2**	**1**	**0**	**3**	**0**	1	**1**	**2**	**1**

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books:

1	Kennedy, X. J., and Dana Gioia. An Introduction to Literature. 13th ed., Pearson, 2016.
2	Roberts, Edgar V., and Henry E. Jacobs. Literature: An Introduction to Reading and Writing. 11th ed., Pearson, 2015.
3	Foster, Thomas C. How to Read Literature Like a Professor. Harper Perennial, 2014.
4	Mays, Kelly J., editor. The Norton Introduction to Literature. 13th ed., W. W. Norton, 2018.Film Studies: An Introduction. Buckland, Warren. *Film Studies: An Introduction*. Hodder Education, 2015.
5	Barry, Peter. Beginning Theory: An Introduction to Literary and Cultural Theory. 4th ed., Manchester UP, 2017.

Reference Books:

1	Eagleton, Terry. Literary Theory: An Introduction. Anniversary ed., University of Minnesota Press, 2008.
2	Richards, I. A. Practical Criticism. Routledge, 2001.
3	Abrams, M. H., and Geoffrey Galt Harpham. A Glossary of Literary Terms. 11th ed., Cengage Learning, 2015.
4	Damrosch, David. The Cambridge Introduction to Literature. Cambridge UP, 2012.
5	Tyson, Lois. Critical Theory Today: A User-Friendly Guide. 3rd ed., Routledge, 2014.

U24GE8503	HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA	L	T	P	C
		3	0	0	0
Course Objectives:	To make the student understand the historical evolution of science and technology in India across ancient, medieval, colonial, and post-independence periods, develop historical thinking for engineers, examine the interaction between science, technology, and society, and analyse policy frameworks, institutional growth, and the social impact of modern technologies in a globalizing India.				

Unit	Title	Periods
Unit - I	**PRINCIPLES AND PERSPECTIVES OF SCIENCE & TECHNOLOGY**	**9**
Meaning of History: Purpose, scope, and relevance to science and technology. Historical Thinking for Engineers: Objectivity, causation, generalization, Interpretation vs. evidence, Lessons from history for technological development. Science & Technology Concepts: Definitions of science and technology, Scope and importance for society and engineering, Interaction between science, technology, and society.		
Unit - II	**EVOLUTION OF INDIAN SCIENCE THROUGH HISTORICAL PERSPECTIVES**	**8**
Overview of historiography of science and technology in India. Key contributors and their works: D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina. Approaches and methods for studying the evolution of Indian science and technology.		
Unit - III	**SCIENTIFIC AND TECHNOLOGICAL PROGRESS IN ANCIENT INDIA**	**9**
Technological developments- prehistoric period - Stone tools and early innovations- Use of fire and primitive techniques, Emergence of agriculture and its influence on technological progress- Impact of agriculture on tools and settlement, Science and technology in the Vedic and Later Vedic periods- Knowledge of astronomy, mathematics, and medicine, Scientific and technological advancements from the 1st century AD to C-1200- Progress in mathematics, astronomy, and medicine-Temple architecture, metallurgy, and engineering.		
Unit – IV	**SCIENCE AND TECHNOLOGY IN INDIA: MEDIEVAL AND COLONIAL PERIODS**	**11**
Legacy of technology in Medieval India- Technological advancements in agriculture, irrigation, metallurgy, textiles, architecture, and craft production. Indo–Arab Interactions and Knowledge Exchange- 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, Indian response to Western Science-Growth of techno-scientific institutions.		
Unit - V	**SCIENCE AND TECHNOLOGY IN POST-INDEPENDENCE INDIA**	**8**
The relationship between science, technology, and development in post-independent India, Evolution and formulation of science and technology policies, Major developments and achievements in the field of science and technology, science and technology in a globalizing Indian economy - Social impacts of emerging technologies, with special reference to Information Technology and Biotechnology - ISRO, DRDO, BARC, CSIR contributions.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the scope of history, apply historical thinking, and analyse the role of science and technology in society.	K2
CO2	Extend historiographical approaches to study and evaluate the evolution of Indian science and contributions of key scholars.	K2
CO3	Relate technological and scientific developments in ancient India to societal progress from the prehistoric period to the 12th century.	K2
CO4	Interpret scientific and technological developments and knowledge exchanges in medieval and colonial India.	K2
CO5	Summarize the evolution, policies, achievements, and societal impacts of science and technology in post-independence India.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	1	-	-	1	-	-	1	-	-	-	2	1	-	-
CO2	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO3	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO4	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO5	2	-	-	1	-	-	1	1	1	1	2	1	-	-
CO	**2**	**-**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1**	2	**1**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Dharampal, Indian Science and Technology in the Eighteenth Century. Impex India,1st Edition, July 1971.
2	Dr.Binod Bihari Satpathy, History of Science, Technology, and Medicine in India, Himalaya Publishing House, 2025.
3	Suvobrata Sarkar. History of Science, Technology, Environment, Routledge India, Taylor & Francis, London, 2022.
4	Arun Kumar Jha & Seema Sahay. Aspects of Science and Technology in Ancient India. Routledge India, 2023.
5	Kuppuram G & Kumudamani K. History of Science and Technology in India. Sundeep Prakashan, 1990.

Reference Books

1	Subbarayappa B.V, Science in India: A Historical Perspective, Rupa Publications India, 2025
2	Nandan Bhattacharya, The History and Philosophy of Science: An Indian Perspective, Routledge India, 2023.
3	Sarma K.V, A History of the Kerala School of Hindu Astronomy, Vishveshvarananda Institute of Sanskrit & Indological Studies, 1972.
4	Jaggi O.P, History of Science and Technology in India, Atma Ram & Sons, 1977.
5	Kamlesh Mohan, Science and Technology in Colonial India, *Routledge* (Taylor & Francis Group), 2023.

U24GE8502	WELL BEING WITH TRADITIONAL PRACTICES- YOGA, AYURVEDA AND SIDDHA	L	T	P	C
		3	0	0	0
Course Objectives:	Promote an enjoyable and balanced lifestyle through engaging health-oriented activities, encourage practical lifestyle changes to prevent common health disorders, enable effective emotional regulation across all situations, develop awareness of affordable and nutritious dietary practices, and strengthen natural immunity to enhance resistance against various health problems.				
Unit - I	**INTRODUCTION TO YOGA**	**9**			
Meaning and definition of Yoga- Origin and historical development of Yoga- Importance of Yoga in modern life- Objectives and aims of Yoga - Types of yoga- The Eight Limbs of Yoga-What yoga can bring to our life -Yoga and meditation. Principles and guidelines for yoga practice- Yogic diet and nutrition -Asanas: Meaning, types, and benefits- Classification of Asanas-Tadasana –Vrikshasana - Trikonasana – Padahastasana.					
Unit - II	**YOGA FOR HEALTH AND WELL-BEING AND YOGA MUDRAS**	**9**			
Yoga for stress management- Yoga for improving concentration and memory-Yoga and immunity- Yoga Mudras and their Significance - Chin Mudra and Jnana Mudra for Mental Clarity- Prana Mudra for Energy Activation - Varuna Mudra for Hydration and Skin Health- Gyan Mudra for Concentration and Memory - Anjali Mudra for Emotional Balance-Mudras for Stress Reduction and Relaxation.					
Unit - III	**ROLE OF AYURVEDA IN MAINTAINING HEALTH**	**9**			
Introduction to Ayurveda-Objectives and scope of Ayurveda-Fundamental Principles-Panchamahabhuta Theory (Five elements) - Tridosha Theory – Vata, Pitta, Kapha-Sapta Dhatus (Seven body tissues)-Malas (Body waste products)-Agni (Digestive fire)-Ojas (Vital essence and immunity)- Basic Therapies-Panchakarma (Introduction)- Rasayana (Rejuvenation therapy)- Herbal formulations.					
Unit – IV	**PREVENTIVE AND LIFESTYLE MEDICINE IN AYURVEDA**	**9**			
Body constitution analysis-Genetic correlations and Ayurveda-Ayurveda and Lifestyle Disorders: Diabetes (Madhumeha) management-Hypertension and cardiovascular health-Stress and psychosomatic disorders-Concept of Satva, Rajas, Tamas-Mental health management-Sadvritta and ethical living-Meditation and mind-body balance.					
Unit - V	**SIDDHA PREVENTIVE HEALTHCARE PRACTICES**	**9**			
Philosophy and origin of the Siddha system- Five elements (Pancha Bootham) and their role in health-Concept of three humors (Mukkuttram) in disease prevention- Kayakalpa therapy for rejuvenation and longevity- Varma therapy and its role in preventive care- Role of traditional dietetics (Pathiyam) in maintaining health- Geriatric care and healthy ageing in Siddha-Siddha Detoxification Practices - Concept of spiritual discipline in disease prevention - Mind–body harmony in Siddha philosophy.					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student able to

CO	Statements	K-Level
CO1	Demonstrate knowledge of yoga practices that promote mental clarity and reduce stress.	K3
CO2	Apply yoga techniques and therapeutic mudras effectively to enhance emotional balance and improve overall mental well-being.	K3
CO3	Explain the fundamental principles of Ayurveda and their role in maintaining health.	K3
CO4	Analyze the role of body constitution, and Ayurvedic approaches in the management of lifestyle disorders and mental well-being.	K3
CO5	Describe the philosophy and principles of the Siddha system for rejuvenation and healthy aging.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO - PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO5	-	-	-	-	-	1	-	-	-	-	2	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	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.
2	Yoga for Promotion of Positive Health- R. Nagarathna& H. R. Nagendra, 2nd Edition Published by Swami Vivekananda Yoga Prakashana.
3	Principles of Ayurveda - Dr. C. S. Munichandra, Kumar Publications, BaghAmberpet, Hyderabad, Telangana, India.
4	Siddha Maruthuvam (Sirappu)- Dr. R. Thiyagarajan, Published by Department of Indian Medicine and Homeopathy.

Reference Books

1	Light on Yoga: The Bible of Modern Yoga- Iyengar, B.K.S. (2015). HarperCollins Publishers India Pvt. Ltd., New Delhi, India.
2	Saraswati, Swami Satyananda. (2008). Asana Pranayama Mudra Bandha, Yoga Publications Trust, Munger, Bihar, India (Bihar School of Yoga).
3	Light on Yoga: The Bible of Modern Yoga-Narayana, K, Scientific Publishers (India).
4	*Textbook of Ayurveda – Vol. I: Fundamental Principles*-Murthy, K. R. S., *Chaukhamba* Orientalia.
5	Ayurveda and Mental Health- Dr. N. S. Rathore, Dr. N. S. Rathore, SAGE Publications India Pvt. Ltd.
6	Siddha Therapy & Kayakalpa, Siddha Therapy & Kayakalpa,, CCRIMH / Siddha Research Publications,Janakpuri, New Delhi – 110058, India.
7	https://youtu.be/7CDb2cGnd4s.
8	https://youtu.be/_oDaV3U-KOg?si=FmYM7TvQs1y59VS6
9	https://youtu.be/S6bqxsjikVs?si=hxNBRH6TtKtHB6Z5

U24GE8505	STATE, NATION BUILDING AND POLITICS IN INDIA	L	T	P	C
		3	0	0	0
Course Objectives:	This course provides an understanding of the state, its functioning, and the role of politics and sovereignty in a globalized world. It covers the national movement, constitutional development, and the rationale for India's Parliamentary-federal system. The course also examines the philosophy of the Constitution and the evolving political system. Finally, it addresses contemporary challenges to national integration and nation-building, fostering a vision for a stronger India.				

Unit - I	**NEED AND ROLE OF STATE AND POLITICS**	**9**
State — Politics — Understanding the need and role of State and politics Concept of the State in India, Politics and Political Process in India, Constitutional Framework, Democracy and Governance, Citizenship, Rights and Social Justice		
Unit - II	**CONCEPT OF SOVEREIGNTY**	**9**
Development of Nation-State, sovereignty, sovereignty in a globalized world, Evolution of the Indian Nation-State, Post-Independence Nation-Building, Concept of Sovereignty in India, Challenges to Sovereignty in a Globalized World, Regional, Economic, and Political Dimensions of Sovereignty.		
Unit - III	**STATE AND ITS ORGANS**	**9**
Organs of State - Structure and Functions of the Executive, Role and Composition of the Legislature, Organization and Powers of the Judiciary, Principle of Separation of Powers and Checks & Balances, Forms of Government: Unitary vs. Federal and Presidential vs. Parliamentary.		
Unit – IV	**THE CONSTITUTION OF INDIA**	**9**
The idea of India— 1857 and the national awakening, 1885 Indian National Congress and development of national movement — its legacies, Constitution making and the Constitution of India, Goals, objective and philosophy—federal system.		
Unit - V	**NATIONAL INTEGRATION AND CHALLENGES OF NATION-BUILDING**	**9**
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.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Recall the basic concepts of State, politics, sovereignty, citizenship, constitutional framework, and national integration in the context of India	K1
CO2	Explain the need and role of the State, organs of government, constitutional philosophy, and the evolution of the nation-state and sovereignty.	K2
CO3	Apply the principles of democracy, governance, separation of powers, and federal	K3

COs	Statements	K-Level
	structure to interpret contemporary political and administrative processes.	
CO4	Analyze the structure and functions of the Executive, Legislature, and Judiciary, and examine challenges to sovereignty, globalization, and nation-building.	K4
CO5	Evaluate issues related to national integration, social justice, and new social movements, and develop reasoned perspectives on the future of the political system and governance models.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	1	1	-	-	-	2	1	-	-	-	1	-	1	-
CO2	1	2	-	-	-	2	2	-	1	-	1	-	1	-
CO3	-	2	1	-	-	3	2	1	1	-	2	1	2	1
CO4	-	3	-	1	-	3	2	-	2	-	2	1	2	2
CO5	-	2	1	1	-	3	3	2	3	1	3	2	3	2
CO	**0**	**2**	**0**	**0**	**-**	**3**	**2**	**1**	**1**	**0**	**2**	**1**	**2**	**1**

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Madhav Khosla, The Indian Constitution, Oxford University Press. New Delhi, 2012.
2	Granville Austin – The Indian Constitution: Cornerstone of a Nation (Oxford University Press, 1966; revised editions)
3	Pratap Bhanu Mehta – The Burden of Democracy (Penguin, 2003)
4	Ramachandra Guha – India After Gandhi (HarperCollins, 2007)
5	Niraja Gopal Jayal – Citizenship and Its Discontents (Harvard University Press, 2013)

U24GE8501	INTRODUCTION TO WOMEN AND GENDER STUDIES	L	T	P	C
		3	0	0	0
Course Objectives:	To infer key gender concepts and feminist theories to understand gender as a social construct. It explores women's movements, gendered language, and media representations across global and local contexts. Students will critically analyze gender roles, power structures, and representations in society and media.				

Unit - I	CONCEPTS	12
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/ private, essentialism, binarism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour - Gender Representation in Media and Literature -Feminist Movements and Gender Equality.		
Unit - II	**FEMINIST THEORY**	**8**
Intersectional Feminism - Post Colonial Feminism (Indian Context) – Transfeminism and Queer Feminist Perspectives Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist - Feminism and Cultural Representation - Contemporary Feminist Debates - Feminism and Literature - Feminism and Media Representation - Dalit Feminism (Indian Context).		
Unit - III	**WOMEN'S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL**	**8**
Rise of feminism in Europe and America. women's movement in India - Women's Suffrage Movement - Social Reform Movements and Women's Rights in India - Women and the Indian Freedom Struggle - Education and Women's Empowerment - Women and Legal Rights - Women in Politics and Leadership - Women and Economic Independence - Women's Organizations and Activism - Women and Human Rights - Feminist Activism in the Digital Age - Contemporary Challenges in Feminism.		
Unit – IV	**GENDER AND LANGUAGE**	**8**
Linguistic Forms and gender. gender and narratives - Gendered Communication Styles - Language and Gender Identity - Sexism in Language - Language and Power Relations - Politeness and Gender - Language and Gender Stereotypes - Gender Representation in Media Language - Gender and Discourse Analysis - Language Socialization and Gender - Language, Identity, and Culture - Future Directions in Gender and Language Studies.		
Unit - V	**GENDER AND REPRESENTATION**	**9**
Advertising and popular visual media - Gender and Representation in Alternative Media - Gender and social media - Gender Stereotypes in Media - Representation of Women in Film and Television - Masculinity in Media Representation - Gender Representation in News Media - Objectification and the Female Body in Media - Gender and Celebrity Culture - Representation of LGBTQ+ Identities in Media - Gender and Fashion Media - Gender Representation in Gaming and Digital Entertainment.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the foundation of gender concepts, constructed and maintained in society.	K2
CO2	Differentiate major feminist theoretical frameworks, critique gender inequalities and social structures.	K2/K4
CO3	Examine the historical development and impact of women's movements globally and in India, and evaluate their role in shaping gender discourse and policy.	K2/K5
CO4	Analyze the relationship between language and gender, including linguistic forms and gendered narratives, and how they influence social perceptions.	K2

COs	Statements	K-Level
CO5	Critically assess the portrayal of gender in mainstream, alternative, and digital media, recognizing patterns of representation, bias, and resistance.	K2/K6

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												PSO		
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03
CO1	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
CO2	-	-	-	-	-	3	-	2	-	-	-	3	-	-	-
CO3	-	-	-	-	-	3	-	2	-	-	-	3	-	-	-
CO4	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
CO5	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-
CO	-	-	-	-	-	3	-	3	-	-	-	3	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Butler, Judith. *Gender Trouble: Feminism and the Subversion of Identity*. Routledge, 1990.
2	Beauvoir, Simone de. *The Second Sex*. Translated by Constance Borde and Sheila Malovany-Chevallier, Vintage, 2011.
3	Cameron, Deborah. *Gender and Language*. 2nd ed., Palgrave Macmillan, 2003.
4	Hall, Stuart, et al. *Representation: Cultural Representations and Signifying Practices*. Sage Publications, 2013.

Reference Links

1	https://archive.mu.ac.in/myweb_test/TYBA%20study%20material/Gender%20&%20Soc.pdf
2	https://revisesociology.com/2016/07/11/liberal-radical-marxist-feminist-perspectives-society-sociology/
3	https://ehne.fr/en/encyclopedia/themes/gender-and-europe/feminisms-and-feminist-movements/feminisms-and-feminist-movements-in-europe
4	https://egyankosh.ac.in/bitstream/123456789/58105/1/Unit13.pdf
5	https://gsdrc.org/topic-guides/gender/gender-and-media/

U24MA8501	EXPLORING VEDIC MATHEMATICS	L	T	P	C
		3	0	0	0
Course Objectives:	Familiarize students with the concepts of Vedic mathematics and the contributions made by Indian mathematicians. Through the use of Vedic methods, it seeks to develop quick and precise computational abilities.				

Unit – I	**CONTRIBUTION OF INDIAN MATHEMATICIANS**	**9**
Contribution of Indian Mathematicians: Pingala, Aryabhata I, Brahmagupta, Varahmihir, Bhaskara I, Aryabhata II, Bhaskara II, Neelkanth Somayya, Srinivasa Ramanujan, Bharti Krishna Tirtha – History of Vedic Mathematics and its Features.		
Unit – II	**VEDIC MATHEMATICS: ADDITION AND SUBTRACTION**	**9**
Sutras and Upsutras – Addition: without carrying, Dot Method (Shudh Vidhi) – Subtraction: Nikhilam Navatashcaramam Dashatah (All from 9 Las from 10) – Fraction: Addition and Subtraction: Urdhva Tiryakbhyam (Vertically and Crosswise).		
Unit – III	**VEDIC MATHEMATICS: MULTIPLICATION AND DIVISION**	**9**
Multiplication: Base Method: Nikhilam Sutra (any two numbers upto three digits) – Multiplication by Urdhva Tiryak Sutra: up to 3-digit numbers by multiplying vertically and diagonally, summing the results, and managing carries – Division by Urdhva Tirvak Sutra (Vinculum Method).		
Unit – IV	**VEDIC MATHEMATICS: SQUARES AND CUBES**	**9**
Squares of any two-digit numbers: Base Method – Square of numbers ending in 5: Ekadhikena Purvena Sutra (By one more than the previous) - Yavadunam Sutra (By the Deficiency) – Cubes: Yavadunam Sutra (By the Deficiency).		
Unit – V	**VEDIC MATHEMATICS: SOLUTION OF LINEAR EQUATIONS**	**9**
Introduction of simple equations - Solutions of simple equations – Solutions of Linear Equations in one variable: Paravartya Yojayet (Transpose and Apply) - Solutions of Linear Equations in two variables: Ratio Comparison (Special Case), Sunyam Samyasamuccaye (When Sum is Same), Anurupye Sunyamanyat (If in ratio, the other is zero) - Practical applications of linear equations.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Investigate the history of Indian mathematics, emphasizing important contributions from mathematicians and the development of Vedic Mathematics, while acknowledging India's important role in worldwide mathematical advancement	K2
CO02	Utilize Vedic sutras and upsutras to execute addition and subtraction effectively using approaches like the dot method and Nikhilam sutra and tackle fractional addition and subtraction issues with precision and swiftness	K3
CO03	Apply the base technique and Urdhva Tiryak sutra for multiplication and division, while employing vinculum methods to streamline calculations and enhance computational speed with large numbers	K3
CO04	Employ Vedic techniques such as Ekadhikena Purvena and Yavadunam sutra to calculate squares and cubes, effectively addressing numerical problems while enhancing their mental math skills.	K3
CO05	Resolve basic linear equations with one or two variables through Vedic methods, and apply these methods in practical scenarios to enhance their problem solving and reasoning skills	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	2	1	-	-	-	2	-	2	-	1	-	-	-	-
CO02	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO03	3	2	1	-	2	-	-	-	-	-	-	-	-	-
CO04	3	2	-	-	1	-	-	-	-	-	-	-	-	-
CO05	3	3	2	-	1	1	-	-	1	1	1	-	-	-
CO	2.8	2	1.5	-	0.8	1.5	-	-	1	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3. Substantial (High)

Text Books

1	T.S. Bhanumurthy, A Modern Introduction to Ancient Indian Mathematics, Wiley Eastern Ltd, New Delhi.
2	Rajes Kumar Thakur, The Essential of Vedic Mathematics, Rupa Publications, New Delhi, 2019.
3	Atul Gupta, The Power of Vedic Maths, Second Edition, Jaico Publishing House, Mumbai, 2010
4	Ramnandan Shastri, For Competitive Exams Vedic Mathematics Made Easy, Arihant Publishers, New Delhi, 2012.
5	Chaitanaya A. Patil, Learn Vedic Speed Mathematics Systematically & Step by Step, 2018

Reference Books

1	S. K. Kapoor, Learning Vedic Mathematics on First Principles, *Lotus Press, 2007.*
2	Vandana Singhal, Vedic Mathematics For All Ages, *Motilal Banarsidas Publishers.*
3	Dhaval Bathia, Vedic Mathematics Made Easy, First Edition, Jaico Publishing House, Mumbai, 2005
4	Bharathi Krisna Tirthaji, Vedic Mathematics, Original Edition, Motilal Banarsidass Publisher & New Delhi, 1990.
5	V.G. Unkalkar, Magical World of Mathematics: Vedic Mathematics, *Vandana publishers, Bangalore.*

U24MA8502	FUNDAMENTALS OF ASTROLOGY	L	T	P	C
		3	0	0	0
Course Objectives:	Provide basic knowledge of astronomical and astrological principles, as well as to foster comprehension of planetary effects and chart interpretation, including Muhurtham and horoscope matching.				

Unit – I	FOUNDATIONS OF ASTROLOGY	9
Origin and introduction of Astrology - History of Astrology – Astrology: In terms of Science and Mathematics (Degree System) - Importance of Astrology. Detailed study of Universe and Galaxies related to astrology.		
Unit – II	**ZODIAC AND PLANETS**	**9**
The Zodiac and the Solar system - signs of the Zodiac – Planets - Motion of Planets - Retrograde and Direct motion of Planets. Tithi, Vaara, Nakshatra, Yoga and Karana (Panchangm). Various systems in astrology (Nadi methods, Jamakkol Prasanam, Deva/Ashtamangala Prasanam)		
Unit – III	**ASTRONOMICAL CONCEPTS**	**9**
Signs and Constellations – Vakkaram (reverse order) (Nodes (Rahu and Kethu) Sayana and Nirayana system - Latitude and Longitudes - Equator, Ecliptic - Lunar Eclipse, Solar Eclipse, Mundane astrology.		
Unit – IV	**PLANETARY EFFECTS**	**9**
Significations of Signs and Planets - Effect of Planets in 12 Houses – Navamsam – varga chakram - Strength of Planets for house judgment - Dasha System - Effects of Conjunction of one or more Planets.		
Unit – V	**CHART ANALYSIS BASICS**	**9**
Rules and general conditions for analyzing a chart - Judgement of Houses / Bhava sign in general - Matching of Horoscopes - Introduction to Muhurtham, Yogangal: Dharma karmaathi yogam, neecha banga raja yogam, sivaraja yogam, vibareetha raja yogam, parvatha raja yogam, Gaja Kesari yogam, Chandra-Mangala yogam.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the origin, history, nature, and importance of Astrology as a science and art.	K2
CO2	Describe the Universe, zodiac, solar system, planets, and their direct and retrograde motions.	K2
CO3	Explain planets, signs, constellations, Rahu–Ketu, Sayana–Nirayana systems, and basic astronomical concepts.	K2
CO4	Describe significations of signs and planets, their effects in houses, planetary strength, Dasha, and conjunctions.	K2
CO5	Explain the general rules of chart analysis, house judgment, horoscope matching, and basics of Muhurtham.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	--	-	-	1	-	2	-	-	1	-	-	-
CO2	3	3	2	-	-	1	-	2	-	-	1	-	-	-
CO3	3	3	2	1	-	1	-	2	-	-	1	-	-	-
CO4	3	3	3	2		2	-	2	1	-	1	-	-	-
CO5	3	3	3	3	1	2	-	2	2	1	1	-	-	-
CO	3	2.8	2.5	2	1	1.8	-	2	1.5	1	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3.Substantial(High)

Text Books

1.	Pulippani Jothidam (300 Astrology Rules from an Ancient Tamil Work , Nakkirar S.Natarajan, Sptarishi Publications.
2.	Astrology For Beginners by Bangalore Venkata Raman
3.	GK win Degree System of Astrology: New Method of Astrology, Tirupur S.Gopala Krishnan (GK), Gk publications
4.	Prashna Shastra: Scientific Applications of Horary Astrology (Set of 2 Volumes) , Deepak Kapoor, Vinita Kapoor Publisher.

Reference Book

1	Astrology For Beginners by Motilal Banarsidass Publishing House

U24ME5A01	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To explore the history, concepts, and terminology of Product Lifecycle Management (PLM), understand the functions of PLM/PDM systems, and develop modules within commercial tools. It also aims to demonstrate PLM/PDM applications in industrial settings and integrate these systems with legacy databases, CAP and ERP systems..				
Unit - I	**HISTORY, CONCEPTS AND TERMINOLOGY OF PLM**	**9**			
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications					
Unit - II	**PLM/PDM FUNCTIONS AND FEATURES**	**9**			
User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration					
Unit - III	**DETAILS OF MODULES IN A PDM/PLM SOFTWARE**	**9**			
Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed					
Unit – IV	**ROLE OF PLM IN INDUSTRIES**	**9**			
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for–business, organisation, users, product or service, process performance- process compliance and process automation					
Unit - V	**BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE**	**9**			
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the history, concepts, and terminology of PLM by tracing its evolution from traditional product management to modern digital practices, and explain key terms and principles.	K2
CO2	Illustrate the functions and features of PLM/PDM by demonstrating data management, collaboration workflows, version control, and process support across product development stages.	K2
CO3	Develop different modules offered in commercial PLM/PDM tools, including PDM, configuration, document, and workflow management, highlighting their interconnections and operational benefits.	K3
CO4	Apply PLM/PDM approaches for industrial applications by implementing system strategies to enhance manufacturing, supply chain, and product lifecycle efficiency.	K3
CO5	Utilize PLM/PDM with legacy databases, CAP and ERP systems to enable seamless data integration, migration, and interoperability across diverse enterprise platforms.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	1	1	3	-	-	-	-	1	1	-	1	1	-	1
CO2	1	1	3	-	-	-	-	1	1	-	1	1	-	1
CO3	1	1	3	2	-	-	-	1	1	-	1	1	-	1
CO4	1	1	3	2	-	-	-	1	1	-	1	1	-	1
CO5	1	1	3	2	-	-	-	1	1	-	1	1	-	1
CO	**1**	**1**	**3**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**1**	**-**	**1**

Text Books

1	Product Lifecycle Management for a Global Market, Springer; 2014 edition (29 September 2016),ISBN-10 : 3662516330
2	Product Life Cycles and Product Management, Praeger Publishers Inc (27 March 1989)ISBN-10 : 0899303196

Reference Books

1	AnttiSaaksvuori and AnselmiImmonen, "Product Lifecycle Management", Springer Publisher, 2008 (3rd Edition)
2	IvicaCrnkovic, Ulf Asklund and AnnitaPerssonDahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003. 4. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
3	John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007
4	John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).
5	John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2nd Edition).

U24ME5A02	VALUE ENGINEERING	L	T	P	C
		3	0	0	3
Course Objectives:	Students will be able to understand the value engineering process, identify its functions, and apply suitable methodologies, decision-making tools, and cost evaluation techniques in product development. They will also be able to implement and improve value engineering solutions across manufacturing, human resources, and marketing applications.				

Unit - I	VALUE ENGINEERING BASICS	9
Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis- Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions – concept of cost and worth - creativity In Value Engineering - uses, applications, advantages and limitations of Value analysis - Role in sustainable product development		
Unit - II	**VALUE ENGINEERING JOB PLAN AND PROCESS**	**9**
Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering - Team roles and stakeholder involvement		
Unit - III	**VALUE ENGINEERING TECHNIQUES**	**9**
Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis- Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) – Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost(LCC) - Application in product redesign		
Unit – IV	**WORKSHEETS AND GUIDELINES**	**9**
Preparation of worksheets - general and information phase - Function Classification, relationship and summary - Meaningful costs - Cost analysis - idea listing and comparison - Feasibility ranking -Investigator phase, study summary - guidelines for writing value engineering proposal - Financial aspects - List cycle cost analysis - Oral presentation - Audit - Case studies and Discussion - Documentation standards and reporting formats in projects		
Unit - V	**VERSATILITY OF VALUE ENGINEERING**	**9**
Value engineering operation in maintenance and repair activities - value engineering in non-hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties - Applications in service and public sector projects		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO01	Apply the principles of value engineering to identify and analyze product functions, cost–worth relationships, and the role of value engineering in sustainable product development.	K3
CO02	Utilize the value engineering job plan to organize and develop systematic approaches such as FAST diagramming and stakeholder collaboration for improving product or process value.	K3
CO03	Select value engineering techniques to identify and solve cost optimization problems using creativity tools, functional analysis, life cycle cost analysis, and decision-making methods.	K3
CO04	Utilize value engineering worksheets and guidelines to develop and organize cost analysis, feasibility ranking, and documentation for effective value engineering proposals.	K3
CO05	Apply value engineering concepts to identify and plan improvement strategies in maintenance, service industries, and public sector projects for enhancing operational efficiency.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	3	2	-	-	-	-	-	-	-	-	1	1	2	-
CO02	2	2	2	-	-	-	-	-	-	-	1	1	2	-
CO03	2	3	2	-	-	-	-	-	-	-	1	1	2	-
CO04	2	2	2	-	-	-	-	-	1	1	1	1	2	-
CO05	2	1	1	-	-	2	-	-	-	-	1	1	2	-
CO	2	2	2	-	-	2	-	-	1	1	1	1	2	-

Text Books

1	Iyer. S.S., “Value Engineering”, New Age International (P) Limited, 9th Edition, 2009 3Ed”, 2009.
2	Anil Kumar. and Mukhopadhyaya., “Value Engineering: Concepts Techniques and applications”, SAGE Publications, 1st Edition, 2003

Reference Books

1	Del L. Younker., “Value Engineering: analysis and methodology”, CRC Press, 2003.
2	Richard Park., “Value Engineering A Plan for Invention”, CRC Press, 1998.
3	Arthur E. Mudge., “Value Engineering :A systematic approach", McGraw Hill, 1989.
4	Alphonse Dell'Isola., “Value Engineering: Practical Applications...for Design, Construction, Maintenance and Operations”, R.S. Means Company, 1997.
5	Lawrence D. Miles., “Techniques of Value Analysis and Engineering”, Lawrence D. Miles Value Foundation, 3rd Edition, 2015.

U24ME5A03	3D ADDITIVE MANUFACTURING	L	T	P	C
		3	0	3	3
Course Objectives:	This course introduces the development, applications, business opportunities, software tools, and major processes of Additive Manufacturing for product development and prototyping.				
Unit - I	**INTRODUCTION**	**9**			
Overview - Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. AM Process Chain- ASTM/ISO 52900 Classification - Benefits. Applications: Building Printing - Bio Printing - Food Printing- Electronics Printing. Business Opportunities and Future Directions – Case studies: Automobile, Aerospace, Healthcare-Industry 4.0 Integration with Additive Manufacturing.					
Unit - II	**DESIGN FOR ADDITIVE MANUFACTURING (DfAM)**	**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-AI-Assisted Generative Design in Additive Manufacturing.					
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-High-Performance Photopolymers and Hybrid DED Systems.					
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-Metal FDM and Bound Metal Deposition (BMD).					
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-Multi-Material and Functional Gradient Printing Applications.					
	Total Periods:	**45**			

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the development of Additive Manufacturing technology and its propagation into various business sectors and emerging opportunities.	K2
CO2	Demonstrate the process of transforming a concept into a final product using Additive Manufacturing technologies.	K3
CO3	Describe vat polymerization and direct energy deposition processes along with their applications.	K2
CO4	Illustrate the processes and applications of powder bed fusion and material extrusion techniques.	K2
CO5	Analyze the advantages, limitations, and applications of binder jetting, material jetting, and sheet lamination processes.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	3	1	2	1	-	-	-	-	-	1	2	2
CO2	2	3	2	2	1	1	-	-	-	-	-	2	3	2
CO3	2	3	2	3	2	1	-	-	-	-	-	1	2	2
CO4	2	2	3	2	2	1	-	-	-	-	-	2	3	3
CO5	2	2	3	2	2	1	-	-	-	-	-	2	3	3
CO	2	2	3	2	2	1	-	-	-	-	-	2	3	2

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.
2	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.

Reference Books

1	Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011, ISBN :9783446425521.
2	Milan Brandt, “Laser Additive, Manufacturing: Materials, Design, Technologies, and Applications”, Woodhead Publishing., United Kingdom, 2016, ISBN: 9780081004333.
3	Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015, ISBN-13: 978-1482223590.
4	Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States,2006, ISBN: 978-1-4614-9842-1.
5	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.

U24ME5A04	INTEGRATED PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce the fundamental concepts of new product development, including the development of material specifications, analysis, and processes. It also involves learning about feasibility studies and reporting related to new product development, studying new product qualification, and conducting market surveys on similar products. Additionally, it covers learning reverse engineering, generating cloud points, and converting cloud data into 3D models.				

Unit - I	**FUNDAMENTALS OF NPD**	**9**
Introduction – Reading of Drawing – Grid reading, Revisions, Engineering 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, VOC and QFD Phases		
Unit - II	**MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS**	**9**
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 – 3D Printing		
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.		
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 Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Infer the fundamental concepts and customer-specific requirements of new product development.	K2
CO2	Outline material specification standards, analysis, fabrication, and manufacturing processes.	K2

COs	Statements	K-Level
CO3	Formulate feasibility studies and prepare reports for new product development.	K2
CO4	Interpret new product qualifications and conduct market surveys on similar products for new product development.	K2
CO5	Summarize the reverse engineering techniques, generate cloud points, and convert cloud data into 3D models.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	2	1		1					1	1		1
CO2	2	1	2	1		1					1	1		1
CO3	2	1	2	1		1					1	1		1
CO4	2	1	2	1		1					1	1		1
CO5	2	1	2	1		1					1	1		1
CO	2	1	2	1		1					1	1		1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Sten Jonsson, Product Development: Work for Premium Values, Copenhagen Business School Press, 2009
2	Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger, McGraw-Hill Education, 2011

Reference Books

1	Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark, 2016
2	Tim Brown , Change by Design How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins Publishers, 2009
3	James Morgan & Jeffrey K. Liker, Toyota Product Development System, CRC Press, 2006
4	Robert Brands, Winning at New Products –3rd Edition, Basic Books, 2001
5	Dr. M.A. Bulsara &Dr. H.R. Thakkar, Product Design & Value Engineering, Charotar Publishing House Pvt. Ltd. 2015

U24ME5A05	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3
Course Objectives:	To equips learners with the ability to interpret process planning principles in relation to product cost estimation, understand major process planning activities, recognize the significance of costing and estimation in manufacturing, and apply production cost estimation and machining time calculation techniques for effective manufacturing decision-making.				

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. Design for Manufacturability (DFM) and Design for Assembly (DFA)		
Unit - II	**PROCESS PLANNING ACTIVITIES**	**9**
Process parameters calculation for various production processes - Selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies. Value engineering in process planning		
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. Activity-Based Costing (ABC)		
Unit – IV	**PRODUCTION COST ESTIMATION**	**9**
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop. Lean cost management and target costing		
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. Integration of CAM software for time estimation		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify and justify suitable processes, equipment, and tools for different industrial products.	K2
CO2	Construct a process planning activity chart for manufacturing operations.	K2
CO3	Interpret the fundamental concepts of cost estimation in manufacturing.	K2
CO4	Determine job order cost for various types of shop floor environments.	K2
CO5	Estimate machining time for different machining operations.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	2	-	-	-	1	1	1	3	2	2
CO2	3	2	2	2	2	-	-	-	1	1	1	3	2	2
CO3	3	2	2	2	2	-	-	-	1	1	1	3	2	2
CO4	3	2	2	2	2	-	-	-	1	1	1	3	2	2
CO5	3	2	2	2	2	-	-	-	1	1	1	3	2	2
CO	3	2	2	2	2	-	-	-	1	1	1	3	2	2

Text Books

1	Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2	Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

Reference Books

1	Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002
2	Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.
3	Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
4	Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”,Pearson Education 2001.
5	K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, KhannaPublishers 1990.

U24ME5A06	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a solid understanding of the fundamentals of surface features and the various types of friction associated with metals and non-metals. It explores the different wear mechanisms, their standard measurement techniques, and the principles of corrosion along with preventive measures. Additionally, the course covers surface properties, surface modification techniques, and practical applications of friction and wear, enabling students to analyze, improve, and engineer material surfaces for enhanced performance and longevity.				

Unit - I	**SURFACES AND FRICTION**	**9**
Basics of surfaces features – Roughness parameters – surface measurement - Cause of friction- Laws of friction – Static friction – Rolling Friction – Stick-slip Phenomenon - Friction properties of metal and nonmetals – Friction in extreme conditions – Thermal considerations in sliding contact.		
Unit - II	**WEAR**	**9**
Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and nonmetals – International standards in friction and wear measurements –		
Unit - III	**CORROSION**	**9**
Introduction – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.		
Unit – IV	**SURFACE TREATMENTS**	**9**
Surface properties – Hydrophobic – Super hydrophobic – Hydrophilic - surface metallurgy –Surface coating Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying - New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.		
Unit - V	**ENGINEERING MATERIALS**	**9**
Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology. 2D Materials and Solid Lubricant Nanomaterials.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Describe the fundamentals of surface features and different types of friction associated with metals and non-metals	K2
CO2	Analyze the different types of wear mechanism and its standard measurement.	K2
CO3	Analyze the different types of corrosion and its preventive measures	K2
CO4	Analyze the different types of surface properties and surface modification techniques	K2

CO5	Analyze the various types of materials used in the friction and wear applications.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	2	2	2	2	-	-	2	1	-	-	3	3	1
CO2	2	2	2	2	2	-	-	2	1	-	-	3	3	1
CO3	1	2	2	2	2	-	-	2	1	-	-	2	2	1
CO4	1	2	2	2	3	-	-	2	1	-	-	2	2	1
CO5	1	1	2	2	1	-	-	2	1	-	-	1	1	1
CO	1	2	2	2	2	-	-	2	1	-	-	2	2	1

Text Books

1	G.W.Stachowiak and A.W.Batchelor, “Engineering Tribology”, Butterworth-Heinemann, 2005.
2	S.K.Basu, S.N.Sengupta and B.B.Ahuja ,”Fundamentals of Tribology”, Prentice Hall of India, 2005.
3	Fontana G., “Corrosion Engineering”, McGraw Hill, 1985.
4	Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

Reference Books

1	Halling, J. (Editor), “Principles of Tribology “, MacMillian, 1984.
2	Rabinowicz.E., “Friction and Wear of materials”, John Willey &Sons,1995.
3	Williams J.A., “Engineering Tribology”, Oxford University Press, 1994.

U24ME5B01	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3
Course Objectives:	To provide a comprehensive understanding of the evolution of automation and Computer Integrated Manufacturing (CIM), including its core principles and architecture. It equips students with knowledge of automation tools, material handling systems, group technology, flexible manufacturing systems, and computer-aided process planning. The course also introduces the fundamentals of data communication, information integration, and control strategies essential for effective implementation of CIM in modern manufacturing environments.				
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					
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					
Unit – III	**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.					
Unit - IV	**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					
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					
	Total Periods:			**45**	

On completion of the course, the student can

COs	Statements	K - Level
CO1	Illustrate the evolution of automation, CIM, and its principles	K2
CO2	Classify various automation tools, including material handling systems.	K2
CO3	Apply the concepts of group technology and FMS.	K2
CO4	Explain the significance of computer-aided process planning in manufacturing.	K2
CO5	Identify the basics of data transactions, information integration, and control in CIM.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	-	2	-	-	-	-	-	-	3	1	2
CO2	3	2	2	-	2	-	-	-	-	-	-	3	1	2
CO3	3	2	2	-	2	-	-	-	-	-	-	3	1	2
CO4	3	2	2	-	2	-	-	-	-	-	-	3	1	2
CO5	3	2	2	-	2	-	-	-	-	-	-	3	1	2
CO	3	2	2	-	2	-	-	-	-	-	-	3	1	2

Text Books

1	T1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
2	T2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

Reference Books

1	1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturingǁ, PHI Learning Pvt. Ltd., New Delhi, 2013.
2	2. Gideon Halevi and Ronald D. Weill, Principles of Process Planningǁ, Chapman Hall, 1995.
3	3. James A. Retrg, Herry W. Kraebber, Computer Integrated Manufacturingǁ, Pearson Education, Asia,3rdEdition,2004.
4	4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.
5	5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

U24ME5B02	ROBOTICS	L	T	P	C
		3	0	0	3
Course Objectives:	To learn the fundamentals of robots, including their classifications; to understand robot kinematics in various planar mechanisms; to study the principles of robot dynamics; to gain knowledge of trajectory planning and robot programming; and to explore the diverse applications of robots in industrial and other domains.				

Unit - I	**BASICS OF ROBOTICS**	**9**
Introduction- Basic components of robot-Laws of robotics- classification of robot- robot architecture, work space-accuracy-resolution –repeatability of robot.		
Unit - II	**ROBOT KINMEATICS**	**9**
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms		
Unit - III	**ROBOT DYNAMICS**	**9**
Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation		
Unit – IV	**TRAJECTORY, PATH PLANNING AND PROGRAMMING**	**9**
Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS		
Unit - V	**ROBOT AND ROBOT APPLICATIONS**	**9**
Sensors and Actuators for Robots, Power transmission systems, Rotary to rotary motion, Rotary to linear motion, Harmonics drives – gear system - belt drives. Robot end effectors & Grippers: Introduction- types & classification- Mechanical gripper- gripper force analysis- other types & special purpose grippers. Robot Applications: pick and place, manufacturing, automotive, medical, space and underwater.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	State the basic concepts and terminologies of robots	K2
CO2	Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots	K2
CO3	Derive the Forward and Inverse Kinematics, Dynamics for Various Robots	K2
CO4	Apply the various programming techniques in industrial applications	K2
CO5	Analyze the use of various types of robots in different applications	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	-	-	-	-	-	-	-	-	-	1	1	-	-
CO2	2	1	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	1	3	2	-
CO4	2	-	2	-	3	-	-	-	-	-	2	2	-	2
CO5	2	3	2	-	-	2	-	-	-	-	2	-	2	2
CO	2	2	2	2	3	2	-	-	-	-	1	2	2	2

Text Books

1	John.J.Craig, " Introduction to Robotics: Mechanics & control", Pearson Publication, Fourth edition, 2018.
2	K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, First Edition, 1987.

Reference Books

1	M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.
2	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010
3	S K Saha, Introduction to Robotics, Tata McGraw-Hill, ISBN: 9789332902800, Second Edition, 9789332902800
4	Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009.

U24ME5B03	SMART MOBILITY AND INTELLIGENT VEHICLES	L	T	P	C
		3	0	0	3
Course Objectives:	Students will be able to understand the concepts of smart mobility, intelligent vehicles, sensor technologies, wireless communication, and cyber-physical systems used in connected and autonomous vehicles. They will also be able to analyze connected car technologies and autonomous vehicle systems with respect to safety, communication, and intelligent decision-making.				

Unit	Title	Periods
Unit - I	**INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES**	**9**
Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles - Levels of vehicle automation		
Unit - II	**SENSOR TECHNOLOGY FOR SMART MOBILITY**	**9**
Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Other Sensors, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems - Sensor calibration and limitations		
Unit - III	**CONNECTED AUTONOMOUS VEHICLE**	**9**
Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy - Decision-making algorithms		
Unit – IV	**VEHICLE WIRELESS TECHNOLOGY & NETWORKING**	**9**
Wireless System Block Diagram and Overview of Components, Transmission Systems - Modulation/Encoding, Receiver System Concepts– Demodulation/Decoding, Wireless Networking and Applications to Vehicle Autonomy, Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks - Vehicular Ad Hoc Networks (VANETs)		
Unit - V	**CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY**	**9**
Connectivity Fundamentals, Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Autonomous Vehicles - Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues, Security Issues - functional safety standards		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Choose the concepts of automotive electronics to identify and analyze the architecture of automated, connected, and intelligent vehicles and the different levels of vehicle automation.	K3
CO2	Select sensor technologies to identify and analyze the working principles of radar, lidar, ultrasonic, camera, and night vision systems used in smart mobility applications.	K3
CO3	Apply control system and cyber-physical system concepts to model and analyze the functioning of connected autonomous vehicles and decision-making mechanisms in intelligent transportation systems.	K3
CO4	Utilize wireless communication and networking technologies to identify and organize vehicle communication systems including IoT integration and vehicular ad hoc networks (VANETs).	K3

CO5	Identify connected car and autonomous vehicle technologies to analyze and evaluate vehicle-to-vehicle and vehicle-to-infrastructure communication systems considering safety, legal, and security aspects.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	-	-	-	-	-	-	-	1	2	1	-
CO2	3	2	1	-	2	-	-	-	-	-	1	2	1	-
CO3	3	2	-	-	2	-	-	-	-	-	1	2	1	-
CO4	2	2	1	-	2	1	-	-	-	-	1	2	1	-
CO5	2	1	-	-	-	2	2	-	-	-	1	2	1	-
CO	3	2	1	-	2	1	1	-	-	-	1	2	1	-

Text Books

1	“Intelligent Transportation Systems and Connected and Automated Vehicles”, 2016, Transportation Research Board
2	Radovan Miucic, “Connected Vehicles: Intelligent Transportation Systems”, 2019, Springer

Reference Books

1	Tom Denton, “Automobile Electrical and Electronic systems, Roultedge”, Taylor & Francis Group,5th Edition,2018.
2	Rajamani, R., Vehicle Dynamics and Control, Springer, 2nd Edition, 2012.
3	Eskandarian, A. (Ed.), Handbook of Intelligent Vehicles, Springer, 2012.
4	Winner, H., Hakuli, S., Lotz, F., Singer, C., Handbook of Driver Assistance Systems, Springer, 2016.

U24ME5B04	AERIAL ROBOTICS	L	T	P	C
		3	0	0	3
Course Objectives:	To understand drone technologies and classifications, learn design, fabrication and basic programming, perform safe flight operations, explore industrial applications, and follow safety regulations and guidelines.				

Unit - I	**INTRODUCTION TO DRONE TECHNOLOGY**	**9**
Drone concepts, vocabulary and terminology, history of drones, classification of current-generation drones based on propulsion methods, basic components and architecture of a drone system, impact of drone technology on business sectors, drone-based entrepreneurship, and opportunities for entrepreneurship and employability.		
Unit - II	**DRONE DESIGN, FABRICATION AND PROGRAMMING**	**9**
Classification of UAVs, overview of major drone components, technical characteristics and functions of components, drone assembly process, energy sources, levels of autonomy, drone configurations, introduction to open-source drone flight controllers, methods of drone programming, downloading and installing programs, execution of programs, multi-rotor stabilization, flight modes, and Wi-Fi connectivity.		
Unit - III	**DRONE FLYING AND OPERATION**	**9**
Concept of drone operation, flight modes, pre-flight checks and basic troubleshooting procedures, operation of a small drone in a controlled environment, drone controls, flight operation management tools, onboard sensors, onboard storage capacity, removable storage devices, and integration with mobile devices and applications.		
Unit – IV	**DRONE SERVICE AND COMMERCIAL APPLICATIONS**	**9**
Selection of drones based on application requirements, use of drones in insurance services, parcel and cargo delivery, agricultural monitoring, inspection of transmission lines and power distribution systems, filming and panoramic imaging, and applications of drones in disaster management and surveillance.		
Unit - V	**FUTURE DRONES, SAFETY AND REGULATIONS**	**9**
Safety risks associated with drone operations, guidelines for safe flying, aviation regulations and standardization, drone licensing, ethical and privacy concerns in drone usage, miniaturization of drones, increasing autonomy, and swarm drone technology.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain different types of drone technologies and their design, fabrication, and programming concepts.	K2
CO2	Apply suitable operating procedures for safe and efficient drone functioning.	K4
CO3	Select appropriate sensors, actuators, and subsystems for drone applications.	K3
CO4	Develop drone mechanisms for specific commercial and industrial applications.	K5
CO5	Create and execute basic programs for drone control and operations.	K4

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	1	-	-	-	-	-	-	1	-	-
CO2	2	2	1	1	1	2	2	1	-	-	-	2	-	-
CO3	2	2	2	1	2	-	-	-	-	-	-	3	2	-
CO4	2	3	3	2	2	1	1	-	1	1	1	2	-	2
CO5	2	2	2	2	3	-	-	-	1	2	1	-	2	2
CO	2	2	2	1	2	1	1	1	1	1	1	2	2	2

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	Terry Kilby and Belinda Kilby, ―Make:Getting Started with Drones ―,Maker Media, Inc,
3	John Baichtal, ―Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs‖, Que Publishing, 2016
4	Zavrsnik, ―Drones and Unmanned Aerial Systems: Legal and Social Implications forSecurity and Surveillance‖, Springer, 2018.
5	Joseph Yiu, ―The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors‖, Newnes, 3rd Edition, 2014.

Reference Books

1	Nitesh Tiwari, Shekhar Yadav, V. K. Giri, Fundamentals of Drone/UAV Technology, SK Kataria & Sons.
2	I. V. S. Yeswanth and A. V. S. Sridhar Kumar, Fundamentals of Drone Technology: Drones—The Future of the 21st Century, (Publisher varies).

U24ME5B05	INDUSTRIAL AUTOMATION SYSTEMS	L	T	P	C
		3	0	0	3
Course Objectives:	To educate on the design of signal conditioning circuits for various applications; to introduce signal transmission techniques and their design; to study components used in data acquisition systems and interface techniques; to provide knowledge of components used in distributed control systems; and to introduce communication buses used in automation industries.				

Unit - I	**INTRODUCTION**	**9**
Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems : Modbus & Profibus		
Unit - II	**AUTOMATION COMPONENTS**	**9**
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.		
Unit - III	**COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS**	**9**
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.		
Unit – IV	**PROGRAMMABLE LOGIC CONTROLLERS**	**9**
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.		
Unit - V	**DISTRIBUTED CONTROL SYSTEM**	**9**
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Design a signal conditioning circuits for various application	K3
CO2	Acquire a detail knowledge on data acquisition system interface and DCS system	K2
CO3	Understand the basics and Importance of communication buses in applied automation Engineering	K2
CO4	Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block	K3
CO5	Able to develop a PLC logic for a specific application on real world problem.	K4

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	1	2	-	-	-	-	-	1	2	-	2
CO2	2	1	-	-	3	-	-	-	-	-	2	1	-	3
CO3	2	-	-	-	2	-	-	-	-	-	2	-	-	2
CO4	2	2	2	-	3	-	-	-	-	-	1	2	-	3
CO5	3	3	3	2	3	2	-	2	2	2	2	3	2	3
CO	2	2	2	1	3	2	-	2	2	2	2	2	2	3

Text Books

1	S.K.Singh, "Industrial Instrumentation", Tata Mcgraw Hill, 2nd edition companies,2003.
2	C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India,8th Edition, 2006.
3	E.A.Parr, Newnes ,NewDelhi,"Industrial Control Handbook",3rd Edition, 2000.

Reference Books

1	John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
2	Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
3	Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.
4	Gary Dunning, Thomson Delmar,"Programmable Logic Controller", CeneageLearning, 3 rd Edition,2005.

U24ME5B06	INTELLIGENT PROCESS AUTOMATION	L	T	P	C
		3	0	0	3
Course Objectives:	Understanding the fundamentals and practical applications of Robotic Process Automation (RPA), including its emergence, evolution, benefits, and key application areas. Enable hands-on experience with RPA platforms and tools by designing workflows, handling user inputs, and implementing flowchart and state machine logic. Equip learners to perform UI automation tasks and build functional RPA solutions that enhance business process efficiency.				
Unit - I	**INTRODUCTION TO ROBOTIC PROCESS AUTOMATION**	**9**			
Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.					
Unit - II	**AUTOMATION PROCESS ACTIVITIES**	**9**			
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events					
Unit - III	**APP INTEGRATION, RECORDING AND SCRAPING**	**9**			
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, scraping data from website and writing to CSV. Process Mining.					
Unit – IV	**EXCEPTION HANDLING AND CODE MANAGEMENT**	**9**			
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.					
Unit - V	**DEPLOYMENT AND MAINTENANCE**	**9**			
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors – OpenSource RPA, Future of RPA					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Build functional RPA workflows by creating sequences to capture and display user inputs, designing flowcharts to navigate conditional paths, and integrating RPA components, platforms, and tools to generate measurable improvements in process efficiency, accuracy, and automation performance.	K3
CO2	Apply RPA concepts by creating state machine workflows to perform decision-making tasks, and implement UI automation activities for data manipulation, control handling,	K3

COs	Statements	K-Level
	and file operations, measuring success through accurate execution, reliable control interaction, and error-free process outcomes.	
CO3	Construct end-to-end RPA automation processes by integrating applications, recording mouse and keyboard actions, scraping website data, and writing outputs to CSV files, and implement system-triggered workflows, measuring effectiveness through successful execution, data accuracy, and process reliability.	K3
CO4	Develop robust and maintainable RPA workflows by implementing exception handling, logging, debugging, and error reporting, while applying project organization, reusable components, templates, and state machine constructs, and measure effectiveness through successful automation of tasks including web login, UI interaction, and data scraping with accurate outputs.	K3
CO5	Identify key processes and components of RPA deployment, including publishing using the publish utility, orchestration server operations, bot control, license management, and update management, and evaluate RPA vendors and emerging trends, measuring proficiency through successful implementation of error handling, web scraping, and email query processing in real-world automation scenarios.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO2	2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO3	2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO4	2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO5	2	3	3	3	2	3	3	2	3	3	3	3	3	3
CO	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**

Text Books

1	Robotic Process Automation Projects: Build Real-World RPA Solutions Using UiPath and Automation Anywhere, Nandan Mullakara, Arun Kumar Asokan, et al., Packt Publishing, 2020.
2	Robotic Process Automation (RPA) – Digitization and Automation of Processes: Prerequisites, Functionality and Implementation Using Accounting as an Example by Christian Langmann and Daniel Turi (Springer Nature, 2022)

Reference Books

1	A Gerardus Blokdyk, "Robotic Process Automation Rpa a Complete Guide ", 2020
2	Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3	Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: A Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018

U24ME5C01	GREEN MANUFACTURING DESIGN AND PRACTICES	L	T	P	C
		3	0	0	3
Course Objectives:	The course focuses on understanding environmental design and industrial ecology, and on examining the causes and environmental impacts of air, noise, and water pollution. It also emphasizes the role and importance of green co-rating systems in promoting sustainable development.				

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 - Social Life Cycle Assessment		
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 behavior 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-dixide, carbon monoxide, oxidants and ozone.		
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.		
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.		
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 Co Rating		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the principles of environmental design and sustainable engineering, emphasizing the selection of eco-friendly and renewable materials.	K2
CO2	Compare various manufacturing processes to minimize or prevent air pollution through cleaner production techniques and emission control.	K2
CO3	Illustrate manufacturing operations and implement strategies to reduce noise pollution, ensuring safer and more comfortable working environments.	K2
CO4	Relate industrial processes to prevent or reduce water pollution, focusing on waste treatment, recycling, and sustainable water management.	K2

CO5	Evaluate green co-rating systems, understanding their environmental, economic, and social benefits, and promoting sustainable industrial practices.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	3			1					1	1		1
CO2	2	1	1			1					1	1		1
CO3	2	1	1			1					1	1		1
CO4	2	1	1			1					1	1		1
CO5	2	1	1			1					1	1		1
CO	2	1	2			1					1	1		1

Text Books

1	Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010
2	Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006

Reference Books

1	Gradel.T.E. and B.R. Allenby – Industrial Ecology – Prentice Hall – 2010 .
2	Frances Cairncross– Costing the Earth: The Challenge for Governments, the Opportunities for Business – Harvard Business School Press – 1993.
3	World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press 2005.
4	Rao M.N. and Dutta A.K. “Wastewater treatment”, Oxford & IBH publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2006
5	Rao CS Environmental Pollution Control Engineering-, Wiley Eastern Ltd., New Delhi, 2006.
6	Lewis H Bell and Douglas H Bell, Industrial noise control, Fundamentals and applications, Marcel Decker, 1994

U24ME5C02	POLYMER COMPOSITES		L	T	P	C
			3	0	0	3
Course Objectives:	The course enables students to understand different fiber and resin materials used in composite manufacturing. Additionally, it introduces the basic destructive and non-destructive testing methods used to evaluate composites.					
Unit - I	**INTRODUCTION AND ADDITIVES OF COMPOSITES**		**9**			
Introduction – Advantages, Characteristics, of composites – Classification – particulate, fibrous, laminated, and hybrid composites, Additives for Composites - Catalysts - Accelerators – Coupling Agents - Fillers - Toughening Agents						
Unit - II	**MATRIX MATERIALS**		**9**			
Classification -Matrix Resins - Unsaturated Polyester - Vinyl Ester - Epoxy- Phenol Formaldehyde - Urea Formaldehyde - Melamine Formaldehyde Resin - Properties and Applications						
Unit - III	**REINFORCEMENT MATERIALS**		**9**			
Fibre Reinforcements - Glass – Types - CSM – Surface Mats - Performs - Woven and Non Woven Fabrics - Carbon - Aramid Fibre - Boron Fibres - Natural Fibres – Cellulose						
Unit – IV	**PROCESSING OF COMPOSITES**		**9**			
DMC, SMC and Prepregs - Hand and Spray Layup - RTM - Bag - Autoclave - Centrifugal and Compression Molding Processes - Filament Winding - Pultrusion Sandwich Construction						
Unit - V	**TESTING AND APPLICATION OF COMPOSITES**		**9**			
Testing of Composites - Tensile, Impact, Compression and Flexural Strength- Non Destructive testing for Composites - Application of FRP Products						
		Total Periods:	**45**			

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the fundamentals, advantages, classification, and additives of composite materials.	K2
CO2	Describe various matrix resins used in composites along with their properties and applications.	K2
CO3	Illustrate different fibre reinforcement materials and their role in composite manufacturing.	K2
CO4	Apply suitable composite processing techniques for manufacturing composite products.	K3
CO5	Evaluate composite materials using destructive and non-destructive testing methods.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	-	-	-	-	-	1	2	1	1
CO2	3	2	1	1	2	-	-	-	-	-	1	2	2	1
CO3	3	2	2	1	2	-	-	-	-	-	1	3	2	1
CO4	3	2	3	2	3	-	-	-	-	-	1	3	2	2
CO5	3	3	2	3	3	-	-	-	-	-	1	2	3	2
CO	3	2	2	2	2	-	-	-	-	-	1	2	2	1

Text Books

1	BorZ.Jang, Advanced Polymer composites, ASM International, USA, 1994.
2	S. K. Nayak, S. N. Yadav, S. Mohanty, Fundamentals of Plastic Testing, Springer, 2010.

Reference Books

1	Mel M. Schwartz,Composite Materials: Processing, fabrication, and applications, Prentice Hall PTR, 1997
2	George Lubin, Stanley T. Peters, Handbook of Composites, Chapman & Hall, 1998.
3	M.C.Gupta and A.P.Gupta, Polymer Composites, New Age International Publishers, 2007.
4	Polymer matrix nanocomposites, processing, manufacturing, and application: An overview
5	Donald F. Adams, Leif Carlsson A Carlsson, R. Byron Pipes Experimental Characterization

U24ME5C03	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3
Course Objectives:	To provide a comprehensive introduction to Six Sigma and Lean Manufacturing philosophies. It aims to develop an understanding of Lean tools, methodologies, concepts, and their elements, and to equip learners with the knowledge required to analyze, implement, and address challenges associated with Lean Manufacturing practices for continuous improvement in industrial environments.				

Unit – I	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. Value Stream Mapping, Poka-Yoke techniques, 5S methodology and workplace organization

Unit - II	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. Failure Mode, Effects and Criticality Analysis (FMECA)

Unit – III	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. Value creation vs. waste elimination

Unit - IV	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. Integration of Lean Six Sigma with ERP, Industry 4.0, and AI

Unit - V	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 of variation, Mean and moving the mean, Various quality costs, cost of poor quality. Voice of the Customer (VOC) and Critical-to-Quality (CTQ) characteristics

Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Interpret the fundamentals of Six Sigma.	K2
CO2	Classify Lean manufacturing tools.	K2
CO3	Illustrate Lean manufacturing methodologies.	K2

CO4	Differentiate Lean concepts and their elements.	K2
CO5	Examine the implementation aspects and challenges of Lean manufacturing.	K2

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO2	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO3	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO4	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO5	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO	3	2	1	-	2	-	-	-	-	-	-	3	1	1

Text Books

1	Quality Planning and Analysis- JM Juran& FM Gryna. Tata Mc Graw Hill
2	Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
3	The Toyota Way: 14 Management Principles
4	Gemba Kaizen: A Commonsense Approach to a Continuous Improvement Strategy,Masaki Imai

Reference Books

1	Quality Council of India https://qcin.org/ & its library. https://qcin.org/nbqp/knowledge_bank/
2	International Society of Six Sigma Professionals: https://isssp.org/about-us/
3	NPTEL / SWAYAM: https://nptel.ac.in/courses/110105123 : Six Sigma, Prof. Jitesh J Thakkar, IIT Kharagpur, Certification course. (Self- Learning).
4	Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5	Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

U24ME5C04	DIGITAL TRANSFORMATIONS AND DIGITAL TWINS	L	T	P	C
		3	0	0	3
Course Objectives:	This course introduces the fundamentals of digital transformation and Digital Twin technology in engineering systems. It highlights basic digital tools and simple industrial applications of Digital Twins in mechanical engineering.				

Unit - I	Basics of Digital Transformation	9
Introduction to digital transformation; evolution of manufacturing systems; traditional manufacturing vs digital manufacturing; overview of Industry 4.0; role of data in engineering systems; basic concepts of Internet of Things (IoT); cloud computing; cyber-physical systems; impact of digital transformation on mechanical engineering industries - digital maturity in manufacturing organizations.		
Unit - II	**Data and Connectivity in Engineering Systems**	**9**
Types of industrial data; basics of sensors and actuators; simple data acquisition systems; introduction to Industrial Internet of Things (IIoT); communication basics in industrial systems; real-time data monitoring; introduction to cloud and edge computing; importance of data security in industries - Industrial communication protocols.		
Unit - III	**Introduction to Digital Twin and Enabling Technologies**	**9**
Definition and concept of Digital Twin; evolution and history of Digital Twin technology; types of Digital Twins; basic requirements for Digital Twin development; importance of Digital Twin in product, process, and service industries; enabling technologies for Digital Twin; virtual CAD models; real-time data connection; introduction to cyber-physical systems - Simulation models in digital twins.		
Unit – IV	**Digital Twin Applications**	**9**
Digital Twin in discrete manufacturing industries; Digital Twin of simple mechanical products; introduction to digital thread; data collection and analysis for product improvement; digital twin in process industries; Digital Twin of a plant; basic control system concepts; role of simulation in Digital Twin; introduction to digital enterprise - use in virtual commissioning and testing.		
Unit - V	**Benefits and Applications of Digital Twin**	**9**
Benefits of Digital Twin technology; improvement in product quality; enhancement of manufacturing processes; process safety and monitoring; identification of bottlenecks; productivity and efficiency improvement; predictive maintenance; reduction of downtime and time-to-market; simple industrial case studies - Economic benefits and barriers.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Choose the concepts of digital transformation and Industry 4.0 to illustrate and analyze the role of digital technologies such as IoT, cloud computing, and cyber-physical systems in modern manufacturing.	K3
CO2	Make use of the principles of industrial data acquisition and connectivity to demonstrate and analyze the operation of sensors, actuators, IIoT systems, and industrial communication networks.	K3
CO3	Identify the concepts of Digital Twin technology to illustrate and analyze the creation of virtual models, real-time data integration, and simulation models in engineering systems.	K3
CO4	Apply Digital Twin concepts to demonstrate and analyze their applications in manufacturing systems, digital thread, virtual commissioning, and industrial process monitoring.	K3

CO5	Apply Digital Twin technologies to evaluate and analyze improvements in product quality, predictive maintenance, productivity, and operational efficiency in industrial environments.	K3

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	1	-	1	-	1	-	1	2	-	-
CO2	3	2	-	-	2	-	-	-	1	-	1	2	-	-
CO3	3	2	1	-	2	-	-	-	1	-	1	2	-	1
CO4	3	2	1	-	2	-	-	-	1	-	1	2	-	2
CO5	3	2	-	-	1	-	2	-	1	-	1	2	-	2
CO	3	2	1	-	2	-	2	-	1	-	1	2	-	2

Text Books

1	Gilchrist, A., Industry 4.0: The Industrial Internet of Things, Apress, 2016.
2	Grieves, M., Digital Twin: Manufacturing Excellence through Virtual Factory Replication, Springer, 2015.
3	Tao, F. and Zhang, M., Digital Twin Driven Smart Manufacturing, Elsevier, 2019.

Reference Books

1	Boschert, Stefan and Rosen, Roland, Digital Twin – The Simulation Aspect, Springer, 2016.
2	Kagermann, Henning, Wahlster, Wolfgang, Helbig, Johannes, Recommendations for Implementing Industry 4.0, Acatech, 2013.
3	Madni, A. M., Madni, C. C., Lucero, S. D., “Leveraging Digital Twin Technology in Model-Based Systems Engineering”, Systems, MDPI, 2019.
4	Lu, Y., Liu, C., Wang, K., “Digital Twin-driven Smart Manufacturing”, Journal of Manufacturing Systems, Elsevier, 2020.

U24ME5C05	INDUSTRY 4.0	L	T	P	C
		3	0	0	3
Course Objectives:	This course introduces the basic concepts and technologies of Industry 4.0 used in modern manufacturing systems. It provides an understanding of smart factories, automation, and challenges in implementing digital manufacturing.				

Unit - I	**INTRODUCTION TO INDUSTRY 4.0**	**9**
Introduction- Core idea of Industry 4.0 - origin - concept of industry 4.0 - Industry 4.0 production system - current state of industry 4.0 – Technologies - How is India preparing for Industry 4.0 - Design principles		
Unit - II	**A CONCEPTUAL FRAMEWORK**	**9**
Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0 - Reference architecture model		
Unit - III	**TECHNOLOGY ROADMAP**	**9**
Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, Strategy Phase, New Product and Process Development Phase - Change management and workforce readiness		
Unit – IV	**ADVANCES IN ROBOTICS AND AUGMENTED REALITY**	**9**
Introduction, Recent Technological Components of Robots - Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. Role of Augmented Reality (AR) - Introduction, AR Hardware and Software Technology, Industrial Applications of AR - Collaborative robots and human–robot interaction		
Unit - V	**OBSTACLES AND FRAMEWORK CONDITIONS**	**9**
Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra-structure, state support, legal framework, protection of corporate data, liability, handling personal data - Sustainability and environmental impact.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply the concepts of Industry 4.0 to identify and model smart manufacturing systems, digital technologies, and design principles used in modern industrial environments.	K3
CO2	Utilize Industry 4.0 frameworks to identify and organize key components, supportive technologies, and reference architecture models for smart factory implementation.	K3
CO3	Apply technology roadmap concepts to develop and plan strategies for digital transformation, new product development, and workforce readiness in Industry 4.0 environments.	K3
CO4	Select advanced robotics and augmented reality technologies to identify and model industrial applications such as cyber-physical robotics, collaborative robots, and human–robot interaction.	K3
CO5	Choose Industry 4.0 implementation concepts to identify and organize solutions for challenges such as digital strategy, data security, infrastructure, and sustainability in smart manufacturing systems.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	2	-	-	-	-	-	1	2	-	1
CO3	2	2	2	-	1	-	-	-	-	-	1	2	-	2
CO4	2	1	1	-	2	-	-	-	-	-	1	2	-	2
CO5	2	1	-	-	-	-	-	1	-	-	1	1	-	-
CO	2	1	2	-	2	-	-	1	-	-	1	2	-	2

Text Books

1	Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation", Springer, 2017.
2	Ortiz, Jesús Hamilton, "Industry 4.0: Current Status and Future Trends", InTech Open, 2020.

Reference Books

1	Bartodziej, Christoph Jan, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer, 2017.
2	Klaus Schwab,"The Fourth Industrial Revolution", Currency, 2017.
3	Christian Schröder, "The Challenges of Industry 4.0 for Small and Medium-sized Enterprises", Friedrich-Ebert-Stiftung, 2017

U24ME5C06	MICRO MANUFACTURING	L	T	P	C
		3	0	0	3
Course Objectives:	Understand the principles, basic machine tools, and developments in the micro manufacturing process and apply design consideration principles for micro manufacturing processes, such as forming, EDM, welding etc.				

Unit - I	**MICRO MACHINING I**	**9**
Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.		
Unit - II	**MICRO MACHINING II**	**9**
Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Hybrid Micro machining – Electro Discharge Grinding – Electro Chemical spark micro machining – Electrolytic in process Dressing.		
Unit - III	**NANO POLISHING**	**9**
Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemomechanical Polishining.		
Unit – IV	**MICRO FORMING AND WELDING**	**9**
Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding. Micro Additive Manufacturing & Micro Joining Integration		
Unit - V	**METROLOGY FOR MICRO MANUFACTURING**	**9**
Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications. Micro/Nano Metrology Using Optical & Interferometric Methods		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the various mechanical Micro machining Process.	K2
CO2	Apply the various Energy based Micro machining Process.	K2
CO3	Illustrate the importance of Nano Polishing Process.	K2
CO4	Explain the Micro forming and welding Process.	K2
CO5	Discuss the metrology advancements for Micro manufacturing.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO2	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO3	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO4	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO5	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO	2	2	3	1	1	-	-	-	1	-	-	2	3	2

Text Books

1	Jain V. K., “Micro Manufacturing Processes”, CRC Press, Taylor & Francis Group, 2012
2	Jain V.K., “Advanced Machining Processes”, Allied Publishers, Delhi, 2002
3	Bharat Bhushan, “Handbook of nanotechnology”, springer, Germany, 2010.

Reference Books

1	Bandyopadhyay. A.K., “Nano Materials”, New age international publishers, New Delhi, 2008, ISBN:8122422578.
2	Janocha H., Actuators – “Basics and applications”, Springer publishers – 2012 .
3	Jain V.K., „Introduction to Micro machining“ Narosa Publishing House, 2011.

U24ME5D01	CAD/CAM	L	T	P	C
		3	0	0	3
Course Objectives:	The course aims to introduce the fundamentals of design, including two-dimensional drafting, bill of material creation, and three-dimensional modeling. It also covers assembly modeling, computer-aided machining, and part programming techniques.				

Unit - I	BASICS OF DESIGNS	9
Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading.		
Unit – II	**2D DRAFTING**	**9**
Projection views – Orthographic view, Axillary view, Full &; Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting.		
Unit – III	**3D MODELING**	**9**
Conversion of Views – 2D to 3D & 3D to 2D – Parametric and Non-Parametric Modeling – Tree features of 3D Modeling and its advantages – Surface Modeling – BIW (Body In White) – Solid Modeling, Boolean operations like Unites, Subtraction, Intersect, etc.		
Unit – IV	**ASSEMBLY MODELING**	**9**
Basics of Assembly modeling, Purpose of Assembly modeling & its advantages – Top to Down & BottomUp modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis – Cumulative effect of Tolerances in after assembly conditions - motion analysis		
Unit – V	**CAM**	**9**
Basics of CNC Machining – 3, 4 & 5 Axis machines - CNC and Part Programing, CAM programing 2D & 3D. Elements of CAM Orientation, Boundary Creation, Cutter Path Selection, Cutter Compensation – Machining Stocks, Roughing, Re-roughing, Semi Finishing & Finishing - Tool Path Generation, Isl and Milling Programing. Machining program simulation, integration of program with machine; Estimation of CNC Cycle time. – Post Process NC Code conversion and Setup Sheet Preparation.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply engineering drawing principles to identify and interpret projections, scales, GD&T symbols, title blocks, revision status, and customer-specific drawing requirements in design documentation.	K3
CO2	Utilize 2D drafting techniques to construct and develop engineering drawings including orthographic views, sectional views, title blocks, bill of materials, and inspection-related annotations.	K3
CO3	Apply 3D modeling concepts to develop and model parametric/non-parametric solid and surface models by converting engineering drawings into three-dimensional CAD representations.	K3
CO4	Utilize assembly modeling techniques to analyze and organize assembly structures, interferences, clearances, tolerance stack-up, and motion behavior in mechanical assemblies.	K3
CO5	Apply CAM principles to develop and generate CNC machining programs, tool paths, NC codes, and machining simulations for manufacturing of engineering components.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	-	-	-	-	-	-	-	1	2	2	-
CO2	3	2	1	1	-	-	1	-	-	-	1	2	2	-
CO3	3	2	1	1	-	-	-	-	-	-	1	2	3	-
CO4	3	2	1	1	-	-	-	-	-	-	1	2	3	-
CO5	3	2	1	1	-	-	1	-	-	-	1	2	3	-
CO	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**2**	**3**	**-**

Text Books

1	Computer Aided Design & Manufacturing - Jacob Moses & Ruchi Agarwal
2	CAD / CAM Principles & Application - J. Srinivas

Reference Books

1	CAD / CAM - Ibrahim Zaid (Text & Reference Book)
2	CAD / CAM – Chandandeep Grewal
3	CAD CAM &; Automation - FarazdakHaideri (Text & Reference Book)
4	Computer Aided Design & Manufacturing – Anup Goel
5	CAD / CAM – PN Rao

24ME5D02	DESIGN CODES AND STANDARDS	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the significance of codes, standards, and government regulations in ensuring safety, quality, and regulatory compliance in industrial applications; to identify the major national and international organizations, such as ISO, IEC, ASME, API, ASTM, NFPA, BIS, and PESO, involved in developing and publishing these standards; and to familiarize with industry-specific codes and standards, particularly in the process industry, for their effective application in the design, construction, operation, and maintenance of equipment and systems.				

Unit	Title	Periods
Unit - I	**INTRODUCTION**	**9**
Introduction to Codes and Standards. What is code? What is Standard? Need for codes and standards. Objective of Codes and Standards. Codes, Standards and Good Engineering Practices. Standardization of Fasteners, Hand Tool Standards and Ergonomics.		
Unit - II	**CODES**	**9**
Codes and Standards used in Different Industry. Material, Design, Inspection and Construction Codes. Process Industry Codes. Machinery Design codes. Codes used in Oil and Gas Industry. Welding Codes. Machine Design. Automotive - HVAC. Performance Test Codes. Other Discipline codes.		
Unit - III	**STANDARDS**	**9**
Sources of Codes and Standards. Who publishes Codes and Standards? International Societies and Professional Bodies. Process of Standardisation and Code publishing in Professional Bodies and Companies. Interdisciplinary Codes.		
Unit – IV	**REGULATIONS**	**9**
Government and Federal Regulations. Need for them. Indian and International Regulations. Standards organisations. Weather and Climatic codes. IS, ISO, IBR, OISD. Certification Bodies. Authorities and Engineers to certify. PE, Chartered Engineers, ASME “U” Stamp certificate, SMPV rules.		
Unit - V	**DESIGN CODES**	**9**
Codes and Standards applicable in Process Industry Equipment Design. Pressure Vessel Design Codes. Heat Exchanger Design Codes. Wind and Seismic Codes. Machinery Codes. Package Equipment Design Codes. Performance Test Codes. ASTM, ASME, API, AWS, ANSI, ISO, ASHRAE. Codes for High-performance materials		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the need for codes and Standards in Industry.	K2
CO2	Discuss the different codes and standards used in different industry.	K2
CO3	Discuss the sources of different codes and standards and the societies that publish them and how these are evolved	K2
CO4	Explain need for Government regulations and Certification authorities and familiar with common regulations in India and International	K2
CO5	Discuss knowledge of codes and standards used in Process equipment design for Oil and Gas Industry.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	2	1	3	-	-	-	-	-	1	-	-	1	2	2
CO02	2	1	3	-	-	-	-	-	1	-	-	1	2	2
CO03	2	1	3	-	-	-	-	-	1	-	-	1	2	2
CO04	2	1	3	-	-	-	-	-	1	-	-	1	2	2
CO05	2	1	3	-	-	-	-	-	1	-	-	1	2	2
CO	2	1	3	-	-	-	-	-	1	-	-	1	2	2

Text Books

1	Mechanical Engg. Handbook. ASME. ASTM.API
2	Perrys Chemical Engg Handbook

Reference Books

1	ASME
2	API , BIS
3	ISO, IBR, OISD
4	AWS
5	ISHRAE

U24ME5D03	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:	To study design requirements and product development processes, including the various stages involved in developing successful products; to learn scientific and systematic design methodologies that effectively translate human needs into practical and innovative design solutions; and to understand the principles of material selection, cost analysis, and manufacturing considerations for creating efficient, economical, and manufacturable engineering designs.

Unit - I	DESIGN TERMINOLOGY	9
Definition-various methods and forms of design-importance of product design-static and dynamic products-various design projects-morphology of design-requirements of a good design-concurrent engineering-computer aided engineering-codes and standards-product and process cycles-bench marking.		
Unit - II	**INTRODUCTION TO DESIGN PROCESSES**	**9**
Basic modules in design process-scientific method and design method-Need identification, importance of problem definition-structured problem, real life problem- information gathering -customer requirements-Quality Function Deployment (QFD)- product design specifications-generation of alternative solutions-Analysis and selection-Detail design and drawings-Prototype, modeling, simulation, testing and evaluation.		
Unit - III	**CREATIVITY IN DESIGN**	**9**
Creativity and problem solving-vertical and lateral thinking-invention-psychological view, mental blocks-Creativity methods-brainstorming, synectics, force fitting methods, mind map, concept map-Theory of innovative problem solving (TRIZ) - conceptual decomposition creating design concepts.		
Unit – IV	**HUMAN AND SOCIETAL ASPECTS IN PRODUCT DEVELOPMENT**	**9**
Human factors in design, ergonomics, user friendly design-Aesthetics and visual aspects environmental aspects-marketing aspects-team aspects-legal aspects-presentation aspects.		
Unit - V	**MATERIAL AND PROCESSES IN DESIGN**	**9**
Material selection for performance characteristics of materials-selection for new design substitution for existing design-economics of materials-selection methods-recycling and material selection-types of manufacturing process, process systems- Design for Manufacturability (DFM) - Design for Assembly (DFA). Design for Additive Manufacturing (DfAM)		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Analyze the various design requirements and get acquainted with the processes involved in product development.	K4
CO2	Apply the design processes to develop a successful product.	K3
CO3	Apply scientific approaches to provide design solutions.	K3
CO4	Design solution through relate the human needs and provide a solution.	K6
CO5	Apply the principles of material selection, costing and manufacturing in design.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	2	2	-	-	-	-	1	-	-	2	1	1
CO2	2	2	2	2	-	-	-	-	1	-	-	2	1	1
CO3	2	2	2	2	-	-	-	-	1	-	-	2	1	1
CO4	2	2	2	2	-	-	-	-	1	-	-	2	1	1
CO5	2	2	2	2	-	-	-	-	1	-	-	2	1	1
CO	2	2	2	2	-	-	-	-	1	-	-	2	1	1

Text Books

1	Dieter. G. N., Linda C. Schmidt, “Engineering Design”, McGraw Hill, 2013..
2	Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.

Reference Books

1	Horenstein, M. N., Design Concepts for Engineers, Prentice Hall, 2010.
2	Edward B. Magrab, Satyandra K. Gupta, F. Patrick McCluskey and Peter A. Sandborn, “Integrated Product and Process Design and Development”, CRC Press, 2009.
3	James Garratt, “Design and Technology”, Cambridge University Press, 1996.
4	Joseph E. Shigley, Charles R.Mische, and Richard G. Budynas, “Mechanical Engineering Design”, McGraw Hill Professional, 2003.
5	Sumesh Krishnan and MukulSukla, Concepts in Engineering Design, Notion Press, 2016.

U24ME5D04	DESIGN FOR X	L	T	P	C
		3	0	0	3
Course Objectives:	To understand and apply economic process selection and design-for-manufacturability (DFM) principles, including casting design considerations, in engineering product development; to apply design principles for conventional manufacturing processes such as forming (extrusion, stamping, forging), machining (turning, drilling, milling, grinding), and welding; and to understand and implement design considerations for additive manufacturing in modern engineering applications.				

Unit - I	**INTRODUCTION**	**9**
General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric Tolerances - Assembly limits -Datum features - Tolerance stacks, Design to minimize material usage – Design for disassembly – Design for recyclability – Design for manufacture – Design for energy efficiency – Design to regulations and standards.		
Unit - II	**FACTORS INFLUENCING FORM DESIGN**	**9**
Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings.		
Unit - III	**COMPONENT DESIGN - MACHINING CONSIDERATION**	**9**
Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic assembly.		
Unit – IV	**COMPONENT DESIGN – CASTING CONSIDERATION**	**9**
Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA.		
Unit - V	**DESIGN FOR ADDITIVE MANUFACTURING**	**9**
Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Elaborate the design principles for manufacturability	K1
CO2	Discuss the factors influencing in form design	K2
CO3	Apply the component design features of various machine	K3
CO4	Discuss the design consideration principles of welding in the design of welded products.	K2
CO5	Discuss the design consideration principles of additive manufacturing.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO2	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO3	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO4	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO5	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO	2	2	3	1	1	-	-	-	1	-	-	2	3	2

Text Books

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

Reference Books

1	CorradoPoli, Design for Manufacturing: A Structured Approach, Elsevier, 2001.
2	David M. Anderson, Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004.
3	Erik Tempelman, Hugh Shercliff, Bruno Ninaber van Eyben, Manufacturing and Design: Understanding the Principles of How Things Are Made, Elsevier, 2014.
4	Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996.
5	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.

U24ME5D05	DESIGN OF PRESSURE VESSELS	L	T	P	C
		3	0	0	3
Course Objectives:	This course introduces the mathematical foundations required for the design of pressure vessels and piping, including stress analysis, reinforcement theory, and buckling and fracture considerations.				

Unit - I	INTRODUCTION	9
Methods for determining stresses – Terminology and Ligament Efficiency – Applications		
Unit - II	**STRESSES IN PRESSURE VESSELS**	**9**
Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels		
Unit - III	**DESIGN OF VESSELS**	**9**
Design of Tall cylindrical self-supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.		
Unit – IV	**BUCKLING AND FRACTURE ANALYSIS IN VESSELS**	**9**
Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.		
Unit - V	**PIPING**	**9**
Introduction – Flow diagram – piping layout and piping stress Analysis.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain methods for determining stresses, terminology, ligament efficiency, and their applications.	K2
CO2	Analyze stresses in pressure vessels under different loading conditions.	K3
CO3	Design and analyze pressure vessels based on applicable design criteria.	K3
CO4	Interpret buckling and fracture behavior in pressure vessels.	K2
CO5	Apply principles of piping design to develop and analyze piping layouts and systems.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	3	1	-	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	2	1
CO3	2	3	2	3	-	-	-	-	-	-	-	1	2	1
CO4	3	2	3	2	-	-	-	-	-	-	-	1	2	2
CO5	3	2	3	2	-	-	-	-	-	-	-	1	-	-
CO	3	2	3	2	-	-	-	-	-	-	-	1	2	1

Text Books

1	John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.
2	Theory And Design Of Pressure Vessels (Pb 2001) by HARVEY J.F. | 1 January 2001

Reference Books

1	Henry H. Bedner, “Pressure Vessels, Design Hand Book", CBS publishers and Distributors,1987.
2	Stanley, M. Wales, “Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3	William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997
4	Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.
5	Theory and design of Pressure Vessels (Pb 2001)by HARVEY J.F. | 1 January 2001

U24ME5D06	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3
Course Objectives:	This course introduces industrial design based on ergonomics and emphasizes the application of ergonomic principles in manufacturing, including the design of controls and displays.				

Unit - I	INTRODUCTION	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 - Human–AI Collaboration in Modern Manufacturing Systems.		
Unit - II	**ERGONOMICS AND PRODUCTION**	**9**
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-Digital Human Modeling (DHM) in 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 - Human–Machine Interface (HMI) Design in Industry 4.0.		
Unit – IV	**ENVIRONMENTAL FACTORS**	**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 - Lighting Design for Smart and Sustainable Industrial Workspaces.		
Unit - V	**AESTHETIC CONCEPTS**	**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-Sustainable and Eco-Friendly Product Design Aesthetics		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the development of Additive Manufacturing technology and its propagation into various business sectors and emerging opportunities.	K2
CO2	Demonstrate the process of transforming a concept into a final product using Additive Manufacturing technologies.	K3
CO3	Describe vat polymerization and direct energy deposition processes along with their applications.	K2
CO4	Illustrate the processes and applications of powder bed fusion and material extrusion techniques.	K2
CO5	Analyze the advantages, limitations, and applications of binder jetting, material jetting, and sheet lamination processes.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	3	1	2	1	-	-	-	-	-	1	2	2
CO2	2	3	2	2	1	1	-	-	-	-	-	2	3	2
CO3	2	3	2	3	2	1	-	-	-	-	-	1	2	2
CO4	2	2	3	2	2	1	-	-	-	-	-	2	3	3
CO5	2	2	3	2	2	1	-	-	-	-	-	2	3	3
CO	2	2	3	2	2	1	-	-	-	-	-	2	3	2

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.

Reference Books

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	Bridger, R.C., Introduction to Ergonomics, 2ndEdition, 2003, McGraw Hill Publications.
4	Martin Helander, A Guide to human factors and Ergonomics, Taylor and Francis, 2006
5	Mayall W.H. “Industrial design for Engineers”, London Hiffee books Ltd., 1988.

U24ME5E01	SOLAR POWER SYSTEM	L	T	P	C
		3	0	0	3
Course Objectives:	The objective of this course is to enable students to recall the basic principles of solar energy and its role in sustainable energy systems, characteristics of solar radiation and the working principles of solar thermal and solar photovoltaic technologies and also gain awareness of solar power applications and system integration for practical energy utilization.				

Unit - I	SOLAR ENERGY FUNDAMENTALS	9
Introduction to renewable and solar energy – Need and scope of solar technologies – Solar radiation fundamentals – Solar constant – Extraterrestrial and terrestrial radiation – Beam, diffuse and global radiation – Measurement of solar radiation – Solar angles – Availability of solar energy – Estimation of solar radiation on horizontal and inclined surfaces.		
Unit - II	**SOLAR THERMAL COLLECTORS**	**9**
Principles of solar thermal energy conversion – Flat plate collectors – Liquid and air heating collectors – Performance analysis of flat plate collectors – Concentrating collectors – Parabolic trough, parabolic dish and central receiver systems – Optical efficiency – Applications of solar thermal collectors.		
Unit - III	**SOLAR THERMAL APPLICATIONS & STORAGE**	**9**
Solar water heating systems – Solar air heating – Solar dryers – Solar stills – Solar cookers – Solar space heating and cooling – Solar ponds – Thermal energy storage methods – Sensible heat storage – Latent heat storage – Thermochemical storage – Basic materials used for energy storage.		
Unit – IV	**SOLAR PHOTOVOLTAIC TECHNOLOGIES**	**9**
Principles of photovoltaic conversion – Solar cell fundamentals – Semiconductor materials – Construction and working of solar cells – I–V characteristics – Efficiency and losses – PV modules and arrays – Series and parallel connections – PV system components – Stand-alone and grid-connected PV systems.		
Unit - V	**SOLAR POWER SYSTEMS & APPLICATIONS**	**9**
Balance of system components – Inverters, charge controllers and batteries – Energy storage in PV systems – Solar power plants – Rooftop solar systems – Hybrid energy systems – Solar pumping systems –Applications of solar energy in industrial, domestic and agricultural sectors – Environmental and economic aspects of solar technologies.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Recall the basic concepts, terminology, and principles related to solar energy and solar radiation characteristics.	K2
CO2	Identify different types of solar thermal collectors and recognize their construction, working principles, and applications.	K2
CO3	Explain the working principles of solar thermal applications and various thermal energy storage methods.	K2
CO4	Describe the operating principles, characteristics, and performance of solar photovoltaic cells, modules, and systems.	K2
CO5	Explain the configuration, components, and applications of solar power systems and their role in sustainable energy development.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	1	-	-	-	-	-	1	1	1	1	-	-
CO2	3	1	1	-	-	-	-	-	1	1	1	1	-	-
CO3	3	2	1	-	-	-	-	-	1	1	1	1	-	-
CO4	3	2	1	-	-	-	-	-	1	1	1	1	-	-
CO5	3	2	1	-	-	-	-	-	1	1	1	1	-	-
CO	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**	**-**	**-**

Text Books

1	Sukhatme, S.P. & Nayak, J.K., Solar Energy: Principles of Thermal Collection and Storage, 3rd Edition, Tata McGraw-Hill, 2008
2	Duffie, J.A. & Beckman, W.A., Solar Engineering of Thermal Processes, 4th Edition, John Wiley & Sons, 2013.
3	Chetan Singh Solanki, Solar Photovoltaics: Fundamentals, Technologies and Applications, 2nd Edition, PHI Learning, 2015.

Reference Books

1	Goswami, D.Y., Kreith, F. & Kreider, J.F., Principles of Solar Engineering, 2nd Edition, Taylor & Francis, 2000.
2	Kalogirou, S.A., Solar Energy Engineering: Processes and Systems, 2nd Edition, Academic Press (Elsevier), 2014.
3	Green, M.A., Solar Cells: Operating Principles, Technology and System Applications, 1st Edition, Prentice Hall, 1982.

U24ME5E02	RENEWABLE ENERGY PRODUCTION	L	T	P	C
		3	0	0	3
Course Objectives:	This course is designed to impart comprehensive knowledge on clean and renewable energy production technologies. It focuses on the principles, working, performance evaluation, environmental benefits, and practical applications of renewable energy systems such as solar, wind, hydro, biomass, geothermal, and ocean energy.				

Unit - I	INTRODUCTION TO CLEAN ENERGY SYSTEMS	9
World energy demand and supply – Indian and global energy scenario – Conventional energy sources and their limitations – Environmental impacts of fossil fuels – Climate change and greenhouse effect – Concept of sustainability – Clean energy and renewable energy definitions – Classification of renewable energy sources – Energy resources assessment – Role of renewable energy in sustainable development		
Unit - II	**SOLAR ENERGY PRODUCTION SYSTEMS**	**9**
Solar radiation fundamentals – Solar geometry – Measurement and estimation of solar radiation – Solar thermal energy conversion – Flat plate and concentrating solar collectors – Solar water heating systems – Solar air heaters – Solar thermal power plants – Principles of photovoltaic conversion – Solar cell materials and characteristics – PV modules and arrays – Grid-connected and standalone PV systems – Performance parameters and applications.		
Unit - III	**WIND AND HYDRO ENERGY SYSTEMS**	**9**
Wind energy basics – Wind characteristics and resource assessment – Betz limit – Types of wind turbines – Horizontal and vertical axis wind turbines – Wind turbine components – Power control and site selection – Small and large wind energy systems – Hydro power fundamentals – Classification of hydro power plants – Small and micro hydro systems – Environmental and economic aspects of wind and hydro energy.		
Unit – IV	**BIOENERGY AND OTHER RENEWABLE SOURCES**	**9**
Biomass energy resources – Biomass conversion technologies – Combustion, gasification, and pyrolysis – Biogas plants – Biofuels and applications – Geothermal energy principles – Types of geothermal systems – Ocean energy sources: tidal, wave, and OTEC – Hybrid renewable energy systems – Energy storage systems for renewable applications.		
Unit - V	**SYSTEM INTEGRATION AND EMERGING TRENDS**	**9**
Renewable energy system integration – Grid connectivity issues – Power quality and stability – Economics of renewable energy – Cost–benefit analysis – Environmental impact assessment – Hydrogen energy production – Fuel cells – Smart grids – Future trends in clean energy technologies – Case studies of renewable energy projects.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the present energy scenario and the importance of clean and renewable energy sources.	K2
CO2	Describe the principles and applications of solar energy production systems.	K2
CO3	Analyze wind and hydro energy systems and their performance characteristics.	K2
CO4	Explain biomass, geothermal, ocean, and hybrid renewable energy systems.	K2
CO5	Evaluate renewable energy integration techniques and emerging clean energy technologies.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	1	-	-	1	-	1	1	1	1
CO2	3	2	2	1	-	1	-	-	1	-	1	1	1	1
CO3	3	2	2	1	-	1	-	-	1	-	1	1	1	1
CO4	3	2	2	1	-	1	-	-	1	-	1	1	1	1
CO5	3	2	1	1	-	1	-	-	1	-	1	1	1	1
CO	**3**	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1**	**1**

Text Books

1	Rai, G.D., Non-Conventional Energy Sources, Khanna Publishers, New Delhi.
2	Boyle, G., Renewable Energy: Power for a Sustainable Future, Oxford University Press.

Reference Books

1	S P Sukhatme, J K Nayak , “Solar Energy: Principles of Thermal Collection and Storage,” The McGraw-Hill.
2	Tiwari, G.N. and Ghosal, M.K., Renewable Energy Resources, Narosa Publishing House.
3	C.S. Solanki, “Solar Photovoltaics - Fundamentals, Technologies and Applications”, Prentice Hall of India.
4	Twidell, J.W. and Weir, A., Renewable Energy Resources, CRC Press.

U24ME5E03	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3
Course Objectives:	To understand energy demand–supply and the role of energy auditing, analyse energy billing and demand side management, evaluate fuel and utility losses, diagnose electrical utility performance and efficiency improvements, and apply CUSUM and economic evaluation methods to estimate energy savings and financial benefits.				
Unit - I	**INTRODUCTION**		**9**		
Energy scenario of the world, India, and Tamil Nadu, environmental aspects of energy generation, material and energy balancing, energy auditing including need, types, methodology, and barriers, role of energy managers, basic instruments used for energy auditing, overview of sustainable energy management practices.					
Unit - II	**ELECTRICAL SUPPLY SYSTEMS**		**9**		
Electricity tariff structures, typical energy billing methods, demand side management, HT and LT supply systems, power factor improvement, energy conservation in transformers, harmonics, impact of power quality on energy efficiency.					
Unit - III	**ENERGY CONSERVATION IN MAJOR THERMAL UTILITIES**		**9**		
Stoichiometry and combustion principles, energy conservation in boilers, steam distribution systems, furnaces, thermic fluid heaters, cooling towers, diesel generator sets, insulation and refractories, waste heat recovery devices, energy efficiency assessment of thermal systems.					
Unit – IV	**ENERGY CONSERVATION IN MAJOR ELECTRICAL UTILITIES**		**9**		
Energy conservation in motors, pumps, fans, blowers, compressed air systems, refrigeration and air conditioning systems, illumination systems, use of energy-efficient electrical equipment and technologies.					
Unit - V	**ENERGY MONITORING, TARGETING, LABELLING AND ECONOMICS**		**9**		
Elements of monitoring and targeting systems, CUSUM technique, energy and cost index diagrams, energy labelling, energy economics, cost of production, life cycle costing, economic evaluation techniques including discounting and non-discounting methods, ESCO concept, PAT scheme, case studies on industrial energy efficiency projects.					
	Total Periods:		**45**		

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the national and global energy demand–supply scenario and the importance of energy auditing for environmental sustainability.	K2
CO2	Analyze energy billing structures and apply demand side management techniques to reduce energy costs.	K4
CO3	Compute stoichiometric air requirements for fuels and evaluate energy losses in industrial thermal utilities.	K3
CO4	Diagnose performance issues in electrical utilities and recommend measures to improve energy efficiency.	K5
CO5	Apply CUSUM and economic evaluation techniques to estimate energy savings and financial benefits of energy efficiency projects.	K4

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	1	-	-	-	3	-	1	-	-	1	1	1
CO2	2	2	1	-	-	-	3	-	1	-	-	1	1	1
CO3	2	2	1	-	-	-	3	-	1	-	-	1	2	1
CO4	2	2	1	-	-	-	3	-	1	-	-	2	2	1
CO5	2	2	1	-	-	-	3	-	1	-	-	2	2	1
CO	3	2	1	-	-	-	3	-	1	-	-	2	2	1

Text Books

1	Guide book for National Certification Examination for "Energy Managers and Energy Auditors" (4 Volumes). Available at http://www.em-ea.org/gbook1.asp. This website is administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.
2	K. Nagabhushan Raju, Industrial Energy Conservation Techniques: (concepts, Applications and Case Studies), Atlantic Publishers & Dist, 2007.

Reference Books

1	Abbi Y P, Shashank Jain., Handbook on Energy Audit and Environment Management, TERI Press,2006.
2	Albert Thumann and Paul Mehta D, "Handbook of Energy Engineering", 7thEdition, The Fairmont Press, 2013.
3	Murphy.W.R. and McKay.G, "Energy Management", Butterworth, London 1982.
4	Paul W.O'Callaghan, Design and management for energy conservation: A handbook for energy managers, plant engineers, and designers, Pergamon Press, 1981.
5	Steve Doty, Wayne Turner C, Energy Management Handbook 7th Edition, The Fairmont Press, 2009.

U24ME5E04	HYDROGEN ENERGY GENERATION	L	T	P	C
		3	0	0	3
Course Objectives:	The course provides students with a comprehensive understanding of hydrogen as an energy carrier, covering its production methods, storage and transport technologies, utilization in fuel cells, and the associated safety, economic, and environmental considerations.				

Unit - I	INTRODUCTION TO HYDROGEN ENERGY	9
Properties of Hydrogen and global energy scenario – Hydrogen color spectrum (Green, Blue, Grey) - Role in decarbonization and energy storage.		
Unit - II	**HYDROGEN PRODUCTION METHODS**	**9**
Electrolysis: Fundamentals, electrolyzer types (PEM, Alkaline, Solid Oxide), stack components Thermo-chemical/Reforming: Steam methane reforming, partial oxidation, auto thermal reforming Advanced methods: Photo electrochemical production, biomass gasification, nuclear production - Technical and economic comparisons of production routes.		
Unit - III	**HYDROGEN STORAGE AND TRANSPORT**	**9**
Physical storage: Compressed gas (high-pressure tanks), Liquid hydrogen (cryogenic storage). - Material-based storage: Metal hydrides, chemical hydrides, carbon nanotubes, adsorption. Underground storage and pipeline transport.		
Unit – IV	**HYDROGEN UTILIZATION AND FUEL CELLS**	**9**
Fuel Cells: Types (PEMFC, SOFC, PAFC), components, efficiency, thermodynamics (equation). Applications: Fuel Cell Vehicles (FCVs), Refueling infrastructure. Industrial use: Ammonia production, petrochemical refining, metallurgical reducing agents. Combined Heat and Power (CHP) systems		
Unit - V	**SAFETY, ECONOMICS, AND ENVIRONMENT**	**9**
Hydrogen safety: Leak detection, risk analysis, fire hazards - Life cycle analysis and environmental impact - Economic analysis: Cost analysis, government policies, regulations, and standards		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Understand the role of hydrogen as a clean energy carrier and its potential in the global energy landscape.	K2
CO2	Infer the various methods for producing hydrogen, including electrolysis, thermochemical, and biological processes.	K2
CO3	Explore technologies and materials for safe and efficient storage and transportation of hydrogen.	K2
CO4	Relate the applications of hydrogen in energy systems, particularly in fuel cells and power generation.	K2
CO5	Compare the safety protocols, economic feasibility, and environmental impacts associated with hydrogen technologies.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	1	1		1						1	1	1	
CO2	1	2	1		1						1	1	1	
CO3	1	1	1		1						1	1	1	
CO4	1	1	1		1						1	1	1	
CO5	1	1	1		1						1	1	1	
CO	1	1	1		1						1	1	1	

Text Books

1	Hydrogen Technologies: Production, Transportation, Storage, and Utilization – Olayinka I. Ogunsola & Olubunmi M. Ogunsola, CRC Press, 1st Edition, 2025.
2	Hydrogen Energy: Production, Storage and Utilization – Edited by Dilshad Ahmad Khan, Akhilesh Kumar Choudhary & Deepak Sharma, CRC Press, 1st Edition, 2025.
3	Hydrogen Energy and Fuel Cells: Science and Applications – Zhen Zhang, Springer Singapore, 1st Edition, 2026.

Reference Books

1	Handbook of Hydrogen Energy – Edited by S.A. Sherif, D. Yogi Goswami, E.K. (Lee) Stefanakos & Aldo Steinfeld, CRC Press, 1st Edition, 2014.
2	Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications – Edited by Detlef Stolten, Wiley-VCH, 1st Edition, 2010.
3	Handbook of Hydrogen Production and Applications (Six-Volume Set) – Edited by Mohammad Reza Rahimpour, Mohammad Amin Makarem & Parvin Kiani, CRC Press, 1st Edition.

U24ME5E05	BIO MASS ENERGY	L	T	P	C
		3	0	0	3
Course Objectives:	The main Objectives of the course is to learn availability of biomass, methods of biomass analysis and study of characteristics, impart knowledge on stoichiometry and combustion of biofuels and costing of biomass technologies & provide insight to the possibilities of producing liquid fuels form biomass.				

Unit - I	INTRODUCTION	9
Biomass: types–advantages and drawbacks–Indian scenario–characteristics–carbon neutrality– conversion mechanisms–fuel assessment studies–densification technologies Comparison with coal – Proximate & Ultimate Analysis – Thermo Gravimetric Analysis –Differential Thermal Analysis– Differential Scanning Calorimetry		
Unit - II	**BIOMETHANATION**	**9**
Microbial systems – phases in biogas production – parameters affecting gas production – effect of additives on biogas yield – possible feed stocks. Biogas plants – types – design –constructional details and comparison – biogas appliances – burner, luminaries and power generation – effect on engine performance.		
Unit - III	**COMBUSTION**	**9**
Perfect, complete and incomplete combustion-stoichiometric air requirement for biofuels-equivalence ratio – fixed Bed and fluid Bed combustion – fuel and ash handling systems –steam cost comparison with conventional fuels.		
Unit – IV	**GASIFICATION, PYROLYSIS AND CARBONISATION**	**9**
Chemistry of gasification- types–comparison–application–performance evaluation–economics– dual fuelling in IC engines – 100 % Gas Engines – engine characteristics on gas mode – gas cooling and cleaning systems – Pyrolysis – Classification – process governing parameters – Typical yield rates. Carbonization Techniques–merits of carbonized fuels		
Unit - V	**LIQUIFIED BIOFUELS**	**9**
History of usage of Straight Vegetable Oil (SVO) as fuel – Biodiesel production from oil seeds, waste oils and algae – Process and chemistry – Biodiesel health effects / emissions /performance. Production of alcoholic fuels (methanol and ethanol) from biomass –engine modifications.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Estimate the availability of surplus biomass and study the characteristics	K2
CO2	Summarize a biogas plant for different bioenergy sources	K2
CO3	Determine and compare the cost of steam generation from biofuels with conventional fuels.	K2
CO4	Explain the influence of process governing parameters in thermo chemical conversion of biomass and in internal combustion engines	K2
CO5	U8nderstand the production of liquid biofuels for power generation from biomass	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	-	-	-	-	-	-	-	1	1		1
CO2	3	2	2	-	-	-	-	-	-	-	1	1		1
CO3	3	2	2	-	-	-	-	-	-	-	1	1		1
CO4	3	2	2	-	-	-	-	-	-	-	1	1		1
CO5	3	2	2	-	-	-	-	-	-	-	1	1		1
CO	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**		**1**

Text Books

1	KhandelwalKC, Mahdi SS, Biogas Technology–A Practical Handbook,Tata McGraw Hill,1986
2	Maheswari,R.C. BioEnergy for Rural Energisation, Concepts Publication,1997
3	Bioenergy: Biomass to Biofuels and Waste to Energy, Academic Press,2020

Reference Books

1	David Boyles,Bio Energy Technology Thermodynamics and costs, Ellis Horwood Chichester,1984.
2	Iyer PV Retal, Thermo chemical Characterization of Biomass, MNES
3	Bioenergy: Biomass to Biofuels and Waste to Energy, Academic Press,2020
4	David C. Dayton , Thomas D. Foust ,Analytical Methods for Biomass Characterization and Conversion (Emerging Issues in Analytical Chemistry), Elsevier,2019

U24ME5E06	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3
Course Objectives:	The main objectives of this course is focuses on power generation principles for real world applications. More specifically this course is focused on application of energy principles and power generation cycles & learn how the power is generated in a power plant and its applications.				

Unit - I	INTRODUCTION TO THE SOURCES OF ENERGY	9
Resources and Development of Power in India. Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipment's, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems. Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.		
Unit - II	**INTERNAL COMBUSTION ENGINE PLANT**	**9**
Diesel Power Plant-Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging. Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison		
Unit - III	**HYDRO ELECTRIC POWER PLANT**	**9**
Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. Hydro Projects & Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.		
Unit – IV	**NUCLEAR POWER STATION**	**9**
Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.		
Unit - V	**POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS:**	**9**
Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor– related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the Different types of Power Plants, site selection criteria of each one of them.	K2
CO2	Understanding of Thermal Power Plant Operation, turbine governing, different types of high pressure boilers including supercritical and supercharged boilers, Fluidized bed combustion systems.	K2
CO3	Explain the design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.	K2
CO4	Summarize the different types of Nuclear power plants including Pressurized water reactor, Boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.	K2
CO5	Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	-	-	-	-	-	-	-	-	1	1	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1	1	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1	1	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1	1	1
CO5	3	2	2	-	-	-	-	-	-	2	-	1	1	1
CO	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**1**	**1**

Text Books

1	Arora S.C and Domkundwar S, 1988, A course in Power Plant Engineering, Dhanpatrai Publishers, New Delhi

Reference Books

1	Nag P.K, 2007, Power plant Engineering, Tata McGraw Hill, New Delhi
2	Rajput R.K, 2008, Power plant Engineering, Laxmi Publications, Chennai
3	Morse Frederick T, 1998, Power plant Engineering, Prentice Hall of India, New Delhi

U24ME5F01	OPERATIONAL RESEARCH	L	T	P	C
		3	0	0	3
Course Objectives:	To provide fundamental knowledge of operations research techniques and to develop the ability to formulate mathematical models and apply analytical methods such as linear programming, transportation and assignment models, game theory, and queuing theory for effective decision-making and optimal utilization of resources.				

Unit	Title	Periods
Unit - I	**BASICS OF OPERATIONS RESEARCH AND FORMULATION OF L.P.P**	**9**
Basics of O.R – Definition of O.R – Characteristics of O.R - Scientific methods in O.R – Necessary of O.R in Industry – O.R and Decision Making – Scope of O.R in Modern Management – Uses and limitations of O.R .Linear Programming Problem – Formulation of L.P.P – Graphical solutions of L.P.P – Problems. Simplex Method – Problems.		
Unit - II	**TRANSPORTATION MODEL**	**9**
Introduction to transportation problem – The transportation table – Solution of transportation problem – Finding an initial basic feasible solution – North-West Corner Method – Least Cost Method – Vogel's Approximation Method – Optimality test (MODI/ Stepping Stone) – Degeneracy and applications.		
Unit - III	**ASSIGNMENT MODEL**	**9**
Introduction – Mathematical Formulation – Solution Methods – Assignment table (cost matrix) – Balance and unbalanced assignment problems – Hungarian method –Maximization assignment problem – Special case – The Traveling Salesman Problem.		
Unit – IV	**GAME THEORY**	**9**
Game Theory – Payoff matrix – Types of games: Two-person zero sum game – The Maximin – Minimax principle – problems – Solution of 2 x 2 rectangular Games – Domination Property – (2 x n) and (m x 2) graphical method – Problems.		
Unit - V	**QUEUING THEORY**	**9**
Introduction – Queuing System – Elements of Queuing System – Operating Characteristics of Queuing System – Classification of Queuing Models – Model I (M/M/1): (∞/FIFO), Model II (M/M/1): (N/FIFO) – Model III (M/M/C): (∞/FIFO), Model IV (M/M/C): (N/FIFO).		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO1	Understand the basic concepts and applications of operations research in various fields.	K2
CO2	Apply transportation problem techniques to construct transportation tables and obtain optimal solutions.	K3
CO3	Apply the mathematical formulation of the Assignment Model to solve optimization problems related to the Traveling Salesman Problem.	K3
CO4	Apply game theory concepts to articulate real-world situations by identifying, analyzing and practicing strategic decisions.	K3
CO5	Apply the models of queuing theory in the real-world applications.	K3

CO–PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	1	-	-	-

Text Books

1	Operations Research – Kanti Swarup, P. K. Gupta, Man Mohan (S. Chand & Sons Education Publications, New Delhi, 12th Revised edition-2003).
2	Hamdy A Taha (2002), “Operations Research” Pearson Education, 7th edition.

Reference Books

1	P.K. Gupta, D.S. Hira, “Problems in Operations Research”, S. Chand Publishers.
2	Operations Research – Prem Kumar Gupta D. S. Hira (S. Chand & Company Ltd, Ram Nagar, New Delhi ,2014).
3	Operations Research Principles and Problems- S. Dharani Venkata Krishnan (Keerthi publishing house PVT Ltd.1994).

U24ME5F02	MAINTENANCE ENGINEERING	L	T	P	C
		3	0	0	3
Course Objectives:	Explain the principles of industrial safety, maintenance engineering, wear analysis and fault diagnosis, and describe periodic preventive maintenance procedures for effective operation of tools, equipment and machines.				

Unit - I	INDUSTRIAL SAFETY	9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods- Digital Safety Management & IoT-based Smart PPE		
Unit - II	**MAINTENANCE ENGINEERING**	**9**
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment- Reliability Centered Maintenance (RCM)		
Unit - III	**WEAR AND CORROSION AND THEIR PREVENTION**	**9**
Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods - Condition Monitoring using Oil Analysis.		
Unit – IV	**FAULT TRACING**	**9**
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes - Root Cause Failure Analysis (RCFA) using Fishbone & FMEA.		
Unit - V	**PERIODIC AND PREVENTIVE MAINTENANCE**	**9**
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of:i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, Advantages of preventive maintenance. Repair cycle concept and importance - Computerized Maintenance Management System (CMMS).		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the fundamental concepts and principles of industrial safety.	K2
CO2	Apply the principles of maintenance engineering in practice.	K3
CO3	Analyse the types of wear and apply suitable methods for their reduction.	K3
CO4	Examine faults in various tools, equipment and machines for proper identification.	K3

CO5	Apply periodic preventive maintenance procedures for effective system performance.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	3	1	-	-	-	-	-	-	-	2	-	1
CO2	2	3	2	2	-	-	-	-	-	-	-	3	-	1
CO3	2	3	2	3	-	-	-	-	-	-	-	2	2	-
CO4	2	2	3	2	-	-	-	-	-	-	-	2	-	1
CO5	2	2	3	2	-	-	-	-	-	-	-	2	3	1
CO	2	3	3	2	-	-	-	-	-	-	-	2	3	1

Text Books

1	L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005
2	Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.

Reference Books

1	Edward Ghali, V. S. Sastri, M. Elboujdaini, Corrosion Prevention and Protection: Practical Solutions, John Wiley & Sons, 2007.
2	Garg, HP, Maintenance Engineering, S. Chand Publishing.
3	J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.
4	R. Keith Mobley, Maintenance Fundamentals, Elsevier, 2011.
5	W. E. Vesely, F. F. Goldberg, Fault Tree Handbook, Create space Independent Pub, 2014

U24ME5F03	GREEN SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	The main objectives of the course is understand the fundamentals of supply chain management and sustainability concepts, analyze environmental impacts across supply chain activities & expose with tools, standards, and best practices in green supply chain implementation.				

Unit	Title	Periods
Unit - I	**INTRODUCTION TO SUPPLY CHAIN AND SUSTAINABILITY**	**9**
Overview of supply chain management – Components and functions of supply chain – Traditional vs green supply chains – Concept of sustainability – Triple bottom line approach – Environmental, economic, and social dimensions – Drivers and barriers of green supply chain management – Regulatory frameworks and environmental legislation – Role of GSCM in sustainable development – Case examples from manufacturing and service sectors.		
Unit - II	**GREEN PROCUREMENT AND GREEN MANUFACTURING**	**9**
Green purchasing and supplier selection – Environmental criteria for procurement – Life cycle assessment (LCA) – Eco-design and design for environment (DfE) – Cleaner production techniques – Energy-efficient and resource-efficient manufacturing – Waste minimization and pollution prevention – Green technologies and materials – Environmental management systems (ISO 14001).		
Unit - III	**GREEN LOGISTICS AND DISTRIBUTION**	**9**
Green logistics concepts – Sustainable transportation systems – Fuel-efficient vehicles and alternative fuels,Warehouse management and energy-efficient storage – Packaging reduction and eco-friendly packaging – Carbon footprint measurement – Distribution network optimization – Information technology for green logistics – Performance evaluation of green logistics systems		
Unit – IV	**REVERSE LOGISTICS AND CLOSED-LOOP SUPPLY CHAINS**	**9**
Reverse logistics fundamentals – Product returns management – Recycling, reuse, and remanufacturing – End-of-life product management – Closed-loop supply chain design – Extended producer responsibility (EPR) – Waste electrical and electronic equipment (WEEE) – Economic and environmental benefits of reverse logistics – Industrial case studies.		
Unit - V	**PERFORMANCE MEASUREMENT AND EMERGING TRENDS**	**9**
Green supply chain performance metrics – Sustainability indicators – Balanced scorecard for GSCM – Risk management in green supply chains – Green supply chain collaboration – Role of digitalization and Industry 4.0 – Circular economy concepts – Future trends and challenges in green supply chain management.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the fundamentals of supply chain management and sustainability principles.	K2
CO2	Describe green procurement and environmentally responsible manufacturing practices.	K2
CO3	Analyze green logistics and distribution systems for improved sustainability.	K2
CO4	Explain reverse logistics and closed-loop supply chain concepts.	K2
CO5	Summarize green supply chain performance and emerging sustainable practices.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	1	-	1	1	-	-	-	2	1	1	1
CO2	3	2	1	1	-	1	1	-	-	-	2	1	1	1
CO3	3	2	1	1	-	1	1	-	-	-	2	1	1	1
CO4	3	2	1	1	-	1	1	-	-	-	2	1	1	1
CO5	3	2	1	1	-	1	1	-	-	-	2	1	1	1
CO	**3**	**2**	**1**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**2**	**1**	**1**	**1**

Text Books

1	Srivastava, S.K., Green Supply-Chain Management: A State-of-the-Art Literature Review, International Journal of Management Reviews.
2	Seuring, S. and Müller, M., From a Literature Review to a Conceptual Framework for Sustainable Supply Chain Management, Journal of Cleaner Production.

Reference Books

1	Chopra, S. and Meindl, P., Supply Chain Management: Strategy, Planning and Operation, Pearson Education.
2	Sarkis, J., Greening the Supply Chain, Springer.
3	Handfield, R.B. et al., Green Supply Chain Management, Pearson Education.
4	Govindan, K., Sustainable Supply Chain Management, Springer.

U24ME5F04	ENTREPRENEURSHIP AND STARTUP DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.				

Unit - I	ENTREPRENEURSHIP	9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth - Entrepreneurial mindset and opportunity recognition.

Unit - II	MOTIVATION	9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives - Role of mentoring and networking in success.

Unit - III	BUSINESS	9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies - Business model canvas

Unit – IV	FINANCING AND ACCOUNTING	9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax - Start-up funding and venture capital.

Unit - V	SUPPORT TO ENTREPRENEURS	9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting - Digital entrepreneurship

Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply entrepreneurial concepts to identify and choose suitable business opportunities by understanding different types of entrepreneurs and factors influencing entrepreneurial growth.	K3
CO2	Utilize entrepreneurial motivation techniques to develop and organize strategies for achievement motivation, stress management, and participation in entrepreneurship development programs.	K3
CO3	Apply business planning principles to construct and develop preliminary project reports through market survey, opportunity identification, and techno-economic feasibility analysis.	K3
CO4	Utilize financial management concepts to plan and solve financial requirements of small enterprises by analyzing sources of finance, capital structure, costing, and break-even analysis.	K3
CO5	Apply entrepreneurial support mechanisms to identify and build growth strategies for small businesses using government policies, business incubators, and startup support systems.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	1	-	1	1	1	-	-	-
CO2	3	2	-	-	-	-	1	-	1	1	1	-	-	-
CO3	3	2	1	-	-	-	-	-	1	-	1	-	-	-
CO4	2	2	1	-	-	-	1	-	1	1	1	-	-	-
CO5	2	2	-	-	-	-	2	-	1	2	1	-	-	-
CO	3	2	1	-	-	-	1	-	1	1	1	-	-	-

Text Books

1	Donald F Kuratko, “Entrepreneurship – Theory, Process and Practice”, 9th Edition, Cengage Learning, 2014.
2	Khanka. S.S., “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013

Reference Books

1	EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.
2	Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
3	Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream tech, 2005.
4	Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.

U24ME5F05	INDUSTRIAL ENGINEERING AND TOOLS		L	T	P	C
			3	0	0	3
Course Objectives:	Apply productivity, facilities planning, work study, ergonomics, and SPC principles to design efficient production systems and enhance organizational competitiveness through effective Production and Operations Management.					
Unit - I	**INTRODUCTION**			**9**		
Scope of industrial engineering in apparel Industry, role of industrial engineers. Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement - Lean Productivity in Apparel Industry.						
Unit - II	**WORK STUDY**			**9**		
Definition, Purpose, Basic procedure and techniques of work-study. Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment Material Handling – Objectives, Classification and characteristics of material handling equipments, Specialized material handling equipments -Digital Work Study using Video Analysis						
Unit - III	**METHOD STUDY**			**9**		
Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart MOTION STUDY: Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart - Method Improvement using ECRS Principle.						
Unit – IV	**WORK MEASUREMENT**			**9**		
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study-equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD - SMV Optimization using GSD.						
Unit - V	**WORK STUDY APPLICATION**			**9**		
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training - Single Minute Exchange of Dies (SMED) in Garment Industry.						
		Total Periods:		**45**		

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain the fundamental concepts of Industrial Engineering and productivity.	K2
CO2	Describe the principles and procedure of method study.	K2
CO3	Explain the concepts and techniques of motion analysis.	K2
CO4	Summarize work measurement methods and Standard Allowed Minute (SAM).	K2
CO5	Outline the ergonomics process and its applications in the garment industry.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	1	2	-	-	-	-	-	-	2	2	-
CO2	2	3	2	2	2	-	-	-	-	-	-	2	3	-
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	-
CO4	3	2	3	2	1	-	-	-	-	-	-	3	2	-
CO5	2	2	3	2	2	-	-	-	-	-	-	2	2	-
CO	2	2	3	2	2	-	-	-	-	-	-	2	2	-

Text Books

1	George Kanwaty, "Introduction to Work Study ", ILO, Geneva, 1996, ISBN: 9221071081 |ISBN-13: 9789221071082
2	Enrick N. L., "Time study manual for Textile industry", Wiley Eastern (P) Ltd., 1989, ISBN: 0898740444 | ISBN-13: 9780898740448
3	Khanna O. P., and Sarup A., "Industrial Engineering and Management", Dhanpat Rai Publications, New Delhi, 2010, ISBN: 818992835X / ISBN: 978-8189928353

References

1	Norberd Lloyd Enrick., "Industrial Engineering Manual for Textile Industry", Wiley Eastern (P) Ltd., New Delhi, 1988, ISBN: 0882756311 | ISBN-13: 9780882756318
2	Chuter A. J., "Introduction to Clothing Production Management", Wiley-Black well Science, U.S. A., 1995, ISBN: 0632039396 | ISBN-13: 9780632039395
3	GordanaColovic., "Ergonomics in the garment industry", Wood publishing India Pvt. Ltd., India, 2014, ISBN: 0857098225 | ISBN-13: 9780857098221
4	Rajesh Bheda, "Managing Productivity in Apparel Industry "CBS Publishers & Distributors, 2008

U24ME5F06	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the fundamentals of quality management, including the evolution of quality, Total Quality Management (TQM) framework, its principles, contributions of quality gurus, and implementation of Quality Management Systems (QMS) and Environmental Management Systems (EMS) in organizations; to apply quality improvement methodologies and tools such as Six Sigma, benchmarking, FMEA, QFD, TPM, Cost of Quality (COQ), Business Process Reengineering (BPR), and other traditional and modern quality tools; and to analyze performance improvement and loss reduction techniques, including Taguchi's Quality Loss Function and other performance measurement methods for continuous and continuous improvement.				

Unit - I	INTRODUCTION	9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

Unit - II	TQM PRINCIPLES	9

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

Unit - III	TQM TOOLS & TECHNIQUES I	9

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

Unit – IV	TQM TOOLS & TECHNIQUES II	9

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR. Sustainable Quality and Green TPM

Unit - V	QUALITY MANAGEMENT SYSTEM	9

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Ability to apply TQM concepts in a selected enterprise.	K2

CO2	Ability to apply TQM principles in a selected enterprise.	K2
CO3	Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.	K2
CO4	Ability to understand Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.	K2
CO5	Ability to apply QMS and EMS in any organization.	K2

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	3	-	-	-	-	-	-	-	-	-	2	-	3
CO2	-	-	-	-	-	3	-	-	-	-	-	-	2	-
CO3	-	-	-	-	3	-	-	-	3	-	-	-	2	3
CO4	-	2	-	-	3	2	3	2	-	-	-	3	2	-
CO5	-		3	-		3	3	2	-	-	-	-	-	-
CO	-	2	3	-	3	3	3	2	3	-	-	3	2	3

Text Books

1	Dale H.Besterfiled, Carol B.Michna,Glen H. Bester field,MaryB.Sacre, HemantUrdhwareshe and RashmiUrdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

Reference Books

1	Joel.E. Ross, “Total Quality Management – Text and Cases”,Routledge.,2017.
2	. Kiran.D.R, “Total Quality Management: Key concepts and case studies, Butterworth – Heinemann Ltd, 2016.
3	. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition, 2003.
4	Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006 .

U24ME5G01	AUTOMOBILE ENGINEERING		L	T	P	C
			3	0	0	3
Course Objectives:	To explore the construction and functioning of automobile components, including engine, transmission, steering, brakes, suspension systems and investigate alternative energy sources for vehicles.					
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) - Lightweight materials in modern automobile design.						
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), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS) - Engine sensor technologies						
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 - Wheels and Tyres						
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, Adaptive suspension systems						
Unit - V	**ALTERNATIVE ENERGY SOURCES**		**9**			
Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol 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 - Battery technologies for electric vehicles.						
		Total Periods:	**45**			

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply the principles of vehicle construction and internal combustion engines to identify and model the layout and components of automobile chassis, body, and engine systems.	K3
CO2	Utilize the concepts of engine auxiliary systems to identify and organize the functioning of fuel injection systems, ignition systems, turbochargers, emission control devices, and engine sensors.	K3
CO3	Apply the working principles of transmission systems to construct and model the power transmission mechanisms including clutch, gearbox, torque converter, differential, and drive systems.	K3
CO4	Select the concepts of steering, braking, and suspension systems to identify and analyze vehicle stability, control, and ride comfort under different operating conditions.	K3
CO5	Develop the principles of alternative fuels and emerging vehicle technologies to implement and evaluate the use of electric vehicles, hybrid vehicles, fuel cells, and biofuels in automobiles.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	2	1	-
CO2	3	2	1	-	-	-	1	-	-	-	1	2	2	-
CO3	3	2	1	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	1	-	-	-	-	-	-	-	1	2	2	-
CO5	3	2	1	1	1	-	1	-	-	-	1	2	2	-
CO	**3**	**2**	**1**	**1**	**1**	-	**1**	-	-	-	**1**	**2**	**2**	-

Text Books

1	Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, New Delhi, 2002.
2	Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.

Reference Books

1	Ganesan V. “Internal Combustion Engines”, Third Edition, Tata McGraw-Hill, 2007.
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
5	Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers, 1989.

U24ME5G02	REFRIGERATION AND AIR CONDITIONING		L	T	P	C
			3	0	0	3
Course Objectives:	The objective of this course is to enable students to recall the fundamental principles of refrigeration and air conditioning systems, including refrigeration cycles, refrigerants, and system components. The course also aims to help students identify different refrigeration and air-conditioning methods and understand their applications					
Unit - I	**INTRODUCTION**				**9**	
Introduction to refrigeration and air conditioning – Applications – Reversed Carnot cycle – Vapour compression refrigeration cycle – Coefficient of performance – Refrigerants: classification, selection, environmental issues (ODP, GWP).						
Unit - II	**VAPOUR COMPRESSION REFRIGERATION SYSTEM**				**9**	
Vapor 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	**OTHER REFRIGERATION SYSTEMS**				**9**	
Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic- Vortex and Pulse tube refrigeration systems.						
Unit – IV	**PSYCHROMETRY AND AIR CONDITIONING**				**9**	
Properties of moist air – Psychrometric chart – Psychrometric processes – Comfort conditions – Summer and winter air conditioning systems. Psychrometric of air-conditioning processes, mixing of air streams.						
Unit - V	**COOLING LOAD AND AIR DISTRIBUTION**				**9**	
Cooling load concepts and terminology – Factors affecting cooling load – External and internal heat gains Cooling load estimation – Heat gains – Air distribution systems – Duct design basics – Fans and filters. Sensible and latent cooling load components – Concept of room sensible heat factor (RSHF) and effective room sensible heat factor (ERSHF).						
	Total Periods:				**45**	

On completion of the course, the student can

COs	Statements	K - Level
CO1	Recall and define the fundamental concepts, terminology, and principles of refrigeration and air conditioning, including basic refrigeration cycles and performance parameters.	K2
CO2	Identify and classify different types of refrigerants, refrigeration components, and system configurations, and recognize their applications and environmental impacts.	K2
CO3	Explain the working principles of vapour compression, vapour absorption, air refrigeration, and other refrigeration systems with the help of basic schematic diagrams	K2
CO4	Describe the properties of moist air, psychrometric processes, and comfort conditions, and explain the operation of summer and winter air-conditioning systems	K2
CO5	Explain the concepts of cooling load estimation and air distribution, including heat gain components, air flow patterns, and the functions of ducts, fans, filters, and air distribution devices used in air-conditioning systems	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	-	-	-	-	-	-	-	1	1	1	1
CO2	3	1	1		-	-	-	-	-	-	1	1	1	1
CO3	3	2	1	-	-	-	-	-	-	-	1	1	1	1
CO4	2	1	1	-	-	-	-	-	-	-	1	1	1	1
CO5	2	2	1	-	-	-	-	-	-	-	1	1	1	1
CO	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**1**

Text Books

1	Arora, C.P., Refrigeration and Air Conditioning, 3rd Edition, McGraw-Hill Education, 2010.
2	Manohar Prasad, Refrigeration and Air Conditioning, 2nd Edition, New Age International Publishers, 2013.
3	Khurmi, R.S. & Gupta, J.K., A Textbook of Refrigeration and Air Conditioning, 14th Edition, S. Chand, 2017.

Reference Books

1	Dossat, R.J., Principles of Refrigeration, 4th Edition, Pearson Education, 2002.
2	Stoecker, W.F. & Jones, J.W., Refrigeration and Air Conditioning, 2nd Edition, McGraw-Hill, 1982.
3	ASHRAE Handbook – Fundamentals, 2021

U24ME5G03	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNT	L	T	P	C
		3	0	0	3

Course Objectives:	To enable students, apply engineering economic principles, use microeconomic and macroeconomic concepts in real-life decision making, understand pricing methods, and analyze cost-related economic factors effectively.

Unit - I	**DEMAND & SUPPLY ANALYSIS**	**9**
Managerial Economics - Relationship with other disciplines - Firms Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function – Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function - Supply elasticity - Market Equilibrium		
Unit - II	**PRODUCTION AND COST ANALYSIS**	**9**
Production Laws and functions - Returns to scale - Production optimization - Least cost input - Isoquants - Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - Short run and Long run cost curves - Cost Output Decision - Estimation of Cost.		
Unit - III	**PRICING**	**9**
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice – Pricing of joint products		
Unit – IV	**FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)**	**9**
Introduction – Accounting standards - Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.		
Unit - V	**CAPITAL BUDGETING (ELEMENTARY TREATMENT)**	**9**
Capital significance and types - Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Acquire the skills to relate the basics of economics and cost analysis to engineering and take economically sound decisions	K2
CO2	Explain the economic theories, cost concepts and pricing policies	K2
CO3	Understand the market structures and integration concepts	K2
CO4	Compare the measures of national income, the functions of banks and concepts of globalization	K2
CO5	Infer the concepts of financial management for project appraisal	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	2	-		1		-			1	1	1		
CO2	1	2	-		1		-			1	1	1		
CO3	1	1	-		-		1			1	1	1		
CO4	1	1	-		-		1			2	1	1		

CO5	1	1	1		-		-			2	1	1		
CO	1	2	1		1		1			1	1	1		

Text Books

1	Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.
2	Managerial Economics: Analysis, Problems and Cases - P. L. Mehta, Edition, 13. Publisher, Sultan Chand, 2007.

Reference Books

1	Chan S.Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2011.
2	Donald.G. Newman, Jerome.P.Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010.
3	Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, New York, 2011.
4	Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012
5	Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

U24ME5G04	MATERIAL HANDLING EQUIPMENT	L	T	P	C
		3	0	0	3

Course Objectives:	To impart comprehensive knowledge of materials handling equipment used in industrial environments. It focuses on familiarizing learners with industrial vehicles, conveyor systems, auxiliary and hoisting equipment, and bulk handling equipment and systems, enabling an understanding of their functions, applications, and selection for effective material movement and operational efficiency.

Unit - I	INTRODUCTION TO MATERIALS HANDLING	9

Basic principles &objectives in material handling and its benefits - Classification of material handling equipment - selection of material handling equipments - guidelines for effective utilisation of material handling equipments -unit load concept. Digital twins and simulation for materials handling systems

Unit - II	INDUSTRIAL VEHICLES	9

Introduction and types - Hand trucks - Two wheel Hand Trucks - Multiple wheel Hand Trucks - Hand Lift Trucks - Power Trucks - Fixed Platform Truck - Platform Lift Truck - Pallet Lift Truck - Walkie Truck - Straddle Carrier - Fork Lift Trucks - Specifications of FLT - FLT Attachments - Tractors - Industrial Tractor-Trailer-Self-propelled trucks and fork trucks - Automated guided vehicles Theory. Autonomous Mobile Robots (AMRs) vs. Automated Guided Vehicles (AGVs)

Unit - III	CONVEYORS	9

Classification of conveyors- Definition - Description - General Characteristics - types and uses of belt Conveyors - Roller conveyors - Haulage Conveyors - Screw Conveyors - Bucket Conveyors - Chain Conveyors - Cable Conveyors - Pneumatic and Hydraulic conveyors - Computer controlled conveyor system. Simulation and digital modeling of conveyor networks

Unit – IV	AUXILIARY EQUIPMENTAND HOISTING EQUIPMENT	9

Hoppers - Gates- Feeders- Chutes-positioners- Ball Table- Weighing and Control Equipment- Pallet loaders and unloaders -applications and advancements. - Hoisting Equipment - parts of hoisting equipment - Description and uses of hoists - Description and uses of ropes - description and purpose of crane hooks - Elevators - Cranes - Derricks - and its types. Smart lifting systems and intelligent hoists

Unit - V	BULK HANDLING EQUIPMENT AND SYSTEMS	9

Storage of bulk solids - bulk handling equipment - Robotic handling - Materials handling at the workplace - Robots and their classification - Major components of a robot - classification of Robotic manipulators - Robotic handling applications. Vision-guided robotics and AI in materials handling

Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Interpret the fundamental concepts of material handling equipment.	K2
CO2	Illustrate the working principles of various industrial vehicles.	K2
CO3	Summarize the operating principles of different conveyor systems.	K2

CO4	Examine the operating principles of auxiliary equipment and hoisting equipment.	K2
CO5	Classify the working principles of bulk handling equipment and systems.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	1	1	1	-	-	-	-	-	-	2	1	1
CO2	2	1	1	1	1	-	-	-	-	-	-	2	1	1
CO3	2	1	1	1	1	-	-	-	-	-	-	2	1	1
CO4	2	1	1	1	1	-	-	-	-	-	-	2	1	1
CO5	2	1	1	1	1	-	-	-	-	-	-	2	1	1
CO	2	1	1	1	1	-	-	-	-	-	-	2	1	1

Text Books

1	Allegri (Sr.), T.H., Material Handling – Principles and Practices, CBS Publishers and Distributors,Delhi, 1987.
2	Siddharta Ray, Introduction to Materials Handling, New Age International Publishers

Reference Books

1	Bolz, H. A and Hagemann, G. E (ed.), ‘‘Materials Handling Handbook’’, Ronald Press
2	8005:1976, Classification of Unit Loads, Bureau of Indian Standards.
3	Apple, J.A., ‘‘Material Handling System Design’’, John Wiley & Sons
4	Theodore H., Allegre Sr., Material Handling Principles and Practice, CBS Publishers and Distributors
5	Immer J. R., Material Handling, Tata McGraw Hill Publication.

U24ME5G05	NON-TRADITIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3
Course Objectives:	An overview of non-traditional machining processes and their classification based on different forms of energy is provided, with emphasis on mechanical, chemical, electrochemical, and thermo-electric energy–based machining methods. Insight into nano-finishing processes is also included. In addition, hybrid non-traditional machining techniques are introduced and the distinguishing features among various hybrid processes are highlighted for advanced manufacturing applications.				

Unit	Title	Periods
Unit - I	**INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES**	**9**
Introduction - Need for non-traditional machining processes - Classification of non-traditional machining processes - Applications, advantages and limitations of non-traditional machining processes - Abrasive jet machining, Abrasive water jet machining, Environmentally sustainable abrasives and water recycling systems, Ultrasonic machining their principles, equipment, effect of process parameters, applications, advantages and limitations.		
Unit - II	**CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES**	**9**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Chemical machining, Electro-chemical machining, Electro-chemical honing, Electro-chemical grinding, Electro chemical deburring. Advanced electrolyte formulations and green electrolytes		
Unit - III	**THERMO-ELECTRIC ENERGY BASED PROCESSES**	**9**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Electric discharge machining, Wire electric discharge machining, Laser beam machining, Plasma arc machining, Electron beam machining, Ion beam machining. Micro-EDM and nano-EDM		
Unit – IV	**NANO FINISHING PROCESSES**	**9**
Principles, equipments, effect of process parameters, applications, advantages and limitations of Abrasive flow machining – Chemo mechanical polishing, Magnetic abrasive finishing, Magnetorheological finishing, Magneto rheological abrasive flow finishing. Surface metrology and nano-scale roughness measurement		
Unit - V	**HYBRID NON-TRADITIONAL MACHINING PROCESSES**	**9**
Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Selection and comparison of different non traditional machining processes. Hybrid laser-assisted machining (LAM)		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Classify different types of non-traditional machining processes and outline mechanical energy–based machining methods.	K2
CO2	Illustrate chemical and electrochemical energy–based machining processes.	K2
CO3	Summarize thermo-electric energy–based machining processes.	K2
CO4	Interpret nano-finishing processes.	K2

CO5	Differentiate hybrid non-traditional machining processes and classify non-traditional machining methods.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO02	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO03	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO04	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO05	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO	3	-	2	-	2	-	-	-	-	1	-	3	1	1

Text Books

1	Adithan. M., "Unconventional Machining Processes", Atlantic, New Delhi, India, 2009. ISBN 13: 9788126910458
2	Anand Pandey, "Modern Machining Processes", Ane Books Pvt. Ltd., New Delhi, India, 2019.

Reference Books

1	Benedict, G.F., "Non-traditional Manufacturing Processes", Marcel Dekker Inc., New York 1987. ISBN-13: 978-0824773526.
2	Carl Sommer, "Non-Traditional Machining Handbook", Advance Publishing., United States, 2000, ISBN-13: 978-1575373256.
3	Golam Kibria, Bhattacharyya B. and Paulo Davim J., "Non-traditional Micromachining Processes: Fundamentals and Applications", Springer International Publishing., Switzerland, 2017, ISBN:978-3 319-52008-7.
4	Jagadeesha T., "Non-Traditional Machining Processes", I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017, ISBN-13: 978-9385909122.
5	Kapil Gupta, Neelesh K. Jain and Laubscher R.F., "Hybrid Machining Processes: Perspectives on Machining and Finishing", 1st edition, Springer International Publishing., Switzerland, 2016, ISBN 13: 978-3319259208.

U24ME5G06	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives:	To develop a comprehensive understanding of electric vehicles, including their overall architecture and key subsystems; to study various energy storage technologies such as batteries and their management systems; to learn the principles of electric drives, motor control, and power electronics used in vehicle propulsion; and to gain knowledge of the design considerations, performance analysis, and integration aspects involved in the development of efficient and sustainable electric vehicles.

Unit - I	**NEED FOR ELECTRIC VEHICLES**	**9**
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges		
Unit - II	**ELECTRIC VEHICLE ARCHITECHTURE**	**9**
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.		
Unit - III	**ENERGY STORAGE**	**9**
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell		
Unit – IV	**ELECTRIC DRIVES AND CONTROL**	**9**
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor - drives and control , AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers		
Unit - V	**DESIGN OF ELECTRIC VEHICLES**	**9**
Materials and types of production, Chassis skateboard design, motor sizing, power pack sizing, component matching, Ideal gear box – Gear ratio, torque–speed characteristics, Dynamic equation of vehicle motion, Maximum tractive effort – Power train tractive effort Acceleration performance, rated vehicle velocity – maximum grad ability, Brake performance, Electronic control system, safety and challenges in electric vehicles. Case study of Nissan leaf, Toyota Prius, tesla model 3, and Renault Zoe cars.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Interpret the need for electric vehicles and their impact on sustainability and transportation.	K2
CO2	Illustrate the architecture of electric vehicles and their key components.	K2
CO3	Build efficient energy storage systems and design thermal management strategies for the PEM fuel cell.	K3
CO4	Make use of electric drives and control systems for efficient vehicle operation.	K3
CO5	Develop innovative designs for electric vehicles.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO2	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO3	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO4	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO5	3	-	2	-	2	-	-	-	-	1	-	3	1	1
CO	3	-	2	-	2	-	-	-	-	1	-	3	1	1

Reference Books

1	Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition CRC Press, 2011.
2	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3	James Larminie, John Lowry, Electric Vehicle Technology Explained - Wiley, 2003.
4	Ehsani, M, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2005

U24ME5H01	PRECISION ENGINEERING	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the fundamental elements of precision engineering, including the principles of geometric dimensioning and tolerancing (GD&T); to gain knowledge of the appropriate application of ASME and ISO standards in engineering design and manufacturing; and to understand advanced processing and measurement systems used for precision engineering at micro- and nano-scale levels.				

Unit - I INTRODUCTION TO PRECISION ENGINEERING 9

Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.

Unit - II GEOMETRIC DIMENSIONING AND TOLERANCING 9

Tolerance zone conversions - surface, features and features of size, datum features - datums - oddly configured and curved surfaces as datum features - equalizing datums - datum feature of size representation - form and orientation controls.

Unit - III PRECISION MACHINING PROCESSES 9

Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

Unit – IV MEASURING SYSTEMS 9

In-process measurement of position of processing unit - post-process and on-machine measurement of dimensional features and surface mechanical and optical measuring systems - nano positioning systems - guide systems for moving elements - servo control systems for tool positioning - computer aided digital and ultra-precision position control.

Unit - V APPLICATIONS AND FUTURE TRENDS 9

Applications and future trends in nano technology - nano-grating systems - nano-lithography, photolithography and electron beam lithography - machining of soft metals: diamond turning - mirror grinding of ceramics - nano-mechanical parts and micro-machines. Quantum and Semiconductor Manufacturing Applications

Total Periods: 45

On completion of the course, the student can

COs	Statements	K - Level
CO1	Apply principles of precision engineering in the design and manufacture of high-accuracy mechanical components.	K2
CO2	Analyze tolerances, fits, and surface finish requirements to ensure dimensional and functional accuracy of parts.	K2
CO3	Select appropriate precision manufacturing processes such as micro-machining, ultra-precision machining, and advanced finishing methods.	K2
CO4	Utilize modern metrology instruments and measurement techniques for inspection and quality control of precision components	K2

CO5	Evaluate errors in manufacturing and measurement systems and implement methods to minimize them for improved performance and reliability.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO2	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO3	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO4	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO5	2	2	3	1	1	-	-	-	1	-	-	2	3	2
CO	2	2	3	1	1	-	-	-	1	-	-	2	3	2

Text Books

1	Gill, P. S., Geometric Dimensioning and Tolerancing, S. K. Kataria & Sons, New Delhi.
2	Murty, R. L., Precision Engineering in Manufacturing, New Age International (P) Limited, New Delhi.
3	Norio Taniguchi, Nanotechnology, Oxford University Press, New Delhi.
4	Davim, J. Paulo, ed. Microfabrication and Precision Engineering: Research and Development. Woodhead Publishing, 2017
5	Gupta K, editor. Micro and Precision Manufacturing. Springer; 2017

Reference Books

1	Meadows, J. D., Geometric Dimensioning and Tolerancing: Applications and Techniques for use in Design, Manufacturing and Inspection, Marcel Dekker, Inc., New York.
2	Dornfeld, D., and Lee, D. E., Precision Manufacturing, 2008, Springer.
3	H. Nakazawa, Principles of Precision Engineering, 1994, Oxford University Press.
4	Whitehouse, D. J., Handbook of Surface Metrology, Institute of Physics Publishing, Philadelphia PA, 1994.
5	Murthy.R.L, —Precision Engineering in Manufacturing‖, New Age International, New Delhi, 2005

U24ME5H02	NDT TECHNIQUES	L	T	P	C
		3	0	0	3
Course Objectives:	To provide a strong foundation in the importance of Non-Destructive Testing (NDT) for quality assurance and reliability. It aims to impart knowledge of the principles, applications, limitations, codes, and standards of various NDT techniques, and to enable learners to detect flaws in materials and products, apply appropriate testing methods in accordance with industry specifications, and select suitable NDT techniques for specific engineering applications.				

Unit - I	INTRODUCTION TO NDT & VISUAL TESTING	9
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting - Codes and standards for NDT		
Unit - II	**LIQUID PENETRANT & MAGNETIC PARTICLE TESTING**	**9**
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation. Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications, Magnetography.		
Unit - III	**EDDY CURRENT TESTING & THERMOGRAPHY**	**9**
Eddy Current Testing: Generation of eddy currents– properties– eddy current sensing elements, probes, Instrumentation, Types of arrangement, applications, advantages, limitations – Factors affecting sensing elements and coil impedance, calibration, Interpretation/Evaluation. Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.		
Unit – IV	**ULTRASONIC TESTING & AET**	**9**
Ultrasonic Testing: Types of ultrasonic waves, characteristics, attenuation, couplants, probes, EMAT. Inspection methods-pulse echo, transmission and phased array techniques, types of scanning and displays, angle beam inspection of welds, time of flight diffraction (TOFD) technique, Thickness determination by ultrasonic method, Study of A, B and C scan presentations, calibration. Acoustic Emission Technique – Introduction, Types of AE signal, AE wave propagation, Source location, Kaiser effect, AE transducers, Principle, AE parameters, AE instrumentation, Advantages & Limitations, Interpretation of Results, Applications, Calibration: ASTM Test blocks and IIW-reference blocks		
Unit - V	**RADIOGRAPHY TESTING**	**9**
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, geometric factors, inverse square law, exposure chart and radiographic equivalence, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Outline the importance of Non-Destructive Testing (NDT) in various engineering fields.	K2
CO2	Summarize the basic principles of surface NDE techniques and their use in performing inspections according to established procedures.	K2
CO3	Illustrate the concepts of instrument calibration and in-service damage inspection using Eddy Current Testing and Thermography.	K2
CO4	Distinguish between various Ultrasonic Testing (UT) and Acoustic Emission Testing (AET) techniques and identify suitable NDT methods for effective evaluation.	K2
CO5	Interpret radiographic testing results and clarify the influence of different parameters on the testing process.	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	1	1	-	-	-	-	-	-	3	1	1
CO2	3	2	2	1	1	-	-	-	-	-	-	3	1	1
CO3	3	2	2	1	1	-	-	-	-	-	-	3	1	1
CO4	3	2	2	1	1	-	-	-	-	-	-	3	1	1
CO5	3	2	2	1	1	-	-	-	-	-	-	3	1	1
CO	3	2	2	1	1	-	-	-	-	-	-	3	1	1

Text Books

1	Baldev Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition, 2002..
2	J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw Hill Education, 2nd edition, 2011.
3	Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

Reference Books

1	ASM Metals Handbook, V-17, "Nondestructive Evaluation and Quality Control", American Society of Metals, USA, 2001.
2	Barry Hull and Vernon John,"Nondestructive Testing", Macmillan, 1989.
3	Chuck Hellier, “Handbook of Nondestructive Evaluation”, Mc Graw Hill, 2012.
4	Louis Cartz, "Nondestructive Testing", ASM International, USA, 1995.

U24ME5H03	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	The course aims to explore the evolution of management, its functions, and principles, while focusing on their application in organizations. It also covers HR activities and analyzes the alignment between individual and company goals in business.				

Unit - I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9
Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Current trends and issues in Management - Social responsibility and ethical management.		
Unit - II	**PLANNING**	**9**
Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process - Risk assessment and scenario planning		
Unit - III	**ORGANISING**	**9**
Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management - Workforce diversity and inclusion		
Unit – IV	**DIRECTING**	**9**
Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT - Emotional intelligence in leadership		
Unit - V	**CONTROLLING**	**9**
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting - Continuous performance improvement.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Select the fundamental principles of management to identify and organize managerial roles, organizational structures, business forms, and ethical responsibilities in modern organizations.	K3
CO2	Utilize planning techniques to develop and plan organizational objectives, policies, strategic decisions, and risk assessment strategies for effective management.	K3
CO3	Apply organizing principles to identify and develop appropriate organizational structures, authority relationships, and human resource management practices in organizations.	K3
CO4	Utilize leadership, motivation, and communication concepts to develop and organize effective strategies for directing individuals and teams in organizational settings.	K3
CO5	Choose controlling techniques to identify and solve performance and productivity issues using management control systems, reporting methods, and continuous improvement practices.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	2	1	2	3	1	1	-	-	-
CO2	1	2	1	-	-	2	2	2	2	2	2	-	-	-
CO3	1	1	1	-	-	2	2	1	2	2	2	-	-	-
CO4	1	-	-	-	-	1	2	2	2	2	2	-	-	-
CO5	1	1	-	-	-	2	2	2	2	2	2	-	-	-
CO	**1**	**1**	**1**	-	-	**2**	**2**	**2**	**2**	**2**	**2**	-	-	-

Text Books

1	Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2	Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition,2009.

Reference Books

1	Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
2	Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 7th Edition, Pearson Education, 2011.
3	Tripathy PC & Reddy PN, “Principles of Management”, Tata Mcgraw Hill, 1999

U24ME5H04	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:	This course enables learners to understand decision making, organizing, leadership, and to analyse managerial roles and functions. It also provides essential knowledge of Supply Chain Management for effective organizational performance.

Unit - I	INTRODUCTION	9
Technology Management - Definition - Functions - Evolution of Modern Management - Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization -Individual Ownership - Partnership - Joint Stock Companies - Co-operative Enterprises - Public Sector Undertakings, Corporate Frame Work- Share Holders - Board of Directors - Committees - Chief Executive Line and Functional Managers,-Financial-Legal-Trade Union - Role of Management in Industrial Organizations		
Unit - II	**FUNCTIONS OF MANAGEMENT**	**9**
Planning - Nature and Purpose - Objectives - Strategies – Policies and Planning Premises - Decision Making - Organizing - Nature and Process - Premises - Departmentalization - Line and staff - Decentralization -Organizational culture, Staffing - selection and training .Placement - Performance appraisal - Career Strategy – Organizational Development. Leading - Managing human factor - Leadership .Communication, Controlling - Process of Controlling - Controlling techniques, productivity and operations management - Preventive control, Industrial Safety- Time Management.		
Unit - III	**ORGANIZATIONAL BEHAVIOUR**	**9**
Definition - Organization - Managerial Role and functions -Organizational approaches, Individual behaviour - causes - Environmental Effect - Behaviour and Performance, Perception - Organizational Implications. Personality - Contributing factors - Dimension – Need Theories - Process Theories - Job Satisfaction, Learning and Behaviour-Learning Curves, Work Design and approaches- Motivation in Organizations.		
Unit – IV	**GROUPDYNAMICS**	**9**
Group Behaviour - Groups - Contributing factors - Group Norms, Communication - Process - Barriers to communication - Effective communication, leadership - formal and informal characteristics – Managerial Grid - Leadership styles - Group Decision Making - Leadership Role in Group Decision, Group Conflicts - Types -Causes - Conflict Resolution -Inter group relations and conflict, Organization centralization and decentralization - Formal and informal - Organizational Structures Organizational Change and Development -Change Process – Resistance to Change - Culture and Ethics - Team Building.		
Unit - V	**MODERN CONCEPTS**	**9**
Management by Objectives (MBO) - Management by Exception (MBE), Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re- engineering (BPR) – Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage - Lean Management – Basic Concept.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Summarize the basic concepts of industrial management.	K2
CO2	Discuss group conflicts and their causes in organizations.	K2

CO3	Illustrate the components and purpose of SWOT analysis.	K2
CO4	Interpret learning curves in industrial applications.	K2
CO5	Outline the concepts of placement and performance in organizations.	K2

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	-	-	-	-	-	-	-	-	2	1	-
CO2	-	3	2	3	-	-	-	-	-	-	-	-	-	2
CO3	2	3	2	3	-	-	-	-	-	-	-	1	2	3
CO4	2	2	3	3	-	-	-	-	-	-	-	-	3	3
CO5	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO	2	2	2	3	-	-	-	-	-	-	-	2	2	3

Text Books

1	M. Govindarajan and S. Natarajan, “Principles of Management”, Prentice Hall of India, New Delhi, 2019.
2	Koontz. H. and Weihrich. H., “Essentials of Management: An International Perspective”, 12th Edition, Tata McGrawhill, New Delhi, 2021.

Reference Books

1	Joseph J, Massie, “Essentials of Management”, 8th Edition, Pearson Education, 2018.
2	Saxena, P. K., “Principles of Management: A Modern Approach”, Global India Publications, 2021.
3	S.Chandran, “Organizational Behaviours”, Vikas Publishing House Pvt. Ltd., 1994.
4	Richard L. Daft, “Organization Theory and Design”, South Western College Publishing, 16th Edition, 2019.
5	Maynard H.B, “Industrial Engineering Hand book”, McGraw-Hill, sixth 2008

U24ME5H05	QUALITY SYSTEMS ENGINEERING		L	T	P	C
			3	0	0	3
Course Objectives:	This course aims to provide fundamental knowledge of quality concepts, statistical quality control, and process capability analysis. It also enables students to apply control charts and acceptance sampling techniques in manufacturing and service industries.					
Unit - I	**INTRODUCTION**					**9**
Quality Dimensions – Quality definitions – Inspection-Quality control – Quality Assurance – Quality Planning - Quality costs – Quality loss function – Role of Customer satisfaction and competitiveness in quality						
Unit - II	**CONTROLCHARTS**					**9**
Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X , R and S charts, attribute control charts - p, np, c and u- Construction and application – Control chart patterns						
Unit - III	**SPECIAL CONTROL PROCEDURES**					**9**
Warning and modified control limits, control chart for individual measurements, multi-vari chart, Xchart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts - Control charts for process monitoring						
Unit – IV	**STATISTICALPROCESSCONTROL**					**9**
Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits - Process capability indices						
Unit - V	**ACCEPTANCE SAMPLING**					**9**
The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables,MIL-STD-105DandMIL-STD-414E&IS2500 standards - average outgoing quality (AOQ)						
	Total Periods:					**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Select the fundamental concepts of quality engineering to identify and analyze quality dimensions, quality costs, and the role of customer satisfaction in achieving competitive manufacturing performance.	K3
CO2	Utilize statistical quality control techniques to construct and interpret control charts for variables and attributes in monitoring and improving process performance.	K3
CO3	Choose special control procedures to develop and analyze advanced control charts such as cumulative sum (CUSUM), exponentially weighted moving average (EWMA), and moving average charts for process monitoring.	K3
CO4	Develop statistical process control methods to analyze and evaluate process stability and capability using histograms, probability plots, and process capability indices.	K3
CO5	Apply acceptance sampling techniques to identify and solve quality inspection problems using sampling plans for attributes and variables based on standard quality control procedures.	K3

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	1	2	1	-
CO3	3	2	-	-	2	-	-	-	-	-	1	3	2	-
CO4	2	3	-	-	2	-	-	-	-	-	1	3	2	-
CO5	2	2	1	-	-	1	-	-	-	-	2	3	2	1
CO	**3**	**2**	**1**	-	**2**	**1**	-	-	-	-	**1**	**3**	**2**	**1**

Text Books

1	Dale H. Besterfield, Quality Control, Pearson Education, 8th Edition, 2009.
2	Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley India, 7th Edition, 2013.

Reference Books

1	Joseph M. Juran and A. B. Godfrey, Juran's Quality Handbook, McGraw-Hill, 6th Edition, 2010.
2	E. L. Grant, R. S. Leavenworth, R. C. McKoon, Statistical Quality Control, McGraw-Hill, 7th Edition, 2014.
3	Kaoru Ishikawa, Guide to Quality Control, Asian Productivity Organization, 1986.

U24ME5H06	INVENTORY PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3
Course Objectives:	To develop an understanding of production planning and control along with work study principles. It aims to apply product planning concepts, analyze production scheduling, implement inventory control techniques, and develop competency in Manufacturing Resource Planning (MRP II) and Enterprise Resource Planning (ERP) for efficient manufacturing operations.				
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. Forecasting techniques in production planning					
Unit - II	**WORK STUDY**	**9**			
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards. Ergonomics and human factors in work study					
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. Computer-Aided Process Planning (CAPP)					
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. Bottleneck analysis and Theory of Constraints					
Unit - V	**INVENTORY CONTROL AND RECENT TRENDS**	**9**			
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP. Introduction to supply chain management					
	Total Periods:	**45**			

On completion of the course, the student can

COs	Statements	K - Level
CO1	Outline the principles of production planning and control along with work study.	K2
CO2	Summarize the concepts of product planning.	K2

CO3	Interpret the concept of production scheduling.	K2
CO4	Outline inventory control concepts.	K2
CO5	Summarize the concepts of Manufacturing Resource Planning (MRP II) and Enterprise Resource Planning (ERP).	K2

CO - PO Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO2	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO3	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO4	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO5	3	2	1	-	2	-	-	-	-	-	-	3	1	1
CO	3	2	1	-	2	-	-	-	-	-	-	3	1	1

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.

Reference Books

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	Norman Gaither, G. Frazier, "Operations Management" 9th Edition, Thomson learning IE, 2007
6	Upendra Kachru, " Production and Operations Management – Text and cases" 1st Edition, Excel books 2007

U24CE6604	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To enable students to understand global product development trends and methodologies, apply requirement engineering and system modeling techniques, and conceptualize, prototype, and develop integrated product management plans, while preparing documentation, test specifications, and coordinating validation activities to support products throughout their lifecycle up to End-of-Life.				
Unit - I	**BASICS OF PRODUCT DEVELOPMENT**	**9**			
Global Trends Analysis: Social trends, technological trends, environmental trends influencing product decisions. Product Development Fundamentals, types of product development; introduction to product development methodologies. Stages of product life cycle, Product Development Planning processes, development strategies, and management approaches in new product development.					
Unit - II	**REQUIREMENTS AND SYSTEM ARCHTECTURE DESIGN**	**9**			
Requirement engineering process – requirement gathering, analysis, prioritization, and documentation; converting requirements into design specifications; system architecture design; system, subsystem, and interface modeling; hardware-software integration; controls, electronics, and mechanical system integration; optimization of system specifications and characteristics.					
Unit - III	**PRODUCT DESIGN, VALIDATION AND QUALITY ASSURANCE**	**9**			
Concept generation and detailed design process; – Challenges in Integration of Engineering Disciplines ,design for manufacturability, reliability, and sustainability; prototyping methods; simulation and validation techniques; preparation of technical documentation; test planning, test specifications, verification and validation (V&V); quality assurance and compliance standards.					
Unit – IV	**SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT**	**9**			
Product deployment and maintenance strategies; configuration management; change management and version control; reliability engineering; customer support engineering; failure analysis and corrective actions; lifecycle management; End-of-Life (EOL) planning, obsolescence management, and product retirement strategies..					
Unit - V	**BUSINESS ENVIRONMENT AND ENGINEERING SERVICES MANAGEMENT**	**9**			
Overview of engineering services industry; business models in product development organizations; global delivery models; cost estimation and project management; intellectual property considerations; regulatory and compliance requirements; industry trends and career opportunities in integrated product development..					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamentals of integrated product development, including product life cycle, development methodologies, and cross-functional collaboration.	K2
CO2	Apply requirement engineering and system architecture principles to translate	K3

COs	Statements	K-Level
	customer needs into optimized system design specifications.	
CO3	Develop and validate product designs using appropriate design, prototyping, testing, and quality assurance techniques.	K4
CO4	Analyze product lifecycle management strategies, including sustenance engineering and End-of-Life (EOL) support processes.	K4
CO5	Evaluate business models, industry practices, and project management approaches in the engineering services sector.	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	1	-	-	1	1	-	-	-	-	-	-	-
CO2	3	3	2	1	2	-	1	-	1	1	1	-	-	-
CO3	2	3	3	2	3	-	1	-	2	1	1	-	-	-
CO4	2	2	2	1	2	1	1	1	1	1	2	-	-	-
CO5	1	2	2	-	1	1	1	2	2	1	3	-	-	-
CO	**2.2**	**2.4**	**2**	**1.3**	**2**	**1**	**1**	**1.5**	**1.5**	**1**	**1.75**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
2	Hiriyappa B, "Corporate Strategy – Managing the Business", Author House, 2013
3	Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

References:

1	John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.
2	Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004

U24CE6606	GEOGRAPHICAL INFORMATION SYSTEM	L	T	P	C
		3	0	0	3
Course Objectives:	To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.				

Unit - I	**FUNDAMENTALS OF GIS**	**9**
Introduction to GIS – Basic spatial concepts – Coordinate Systems – GIS and Information Systems – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software – Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		
Unit - II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – Entities – ER diagram – data models – conceptual, logical and physical models – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster vs Vector Models- TIN and GRID data models.		
Unit - III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner – Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input – Digitizer – Datum Projection and reprojection -Coordinate Transformation – Topology – Adjacency, connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data linking – Linking External Databases – GPS Data Integration		
Unit – IV	**DATA QUALITY AND STANDARDS**	**9**
Data quality – Basic aspects – completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability – OGC – Spatial Data Infrastructure		
Unit - V	**DATA MANAGEMENT AND OUTPUT**	**9**
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion – Data Output – Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GISdistributed GIS.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental concepts and terminologies of Geographic Information Systems (GIS).	K2
CO2	Describe the different types of data models used in GIS.	K2
CO3	Summarize the methods of data input and explain the concept of topology.	K2
CO4	Discuss the importance of data quality and standards in GIS applications.	K2
CO5	Explain the functions of data management and describe the processes of data output.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	3	1	-

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO2	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO4	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO5	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw Hill Publishing, Fourth Edition, 2017.
2	Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.

Reference Books

1	Chor Pang LO, Albert K. W. Yeung, “Concepts and Techniques of Geographic Information Systems”, Pearson Education, 2nd Edition, November 2016. ISBN: 9789332581883

U24CE6602	REMOTE SENSING CONCEPTS	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce the concepts of remote sensing processes and its components. To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation				

Unit - I	**REMOTE SENSING AND ELECTROMAGNETIC RADIATION**	**7**
Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law – Radiation sources: active & passive - Radiation Quantities		
Unit - II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL**	**10**
Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.		
Unit - III	**ORBITS AND PLATFORMS**	**10**
Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.		
Unit – IV	**SENSING TECHNIQUES**	**10**
Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV – Orbital and sensor characteristics of live Indian earth observation satellites		
Unit - V	**DATA PRODUCTS AND INTERPRETATION**	**8**
Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the concepts and laws related to remote sensing.	K2
CO2	Describe the interaction of electromagnetic radiation with the atmosphere and earth materials.	K2

COs	Statements	K-Level
CO3	Discuss satellite orbits and explain the different types of satellites	K2
CO4	Explain the different types of remote sensors.	K2
CO5	Summarize the concepts involved in the interpretation of satellite imagery	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO2	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO3	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO4	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO5	3	2	-	-	-	-	-	-	-	-	1	3	1	-
CO	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**1**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc, New York,2015.
2	George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018

Reference Books

1	Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.1, AmericanSociety of Photogrametry, Virginia, USA, 2002.
2	Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3	Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.
4	Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl, 2006 Edition II, Wiley Publication.
5	Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

U24CE6601	APPLIED DESIGN THINKING	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a comprehensive understanding of design thinking principles, emphasizing user-focused problem identification, application of structured design thinking tools and techniques, and systematic product development processes, enabling them to create value-driven solutions applicable across engineering, business, and societal contexts.				

Unit - I	INNOVATION AND DESIGN THINKING PRINCIPLES	9
Principles and philosophy of Human-Centered Design –Understanding the Innovation process, discovering areas of opportunity, Interviewing & empathy, Design thinking framework – Stages of innovation process: Empathize, Define, Ideate, Prototype, Test – Problem identification and framing. Activity: Problem statement canva- case studies.		
Unit - II	**USER-CENTRIC INNOVATION**	**9**
Importance of customer-centric innovation – Understanding problem incidence and problem significance- pain points- Defining the problem- Customer persona and validation- - Analysis of alternative solutions- impact on the customer. Activity: Empathy map-Customer interviews and field visit		
Unit - III	**APPLIED DESIGN THINKING TOOLS**	**9**
Ideation tools- Brainstorming, SCAMPER, mind mapping- Proof of concept- Concept sketching, rapid prototyping-Concept of Minimum viable Prototype [MVP] - Designing & Crafting the value proposition- Value proposition Canva- Introduction to technology readiness level.		
Unit – IV	**DESIGN THINKING TECHNIQUES AND PRODUCT DEVELOPMENT**	**9**
Creative thinking, constraints in design, designing today for tomorrow. Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution; explore, iterate and learn; build the right prototype; Assess desirability, viability and feasibility.		
Unit - V	**DESIGN THINKING APPLICATIONS**	**9**
Design thinking for strategic innovation, application of design, thinking in business and strategy, linking design thinking solution to business challenges, enterprise creativity,competitive logic of business strategy, design thinking for start-ups		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the principles of Human-Centered Design, stages of the design thinking framework, and methods for problem identification and framing.	K2
CO2	Interpret customer needs using tools such as empathy mapping, customer persona, and problem significance analysis to understand user-centric innovation.	K2
CO3	Apply ideation techniques, prototyping methods, and value proposition design tools to develop feasible and innovative solutions.	K3

COs	Statements	K-Level
CO4	Demonstrate the use of design thinking techniques to conceptualize, develop, and refine product/service solutions considering desirability, viability, and feasibility.	K3
CO5	Analyze business challenges and strategic opportunities by integrating design thinking approaches for innovation, start-ups, and enterprise applications.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	2	2	1	-	-	1	-	-	-	-	-	-	-	-
CO2	2	3	2	2	-	2	-	-	1	1	-	-	-	-
CO3	2	2	3	2	3	-	-	-	2	1	2	-	-	-
CO4	2	3	2	2	-	1	1	-	2	1	2	-	-	-
CO5	2	3	2	2	1	2	1	1	2	1	2	-	-	-
CO	**2**	**2.6**	**2.2**	**2**	**2.2**	**1.2**	**1**	**1**	**1.8**	**1**	**2**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Tim Brown,(2012) “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business.
2	Donella H. Meadows, (2015), “Thinking in Systems -A Primer”, Sustainability Institute
3	Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.

Reference Books

1	Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, Trish Papadakos, (2014), Value
2	https://blog.forgeforward.in/valuation-risk-versus-validation-risk-in-product-nnovations49f253ca8624

U24EC6602	DRONE TECHNOLOGIES	L	T	P	C
		3	0	0	3
Course Objectives:	To understand drone technologies and classifications, learn design, fabrication and basic programming, perform safe flight operations, explore industrial applications, and follow safety regulations and guidelines.				

Unit - I	INTRODUCTION TO DRONE TECHNOLOGY	9
Drone concepts, vocabulary and terminology, history of drones, classification of current-generation drones based on propulsion methods, basic components and architecture of a drone system, impact of drone technology on business sectors, drone-based entrepreneurship, and opportunities for entrepreneurship and employability.		
Unit - II	**DRONE DESIGN, FABRICATION AND PROGRAMMING**	**9**
Classification of UAVs, overview of major drone components, technical characteristics and functions of components, drone assembly process, energy sources, levels of autonomy, drone configurations, introduction to open-source drone flight controllers, methods of drone programming, downloading and installing programs, execution of programs, multi-rotor stabilization, flight modes, and Wi-Fi connectivity.		
Unit - III	**DRONE FLYING AND OPERATION**	**9**
Concept of drone operation, flight modes, pre-flight checks and basic troubleshooting procedures, operation of a small drone in a controlled environment, drone controls, flight operation management tools, onboard sensors, onboard storage capacity, removable storage devices, and integration with mobile devices and applications.		
Unit – IV	**DRONE SERVICE AND COMMERCIAL APPLICATIONS**	**9**
Selection of drones based on application requirements, use of drones in insurance services, parcel and cargo delivery, agricultural monitoring, inspection of transmission lines and power distribution systems, filming and panoramic imaging, and applications of drones in disaster management and surveillance.		
Unit - V	**FUTURE DRONES, SAFETY AND REGULATIONS**	**9**
Safety risks associated with drone operations, guidelines for safe flying, aviation regulations and standardization, drone licensing, ethical and privacy concerns in drone usage, miniaturization of drones, increasing autonomy, and swarm drone technology.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain different types of drone technologies and their design, fabrication, and programming concepts.	K2
CO2	Apply suitable operating procedures for safe and efficient drone functioning.	K4
CO3	Select appropriate sensors, actuators, and subsystems for drone applications.	K3
CO4	Develop drone mechanisms for specific commercial and industrial applications.	K5
CO5	Create and execute basic programs for drone control and operations.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	–	–	1	–	–	–	–	–	–	2	1	2
CO2	2	2	1	1	1	2	2	1	–	–	–	2	1	2
CO3	2	2	2	1	2	–	–	–	–	–	–	3	2	2
CO4	2	3	3	2	2	1	1	–	1	1	1	3	2	3
CO5	2	2	2	2	3	–	–	–	1	2	1	3	2	3
CO	2.2	2.0	1.6	1.2	1.8	0.6	0.6	0.2	0.4	0.6	0.4	2.6	1.6	2.4

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

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	Terry Kilby and Belinda Kilby, "Make:Getting Started with Drones ",Maker Media, Inc,
3	John Baichtal, "Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs", Que Publishing, 2016
4	Zavrsnik, "Drones and Unmanned Aerial Systems: Legal and Social Implications forSecurity and Surveillance", Springer, 2018.
5	Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes, 3rd Edition, 2014.

Reference Books

1	Nitesh Tiwari, Shekhar Yadav, V. K. Giri, Fundamentals of Drone/UAV Technology, SK Kataria & Sons.
2	I. V. S. Yeswanth and A. V. S. Sridhar Kumar, Fundamentals of Drone Technology: Drones—The Future of the 21st Century, (Publisher varies).

U24EC6603	WEARABLE TECHNOLOGY	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the fundamentals, design principles, and components of wearable systems and sensors, analyze signal processing challenges, wearability constraints, and energy-efficient techniques, learn wireless communication and apply wearable and IoT technologies in healthcare and smart environments.				

Unit - I	WEARABLE SYSTEMS AND SENSORS	9
Introduction to wearable technology – Evolution and need for wearable systems – Limitations of conventional monitoring systems –Inertial sensors (accelerometer, gyroscope), physiological sensors (heart rate, ECG, SpO_2), respiration sensors, temperature sensors, pressure sensors, , wearable ground reaction force sensors.		
Unit - II	**SIGNAL PROCESSING AND ENERGY MANAGEMENT**	**9**
Wearability issues – ergonomics, placement, comfort, and usability – Signal acquisition and conditioning – Noise and motion artifact removal – Constraints on sampling frequency and power consumption. Battery technologies, power optimization, energy harvesting techniques – solar, thermal, piezoelectric, kinetic energy harvesting – human body energy sources – thermoelectric generators.		
Unit - III	**WIRELESS COMMUNICATION AND BODY AREA NETWORKS**	**9**
Need for wireless monitoring – Introduction to Body Area Networks (BAN) – BAN architecture and components – Communication standards: Bluetooth Low Energy (BLE), Zigbee, Wi-Fi, NFC. Data transmission and synchronization – Cloud connectivity – Security and privacy challenges – Reliability issues in wearable communication systems.		
Unit – IV	**SMART TEXTILES AND FLEXIBLE ELECTRONICS**	**9**
Introduction to smart textiles – Passive and active smart textiles – E-textiles and wearable fabrics. Conductive fibers, conductive yarns, conductive fabrics, printed electronics, conductive inks. Flexible and stretchable electronics – Sensors integrated into textiles – Case study: Smart garments for ECG and respiration monitoring.		
Unit - V	**APPLICATIONS OF WEARABLE SYSTEMS AND IOT**	**9**
Healthcare applications – remote patient monitoring, chronic disease management, rehabilitation systems – Fitness and sports analytics. Definition and characteristics of IoT – Architecture and protocols – Data analytics and cloud integration – Smart devices: smartwatches, smart glasses, smart clothing, fitness trackers – Emerging trends in wearable technology.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamentals, components, and types of wearable systems and sensors	K2
CO2	Analyze signal processing challenges and energy management techniques in wearable devices	K4
CO3	Apply wireless communication and BAN concepts in wearable system design	K3
CO4	Examine smart textile fabrication methods and flexible electronics for biomedical use	K4
CO5	Apply wearable and IoT technologies in healthcare, fitness, and real-time monitoring	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	-	-	-	-	-	-	-	-	1	-	1
CO2	3	3	3	-	-	-	-	-	-	-	-	1	-	1
CO3	3	3	3	-	-	-	-	-	-	-	-	1	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1	-	1
CO5	3	3	3	-	-	-	-	-	-	-	-	1	-	1
CO	3	3	3	-	-	-	-	-	-	-	-	1	-	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Edward Sazonov and Michael R. Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014.
2	Roozbeh Jafari (Ed.), Wearable Sensors and Systems: From Enabling Technology to Clinical Applications, Springer, 2017.
3	Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012

Reference Books

1	Annalisa Bonfiglio – Wearable Monitoring Systems, Springer
2	Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.
3	Mehmet R. Yuce – Wireless Body Area Networks, Pan Stanford

U24EC6604	MEDICAL INFORMATICS	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the core concepts and structure of medical informatics and its role in healthcare systems; comprehend medical data standards and interoperability protocols, apply data management and automation techniques in clinical settings and analyze various health informatics applications such as telemedicine, virtual reality, biometrics, and cloud-based healthcare solutions.				

Unit - I	**MEDICAL INFORMATICS**	**9**
Medical Informatics – Bioinformatics – Health Informatics - Structure of Medical Informatics –Functional capabilities of Hospital Information System - On-line services and Off – line services - Dialogue with the computer		
Unit - II	**MEDICAL STANDARDS**	**9**
Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA –Electronics Patient Records – Healthcare Standard Organizations – JCAHO (Joint Commission on Accreditation of Healthcare Organization) - JCIA (Joint Commission International Accreditation) - Evidence Based Medicine - Bioethics		
Unit - III	**MEDICAL DATA STORAGE AND AUTOMATION**	**9**
Representation of Data, Data modeling Techniques, Relational Hierarchical and network Approach, Normalization techniques for Data handling - Data Acquisition using Serial Interface – Medical Data formats – Signal, Image and Video Formats – Medical Databases - Automation in clinical laboratories - Intelligent Laboratory Information System – PACS		
Unit – IV	**HEALTH INFORMATICS**	**9**
Bioinformatics Databases, Bio-information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training		
Unit - V	**RECENT TRENDS IN MEDICAL INFORMATICS**	**9**
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment – Surgical simulation - Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - Cloud Computing in Medicine		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the concepts of medical, bio, and health informatics to understand the structure and functions of hospital information systems and online/offline medical services.	L3
CO2	Explain and compare medical data standards like IEEE 11073, HL7, DICOM, and HIPAA, and relate them to healthcare data security and ethics.	L2
CO3	Apply data modelling, normalization, and acquisition techniques to manage and	L3

COs	Statements	K-Level
	automate medical databases and laboratory systems.	
CO4	Analyze and apply informatics principles in bioinformatics, clinical, nursing, and public health domains.	L4
CO5	Apply emerging technologies like telemedicine, virtual reality, biometrics, and cloud computing in modern healthcare systems.	L3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	3	2	-	-	-	-	-	-	-	-			
CO2	3	3	3	1	2	-	2	-	-	-	-			
CO3	3	3	3	1	2	-	2	-	-	-	1			
CO4	3	3	2	-	2	-	2	-	-	-	1			
CO5	3	3	2	-	2	-	2	-	-	-	1			
CO	3	3	2.4	1	2	-	2	-	-	-	1			

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	R.D.Lele, “Computers in medicine progress in medical informatics”, Tata McGraw Hill Publishing Ltd, 2005 (Units I, III & IV)
2	Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003 (Units II, IV & V).

Reference Books

1	Orpita Bosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2007
2	Yi Ping Phoebe Chen, “Bioinformatics Technologies”, Springer International Edition, New Delhi, 2007.

U24EC6606	SIXTH GENERATION WIRELESS TECHNOLOGY	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce wireless communication concepts with a focus on 6G, understand signal transmission for high-speed networks, learn techniques enabling 6G communication, study key technologies supporting 6G, and explore real-world and future applications of 6G.				
Unit - I	**BASICS OF WIRELESS COMMUNICATION WITH 6G EVOLUTION**	**9**			
Introduction to communication – Wired and wireless communication – Basic communication system – Evolution from 1G to 5G – Introduction to 6G – Need for 6G and high-speed communication – Overview of 6G vision and applications·					
Unit - II	**SIGNALS AND DATA TRANSMISSION FOR 6G**	**9**			
Basic concepts of signals – Analog and digital signals – Data transmission – Data rate and bandwidth – High-speed data requirements in 6G – Noise and interference – Challenges in achieving reliable 6G communication.					
Unit - III	**TECHNIQUES FOR HIGH-SPEED 6G COMMUNICATION**	**9**			
Need for advanced communication techniques – Basic modulation concepts – Digital communication overview – Multiple access techniques – FDMA and TDMA – Introduction to advanced methods for 6G high-speed transmission.					
Unit – IV	**KEY TECHNOLOGIES ENABLING 6G**	**9**			
Overview of 6G technologies – Artificial intelligence in wireless communication – Terahertz communication basics – Satellite communication – Internet of Things – Smart and intelligent communication systems in 6G.					
Unit - V	**APPLICATIONS OF 6G TECHNOLOGY**	**9**			
Smart cities – Autonomous vehicles – Remote healthcare – Virtual and augmented reality – Holographic communication – Industrial automation – Future digital society enabled by 6G.					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret the fundamentals of wireless communication with emphasis on 6G	K2
CO2	Summarize signal transmission and high-speed data communication in 6G networks	K2
CO3	Apply basic techniques supporting high-speed 6G communication	K3
CO4	Demonstrate key technologies enabling 6G communication systems	K3
CO5	Classify real-world and future applications of 6G technology	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	2	-	3	1
CO2	3	1	-	-	-	1	-	-	-	-	2	-	3	1
CO3	3	1	2	-	-	1	-	-	-	-	2	-	3	1
CO4	3	2	1	-	-	-	-	-	-	-	2	-	3	1
CO5	3	1	-	-	-	2	-	-	-	-	2	-	2	1
CO	3	1.2	1.5	-	-	1.3	-	-	-	-	2	-	2.8	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Wei Xiang, Kan Zheng, Xuemin Shen, 6G Mobile Wireless Networks, Springer, 2022.
2	Anwer Al-Dulaimi, 6G Fundamentals: Vision and Enabling Technologies, Wiley, 2023.
3	aad, Bennis and Chen, A Vision of 6G Wireless Systems, IEEE/Wiley, 2021.

Reference Books

1	Zhang et al., Towards 6G: A New Era of Wireless Communications, Academic Press, 2022.
2	Tataria et al., 6G Wireless Systems: Vision, Requirements and Challenges, Elsevier, 2023.

Web-links

1. https://fitech.io/en/studies/basic-course-on-wireless-communications/?utm
2. https://www.coursera.org/learn/wireless-communications?utm
3. https://www.rfwireless-world.com/Tutorials/?utm

U24EC6607	HIGH SPEED WIRELESS COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce the basic concepts of wireless communication, understand signal transmission and data speed, learn the principles of high-speed communication, study modern wireless technologies, and explore real-world applications of wireless networks.				
Unit - I	**FUNDAMENTALS OF WIRELESS COMMUNICATION**	**9**			
Introduction to communication – Wired and wireless communication – Basic communication system – Evolution of mobile communication from 1G to 5G – Need for high-speed communication – Applications of wireless systems					
Unit - II	**SIGNAL BEHAVIOR IN WIRELESS SYSTEMS**	**9**			
Introduction to signals – Analog and digital signals – Data rate and bandwidth – Signal propagation – Noise and interference – Basic idea of signal quality and performance					
Unit - III	**HIGH-SPEED DATA TRANSMISSION TECHNIQUES**	**9**			
Basic idea of modulation – Introduction to digital modulation – BPSK and QPSK – Concept of high data rate transmission – Multiple access techniques including FDMA and TDMA – Introduction to efficient data sharing					
Unit – IV	**MODERN WIRELESS COMMUNICATION TECHNOLOGIES**	**9**			
Overview of mobile communication systems – 3G, 4G and 5G technologies – Wi-Fi – Bluetooth – Introduction to high-speed wireless systems and devices					
Unit - V	**APPLICATIONS OF HIGH-SPEED WIRELESS NETWORKS**	**9**			
1. Basic cellular network concept – Network performance measures such as speed and delay – Applications in daily life including video streaming, online communication and smart systems – Introduction to IoT – Future trends in wireless communication					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	**Interpret** the basic concepts of wireless communication in real-life scenarios	K2
CO2	**Summarize** signal transmission and data speed in wireless systems	K2
CO3	**Apply** basic modulation and multiple access techniques for data transmission	K3
CO4	**Demonstrate** modern wireless technologies for high-speed communication	K3
CO5	**Classify** real-world applications of high-speed wireless networks	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	1	-	-	-	-	-	-	-	-	-	-	3	1
CO2	3	1	-	-	-	-	-	-	-	-	-	-	3	1
CO3	3	1	2	-	-	-	-	-	-	-	-	-	3	1
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	1
CO5	3	1	3	-	-	-	-	-	-	-	-	-	2	1
CO	3	1.2	1.6	-	-	-	-	-	-	-	-	-	2.8	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Rommer, S. et al., 5G Core Networks: Powering Digitalization, Academic Press, **2019**.
2	Velrajan, S., An Introduction to 5G Wireless Networks: Technology, Concepts and Use Cases, **2020**.
3	Asif, S., 5G Mobile Communications: Concepts and Technologies, CRC Press, **2019**.
4	Sauter, M., From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband, Wiley, **2021**.

Reference Books

1	Penttinen, J. T. J., 5G Simplified: ABCs of Advanced Mobile Communications, **2019**.
2	Lei, W., Soong, A. C. K., et al., 5G System Design: An End to End Perspective, Springer, **2021**.

Web-links

1. https://www.coursera.org/learn/5g-network-fundamentals?utm_source=chatgpt.com
2. https://www.futurelearn.com/courses/5g-and-wireless-communication-for-beginners?utm_source=chatgpt.com

U24EC6605	IoT CONCEPTS AND APPLICATIONS	L	T	P	C
		3	0	0	3
Course Objectives:	Tounderstand IoT architecture, components, protocols, platforms, and cloud-based data processing, while introducing real-world applications with basic AI-based anomaly detection for problem solving.				

Unit - I	**INTRODUCTION TO INTERNET OF THINGS**	**9**
Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT		
Unit - II	**COMPONENTS IN INTERNET OF THINGS**	**9**
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)		
Unit - III	**PROTOCOLS AND TECHNOLOGIES BEHIND IOT**	**9**
IoT Protocols – IPv6, 6LoWPAN, MQTT, CoAP – RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.		
Unit – IV	**OPEN PLATFORMS AND PROGRAMMING**	**9**
IoT deployment for Raspberry Pi /Arduino platform-Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
Unit - V	**IOT APPLICATIONS**	**9**
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture- Introduction to Artificial intelligence based anomaly detection in IoT sensor data.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Summarize IoT architectures, functional blocks, and enabling technologies.	K2
CO2	Cmpare IoT components such as sensors, actuators, control units, and communication modules.	K2
CO3	Apply IoT communication protocols and cloud technologies for data transmission.	K3
CO4	Implement IoT applications using open platforms and programming interfaces.	K4
CO5	Identify real-world IoT applications	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix Programme Outcomes

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	1	-	-	-	-	-	-			
CO2	3	2	-	-	2	-	-	-	-	-	-			
CO3	3	3	-	-	2	-	-	-	-	-	-			
CO4	2	3	2	-	3	-	-	-	-	-	-			
CO5	2	2	-	-	2	-	-	-	-	-	-			
CO	**2.6**	**2.4**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**			

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
2	Samuel Greengard, The Internet of Things, The MIT Press, 2015.

Reference Books

1	Perry Lea, "Internet of things for architects", Packt, 2018.
2	Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012
3	IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
4	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5	ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.
6	https://www.arduino.cc/https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

U24CY6602	RENEWABLE ENERGY SYSTEMS `		L	T	P	C
			3	0	0	3
Course Objectives:	The objectives of this course are to provide knowledge about various renewable energy technologies, to enable students to understand and design a photovoltaic (PV) system, to impart knowledge about wind energy systems, to introduce various possible hybrid energy systems, and to help students gain knowledge about the applications of different renewable energy technologies.					
Unit - I	**ENERGY SCENARIO**			**9**		
Primary energy sources – renewable vs. non-renewable primary energy sources – renewable energy resources in India – Current usage of renewable energy sources in India – Future potential of renewable energy in meeting energy demand, power production, and sustainable development – Development of renewable energy technologies – policy initiatives and challenges associated with large-scale implementation.						
Unit - II	**SOLAR ENERGY**			**9**		
Solar Radiation and its measurements – Solar Thermal Energy Conversion from plate Solar Collectors, Concentrating Collectors and its Types – Efficiency and performance of collectors – Direct Solar Electricity Conversion from Photovoltaic – types of solar cells and its application of battery charger, domestic lighting, street lighting, and water pumping, power generation schemes – Recent Advances in PV Applications: Building Integrated PV, Grid Connected PV Systems.						
Unit – III	**WIND ENERGY**			**9**		
Wind energy principles – wind site and its resource assessment – Measurement Equipments – Wind Resource Maps – Wind Power Density – wind assessment – Power Curve – Turbulence Intensity– Factors influencing wind – wind turbine components – wind energy conversion systems (WECS) – Classification of WECS devices – wind electric generating and control systems - Offshore wind farms & smart turbine control– characteristics and applications.						
Unit – IV	**BIO-ENERGY**			**9**		
Energy from biomass – Principle of biomass conversion technologies/process and their classification – Bio gas generation – types of biogas plants – selection of site for biogas plant– classification of biogas plants– Advantage and disadvantages of biogas generation – thermal gasification of biomass - Bio-refineries & waste-to-energy technologies – Application of biomass and biogas plants and their economics.						
Unit - V	**OTHER TYPES OF ENERGY**			**9**		
Energy conversion from Hydrogen and Fuel cells – Geo thermal energy Resources – types of wells – methods of harnessing the energy – potential in India – OTEC (Ocean Thermal Energy Conversion): Principles, utilization – setting of OTEC plants – thermodynamic cycles – Tidal and wave energy: Potential and conversion techniques –mini- hydel power plants and their economics.						
		Total Periods:		**45**		

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the knowledge about various renewable energy technologies	K2
CO2	Interpret a photovoltaic (PV) system and understand its working.	K2
CO3	Infer the concept of various wind energy system.	K2
CO4	Explain the knowledge about various possible hybrid energy systems.	K2
CO5	Explain the knowledge about various application of renewable energy technologies.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	-	1	-	-	2	1	-	-	1	2	-	1	-
CO2	3	-	1	-	-	2	-	-	-	1	2	-	1	-
CO3	3	-	1	-	-	2	-	-	-	1	1	-	1	-
CO4	3	-	1	-	-	2	1	-	-	1	2	-	2	-
CO5	3	-	1	-	-	2	1	-	-	1	1	-	1	-
CO	**3**	-	1	-	-	2	**1**	-	-	**1**	**2**	-	**1**	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Mehmet Kanoglu, Yunus A Cengel, John M Cimbala –- Fundamentals and Applications of Renewable Energy, McGraw Hill, 2020.
2	Kothari D.P, Singhal K.C - Renewable Energy Sources and Emerging Technologies, PHI Learning, India, 2013.
3	Godfrey Boyle - Renewable Energy: Power for a Sustainable Future, Oxford University Press, U.K., 2012
4	James F Manwell, Jon G McGowan, Anthony L Rogers - Wind Energy Explained: Theory, Design and Application, Wiley, U.K., 2010.
5	Sukhatme S.P - Solar Energy: Fundamentals, Design, Modeling & Applications, Tata McGraw Hill, India, 2008.

Reference Books

1	Twidell J.W & Wier A –- Renewable Energy Resources, CRC Press (Taylor & Francis), 2006.
2	Tiwari A, Ghosal M.K –- Renewable energy resources, Narosa Publishing House, India, 2007.
3	Anuj K Chandel, S. S. da Silva - Bioenergy: Biomass to Biofuels, Academic Press, U.S., 2017.
4	Chauhan D.S, Srivastava S.K –- Non–Conventional Energy Resources, New Age Publishers, 2006.
5	Khan B.H –- Non-Conventional Energy Resources, Tata Mc Graw Hill, 2006.

U24GE6601	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce students to the concepts, types, and legal frameworks of intellectual property and develop understanding of protection, enforcement, licensing, and commercialization while promoting awareness of ethical practices.				

Unit - I	**INTRODUCTION TO IPR**	**9**
. Introduction and the need for intellectual property right (IPR) – Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication–Traditional Knowledge – Trade Secret – IPR in India : Genesis and development – IPR in abroad, Introduction to TRIPS and WTO, Paris convention, WIPO convention and TRIPS agreement.		
Unit - II	**PATENTS**	**10**
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, E-filing, Examination of patent, Grant of patent, Revocation. Case studies in patent infringement.		
Unit - III	**COPYRIGHT, TRADEMARKS AND DESIGN**	**10**
COPY RIGHT—Origin, Definition &Types of Copy Right, Registration procedure, plagiraism, Piracy, Infringement, Copy rights with special reference to software, Case studies. TRADE MARKS: Concept of Trademarks - Different kinds of marks- Registration of Trademarks - Rights of holder - Infringement, Remedies & Penalties. DESIGN - Design: meaning and concept of novel and original - Procedure for registration and term of protection, Semiconductor Integrated circuits and layout design Act-2000		
Unit – IV	**GEOGRAPHICAL INDICATION, DIGITAL PRODUCTS AND LAWS**	**9**
GEOGRAPHICAL INDICATION (GI) - Geographical indication: meaning,difference between GI and trademarks - Procedure for registration, effect of registration and term of protection Digital Innovations– cyber security and IPR, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.		
Unit - V	**NATIONAL IPR POLICY AND TECHNOLOGY TRANSFER**	**7**
Overview of India's National IPR Policy, government schemes promoting IPR; mechanisms of technology transfer and commercialization; role of Technology Transfer Offices (TTOs), incubation centres, and industry–institute partnerships in commercialization of intellectual property- career opportunities in IP.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the need and importance of Intellectual Property Rights in innovation and development of IPR in India and abroad.	K2
CO2	Evaluate patentability criteria, filing procedures, and infringement issues to assess the legal protection of inventions.	K4

COs	Statements	K-Level
CO3	Apply the provisions of copyright, trademark, and design laws to resolve issues related to registration, protection, and infringement in practical scenarios..	K3
CO4	Analyze the protection of Geographical Indications and digital intellectual assets in relation to cyber laws and unfair competition..	K4
CO5	Outline the mechanisms of technology transfer, commercialization, and career opportunities in the intellectual property domain.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	2	1	-	-	-	2	-	2	-	1	-	-	-	-
CO2	2	3	1	2	1	1	-	2	-	1	1	-	-	-
CO3	2	2	2	1	1	2	-	2	1	1	1	-	-	-
CO4	2	3	1	2	2	2	1	2	-	1	1	-	-	-
CO5	2	2	2	1	2	2	-	1	1	1		-	-	-
CO	**2**	**2.2**	**1.5**	**1.5**	**1.5**	**1.2**	**1**	**1.2**	**1**	**1**	**1**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	N. K. Acharya, “Textbook of Intellectual Property Rights”, 9th Edition, 2025, Asia Law House
2	Dr. G. B. Reddy, “Intellectual Property Rights and the Law”, 11th Edition, 2020, Gogia Law Agency, ISBN: 9788189804030
3	V. K. Ahuja,” Law Relating to Intellectual Property Rights”, LexisNexis India, ISBN: 9788131250922.

U24CY6601	UNIVERSAL HUMAN VALUES	L	T	P	C
		3	0	0	3

Course Objectives: To help students develop a holistic understanding of life and profession by appreciating the essential complementarity of values and skills, enabling sustained happiness and prosperity through correct understanding of human reality, ethical conduct, trustful and fulfilling human relationships, and mutually enriching interaction with nature, forming the foundation for universal human values and value-based living.

Unit - I	HUMAN ASPIRATIONS AND HOLISTIC RESOLUTION FOR HARMONIOUS LIVING	9

Basic Human Aspirations – Identification, Method to fulfill the aspirations – Aspirations and Harmonius Living - Right Understanding and Resolution as the activities of the Self- All-encompassing Resolution for a Human Being, Details and solution of problems in the light of Resolution- Problems and Conflicts in Human life - Role of individuals in promoting collective well-being.

Unit - II	RIGHT UNDERSTANDING - Knower, Known & the Process of Knowing	9

Need for right understanding - Understanding the human being (the knower, the experiencer and the doer) - Understanding nature/existence – its interconnectedness and co-existence; Understanding the role of human being in existence (human conduct) - Understanding Human being as the Co-existence of the Self and the Body - Distinguishing between the Needs of the Self and the Body - Role of Right understanding with Family, Peers, Society and Nation.

Unit - III	UNDERSTANDING HUMAN BEING	9

Introduction to understanding human being - Misidentification and its consequences - Distinguishing between the Needs of Self and Body – Activities of the self – Potentialities inherent in the Self- Basis for harmony in the self – desire, thought & expectation – Basis for contradiction in the self - assumptions, beliefs, Internal conflict, dissatisfaction, and anxiety – Resolving contradiction through self-exploration.

Unit – IV	UNDERSTANDING THE NATURE AND EXISTENCE	9

Introduction to Existence & Nature - Understanding Harmony in the Nature –need and process of inner evolution through self-exploration, self- awareness and self-evaluation, Order and harmony in nature – Bio order, Animal order, Human order, Physical order - Realizing Existence as Co-existence at all Levels - The Holistic Perception of Harmony in Existence – Harmony in Society – Dimensions of human order - Contemplation of Human Participation in Harmony- Comprehensive knowledge of existence.

Unit - V	HUMAN CONDUCT AND SUSTAINABLE DEVELOPMENT	9

Introduction to Human Conduct and Sustainability: Need for value-based sustainable development, Overview of holistic development - Human Conduct Based on Right Understanding - All-Encompassing Resolution - Holistic way of living for Human Being with All- encompassing Resolution : realization, thought, behavior and work - Participation in the larger order leading to harmony at all levels from Self to Nature and entire Existence - Human Participation in Sustainable Development - Sustainable Development as an Outcome of Right Living - Holistic vision for sustainable and human development.

Total Periods:	45

On completion of the course, the student can

COs	Statements	K - Level
CO1	Identify basic human aspirations and apply holistic resolution for harmonious living.	K2
CO2	Understand the human being as the co-existence of self and body and develop right understanding.	K2
CO3	Analyze internal conflicts and resolve them through self-exploration and clarity of self-needs.	K4
CO4	Understand harmony in nature and existence through interconnectedness and co-existence.	K2
CO5	Apply right understanding to ethical human conduct and value-based sustainable development.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create.

CO - PO Matrix

	Programme Outcomes												**PSO**		
	01	02	03	04	05	06	07	08	09	10	11		01	02	03
CO1	-	-	-	-	-	1	3	1	1	-	3		-	-	-
CO2	-	-	-	-	-	1	3	1	1	-	3		-	-	-
CO3	-	-	-	-	-	1	3	2	1	-	3		-	-	-
CO4	-	-	-	-	-	1	3	1	1	-	3		-	-	-
CO5	-	-	-	-	-	2	3	2	1	-	3		-	-	-
CO	-	-	-	-	-	1	3	1	1	-	3		-	-	-

Text Books

1	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2010. ISBN 978-8174467812-47-1.
2	Premvir Kapoor, Professional Ethics and Human Values, Khanna Book Publishing, New Delhi, 2022.

Reference Books

1	M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (includes Human Values), Eastern Economy 1st Edition, ISBN13 - 978-8120325784, 2004, Prentice Hall India Learning Private Limited.
2	B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
3	B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
4	A N Tripathy, 2003, Human Values, New Age International Publishers.
5	E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.

U24GE6604	COMMUNITY ENGAGEMENT AND SOCIAL RESPONSIBILITY	L	T	P	C
		3	0	0	3
Course Objectives:	To appreciate rural culture and wisdom, understand agricultural programs, analyze causes of rural distress and poverty, and apply classroom knowledge to real-world field conditions.				

S. No	Module Title	Module Content	Assignment	Teaching/ Learning Methodology	No. of Classes
1	**Appreciation of Rural Society**	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of “soul of India lies in villages’ (Gandhi), rural infrastructure.	Prepare a map (physical, visual or digital) of the village you visited and write an essay about interfamily relations in that village.	Classroom discussions	3
				Field visit**	5
				Assignment Map	3
2	**Understanding rural and local economy and livelihood**	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.	Describe your analysis of the rural house hold economy, its challenges and possible pathways to address. Circular economy and migration patterns.	Field visit**	4
				Group discussions in class	5
				Assignment	3
3	**Rural and local Institutions**	Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees),Nagarpalikas and municipalities, local civil society, local administration.	How effectively are Panchayati Raj and Urban Local Bodies (ULBs) institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audiovisual).	Classroom	3
				Field visit**	5
				Group presentation of assignment	3
4	**Rural and National Development Programmes**	History of rural development and current national programmes in India: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swachh Bharat, PM AwaasYojana, Skill India, Gram Panchayat Decentralised Planning, National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), Atma Nirbhar Bharat, etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the poor. Special focus on the urban informal sector and migrant households.	Classroom	3
				Each student selects one program for field visit**	5
				Written assignment	3

*3 Credits Course (2 Credit for Classroom and Tutorials and 1 Credit for Field Engagement) \
**at least 50% in the field, for all students

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Gain an understanding of rural life, Indian culture and ethos and social realities	K5
CO2	Develop a sense of empathy and bonds of mutuality with the local community	K5
CO3	Appreciate significant contributions of local communities to Indian society and economy	K5
CO4	Learn to value the local knowledge and wisdom of the community	K5
CO5	Identify opportunities for contributing to community's socio-economic improvements	K5

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes												**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**01**	**02**	**03**
CO1						3	2	3	1			3			
CO2						3	2	3	3			3			
CO3						3	3	3	2			3			
CO4						3	2	3	1			3			
CO5						3	3	3	3			3			
CO						**3**	**2**	**3**	**2**			**3**			

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

U24MA6604	RESOURCE MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3
Course Objectives:	Provide fundamental knowledge of optimization and resource management techniques and to develop the ability to formulate mathematical models and apply analytical methods such as linear programming, integer programming, network models, and scheduling techniques for effective decision-making and efficient resource utilization.				

Unit - I	**LINEAR PROGRAMMING**	**9**
Principal components of decision problem – Modeling phases – LP Formulation and graphic solution – Components of LPP – Resource allocation problems – Simplex method – Sensitivity analysis – Artificial variable techniques – Corner point method – Applications of Linear programming.		
Unit - II	**DUALITY AND NETWORKS**	**9**
Definition of dual problem - Primal - Dual relationships - Dual simplex methods – Duality theorem – Post optimality analysis - Transportation and assignment model - Shortest route problem – Minimum spanning tree problem – Maximum flow problem – Applications of network optimization.		
Unit - III	**INTEGER PROGRAMMING**	**9**
Introduction to integer programming problems – Formulation of integer programming models – Types of integer programming – Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic)programming – Applications of integer programming in Resource Allocation and Scheduling.		
Unit – IV	**CLASSICAL OPTIMISATION THEORY**	**9**
Unconstrained optimization – Necessary and sufficient conditions for optimality – Multivariable optimization – Equality constrained optimization – Lagrange multiplier method – Kuhn–Tucker conditions – Applications in engineering optimization.		
Unit - V	**OBJECT SCHEDULING**	**9**
Introduction to scheduling – sequencing problems – processing of n jobs through two machines – processing of n jobs through three machines – Johnson's rule – project networks – CPM and PERT techniques – resource allocation and leveling.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Formulate linear programming problems from practical situations.	K3
CO02	Apply simplex, transportation, and assignment methods to obtain optimal solutions.	K3
CO03	Apply integer programming to solve real-life applications.	K3
CO04	Apply classical optimization techniques to solve unconstrained and constrained problems using Newton–Raphson, Jacobian, Lagrangian, and Kuhn–Tucker methods.	K3
CO05	Use PERT and CPM for problems in project management	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO–PO–PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO02	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO03	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO04	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO05	3	2	-	-	-	-	-	-	-	-	1	-	-	-
CO	3	2	-	-	-	-	-	-	-	-	1	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1.Slight 2. Moderate 3.Substantial(High)

Text Books

1	H.A. Taha, "Operation Research", Prentice Hall of India, 2002.

Reference Books

1	Paneer Selvam, 'Operations Research', Prentice Hall of India, 2002
2	Anderson 'Quantitative Methods for Business', 8th Edition, Thomson Learning, 2002.
3	Winston 'Operation Research', Thomson Learning, 2003.
4	Vohra, 'Quantitative Techniques in Management', Tata Mc Graw Hill, 2002.
5	Anand Sarma, 'Operation Research', Himalaya Publishing House, 2003.

U24GE6602	IT IN AGRICULTURAL SYSTEMS	L	T	P	C
		3	0	0	3
Course Objectives:	Apply ground-based sensors, remote sensing techniques, GPS, GIS, and yield mapping systems to demonstrate precision agriculture practices and illustrate crop production modeling for effective agricultural management.				

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 modeling.		
Unit - II	**ENVIRONMENT CONTROL SYSTEMS**	**9**
Artificial light systems, management of crop growth in greenhouses, simulation of CO2 consumption in greenhouses, on-line measurement of plant growth in the greenhouse, models of plant production and expert systems in horticulture.		
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.		
Unit - V	**E-GOVERNANCE IN AGRICULTURAL SYSTEMS**	**9**
Expert systems, decision support systems, Agricultural and biological databases, e-commerce, ebusiness systems & applications, Technology enhanced learning systems and solutions, e-learning, Rural development and information society.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply precision agriculture techniques such as ground-based sensors, remote sensing, GPS, GIS mapping software, yield mapping systems, and crop production modeling to improve agricultural management and decision-making.	K3
CO2	Build environment control systems integrating artificial light technologies, greenhouse crop growth management, CO_2 consumption simulation, online plant growth measurement, production models, and expert systems in horticulture to optimize sustainable agricultural practices.	K3
CO3	Choose appropriate weather prediction models by analysing climate variability, global climatic systems, seasonal forecasting methods, and systems approaches to apply seasonal climate forecasts for effective agricultural planning.	K3
CO4	Construct climate forecasting frameworks by integrating knowledge of climate variability, global climate systems, seasonal forecasting models, and systems approaches to apply seasonal climate predictions for agricultural and environmental management.	K3
CO5	Develop e-governance solutions for agricultural systems by integrating expert systems, decision support tools, agricultural and biological databases, e-commerce and e-business applications, technology-enhanced learning platforms, and rural information society initiatives to support sustainable rural development.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	3	3	3	3	2	-	3	3	3	3	3	3	3
CO2	3	3	3	3	3	2	-	3	3	3	3	3	3	2
CO3	3	3	3	3	3	3	-	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	-	3	3	3	3	3	2	3
CO5	3	3	3	3	3	2	-	3	3	3	3	3	3	3
CO	3	3	3	3	3	2.4	-	3	3	3	3	3	2.8	2.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Hazem Shawky Fouda, “Information Technology in Agriculture”, Delve Publishing, 2022
2	Amitava Choudhury, Arindam Biswas, Manish Prateek, Amlan Chakrabarti, “Agricultural Informatics”, Wiley-VCH / Wiley Online Library, 2021
3	Peart, R.M., and Shoup, W. D., “Agricultural Systems Management”, Marcel Dekker, New York, 2004.
4	National Research Council, “Precision Agriculture in the 21st Century”, National Academies, Press, Canada, 1997.

Reference Books

1	Hammer, G.L., Nicholls, N., and Mitchell, C., “Applications of Seasonal Climate”, Springer, Germany, 2000.
2	H. Krug, Liebig, H.P. “International Symposium on Models for Plant Growth, Environmental Control and Farm Management in Protected Cultivation”, 1989.

U24PH6602	NANOTECHNOLOGY		L	T	P	C
			3	0	0	3
Course Objectives:	Aims to equip students with a comprehensive understanding of nanoscience and nanotechnology, encompassing synthesis methods, characterization techniques, nanodevice design, and their diverse applications in engineering, medicine, energy, and sustainable technologies.					
Unit - I	**INTRODUCTION TO NANOTECHNOLOGY**					**7**
Understand the term Nano, Nanoscience and Nanotechnology - scope for nanotechnology in Energy, Medicine, Electronics and Environment - Evolution from micro technology to nanotechnology, key milestones - Quantum size effects and nanoscale phenomena, surface to volume ratio, Novel properties - Implication of nanotechnology in physics, chemistry, biology and engineering disciplines.						
Unit - II	**SYNTHESIS TECHNIQUES**					**8**
Top-down Vs. bottom-up approaches: concept, examples, advantages and limitations - Physical methods: lithography, types, applications, limitations – Physical vapor deposition (PVD) – Spray pyrolysis -Sputtering - laser ablation Atomic layer deposition (ALD) (Process, applications and limitations). Chemical methods: Sol-gel - chemical vapor deposition (CVD) - Hydrothermal - solvothermal synthesis, Electrospinning (process, applications and limitations).						
Unit - III	**CHARACTERIZATION TOOLS**					**9**
Scanning Electron Microscopy (SEM): Principle, image formation, resolution and magnification limit and application - Transmission Electron Microscopy (TEM): Principle, image formation, high resolution image concept and application - Atomic Force Microscopy (AFM): Principle, modes and application, Scanning Tunnelling Microscopy (STM): Principle, image formation and application - Spectroscopic techniques (UV-Vis, FT-IR, XPS, Raman): Principle, observations and applications.						
Unit – IV	**NANODEVICES AND SYSTEMS**					**11**
Nanoelectronics - quantum dots: principle, fabrication methods and applications - carbon nanotube transistors: CNT structure, types and properties, device fabrication, advantages and challenges - MEMS/NEMS (Micro/Nano Electromechanical Systems): Definition, fabrication techniques, examples and applications – Nanorobotics: Concept of nanoscale machines and actuators, design principle and applications - Nano sensors: types, mechanism, application.						
Unit - V	**ADVANCED APPLICATIONS IN ENGINEERING**					**10**
Nanotechnology in manufacturing and precision engineering: Nanoimprint lithography, self-assembly, atomic layer deposition, Ultra-precision machining, Nano coatings for wear resistance and durability - Energy harvesting (nano-generators, fuel cells): Piezoelectric nanogenerators, Triboelectric nanogenerators, Nano catalysts, Nanostructured solar cells, Supercapacitors and advanced batteries - Nanotechnology in aerospace and automotive industries.						
	Total Periods:					**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Illustrate the foundation of nanoscience and nanotechnology, their interdisciplinary nature and diverse applications.	K2
CO2	Explain top-down and bottom-up synthesis approaches, along with physical and chemical methods for fabricating nanomaterials.	K2
CO3	Explain the techniques of analysing nanoscale structures using advanced microscopy and spectroscopic techniques.	K2
CO4	Interpret the design, fabrication, and applications of nanodevices and systems including quantum dots, CNT transistors, MEMS/NEMS, nanorobotics, and nanosensors.	K2
CO5	Apply cutting-edge engineering of nanotechnology in manufacturing, energy harvesting, aerospace, and automotive industries.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	1	-	-	-	1	-	-	-	-	3	2	2	2
CO2	3	2	-	2	-	1	-	-	-	-	3	2	2	2
CO3	3	2	-	2	1	-	-	-	-	-	3	2	3	2
CO4	3	2	2	2	2	2	-	-	-	2	3	2	3	3
CO5	3	2	2	2	2	2	2	2	2	3	3	2	3	3
CO	3	2	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	3	2	3	**2**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Edelstein A.S. and Cammearata, R.C. eds., Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2	John Dinardo, N Nanoscale characterisation of surfaces & Interfaces, 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000.
3	Chattopadhyay K.K. &. Banerjee, A.N "Introduction to Nanoscience and Nanotechnology", PHI Learning Pvt. Ltd., 2009.
4	Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, Springer, 2014.
5	Ramachandra Rao M.S. & Shubra Singh, "Nanoscience and Nanotechnology: Fundamentals to Frontiers", Wiley India Pvt. Ltd., 2013.

Reference Books

1	G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999
2	Akhlesh Lakhtakia (Editor), The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.
3	Robert W. Kelsall (Editor), Nanoscale Science and Technology, John Wiley and Son, Ltd., England, 2005.
4	Klaus D. Sattler, Springer Handbook of Nanomaterials, Verlag Berlin Heidelberg, 2011
5	Guozhong Cao & Ying Wang, Nanostructures and Nanomaterials: Synthesis, Properties and Applications, World Scientific Publishing (2nd Edition), 2011.

U24AD6603	AUGMENTED REALITY/VIRTUAL REALITY TECHNOLOGY	L	T	P	C
		3	0	0	3
Course Objectives:	The course introduces the core concepts, technologies, and system components of Virtual Reality and Augmented Reality. It develops knowledge of VR modeling, programming, human factors, and real-world applications for immersive systems.				

Unit - I	**INTRODUCTION**	**9**
Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input 144 Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.		
Unit - II	**VR MODELING**	**9**
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management		
Unit - III	**VR PROGRAMMING**	**9**
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D		
Unit –IV	**APPLICATIONS**	**9**
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		
Unit - V	**AUGMENTED REALITY**	**9**
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply fundamental Virtual Reality and Augmented Reality concepts to identify system components, tracking methods, input–output devices, and human visual and auditory considerations	K3
CO2	Apply geometric, kinematic, and physical modeling techniques to create three-dimensional virtual objects using transformations, object hierarchies, and collision detection.	K3
CO3	Develop interactive virtual environments using VR programming toolkits and scene graph concepts to construct realistic 3D scenes with audio and visual effects.	K3
CO4	Analyze Virtual Reality applications across healthcare, education, manufacturing, robotics, and entertainment by evaluating human factors, safety issues, and interaction requirements.	K4
CO5	Analyze Augmented Reality systems by examining computer vision methods, interaction techniques, modeling approaches, and wearable devices to design AR and MR applications	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	1	3	2	1	1	2	1	2	3	3	3
CO2	3	3	3	2	3	-	-	1	1	2	2	3	3	3
CO3	3	3	3	2	3	-	1	2	2	3	3	3	3	3
CO4	3	3	2	3	3	3	3	2	3	2	3	3	3	3
CO5	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO	3.00	2.80	2.60	2.20	3.00	2.67	1.75	1.60	2.20	2.20	2.60	3.0 0	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018
2	Dieter Schmalstieg, Tobias Hollerer – Augmented Reality: Principles and Practice, Pearson / Addison-Wesley Professional, 2022
3	John Vince, “Introduction to Virtual Reality”, Springer-Verlag, 2004.
4	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design”, Morgan Kaufmann, 2003

Reference Books

1	Ralf Doerner, Wolfgang Broll, Bernhard Jung, Paul Grimm, Martin Göbel, Frank Steinicke – Virtual and Augmented Reality: Foundations and Methods of Extended Realities (XR), Springer Nature, 2022
2	Naveen Kumar Singh, Shanu Gupta – Augmented and Virtual Reality, S.K. Kataria & Sons, 2025 (1st Edition)

U24AD6602	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with fundamental knowledge of Artificial Intelligence and Machine Learning, including intelligent agents, search techniques, logic-based reasoning, and supervised and unsupervised learning algorithms, enabling them to analyze problems and apply appropriate AI and ML techniques for decision-making and data-driven applications.				

Unit - I	**INTELLIGENT AGENT AND UNINFORMED SEARCH**	**9**
Introduction - Foundations of AI - History of AI- The state of the art - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems - Uninformed Search - Breadth First Search -Uniform-cost search - Depth First Search - Depth Limited Search		
Unit - II	**PROBLEM SOLVING WITH SEARCH TECHNIQUES**	**9**
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP)		
Unit - III	**MACHINE LEARNING FUNDAMENTALS**	**9**
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting.		
Unit – IV	**SUPERVISED LEARNING**	**9**
Neural Network: Introduction, Perceptron Networks – Back propagation networks - Decision Tree: Entropy – Information gain - Gini Impurity - classification algorithm -Naïve Bayesian classification - Support Vector Machines (SVM)		
Unit - V	**UNSUPERVISED LEARNING**	**9**
Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K - Level
CO01	Identify intelligent agents, problem environments, and uninformed search techniques to solve artificial intelligence problems.	K3
CO02	Construct solutions using informed search strategies, adversarial search techniques, and constraint satisfaction problems.	K3
CO03	Examine machine learning fundamentals including learning paradigms, hypothesis space, bias–variance trade-off, and regression models.	K4
CO04	Develop supervised learning models using neural networks, decision trees, Naïve Bayes, and support vector machines.	K3
CO05	Classify data patterns using unsupervised learning techniques such as clustering, dimensionality reduction, and self-organizing maps.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO01	2	2	2	-	1	2	-	2	-	-	2	3	3	3
CO02	2	2	3	-	2	2	-	2	-	-	2	3	3	3
CO03	2	3	3	2	2	2	-	2	-	-	2	3	3	3
CO04	2	3	3	2	2	2	-	2	-	-	2	3	3	3
CO05	2	3	3	2	2	2	-	2	-	-	2	3	3	3
CO	**2.00**	**2.60**	**2.80**	**2.00**	**1.80**	**2.00**	**-**	**2.00**	**-**	**-**	**2.00**	**3.00**	**3.00**	**3.00**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson Education, 4th Edition (Global Edition), 2022.
2	Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O’Reilly Media, 3rd Edition, 2023.
3	Ethem Alpaydin, Machine Learning, MIT Press, Revised Edition, 2024.

Reference Books

1	Kevin P. Murphy, Probabilistic Machine Learning: An Introduction, MIT Press, 2022.
2	Sebastian Raschka, Yuxi Liu and Vahid Mirjalili, Machine Learning with PyTorch and Scikit-Learn, Packt Publishing, 2022.
3	Andreas C. Müller and Sarah Guido, Introduction to Machine Learning with Python, O’Reilly Media, Updated Edition, 2023.
4	Charu C. Aggarwal, Artificial Intelligence: A Textbook, Springer, 2nd Edition, 2023.
5	Christopher M. Bishop and Hugh Bishop, Deep Learning: Foundations and Concepts, Springer, 2024.

<table>
<tr><td>U24CS6601</td><td colspan="2">DIGITAL MARKETING ESSENTIALS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Objectives:</td><td colspan="6">To understand the role and significance of digital marketing in today's dynamic business environment and to explore the organizations effectively implement digital marketing strategies. It also emphasizes measuring and evaluating the effectiveness of these digital initiatives to support informed decision-making.</td></tr>
<tr><td>Unit - I</td><td colspan="2">INTRODUCTION TO ONLINE MARKET</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.</td></tr>
<tr><td>Unit - II</td><td colspan="2">SEARCH ENGINE OPTIMISATION</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement</td></tr>
<tr><td>Unit - III</td><td colspan="2">E- MAIL MARKETING</td><td colspan="4">9</td></tr>
<tr><td colspan="7">E- Mail Marketing - 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 Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting</td></tr>
<tr><td>Unit – IV</td><td colspan="2">SOCIAL MEDIA MARKETING</td><td colspan="4">9</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td>Unit - V</td><td colspan="2">DIGITAL TRANSFORMATION</td><td colspan="4"></td></tr>
<tr><td colspan="7">Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.</td></tr>
<tr><td colspan="3">Total Periods:</td><td colspan="4">45</td></tr>
</table>

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply digital marketing strategy concepts by analyzing the online marketplace and its components to plan and create effective brand websites.	K3
CO2	Identify SEO and SEM strategies by developing keyword plans and using on-page and off-page techniques to improve search engine visibility.	K3
CO3	Construct the email marketing techniques to create automated campaigns, generate leads, and measure campaign performance and use mobile marketing channels such as apps, SMS, and offers to target and engage customers effectively.	K3
CO4	Examine the social media marketing strategies by using platforms to create brand conversations and engagement and use engagement and influencer marketing to build customer relationships and loyalty.	K4
CO5	Analyze the digital analytics tools across channels such as AdWords, email, mobile, social media, and web to measure performance and attribute results, adapt digital marketing strategies and recent trends in digital marketing.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO4	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	-	3	3	3	3	3	3	3	3
CO	**3.00**	**3.00**	**2.00**	**3.00**	**3.00**	**-**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight   2. Moderate   3. Substantial (High)

Text Books

1	Puneet Singh Bhatia, “Fundamentals of Digital Marketing”, Third Edition, Pearson Education, 2023.
2	Ryan, D., & Kartajaya, H., & Setiawan, I, “Understanding Digital Marketing: A Complete Guide to Engaging Customers and Implementing Successful Digital Campaigns”, Fifth Edition, Kogan Page, 2020.
3	Kotler, Philip, Hermawan Kartajaya, and Iwan Setiawan, “Marketing 4.0: Moving from Traditional to Digital”, Seventh Edition, 2017.
4	Vandana Ahuja, “Digital Marketing”, Seventh Edition, Oxford University Press, 2015.

Reference Books

1	Barker, Bormann and Neher, “Social Media Marketing: A Strategic Approach”, Second Edition, South-Western, Cengage Learning, 2017.
2	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

U24CB5V01	FINANCIAL MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To understand key financial decisions, sources of finance, and capital budgeting concepts learning capital structure, dividend policy, and working capital management tools.				

Unit	Title	Periods
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 Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Identify and be familiar with the basic layers and its functions in computer networks.	K3
CO2	Apply the basics of networks to show how data flows from one node to another	K3
CO3	Construct the different types of routing algorithms	K3
CO4	Experiment with different types of protocols for various functions in the network	K3
CO5	Develop the operation of different application layer protocols	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO2	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO3	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO4	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO5	3	3	2	2	3	2	2	3	3	2	3	3	3	3
CO	**3.00**	**3.00**	**2.00**	**2.00**	**3.00**	**2.00**	**2.00**	**3.00**	**3.00**	**2.00**	**3.00**	**3.00**	**3.00**	**3.00**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	M.Y. Khan and P.K.Jain, Financial Management: Text, Problems & Cases, Eight Edition, Tata McGraw Hill, 2024
2	Prasanna Chandra, Financial Management: Theory & Practice, Eleventh Edition, McGraw Hill Education (India) Pvt. L, 2022
3	M. Pandey, Financial Management, Eleventh Edition, Vikas Publishing House Pvt. Ltd, 2015

Reference Books

1	James C. Vanhorne, Fundamentals of Financial Management, 13th Edition, PHI Learning, 2019
2	Srivatsava, Mishra, Financial Management, Oxford University Press, 2011

U24CB5V02	FUNDAMENTALS OF INVESTMENT		L	T	P	C
			3	0	0	3
Course Objectives:	To analyze the investment environment, value bonds and equities, apply security valuation approaches, build efficient portfolios through diversification, and understand investor protection mechanisms 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 TOEQUITYANALYSIS**	**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 Periods:	**45**				

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply concepts of investment decision-making, classify asset types, interpret the functioning of Indian securities markets, and compute risk–return measures under taxation and inflationary conditions.	K3
CO2	Utilize bond valuation methods to calculate yields, differentiate bond features and categories, and appraise risks including default probability and credit ratings	K3
CO3	Employ analytical techniques to implement fundamental and technical approaches, examine market efficiency, and apply dividend-based and P/E multiple models for equity valuation	K3

COs	Statements	K-Level
CO4	Apply portfolio management principles to design diversified portfolios, quantify portfolio risk and return, assess mutual fund performance, and illustrate the role of financial derivatives in Indian markets.	K3
CO5	Apply regulatory frameworks to evaluate SEBI's functions, examine stock exchange practices, analyze grievance redressal mechanisms, and foster investor awareness and activism.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO2	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO3	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO4	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO5	2	2	3	-	3	3	3	3	-	3	3	3	3	3
CO	2.00	2.00	3.00	-	3.00	3.00	3.00	3.00	-	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Rustagi, R. P. Investment Management Theory and Practice. Sultan Chand & Sons, 2021.
2	Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.
3	ZviBodie, Alex Kane, Alan J Marcus, Pitabus Mohanty, Investments, McGraw Hill Education (India), 11 Edition (SIE), 2019
4	Charles P. Jones, Gerald R. Jensen. Investments: analysis and management. Wiley, 14TH Edition, 2019.
5	Chandra, Prasanna. Investment analysis and portfolio management. McGraw-hill education, 5th, Edition, 2017.

U24CB5V03	BANKING, FINANCIAL SERVICES AND INSURANCE	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a clear understanding of insurance principles and fee-based financial services within the Indian financial system.				

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&As 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	**INSURANCE**	**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 Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the principles of banking operations by analyzing the structure and functions of the banking system in India, complying with key regulations by the RBI, managing banker-customer relationships, and effectively performing retail and wholesale banking operations including opening and operating various types of accounts.	K3
CO2	Develop strategies for effective asset and liability management in banks by designing deposit schemes, managing investments in securities, advances, and loans, handling negotiable instruments, and addressing contemporary issues such as NPAs and bank mergers in the securities market.	K3
CO3	Examine the payment systems in India, including paper-based and electronic modes, e-banking, plastic money, and e-money, by analyzing cash forecasting at ATMs, evaluating regulatory frameworks such as the Information Technology Act, 2000, RBI's technology vision, and assessing security threats and RBI initiatives in e-banking.	K4
CO4	Construct comprehensive financial service solutions by designing and integrating services such as NBFC operations, leasing and hire purchase schemes, mutual funds, venture capital financing, bill discounting, factoring, and merchant banking to meet the needs of the financial market in India.	K3
CO5	Analyze the structure and functioning of the insurance industry in India by examining the historical development, regulatory framework including the Insurance Act, 1938 and IRDA regulations, and evaluating life insurance products, annuities, unit-linked policies, policy lapses, revivals, and claim settlement processes.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	-	2	-	1	3	3	3	-	3	3	3	3	2
CO2	1	-	1	-	1	3	2	2	-	2	2	-	-	1
CO3	3	-	3	-	3	3	3	3	-	3	3	3	3	3
CO4	3	3	3	-	3	-	-	-	-	-	-	2	2	3
CO5	2	2	2	-	2	-	-	-	-	-	-	2	2	2
CO	**2.20**	**2.50**	**2.20**	**-**	**2.00**	**3.00**	**2.67**	**2.67**	**-**	**2.67**	**2.67**	**2.50**	**2.50**	**2.20**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Padmalatha Suresh & Justin Paul, Management of Banking and Financial Services, Pearson, Delhi, 2017
2	M.Y. Khan Indian Financial System, McGraw Hill Education, 2015

Reference Books

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 & Sylvia C. Hudgins Bank Management and Financial Services, Tata McGraw Hill, New Delhi, 2017.
3	K.C. Shekhar & Lekshmy Shekhar Banking Theory and Practice, Vikas Publishing, 2015.
4	M.Y. Khan Indian Financial System, McGraw Hill Education, 2015.

U24CB5V04	INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3
Course Objectives:	Apply blockchain and cryptocurrency concepts by constructing and demonstrating practical use cases involving distributed systems, consensus mechanisms, smart contracts, Ethereum networks, Web3 frameworks, Hyperledger protocols, and emerging blockchain platforms to solve real-world problems in decentralization, scalability, and privacy.				

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 Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply blockchain principles by constructing examples of distributed systems, consensus mechanisms, and decentralization methods to demonstrate how smart contracts and decentralized organizations function within different types of blockchain ecosystems.	K3
CO2	Build Bitcoin transactions by utilizing digital keys and addresses, demonstrating mining and wallet operations, and deploying smart contracts on blockchain platforms to explore the functionality and limitations of alternative cryptocurrencies.	K3
CO3	Choose appropriate components of the Ethereum ecosystem and development	K3

COs	Statements	K-Level
	environment to build private networks, deploy transactions, and utilize the Ethereum Virtual Machine for practical blockchain applications.	
CO4	Construct decentralized applications by deploying smart contracts, configuring POST requests, and utilizing development frameworks, while implementing Hyperledger Fabric and Corda to demonstrate distributed ledger solutions.	K3
CO5	Develop blockchain-based solutions by experimenting with platforms such as Kadena, Ripple, Rootstock, Quorum, and Tendermint to address challenges of scalability, privacy, and interoperability, while analyzing notable projects and research tools.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	3	1	3	3	3	3	3	3	2	2
CO2	3	3	2	3	3	-	3	3	3	3	3	3	2	3
CO3	3	3	2	3	3	1	3	3	3	3	3	2	1	2
CO4	3	3	2	3	3	1	3	3	3	3	3	-	2	1
CO5	3	3	2	3	3	1	3	3	3	3	3	2	2	1
CO	3	3	2	3	3	1	3	3	3	3	3	2.5	1.8	1.8

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018
2	Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

Reference Books

1	Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.

U24CB5V05	FINTECH PERSONAL FINANCE AND PAYMENTS	L	T	P	C
		3	0	0	3
Course Objective:	Introduce learners to the fundamentals of FinTech and its role in personal finance, digital payment systems and platforms develop practical knowledge of personal financial planning using FinTech tools and familiarize with emerging trends in personal finance.				

Unit - I	**INTRODUCTION TO FINTECH AND PERSONAL FINANCE**	**9**
Evolution of FinTech, Traditional vs Digital Financial Services, Basics of Personal Finance: Income, Expenses, Savings, Investments, Role of FinTech in Personal Financial Management, Overview of FinTech Ecosystem.		
Unit - II	**DIGITAL PAYMENT SYSTEMS**	**9**
Digital Payment Instruments: Cards, Wallets, UPI, QR Codes, Payment Gateways and Aggregators, Mobile Banking and Internet Banking, Real-Time Payment Systems, Cross-Border Payments and Remittances.		
Unit - III	**FINTECH TOOLS FOR PERSONAL FINANCIAL MANAGEMENT**	**9**
Budgeting and Expense Tracking Apps, Digital Savings and Investment Platforms, Robo-Advisors and Automated Wealth Management, Credit Scoring and Digital Lending Platforms, Buy Now Pay Later (BNPL) Models.		
Unit – IV	**SECURITY, RISK, AND REGULATION IN FINTECH**	**9**
Cybersecurity Threats in Digital Payments, Data Privacy and Consumer Protection, Fraud Detection and Risk Management, Regulatory Frameworks (RBI, NPCI, Global Standards), Compliance and Ethical Issues in FinTech.		
Unit - V	**EMERGING TRENDS AND FUTURE OF PERSONAL FINANCE**	**9**
AI and Big Data in Personal Finance, Blockchain and Cryptocurrencies in Payments, Open Banking and API-based Finance, Embedded Finance, Future Challenges and Opportunities in FinTech.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamentals of FinTech and personal finance concepts	K2
CO2	Infer various digital payment systems and platforms	K2
CO3	Apply FinTech tools for budgeting, saving, and investing	K3
CO4	Solve security, risk, and regulatory issues in digital finance	K3
CO5	Identify emerging FinTech trends and their impact on personal finance	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	1	1	-	2	-	-	-	2	-	1
CO2	2	2	1	-	3	1	-	2	-	1	-	3	2	1
CO3	2	3	3	2	3	-	-	1	1	1	-	3	3	2
CO4	2	3	2	3	2	2	1	3	-	-	1	2	3	2
CO5	1	2	2	3	3	1	2	2	-	-	2	2	2	3
CO	**2.00**	**2.40**	**2.00**	**2.67**	**2.40**	**1.25**	**1.50**	**2.00**	**1.00**	**1.00**	**1.50**	**2.40**	**2.50**	**1.80**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight   2. Moderate   3. Substantial (High)

Text Books

1	Financial Technology (FinTech) and Digital Banking in India — Jaspal Singh (2022)
2	Finance For Fintech Professionals – World Scientific (2022 edition)
3	Fintech Regulation In Practice: Navigate the Complexities and Opportunities of Regulation by *Maha* El Dimachki, 2024 edition.
4	Trends and Challenges of Electronic Finance: Perspectives from Emerging Markets by Ananda S., Tamanna Dalwai & Dharmendra Singh, 2025 edition.

Reference Books

1	Felix I. Lessambo “Fintech Regulation and Supervision Challenges Within the Banking Industry” 2023 edition
2	Financial Services Technology: Processes, Architecture and Solutions by Randall E. Duran, 2023 Edition

U24CB5V06	FINTECH	L	T	P	C
		3	0	0	3
Course Objective:	To familiarize foundational understanding of FinTech concepts with digital payment systems, electronic banking, blockchain, cryptocurrencies, FinTech applications in lending, insurance, wealth management, FinTech regulations and compliance frameworks.				

Unit - I	**INTRODUCTION TO FINTECH**	**9**
Definition and scope of FinTech, Evolution of financial systems, Traditional finance vs FinTech, FinTech ecosystem: startups, regulators, banks, customers, Overview of global and Indian FinTech landscape.		
Unit - II	**DIGITAL PAYMENTS AND ELECTRONIC BANKING**	**9**
Digital payment systems: UPI, wallets, cards, Online and mobile banking, Payment gateways and settlement systems, Role of FinTech in financial inclusion.		
Unit - III	**BLOCKCHAIN AND CRYPTOCURRENCIES**	**9**
Blockchain fundamentals and architecture, Distributed Ledger Technology (DLT), Cryptocurrencies and crypto exchanges, Smart contracts and applications.		
Unit – IV	**FINTECH IN LENDING, INSURANCE, AND WEALTH MANAGEMENT**	**9**
Peer-to-Peer (P2P) lending platforms, Digital lending and credit scoring, InsurTech models, Robo-advisors and wealth management tools.		
Unit - V	**REGULATION, SECURITY, AND FUTURE TRENDS**	**9**
FinTech regulations and compliance frameworks, Cybersecurity and data privacy issues, Ethical challenges in FinTech, Emerging trends: AI, Big Data, Open Banking.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Understand the fundamentals, evolution, and ecosystem of FinTech	K2
CO2	Illustrate digital payment systems and electronic banking technologies	K2
CO3	Identify blockchain technology, cryptocurrencies, and smart contracts	K3
CO4	Apply FinTech concepts in lending, insurance, and wealth management domains	K3
CO5	Select regulatory, security, and ethical challenges and future trends in FinTech	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	3	1	-	2	-	-	-	-	-	-	3	2	1
CO3	2	3	2	1	2	-	-	-	-	-	-	3	2	1
CO4	1	2	3	2	2	-	-	-	-	-	-	3	3	2
CO5	1	2	-	3	3	1	1	2	-	1	2	2	2	3
CO	**1.80**	**2.40**	**2.00**	**2.00**	**2.00**	**1.00**	**1.00**	**2.00**	**-**	**1.00**	**2.00**	**2.60**	**2.00**	**1.75**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Ross P. Buckley, Douglas W. Arner & Dirk A. Zetzsche “FinTech: Finance, Technology and Regulation — Cambridge University Press” 2024 edition
2	Fintech Regulation In Practice: Navigate the Complexities and Opportunities of Regulation, by Maha El Dimachki, 2024 edition.
3	Understanding Cybersecurity Management in FinTech: Challenges, Strategies, and Trends by Gurdip Kaur, Ziba Habibi Lashkari, and Arash Habibi Lashkari 2022 edition.

Reference Books

1	Jayanta Chakraborti, Shalini Aggarwal & Pardeep Kumar “FinTech 5.0: The Journey from Cryptocurrency to Neobanking” 2025 edition
2	Fintech and Cryptocurrency by Mohd Naved, V. Ajantha Devi, Aditya Kumar Gupta, 2023 edition.
3	Fintech Regulation and Supervision Challenges within the Banking Industry by Felix I. Lessambo, 2023 edition.
4	Applications and Trends in Fintech by David Kuo Chuen Lee, Joseph Lim, Kok Fai Phoon & Yu Wang, 2023 edition.

U24CB5W01	FOUNDATIONS OF ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

Course Objectives:	To develop a strong foundation in entrepreneurship and technopreneurship by understanding skills, ownership, environment, and technology-driven ventures through practical and global insights.

Unit - I	**INTRODUCTION TO ENTREPRENEURSHIP**	**9**
Entrepreneurship- Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.		
Unit - II	**BUSINESS OWNERSHIP & ENVRIONMENT**	**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	**FUNDAMENTALS OF TECHNOPRENEURSHIP**	**9**
Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy- Job Opportunities in Technopreneurship - Recent trends		
Unit – IV	**APPLICATIONS OF TECHNOPRENEURSHIP**	**9**
Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching – Managing Technology based Product / Service entrepreneurship -– Success Stories of Technopreneurs - Case Studies		
Unit - V	**EMERGING TRENDS IN ENTREPRENEURSHIP**	**9**
Effective Business Management Strategies For Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Make use of core entrepreneurship concepts to analyze traits, classifications, economic contributions, and growth factors through measurable evaluation.	K3
CO2	Identify business ownership types and environmental factors while applying HR, finance, marketing, and operations concepts in measurable scenarios.	K3
CO3	Utilize technopreneurship concepts to evaluate its principles, scope, and socio-economic impact through measurable contemporary scenarios.	K3
CO4	Apply technology entrepreneurship concepts across contexts by integrating intrapreneurship, networking, and product launch strategies to achieve measurable outcomes.	K3
CO5	Develop business strategies for diverse entrepreneurial models, including	K3

COs	Statements	K-Level
	franchising and technopreneurship, through measurable local and global analyses.	

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	3	3	2	2	2	3	3	3	3	3	3	3	3
CO2	1	3	3	2	2	2	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO	**1.60**	**3.00**	**3.00**	**2.60**	**2.60**	**2.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**	**3.00**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S. S. Khanka, “Entrepreneurial Development”, Revised Edition, S. Chand Publishing, 2023
2	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, “Entrepreneurship”, 11th Edition, McGraw-Hill Education, 2024
3	Peter F. Drucker, “Innovation and Entrepreneurship”, Routledge Modern Classics Edition, 2025 Reprint
4	Brad Feld & Jason Mendelson, “Venture Deals”, 4th Edition, Wiley, 2023

Reference Books

1	Donald F. Kuratko, “Entrepreneurship: Theory, Process, Practice”, 12th Edition, Cengage Learning, 2023
2	Thomas H. Byers, Richard C. Dorf & Andrew J. Nelson, “Technology Ventures: From Idea to Enterprise”, 5th Edition, McGraw-Hill Education, 2024
3	Tidd & Bessant, “Managing Innovation”, 8th Edition, Wiley, 2024
4	Eric Ries, “The Lean Startup”, Updated Edition, Crown Business, 2023

U24CB5W02	TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS		L	T	P	C
			3	0	0	3
Course Objectives:	It provides a comprehensive understanding of team dynamics, formation, and management, including virtual and multicultural teams, while developing measurable skills in leadership, coaching, mentoring, motivation, conflict resolution, and global practices.					
Unit - I	**INTRODUCTION TO MANAGING TEAMS**	**9**				
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) -Multicultural Teams.						
Unit - II	**MANAGING AND DEVELOPING EFFECTIVE TEAMS**	**9**				
Team-based Organizations- Leadership roles in team-based organizations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building – Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others – Team Building at the Top - Leadership in Teamwork Effectiveness						
Unit - III	**INTRODUCTION TO LEADERSHIP**	**9**				
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.						
Unit – IV	**LEADERSHIP IN ORGANISATIONS**	**9**				
Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model – Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership - Role of Ethics and Values in Organisational Leadership.						
Unit - V	**LEADERSHIP EFFECTIVENESS**	**9**				
Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.						
	Total Periods:	**45**				

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Build effective teams by applying team dynamics and development strategies to achieve measurable outcomes in coaching, decision-making, and multicultural or virtual environments.	K3
CO2	Construct high-performance teams by applying leadership, coaching, and mentoring to enhance trust, skills, and overall teamwork effectiveness with measurable outcomes.	K3
CO3	Develop a comprehensive understanding of leadership by analyzing traits, intelligence, and leader-follower dynamics while demonstrating measurable skills in	K3

COs	Statements	K-Level
	delegation, empowerment, and use of leadership power.	
CO4	Utilize leadership styles and theories—LMX, situational, contingency, path-goal, transactional, transformational, and charismatic—to solve organizational challenges while integrating measurable ethics and values.	K3
CO5	Model effective leadership by evaluating motivation, conflict, negotiation, and cultural influences while addressing destructive and global leadership challenges with measurable strategies.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	1	-	-	-	-	-	-	2	-	3	-	2	2	2
CO2	1	3	2	1	2	-	-	2	2	3	-	3	3	3
CO3	1	3	3	2	3	-	-	2	2	3	-	3	3	3
CO4	1	3	2	2	3	-	3	3	2	3	-	3	3	3
CO5	1	3	2	3	3	-	3	2	2	3	-	3	3	3
CO	**1.00**	**3.00**	**2.25**	**2.00**	**2.75**	**-**	**3.00**	**2.20**	**2.00**	**3.00**	**-**	**2.80**	**2.80**	**2.80**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	W.G. Dyer, J.H. Dyer & W.G. Dyer Jr.," Team Building: Proven Strategies for Improving Team Performance", 6th Edition, Wiley, 2024
2	Hughes, Ginnett & Curphy, "Leadership: Enhancing the Lessons of Experience", 10th Edition, McGraw-Hill Education, 2023
3	Daniel Levi, "Group Dynamics for Teams", 6th Edition, Sage Publications, 2023

Reference Books

1	Richard L. Daft, "The Leadership Experience", 8th Edition, Cengage Learning, 2022
2	Peter G. Northouse, "Leadership: Theory and Practice", 9th Edition, Sage Publications, 2022
3	Stephen P. Robbins & Timothy A. Judge, "Organizational Behavior", 19th Edition, Pearson, 2023

U24CB5W03	CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3
Course Objectives:	To develop students' creativity and creative intelligence by understanding creative processes, tools, personality traits, and environments that enhance innovation. It also seeks to build competence in innovation, entrepreneurship, and designing responsible and innovative business models through systematic analysis, design thinking, and opportunity evaluation.				
Unit - I	**CREATIVITY**			**9**	
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- - Creative Personality and Motivation					
Unit - II	**CREATIVE INTELLIGENCE**			**9**	
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training--Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment					
Unit - III	**INNOVATION**			**9**	
Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation-Product Innovation and Process- Technological, Organizational Innovation – Indicators- Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity- Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system					
Unit – IV	**INNOVATION AND ENTREPRENEURSHIP**			**9**	
Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours- Opportunity Analysis and Decision Making- Industry Understanding – Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit					
Unit - V	**INNOVATIVE BUSINESS MODELS**			**9**	
Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.					
	Total Periods:			**45**	

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Select suitable forms of creativity by evaluating context, environment, personality, technology, and motivation in practical scenarios.	K3
CO2	Utilize creative intelligence through convergent thinking and training techniques while overcoming barriers to design measurable creativity-enhancing environments.	K3
CO3	Make use of innovation concepts by differentiating types and levels across domains	K3

COs	Statements	K-Level
	and using design thinking to implement and measure innovation effectively.	
CO4	Develop an entrepreneurial mindset by evaluating motivations and opportunities and applying measurable strategies to achieve product–market fit.	K3
CO5	Construct innovative business models by defining customer segments and value propositions while implementing measurable, responsible innovation strategies.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	3	3	-	-	3	3	3	3	3	3	3
CO2	2	3	2	3	3	1	3	3	3	3	3	1	1	1
CO3	2	3	2	3	3	2	3	3	3	3	3	1	1	1
CO4	2	3	3	3	3	1	3	3	3	3	3	2	2	2
CO5	3	3	3	3	3	3	3	3	3	3	3	2	2	2
CO	2.40	3.00	2.40	3.00	3.00	1.75	3.00	3.00	3.00	3.00	3.00	1.80	1.80	1.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Paul Trott, “Innovation Management & New Product Development”, 6th Edition, Pearson, 2023
2	Tidd & Bessant, “Managing Innovation: Integrating Technological, Market and Organizational Change”, 8th Edition, Wiley, 2024
3	V. K. Narayanan & G. S. Balasubramanian, “Innovation: A Strategic Management Perspective”, 2nd Edition, Cengage Learning India, 2023
4	Stephen P. Robbins & Timothy A. Judge, “Organizational Innovation and Change”, Pearson, 2024

Reference Books

1	A. Dale Timpe, Creativity, Jaico Publishing House, 2003.
2	Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009
3	Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata Mc Graw Hill, 2004.

U24CB5W04	PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS	L	T	P	C
		3	0	0	3
Course Objectives:	It provides a comprehensive understanding of marketing management by covering concepts, marketing mix, research, product, pricing, promotion, distribution, and contemporary practices like CRM, relationship, and e-marketing for measurable skill development.				

Unit – I	INTRODUCTION TO MARKETING MANAGEMENT	9
Introduction - Market and Marketing – Concepts- Functions of Marketing - Importance of Marketing - Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix - The Additional 3Ps - Developing an Effective Marketing Mix.		
Unit – II	**MARKETING ENVIRONMENT**	**9**
Introduction - Environmental Scanning - Analysing the Organisation's Micro Environment and Macro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.		
Unit – III	**PRODUCT AND PRICING MANAGEMENT**	**9**
Product- Meaning, Classification, Levels of Products – Product Life Cycle (PLC) – Product Strategies - Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies – National and Global Pricing.		
Unit – IV	**PROMOTION AND DISTRIBUTION MANAGEMENT**	**9**
Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) - Introduction to Advertising and Sales Promotion – Basics of Public Relations and Publicity - Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)- Logistics Management- Introduction to Retailing and Wholesaling.		
Unit – V	**CONTEMPORARY ISSUES IN MARKETING MANAGEMENT**	**9**
Introduction - Relationship Marketing Vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business – Services Marketing - E-Marketing or Online Marketing.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Choose appropriate marketing concepts and functions to design an effective mix using traditional 4Ps, modern elements, and additional 3Ps for measurable organizational outcomes.	K3
CO2	Model effective marketing strategies by analyzing environmental factors and leveraging measurable insights from marketing research and information systems for informed decision-making.	K3
CO3	Organize product activities by classifying products, analyzing life cycles, and formulating branding strategies while applying measurable pricing approaches for	K3

COs	Statements	K-Level
	domestic and global markets.	
CO4	Plan promotional and distribution activities by integrating marketing channels and communication tools while applying measurable strategies for STP, logistics, retailing, and wholesaling to achieve organizational goals.	K3
CO5	Utilize relationship marketing and CRM concepts to manage customer loyalty and interactions while implementing measurable strategies in services and e-marketing to improve business performance.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	3	3	3	3	3	3	3	3	3	3	2	2	2
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	2	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO5	2	3	3	3	3	2	3	3	3	3	3	3	3	3
CO	2.20	3.00	3.00	3.00	3.00	2.60	3.00	3.00	3.00	3.00	3.00	2.80	2.80	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)s

Text Books

1	V.S. Ramaswamy & S. Namakumari, “Marketing Management: Global Perspective, Indian Context”, 7th Edition, Sage Publications India, 2023
2	S.A. Sherlekar & Dr. P. Krishnamoorthy, “Marketing Management”, Revised Edition, Himalaya Publishing House, 2023
3	Dhruv Grewal & Michael Levy, “Marketing”, 8th Edition, McGraw-Hill Education, 2024

Reference Books

1	Philip Kotler, Kevin Lane Keller, Alexander Chernev, “Marketing Management”, 16th Edition, Pearson, 2022
2	C.B. Gupta & N. Rajan Nair, “Marketing Management: Text and Cases”, 18th Edition, Sultan Chand & Sons, 2022
3	Tapan K. Panda & Sunil Sahadev, “Marketing Management: A Strategic Approach”, Oxford University Press, 2023

4	Kerin, Hartley & Rudelius, "Marketing", 14th Edition, McGraw-Hill Education, 2023

U24CB5W05	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	L	T	P	C
		3	0	0	3
Course Objectives:	It provides a comprehensive understanding of Human Resource Management by covering HR planning, recruitment, development, performance appraisal, compensation, and emerging trends to effectively manage organizational human capital.				

Unit – I	**INTRODUCTION TO HRM**	**9**
Concept, Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting - HR Audit - Challenges in HRM.		
Unit - II	**HUMAN RESOURCE PLANNING**	**9**
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends		
Unit – III	**RECRUITMENT AND SELECTION**	**9**
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources -eRecruitment - Selection Process- Selection techniques -eSelection- Interview Types- Employee Engagement.		
Unit – IV	**TRAINING AND EMPLOYEE DEVELOPMENT**	**9**
Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices		
Unit – V	**CONTROLLING HUMAN RESOURCES**	**9**
Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods – Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment - Union Management Relationship - Recent Trends - Case Studies - HR software exposure		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Construct a comprehensive understanding of HRM by analyzing its concepts, scope, and challenges while applying measurable knowledge of HR roles, policies, and audits.	K3
CO2	Experiment with planning tools and techniques for job analysis, rotation, and descriptions while using measurable approaches for career planning, succession, HRIS, and current HR trends.	K3
CO3	Apply recruitment strategies by selecting suitable internal, external, and digital sources, and implementing measurable selection, interview, and engagement processes.	K3

COs	Statements	K-Level
CO4	Model effective training programs by analyzing training needs, managing induction, and integrating measurable compensation, benefits, and Green HRM practices.	K3
CO5	Choose appropriate performance appraisal, grievance, and collective bargaining methods while implementing measurable strategies for discipline, promotions, transfers, and union-management relations.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	2	2	2	1	1	2	1	3	3	3	2	2
CO2	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO3	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO4	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO5	3	2	2	2	2	1	1	3	1	3	3	3	2	2
CO	3.00	2.00	2.00	2.00	2.00	1.00	1.00	2.80	1.00	3.00	3.00	3.00	2.00	2.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Dessler & Varkkey – Human Resource Management, 16th Ed., Pearson, 2023
2	Mondy & Noe – Human Resource Management, 16th Ed., Cengage, 2022
3	DeCenzo, Robbins & Verhulst – Fundamentals of Human Resource Management, 8th Ed., Wiley (Reprint 2023)

Reference Books

1	Aswathappa & Dash – Human Resource Management: Text and Cases, 10th Ed., McGraw Hill, 2024
2	Gomez-Mejia, Balkin & Cardy – Managing Human Resources, 8th Ed., Pearson/PHI, 2023
3	Ivancevich, Konopaske & Matteson – Organizational Behavior and Management, 12th Ed., McGraw Hill, 2022
4	P. Subba Rao – Essentials of Human Resource Management & Industrial Relations, 4th Ed., Himalaya Publishing, 2022

U24CB5W06	FINANCING NEW BUSINESS VENTURES	L	T	P	C
		3	0	0	3
Course Objectives:	It provides comprehensive knowledge of launching new ventures, including registration, location, government support, financing options, and fund-raising strategies for sustainable growth.				

Unit - I	ESSENTIALS OF NEW BUSINESS VENTURE	9
Setting up new Business Ventures – Need - Scope - Franchising - Location Strategy, Registration Process - State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.		
Unit - II	**INTRODUCTION TO VENTURE FINANCING**	**9**
Venture Finance – Definition – Historic Background - Funding New Ventures- Need – Scope – Types - Cost of Project - Means of Financing - Estimation of Working Capital - Requirement of funds – Mix of Dent and Equity - Challenges and Opportunities - NPV, IRR, Payback.		
Unit - III	**SOURCES OF DENT FINANCING**	**9**
Fund for Capital Assets - Term Loans - Leasing and Hire-Purchase - Money Market instruments – Bonds, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.		
Unit – IV	**SOURCES OF EQUITY FINANCING**	**9**
Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding – Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital		
Unit - V	**METHODS OF FUND RAISING FOR NEW VENTURES**	**9**
Investor Decision Process - Identifying the appropriate investors- Targeting investors- Developing Relationships with investors - Investor Selection Criteria- Company Creation- Raising Funds – Seed Funding- VC Selection Criteria – Process- Methods- Recent Trends		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

Cos	Statements	K-Level
CO1	Develop a structured plan for launching new ventures by assessing scope, location, registration, franchising, and financing options through government agencies and financial institutions.	K3
CO2	Build a comprehensive understanding of venture finance by evaluating funding needs, cost components, working capital, debt–equity mix, and financing challenges using measurable parameters.	K3
CO3	Apply debt financing and working capital tools—including term loans, leasing, bonds, cash credit, and overdraft—in measurable financial scenarios.	K3

Cos	Statements	K-Level
CO4	Identify suitable equity financing sources—including private equity, angel funding, crowdfunding, and venture capital—through measurable financial case analyses.	K3
CO5	Make use of investor decision process to identify and secure suitable funding sources, including seed and venture capital, using measurable investment criteria and trends.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	3	3	3	-	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	1	3	2	3	3	3	3	3	3
CO3	2	3	2	3	3	1	3	2	3	3	3	3	3	3
CO4	2	3	3	3	3	1	2	2	3	3	3	3	3	3
CO5	2	3	3	3	3	1	3	3	3	3	3	3	3	3
CO	2.40	3.00	2.80	3.00	3.00	1.00	2.80	2.20	3.00	3.00	3.00	3.00	3.00	3.00

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Brealey, Myers & Allen, “Principles of Corporate Finance”, 14th Edition, McGraw-Hill Education, 2023
2	Ross, Westerfield & Jaffe, “Corporate Finance”, 13th Edition, McGraw-Hill Education, 2024
3	Prasanna Chandra, “Projects: Planning, Analysis, Selection, Financing, Implementation & Review”, 10th Edition, McGraw-Hill Education, 2022
4	Yescombe, E.R, “Principles of Project Finance”, 3rd Edition, Academic Press (Elsevier), 2024
5	Andrew Metrick & Ayako Yasuda, “Venture Capital and the Finance of Innovation”, 3rd Edition, Wiley, 2021

Reference Books

1	Brad Feld & Jason Mendelson, “Venture Deals”, 4th Edition, Wiley, 2023
2	Thomas H. Byers, Richard C. Dorf & Andrew J. Nelson, “Technology Ventures: From Idea to Enterprise”, 5th Edition, McGraw-Hill Education, 2024
3	Josh Lerner, Ann Leamon & Felda Hardymon, “Venture Capital, Private Equity, and the Financing of Entrepreneurship “, 3rd Edition, Wiley, 2022

U24GE5X01	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3
Course Objectives:	The course aims to help students understand the meaning, scope, importance, and evolution of Public Administration. It introduces major administrative approaches, theories, and thinkers, along with new trends in administration. The course also develops knowledge of key administrative processes such as leadership, communication, and decision making.				

UNIT - I	INTRODUCTION TO PUBLIC ADMINISTRATION	9
Meaning, nature and scope of Public Administration; importance of Public Administration; Public Administration as an art and science; role of Public Administration in a welfare state; evolution and growth of Public Administration.		
UNIT - II	**NEW TRENDS IN PUBLIC ADMINISTRATION**	**9**
New Public Administration – meaning and objectives; New Public Management – concept and features; Public Administration and Private Administration – meaning; similarities and differences; changing role of the government.		
UNIT - III	**APPROACHES AND INTERDISCIPLINARY RELATIONS**	**9**
Relationship of Public Administration with Political Science, History and Sociology; Classical Approach – meaning and features; Scientific Management Approach – principles and limitations.		
UNIT – IV	**ADMINISTRATIVE THEORIES**	**9**
Bureaucratic Approach – Max Weber and features of bureaucracy; merits and demerits of bureaucracy; Human Relations Approach – Elton Mayo and Hawthorne Experiments; Ecological Approach – Fred W. Riggs and his model.		
UNIT - V	**ADMINISTRATIVE PROCESSES**	**9**
Leadership – meaning, importance, styles and approaches; Communication – meaning, types, process and barriers; Decision Making – meaning, types, techniques and process.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the meaning, nature, scope, and importance of Public Administration.	K2
CO2	Describe the evolution of Public Administration and recent trends such as New Public Administration and New Public Management.	K2

COs	Statements	K-Level
CO3	Illustrate the interdisciplinary relationships of Public Administration and the basic ideas of classical and scientific management approaches.	K2
CO4	Explain major administrative theories and contributions of thinkers like Max Weber, Elton Mayo, and Fred W. Riggs.	K2
CO5	Describe the concepts and processes of leadership, communication, and decision making in public administration.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	-	-	-
CO5	-	-	-	-	-	1	1	2	-	-	-	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
2	Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.

Reference Books

1	R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.
2	Rumki Basu: Public Administration:Concept and Theories, New Delhi:Sterling, 2013

3	R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.

U24GE5X02	CONSTITUTION OF INDIA	L	T	P	C
		3	0	0	3
Course Objectives:	The course introduces students to the historical development and making of the Indian Constitution. It explains the fundamental rights, duties, directive principles, and key constitutional institutions at the Union and State levels.It develops awareness of constitutional values such as secularism, social justice, and minority safeguards for understanding democratic governance.				

UNIT - I	CONSTITUTIONAL BACKGROUND	9
Constitutional development in India from 1909 to 1947; making of the Indian Constitution; Constituent Assembly – composition, role, and functioning.		
UNIT - II	**RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES**	**9**
Fundamental Rights-meaning, significance, and enforcement; Fundamental Duties -purpose and importance; Directive Principles of State Policy-objectives and relevance in governance.		
UNIT - III	**UNION GOVERNMENT**	**9**
President-powers and functions; Parliament-structure, composition, and functions; Supreme Court-composition, powers, and role in the constitutional framework.		
UNIT – IV	**STATE GOVERNMENT**	**9**
Governor -powers and functions; State Legislature-composition and functions; High Court -structure, powers, and jurisdiction.		
UNIT - V	**CONSTITUTIONAL VALUES**	**9**
Secularism-meaning and significance; Social Justice-principles and application; safeguards for minorities under the Constitution.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the historical development and the making of the Indian Constitution.	K2
CO2	Infer the role and functioning of the Constituent Assembly.	K2

COs	Statements	K-Level
CO3	Illustrate the Fundamental Rights, Fundamental Duties, and Directive Principles of State Policy.	K2
CO4	Compare the structure, powers, and functions of key Union and State government institutions including the President, Parliament, Supreme Court, Governor, State Legislature, and High Courts.	K2
CO5	Describe constitutional values such as secularism, social justice, and safeguards for minorities in India.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	2	-	-	1	-	-	-	-	-
CO2	-	-	-	-	-	2	-	-	1	-	-	-	-	-
CO3	-	-	-	-	-	2	-	-	2	-	-	-	-	-
CO4	-	-	-	-	-	2	2	-	2	-	-	-	-	-
CO5	-	-	-	-	-	1	2	2	3	1	-	-	-	-
CO	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Basu. D.D.: Introduction to Indian Constitution ; Prentice Hall; New Delhi
2	Kapur. A.C: Indian Government and Political System; S.Chand and Company Ltd., New Delhi.

Reference Books

1	Johari J.C.: Indian Politics, Vishal Publications Ltd, New Delhi
2	Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

U24GE5X03	PUBLIC PERSONNEL ADMINISTRATION	L	T	P	C
		3	0	0	3
Course Objectives:	The course introduces students to the meaning, scope, and importance of personnel administration and different types of personnel systems.It also explains recruitment, training, promotion, service conditions, employee relations, and compensation in public organizations.				

UNIT - I	INTRODUCTION TO PERSONNEL ADMINISTRATION	9
Meaning, scope, and importance of personnel administration; types of personnel systems – bureaucratic, democratic, and representative systems.		
UNIT - II	**CIVIL SERVANTS AND ADMINISTRATION**	**9**
Generalist vs. specialist roles; relationship of civil servants with the political executive; integrity and ethical conduct in administration.		
UNIT - III	**RECRUITMENT, TRAINING, AND PROMOTION**	**9**
Recruitment – direct recruitment and recruitment from within; training – kinds and objectives; promotion policies and procedures.		
UNIT – IV	**SERVICES AND SERVICE CONDITIONS**	**9**
All India Services – structure and functions; service conditions of personnel; role and functions of the State Public Service Commission.		
UNIT - V	**EMPLOYEE RELATIONS AND COMPENSATION**	**9**
Employer-employee relations; wage and salary administration; allowances, benefits, and incentives.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Illustrate the meaning, scope, importance, and types of personnel administration systems.	K2
CO2	Infer the role of civil servants, their relationship with the political executive, and ethical standards in administration.	K2

COs	Statements	K-Level
CO3	Explain the processes of recruitment, training, and promotion in public services.	K2
CO4	Describe the structure, functions, and service conditions of All India Services and State Public Service Commissions.	K2
CO5	Compare employer–employee relations and the principles of wage, salary administration, allowances, and benefits.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO	-	-	-	-	-	**2**	**2**	**2**	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Stahl Glean O: Public Personnel Administration
2	Parnandikar Pai V.A: Personnel System for Development Administration
3	Bhambhiru . P: Bureaucracy and Policy in India

Reference Books

1	Dwivedi O.P and Jain R.B: India's Administrative state.
2	Muttalis M.A: Union Public Service Commission.

3	Bhakara Rao .V: Employer Employee Relations in India

U24GE5X04	ADMINISTRATIVE THEORIES	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the concepts, scope, and evolution of Public Administration.To study organizational theories, behaviour, motivation, leadership, and decision-making.To learn the contributions of major administrative thinkers and their relevance to modern administration.				

UNIT - I	**INTRODUCTION TO PUBLIC ADMINISTRATION**	**9**
Meaning, nature, scope, and significance of Public Administration; Evolution of Public Administration as a discipline; Identity and status of Public Administration.		
UNIT - II	**ORGANIZATIONAL THEORIES**	**9**
Theories of organization with special reference to Scientific Management Theory, Classical Organizational Model, and Human Relations Theory.		
UNIT - III	**ORGANIZATIONAL BEHAVIOUR AND DESIGN**	**9**
Organizational goals and behaviour; Groups in organizations and group dynamics; Principles and approaches to organizational design.		
UNIT – IV	**MOTIVATION, LEADERSHIP, AND DECISION-MAKING**	**9**
Motivation theories: content, process, and contemporary theories; Leadership theories: traditional and modern approaches; Decision-making process and techniques.		
UNIT - V	**ADMINISTRATIVE THINKERS**	**9**
Contributions of Kautilya, Woodrow Wilson, C. I. Barnard, and Peter F. Drucker to administrative thought.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Interpret the concepts, scope, importance, and development of Public Administration as an academic discipline.	K2
CO2	Summarize the fundamental organizational theories including Scientific Management, Classical, and Human Relations approaches.	K2
CO3	Discuss organizational objectives, group behaviour, group processes, and organizational design concepts.	K2

COs	Statements	K-Level
CO4	Outline motivation theories, leadership styles, and the methods involved in administrative decision-making.	K2
CO5	Describe the ideas and contributions of prominent administrative thinkers and their relevance to administration.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO	-	-	-	-	-	**2**	**2**	**2**	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Crozior M : The Bureaucratic phenomenon (Chand)
2	Blau. P.M and Scott. W : Formal Organizations (RKP)
3	Presthus. R : The Organizational Society (MAC)

Reference Books

1	Alvi, Shum Sun Nisa : Eminent Administrative Thinkers.
2	Keith Davis : Organization Theory (MAC)

U24GE5X05	INDIAN ADMINISTRATIVE SYSTEM	L	T	P	C
		3	0	0	3
Course Objectives:	To provide students with a comprehensive understanding of the structure, functioning, and constitutional framework of Indian administration, and to develop insight into contemporary administrative issues, governance, and accountability mechanisms.				

UNIT - I	**EVOLUTION AND CONSTITUTIONAL FRAMEWORK OF INDIAN ADMINISTRATION**	**9**
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India.		
UNIT - II	**DISTRICT AND LOCAL ADMINISTRATION IN INDIA**	**9**
Role, powers, and functions of the District Collector. Relationship between the District Collector and the Superintendent of Police. Role of the Block Development Officer in planning and implementation of development programmes. Structure and functioning of local government institutions.		
UNIT - III	**PANCHAYATI RAJ AND URBAN LOCAL GOVERNANCE**	**9**
Main features of the 73rd Constitutional Amendment Act, 1992 with special reference to Panchayati Raj Institutions. Salient features of the 74th Constitutional Amendment Act, 1992 relating to urban local bodies.		
UNIT – IV	**CONTEMPORARY ISSUES IN INDIAN ADMINISTRATION**	**9**
Coalition politics in India and its impact on governance and administration. Concepts of integrity and vigilance in Indian administration, including mechanisms to promote ethical governance.		
UNIT - V	**CORRUPTION AND INSTITUTIONAL MECHANISMS FOR ACCOUNTABILITY**	**9**
Nature and causes of corruption in public administration. Ombudsman system in India. Structure, powers, and functions of Lokpal and Lokayukta.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level

COs	Statements	K-Level
CO1	Illustrate the evolution and constitutional framework of the Indian administrative system.	K2
CO2	Describe the roles and functions of district and local administrative institutions in India	K2
CO3	Summarize the features of the 73rd and 74th Constitutional Amendment Acts and their significance in local governance.	K2
CO4	Discuss contemporary issues such as coalition politics, integrity, and vigilance in Indian administration.	K2
CO5	Explain the nature of corruption and the role of Lokpal, Lokayukta, and ombudsman institutions in ensuring accountability.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	3	-	3	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO	-	-	-	-	-	**2**	**2**	**2**	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	S.R. Maheswari : Indian Administration
2	Khera. S.S : Administration in India
3	Ramesh K. Arora : Indian Public Administration

Reference Books

1	T.N. Chaturvedi : State administration in India
2	Basu, D.D : Introduction to the Constitution of India

U24GE5X06	PUBLIC POLICY ADMINISTRATION	L	T	P	C
		3	0	0	3
Course Objectives:	To familiarize students with different approaches to policy analysis, enabling them to critically assess and select appropriate frameworks for evaluating public policies.				

UNIT - I	FOUNDATIONS AND SCOPE OF PUBLIC POLICY	**9**
Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration.		
UNIT - II	APPROACHES AND MODELS OF POLICY ANALYSIS	**9**
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model		
UNIT - III	PUBLIC POLICY PROCESS AND STAGES OF POLICY MAKING	**9**
Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation.		
UNIT – IV	INSTITUTIONAL ACTORS IN PUBLIC POLICY MAKING	**9**
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.		
UNIT - V	OVERVIEW OF MAJOR PUBLIC POLICIES IN INDIA	**9**
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the meaning, scope, and significance of public policy	K2
CO2	Extend and apply various approaches to policy analysis	K2

COs	Statements	K-Level
CO3	Identify and describe the major stages of the policy-making process	K2
CO4	Examine the roles of key stakeholders in the policy-making process	K2
CO5	Compare the specific public policies, such as the New Economic Policy, Population Policy, Agriculture Policy, and Information Technology Policy	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO2	-	-	-	-	-	2	-	2	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	3	-	-	-	-	-	-
CO4	-	-	-	-	-	3	2	3	-	-	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	-	-	-	-	-
CO	-	-	-	-	-	**2**	**2**	**2**	-	-	-	-	-	-

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Reference Books

1	Rajesh Chakrabarti & Kaushik Sanyal : Public Policy in India, Oxford University Press, 2016
2	Kuldeep Mathur : Public Policy and Politics in India, Oxford University Press, 2016.
3	Bidyutv Chakrabarty: Public Policy: Concept, Theory and Practice, 2015.
4	Pradeep Saxena : Public Policy Administration and Development
5	Sapru R.K. : Public Policy: Formulation, Implementation and Evaluation, Sterling Publishers, 2016.

U24CB5Y01	STATISTICS FOR MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	Provide foundational knowledge in sampling distributions, estimation, hypothesis testing, and both parametric and non-parametric methods, also develop analytical skills in correlation and regression for effective data interpretation and decision making.				
Unit - I	**INTRODUCTION**				**9**
Basic definitions and rules for probability - Conditional probability independence of events - Baye's theorem - Random variables - Moments - Moment generating functions - Probability distributions: Binomial, Poisson, Geometric, Uniform, Exponential 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 (z test) – One sample and two sample tests for means of small samples (t-test) - F-test for two sample standard deviations - ANOVA one way and two-way classification.					
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 - Kruskal Wallis test - One sample run test.					
Unit - V	**CORRELATION AND REGRESSION**				**9**
Correlation - Scatter diagram - Karl Pearson's coefficient of correlation - Coefficient of determination - Rank Correlation (Spearman's rank correlation) - Concept of regression - Regression lines and regression coefficients - Estimation of regression equation - Method of Least Squares - Standard Error of estimate and interpretation of results.					
	Total Periods:				**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Apply the quantitative techniques to obtain objective solutions in business decision-making.	K3
CO2	Use an appropriate analytical technique to solve business problems.	K3
CO3	Construct an appropriate statistical technique to analyse data sets and interpret the results accurately.	K3
CO4	Make use of the relevant analytical and research skills in both research and	K3

COs	Statements	K-Level
	business environments.	
CO5	Develop the statistical techniques to solve problems in workplace settings.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2		1						1	1			
CO2	3	2		1						1	1			
CO3	3	2		1						1	1			
CO4	3	2		1						1	1			
CO5	3	2		1						1	1			
CO	**3**	**2**		**1**						**1**	**1**			

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Richard I. Levin, David S. Rubin, Masood H.Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2	Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.
3	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.
4	T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.

Reference Books

1	Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
2	N. D. Vohra, Business Statistics, Tata McGraw Hill, 2017.
3	Gupta. S.C. and Kapoor. V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand &Sons, New Delhi, 12th Edition, 2020.
4	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4 th Edition, 2012.

U24CB5Y02	DATA MINING FOR BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the concepts of data mining and business intelligence, explore data preprocessing and warehousing, apply major data mining techniques, analyze business decision-making using BI systems, and interpret insights using visualization and reporting tools.				

Unit - I	**INTRODUCTION TO DATA MINING & BUSINESS INTELLIGENCE**	**9**
Basics of Data Mining – KDD Process – Types of Data – Types of Patterns – Importance of Data Mining for Business – Role of BI in Decision Making – BI Architecture – Business Metrics and KPIs – Applications of Data Mining in Marketing, Finance, Retail and Healthcare – Introduction to Real-time BI and Big Data Analytics		
Unit - II	**DATA PREPROCESSING & DATA WAREHOUSING**	**9**
Data Quality – Missing Data Handling – Noise and Outlier Detection – Data Cleaning – Data Integration and Transformation – Discretization and Normalization – Data Reduction Techniques – ETL: Extraction, Transformation and Loading – Data Warehouse Characteristics – OLTP vs OLAP – Star and Snowflake Schemas – Fact and Dimension Tables – OLAP Operations (Roll-up, Drill-down, Slice, Dice, Pivot).		
Unit - III	**DATA MINING TECHNIQUES**	**9**
Classification: Decision Trees, Naïve Bayes, k-Nearest Neighbour – Prediction and Regression Basics – Clustering: k-Means, Hierarchical Clustering – Cluster Evaluation – Association Rule Mining: Apriori and FP-Growth Algorithms – Support, Confidence and Lift – Model Evaluation Measures: Accuracy, Precision, Recall, F-measure, ROC and AUC – Overfitting and Model Pruning.		
Unit – IV	**BUSINESS INTELLIGENCE SYSTEMS & TOOLS**	**9**
BI Lifecycle – Data Analysis and Insights – Principles of Data Visualization – Dashboards and Scorecards – Static and Interactive Reporting – KPI Dashboards – Introduction to BI Tools (Power BI, Tableau, Qlik Sense) – Basic Operations: Data Importing, Modeling and Visualization – SQL Server BI Tools: SSIS, SSAS, SSRS – Role of OLAP Cubes in BI.		
Unit - V	**APPLICATIONS OF DATA MINING IN BUSINESS**	**9**
Customer Analytics – Customer Segmentation – Churn Prediction – Lifetime Value Prediction – Marketing Analytics: Recommendation Systems, Cross-sell and Up-sell Analysis – Fraud Detection and Risk Analysis – Retail Analytics: Market Basket Analysis, Demand Forecasting – Case Studies in Banking, Healthcare, Telecom and E-commerce – Ethical, Legal and Privacy Issues in Data Mining..		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Outline the fundamentals of data mining and business intelligence concepts.	K2
CO2	Explain data preprocessing techniques and data warehouse operations for analytical processing	K2

COs	Statements	K-Level
CO3	Apply classification, clustering, and association rule mining techniques for business datasets.	K3
CO4	Utilize business intelligence tools for reporting, visualization, and KPI dashboard development.	K3
CO5	Analyze real-world business problems and interpret insights using data mining applications.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	2	1	2	1	-	1	1	1	1	1	2	1	1
CO2	2	2	2	2	2	-	1	1	1	1	1	2	2	1
CO3	3	3	2	3	3	1	1	1	2	1	1	3	2	1
CO4	2	2	3	3	3	1	1	1	2	2	1	2	3	2
CO5	3	3	2	3	2	2	2	2	2	2	1	3	2	2
CO	**2.40**	**2.40**	**2.00**	**2.60**	**2.20**	**1.33**	**1.20**	**1.20**	**1.60**	**1.40**	**1.00**	**2.40**	**2.00**	**1.40**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Jiawei Han, Jian Pei, Hanghang Tong, Data Mining: Concepts and Techniques, Fourth Edition, Morgan Kaufmann / Elsevier, 2022.
2	Galit Shmueli, Peter C. Bruce, Peter Gedeck, Nitin R. Patel, Inbal Yahav, Data Mining for Business Analytics: Concepts, Techniques and Applications in Python, Second Edition, Wiley, 2023.
3	Dr. Jyotiranjan Hota, Data Mining and Business Intelligence: Data-Driven Strategy for Business Transformation, First Edition, Wiley / Academic Press, 2025
4	Ivo D. Dinov, Data Science and Predictive Analytics: Biomedical and Health Applications Using R, Second Edition, Springer, 2023.

Reference Books

1	Foster Provost, Tom Fawcett, Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking, Second Edition, O'Reilly Media, 2023.
2	Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst, Second Edition, Wiley, 2023.
3	Jack A. Hyman, Luca Massaron, Paul McFedries et al., Data Analytics and Visualization All-in-One for Dummies, Wiley, 2024
4	R.N. Prasad, Seema Acharya, Fundamentals of Business Analytics, First Edition, Wiley India, 2011.
5	Subhash Sharma, Applied Business Analytics: Integrating Business Process, Big Data, and Advanced Analytics, First Edition, McGraw-Hill Education, 2017.

U24CB5Y03	HUMAN RESOURCE ANALYTICS	L	T	P	C
		3	0	0	3
Course Objectives:	To introduce the foundations and importance of Human Resource Analytics, explain the role of HR data and metrics in decision-making, illustrate analytical and predictive methods for workforce insights, and describe the strategic and ethical implications of applying analytics in HR functions.				
Unit - I	**INTRODUCTION TO HR ANALYTICS**	**9**			
Understanding HR Analytics – Evolution of HR Analytics – Role of Data in HR Decision Making – Types of HR Data – HR Metrics and KPIs – HR Scorecards – Importance of Evidence-Based HR – Applications of HR Analytics in Recruitment, Performance Management, Retention and Engagement.					
Unit - II	**HR DATA MANAGEMENT & METRICS**	**9**			
HRIS: Concepts and Components – Workforce Data Sources – Data Cleaning and Validation – Employee Demographic Data, Job Data, Compensation Data – HR Metrics: Recruitment Metrics, Training Metrics, Performance Metrics, Retention Metrics – HR Dashboards – Data Visualization for HR Reporting.					
Unit - III	**ANALYTICAL METHODS IN HR**	**9**			
Descriptive Analytics in HR – Workforce Trends and Pattern Identification – Predictive Analytics Concepts – Regression Analysis for HR – Predicting Attrition, Performance, Absenteeism – Identifying High-Potential Employees – Predictive Models for Hiring and Promotion – Data Interpretation for HR Decision Support.					
Unit – IV	**HR ANALYTICS TOOLS & APPLICATIONS**	**9**			
Introduction to HR Analytics Tools (Excel, Power BI, Tableau, SPSS, Python basics) – HR Dashboard Creation – Employee Survey Analytics – Competency Mapping Analytics – Talent Acquisition Analytics – Compensation Analytics – Case Studies in HR Analytics Implementation – Challenges in Deploying HR Analytics.					
Unit - V	**STRATEGIC & ETHICAL DIMENSIONS OF HR ANALYTICS**	**9**			
Strategic HR Analytics – Linking HR Analytics to Business Outcomes – Workforce Planning and Optimization – ROI of HR Initiatives – Ethical Issues in HR Data – Data Privacy, Bias, Transparency & Fairness – Responsible Use of Analytics – Future Trends in People Analytics and AI in HR.					
	Total Periods:	**45**			

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the fundamental principles and applications of Human Resource Analytics.	K2
CO2	Discuss HR data sources, HR metrics, and analytical reporting for workforce insights.	K2
CO3	Interpret HR analytical methods for predicting employee performance and retention.	K2
CO4	Summarize the use of HR analytics tools for visualization, dashboards, and decision support.	K2
CO5	Illustrate strategic, ethical, and organizational dimensions of HR Analytics in real-world contexts.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	-	-	3	-	3	3	-	2	2	3	3	3
CO2	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO3	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO4	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO5	3	3	-	-	3	-	3	3	-	3	3	3	3	3
CO	**3.00**	**3.00**	**-**	**-**	**3.00**	**-**	**3.00**	**3.00**	**-**	**2.80**	**2.80**	**3.00**	**3.00**	**3.00**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Jonathan Ferrar, David Green, Excellence in People Analytics: How to Use Workforce Data to Create Business Value, Second Edition, Kogan Page, 2023.
2	Ben Waber, People Analytics: How Social Sensing Technology Will Transform Business and What It Tells Us About the Future of Work, Updated Edition, FT Press / Pearson, 2022.
3	JDipak Kumar Bhattacharyya, HR Analytics: Understanding Theories and Applications, Second Edition, Sage Publications India, 2023.
4	Martin R. Edwards, Kirsten Edwards, Predictive HR Analytics: Mastering the HR Metric, Second Edition, Kogan Page, 2023.

Reference Books

1	Tracey Smith, HR Analytics: The What, Why and How, Second Edition, Kogan Page, 2023.
2	Bernard Marr, Data-Driven HR: How to Use Analytics and Metrics to Drive Performance, Updated Edition, Kogan Page, 2022.
3	Jean Paul Isson, Jesse Harriott, People Analytics in the Era of Big Data: Changing the Way You Attract, Acquire, Develop and Retain Talent, Second Edition, Wiley, 2022.

U24CB5Y04	MARKETING AND SOCIAL MEDIA WEB ANALYTICS	L	T	P	C
		3	0	0	3
Course Objectives:	To showcase the opportunities that exist today to leverage the power of the marketing, web and social media				

Unit - I	**MARKETING ANALYTICS**	**9**
Basics of marketing analytics-Marketing budget and performance measurement-Marketing metrics and their applications-Financial impact of marketing strategies-Geographic analysis and data exploration-Market basket analysis-Customer Lifetime Value (CLV) and Marketing ROI Analysis.		
Unit - II	**COMMUNITY BUILDING AND MANAGEMENT**	**9**
Evolution and basics of social media-Goals and audience of social media-Influencers and social media theories-Community building strategies-Promoting and linking social media platforms-Viral marketing and digital PR-Managing online identity and communities-Social media for business use-Social Media Content Strategy and Engagement Planning-Social Media Crisis Management and Community Moderation		
Unit - III	**SOCIAL MEDIA POLICIES AND MEASUREMENTS**	**9**
Social media policies and etiquette-Privacy and ethical issues-Future trends in social media-Social media tracking and analytics-Campaign performance analysis-Understanding user behavior on social platforms-Sentiment Analysis and Social Listening Techniques.		
Unit – IV	**WEB ANALYTICS**	**9**
Introduction to web analytics-Data collection methods-Qualitative and business analysis-KPIs and planning-Web analytics strategy components-Web data analysis and reporting-User Journey Mapping and Conversion Funnel Analysis-A/B Testing and Website Optimization Techniques		
Unit - V	**SEARCH ANALYTICS**	**9**
Search engine optimization (SEO)-User engagement and behaviour-Web traffic and usability analysis-Content management systems-Data visualization and RSS feeds-Mobile platforms and user-centered design-Understanding search pattern-Keyword Research and Competitive Search Analysis.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level

CO1	Identify fundamental concepts tools and metrics of marketing web and social media analytics related to performance measurement data interpretation and digital marketing decision making	K3
CO2	Outline the structure evolution and purpose of social media platforms community building practices and management strategies including policies ethics and privacy considerations	K2
CO3	Analyze marketing web and social media data to understand user behavior engagement patterns and campaign performance effectiveness	K3
CO4	Develop data driven insights and strategies to support marketing decision making and solve marketing related problems	K3
CO5	Build basic analytical reports dashboards and summaries to monitor key performance indicators for marketing web and social media analytics	K3

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	2	-	1	-	1	2	2	2	-	2	2	2	2	1
CO2	1	-	1	-	1	2	1	1	-	1	1	1	1	-
CO3	3	-	3	-	3	3	3	3	-	3	3	3	3	3
CO4	2	2	3	-	3	-	1	1	-	1	1	1	2	1
CO5	1	1	2	-	2	-	2	2	-	2	2	2	2	2
CO	**1.80**	**1.50**	**2.00**	**-**	**2.00**	**2.33**	**1.80**	**1.80**	**-**	**1.80**	**1.80**	**1.80**	**2.00**	**1.75**

Text Books

1	Social Media and Web Analytics – Gupta, Mukul & Gupta et al. *(2025 edition)* – Comprehensive coverage of social media analytics, web metrics, tools, and integration of web & social analytics.
2	Web and Social Media Analytics – M. M. Sankar, Fezeena Khadir & Senthilmurugan *(2023)* – Focuses specifically on analytics practices for web and social media including recent tools & trends.
3	Essentials of Marketing Analytics – Joseph F. Hair, Dana E. Harrison & Haya Ajjan *(Recent edition)* – Covers fundamental marketing analytics concepts and models, useful for Units I, IV & V

Reference Books

1	Digital Marketing and Social Media Web Analytics – Bharti Publications *(Latest edition)* – Designed for students studying digital marketing and analytics basics including web and social data.
2	Social Media Analytics and Practical Applications – Kumar & Qiu *(Routledge)* – Focus on practical techniques and case examples of social media analytics in business.
3	Social Analytics: Network and Text Methods with NodeXL and R – Miranda *(Prospect Press)* – Good for Unit II/III topics involving analysis tools (network/text analytics).

U24CB5Y05	**OPERATION AND SUPPLY CHAIN ANALYTICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Course Objective:	To provide in-depth knowledge of advanced quantitative models and analytical methods used in operations and supply chain management and to understand recent developments in the field				

Unit - I	**INTRODUCTION**	**9**
Basics of analytics including descriptive predictive and prescriptive analytics-Concept of data driven supply chains-Transformation of supply chains using analytics-Challenges in implementation and implementation roadmap-Supply Chain Analytics Architecture and Data Sources.		
Unit - II	**WAREHOUSING DECISIONS**	**9**
Mathematical programming models for warehouse decisions-Facility location models such as P median and dynamic location models-Layout planning and space determination methods-Heuristic approaches for warehouse optimization-Automation and Technology Enabled Warehouse Analytics.		
Unit - III	**INVENTORY MANAGEMENT**	**9**
Inventory aggregation and lot sizing models-Multi echelon inventory systems-Aggregate inventory planning-Supply chain risk analysis including transit supply and delivery risks-Risk pooling strategies in inventory management-Demand Forecasting Models for Inventory Control.		
Unit – IV	**TRANSPORTATION NETWORK MODELS**	**9**
Basics of graphs and network models-Shortest path minimal spanning tree and maximum flow problems-Transportation and transshipment models-Set covering and set partitioning problems-Traveling salesman and vehicle routing heuristics-Scheduling algorithms for supply chain operations-Network Design and Capacity Planning Models.		
Unit - V	**MCDM MODELS**	**9**
Multi criteria decision making models in supply chain management-Analytic Hierarchy Process and Analytic Network Process-Data Envelopment Analysis-Fuzzy logic based decision models-TOPSIS and its applications in supply chains-Integrated MCDM Approaches for Supply Chain Partner Selection		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

COs	**Statements**	**K-Level**
CO1	Analyze supply chain data using descriptive predictive and prescriptive analytics to evaluate operational performance and identify patterns in inventory transportation and warehousing systems	K4
CO2	Extend quantitative supply chain models to address multi echelon inventory dynamic lot sizing and risk considerations under real world constraints	K2
CO3	Explain the principles and functioning of transportation network models facility location methods and inventory management techniques used in supply chain	K2

COs	Statements	K-Level
	analytics	
CO4	Outline multi criteria decision making models such as AHP ANP DEA fuzzy logic and TOPSIS and their role in supporting supply chain decisions	K2
CO5	Apply analytical tools techniques and optimization methods to solve warehousing inventory transportation and supply chain decision problems	K3

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	1	-	1	1	2	2	-	2	2	2	1	1
CO2	1	-	1	-	2	3	1	1	-	1	1	1	1	-
CO3	3	-	3	-	3	3	3	2	-	3	2	3	3	2
CO4	2	3	2	-	2	-	1	1	-	1	1	2	1	1
CO5	1	2	3	-	3	-	2	2	-	2	2	3	2	3
CO	**1.80**	**2.00**	**2.00**	**-**	**2.20**	**2.33**	**1.80**	**1.60**	**-**	**1.80**	**1.60**	**2.20**	**1.60**	**1.75**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Supply Chain and Operations Analytics: Areas, Analytics Formulations, and Results — Bhattacharya, Maitra & Bhattacharyya (Routledge / 2022–2024). A modern, application-focused book that covers analytics formulations across supply chain and operations.
2	Introduction to Supply Chain Analytics — Dmitry Ivanov (Springer, recent edition) — concise, up-to-date treatment of management, modeling and technology perspectives in SCA. Good as a companion text.

Reference Books

1	Supply Chain Analytics — T. A. S. Vijayaraghavan (Wiley India, 2021) — practical coverage of analytics techniques applied to forecasting, inventory and distribution.
2	Supply Chain Analytics: Concepts, Techniques and Applications (Springer / Palgrave style titles, ~2021–2023) — an accessible introduction to concepts, methods and case studies in SCA.

U24CB5Y06	FINANCIAL ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives:	To provide knowledge of corporate finance and financial market analytics using quantitative methods for investment evaluation, risk analysis, and portfolio management. It introduces time-series analysis, technical indicators, and basic machine learning techniques for market prediction. The course also develops skills to design and evaluate credit risk models for informed financial decision-making.

Unit - I	CORPORATE FINANCE ANALYSIS	9
Introduction to corporate financial analytics – Basics of financial predictive modeling – Project evaluation and cash flow estimation – Cost of capital and sensitivity analysis – Indifference point and financial break-even modeling – Capital budgeting techniques: Payback Period, NPV, IRR, MIRR – Scenario and what-if analysis – Financial distress and bankruptcy prediction: Beaver's ratios, Ohlson logistic model, Altman Z-score and early warning indicators.		
Unit - II	**FINANCIAL MARKET**	**9**
Risk and return estimation for bonds and stocks – Adjustments for stock splits, dividends, and mergers – Multi-series visualization – Data acquisition from web portals and APIs – Data cleaning and normalization – Nature of financial time-series data – Trend and seasonality – Exponential Weighted Moving Averages – Value at Risk (VaR) – ARMA, ARCH, and GARCH models for volatility.		
Unit - III	**PORTFOLIO ANALYSIS**	**9**
Modern Portfolio Theory – Risk–return trade-off – CAPM and beta estimation – Sharpe ratio and portfolio performance measures – Markowitz mean–variance optimization – Cluster analysis for portfolio categorization – Introduction to derivatives – Binomial option pricing – Black–Scholes model – Option implied volatility and basic Greeks.		
Unit – IV	**TECHNICAL ANALYSIS**	**9**
Technical indicators and chart patterns – RSI, ROC, MACD, Moving Averages, Candlestick charts and trend analysis – Design and simulation of trading strategies – Fundamental vs technical signals – Machine learning for price prediction – ANN and SVM – Model validation and overfitting in financial data.		
Unit - V	**CREDIT RISK ANALYSIS**	**9**
Foundations of credit risk – Data pre-processing and feature engineering – Decision trees for risk classification – Logistic regression for credit scoring – Evaluation of credit models using accuracy, ROC, and AUC – Bias and explainability in financial models – Design of simple end-to-end credit risk decision systems.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO01	Apply corporate finance analytics techniques to evaluate investment projects by estimating cash flows, analyzing cost of capital, and performing capital budgeting using Payback, NPV, IRR, and MIRR methods, enabling practical financial decision-making and identification of financial viability in corporate scenarios.	K3
CO02	Analyze financial market data to estimate and predict risk and return for bond and stock investments by performing data acquisition, cleansing, visualization, and time-series modeling using EWMA, VaR, ARMA, ARCH, and GARCH techniques for volatility assessment.	K4
CO03	Evaluate portfolio performance and associated risk by applying modern portfolio theory concepts such as CAPM, Sharpe ratio, and mean–variance optimization, and by using clustering techniques and option pricing models to assess diversified investment portfolios.	K4
CO04	Examine market trends and price movements by interpreting technical indicators and chart patterns, simulating trading strategies, and applying machine learning models such as ANN and SVM to predict share prices while assessing model accuracy and overfitting.	K4
CO05	Develop credit risk assessment models by pre-processing financial data and applying decision tree and logistic regression techniques, and evaluate credit scoring performance using standard metrics to support data-driven financial decision systems.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	1	1	-	-	-	-	-	-	2	1	-
CO2	2	2	-	2	1	-	-	-	-	-	-	2	2	-
CO3	1	2	1	1	1	-	-	-	-	-	-	1	2	1
CO4	1	2	2	2	2	-	-	-	-	-	-	1	2	2
CO5	2	2	2	1	2	-	-	-	-	-	-	2	2	2
CO	**1.60**	**1.80**	**1.67**	**1.40**	**1.40**	**-**	**-**	**-**	**-**	**-**	**-**	**1.60**	**1.80**	**1.67**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John C. Hull, Options, Futures, and Other Derivatives, Pearson Education, 2022
2	James Chen, Essentials of Financial Analytics: Data-Driven Finance and Investment, Wiley, 2023.
3	Tomasz R. Bielecki and Marek Rutkowski, Credit Risk: Modeling, Valuation and Hedging , Springer, 2022..

Reference Books

1	Marcos López de Prado, Machine Learning for Asset Managers, Cambridge University Press, 2022..
2	Ben Sita, Financial Modeling in Python, Wiley, 2023.

U24GE5Z01	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To provide comprehensive knowledge on sustainable development principles and their integration into planning, design, operation and management of infrastructure systems while ensuring environmental protection, social equity and economic viability.				

Unit - I	**CONCEPT OF SUSTAINABLE DEVELOPMENT**	**9**
Fundamental concepts and evolution of sustainable development. Environmental, social and economic pillars of sustainability and the triple bottom line approach. Sustainability indicators. UN Sustainable Development Goals and their linkage to infrastructure growth. Impacts of climate change on infrastructure systems and adaptive planning strategies. Environmental Impact Assessment and Life Cycle Assessment methodologies for infrastructure evaluation. Concepts of carbon neutrality and sustainable resource efficiency in infrastructure projects.		
Unit - II	**ECO-URBAN INFRASTRUCTURE**	**9**
Principles of sustainable urban planning and integrated land use development. Smart cities mission, intelligent urban services and digital infrastructure. Public transportation systems, non-motorized transport and transit-oriented development. Green building concepts, sustainable housing strategies and rating systems such as LEED and GRIHA. Low-impact development techniques and urban heat island mitigation measures. Urban resilience planning and inclusive infrastructure for equitable community development.		
Unit - III	**SUSTAINABLE WATER AND WASTE SYSTEMS**	**9**
Sustainable water resource planning, water supply systems and demand-side management. Rainwater harvesting, aquifer recharge and watershed management practices. Wastewater treatment technologies, reuse strategies and decentralized sanitation systems. Integrated solid waste management and circular economy principles. Resource recovery from waste and waste-to-energy technologies. Plastic waste management and sustainable material recovery systems.		
Unit – IV	**GREEN ENERGY AND CLEAN TECHNOLOGY**	**9**
Application of renewable energy systems including solar, wind, biomass and hybrid energy solutions in infrastructure. Energy efficiency measures and green technologies in buildings and utilities. Sustainable transportation planning, electric vehicles, alternative fuels and mass transit systems. Carbon footprint analysis, greenhouse gas mitigation and climate action strategies. Energy auditing and demand-side energy management. Concepts of green hydrogen and emerging clean energy technologies. .		
Unit - V	**RESILIENT AND SMART INFRASTRUCTURE**	**9**
Concept of resilient infrastructure and disaster risk reduction strategies. Climate-resilient design approaches and adaptation techniques for infrastructure systems. Smart infrastructure technologies including IoT-enabled monitoring, GIS-based planning and data-driven decision making. Public–Private Partnership (PPP) frameworks in sustainable infrastructure development. Infrastructure financing mechanisms and green bonds. Case studies on sustainable and resilient infrastructure projects.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Explain principles of sustainable development, SDGs, EIA and LCA in infrastructure projects.	K2
CO2	Apply sustainable urban planning concepts including green buildings, smart cities and public transport systems.	K3
CO3	Analyze sustainable water, waste management and circular economy practices in infrastructure systems.	K4
CO4	Illustrate renewable energy, sustainable transportation and carbon reduction strategies	K2
CO5	Develop resilient and smart infrastructure solutions considering societal, environmental and economic factors	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze

CO - PO Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	2	1	2	1	2	3	1	-	1	2	-	-	-
CO2	3	2	3	2	2	2	3	1	2	1	2	-	-	-
CO3	2	3	3	2	2	2	3	1	2	1	2	-	-	-
CO4	3	2	3	2	2	2	3	1	1	1	2	-	-	-
CO5	2	3	3	2	2	3	3	2	2	2	3	-	-	-
CO	3	2	3	2	2	2	3	1	1	1	2	-	-	-

Text Books

1	Grigg, N. S. (1988). Infrastructure engineering and management (1st ed.). Wiley-Interscience. ISBN-13: 9780471849742.
2	Proag, V. (2021). Infrastructure planning and management: An integrated approach (1st ed.). Springer International Publishing. ISBN-13: 978-3-030-48558-0.

Reference Books

1	Theis, T., & Tomkin, J. (2018). Sustainability: A comprehensive foundation (1st ed.). 12th Media Services. ISBN-13: 9781680921533.
2	Mulder, K. (2006). Sustainable development for engineers: A handbook and resource guide (1st ed.). Routledge. ISBN-13: 9781874719199.

3	Rogers, P. P., Jalal, K. F., & Boyd, J. A. (2007). An introduction to sustainable development (1st ed.). Earthscan. ISBN-13: 9781844075218.

U24GE5Z02	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To impart knowledge on ecological principles, sustainable resource management, smart irrigation, waste-to-energy technologies, and sustainability assessment for developing environmentally responsible and resilient agricultural systems.				

Unit	Title	Periods
Unit - I	**ECOLOGICAL AND SUSTAINABLE APPROACHES IN MODERN AGRICULTURE**	**9**
Ecosystem Concepts and Structure – Biotic and Abiotic components of Ecosystem - Ecosystem Processes - Energy Flow and Ecological Pyramid - Ecological services and agriculture – Industrial Agriculture and Food System Challenges–Technology-driven intensification vs ecological imbalance, Life Cycle Assessment (LCA) tools for food systems - Concept and Dimensions of Sustainability - Characteristics and Practices of Sustainable Agriculture - Regenerative vs. Sustainable Agriculture Systems - Future-Ready Ecological Agriculture.		
Unit - II	**SUSTAINABLE SOIL, NUTRIENT AND PEST MANAGEMENT**	**9**
Concept of Sustainable Soil - Soil Organic Matter & Carbon Management - Soil Degradation & Restoration - Sustainable Nutrient Management – Principles - Integrated & Precision Nutrient Management - Soil–Plant–Microbe Interactions - Sustainable Pest Management – Concepts - Ecological & Biological Pest Control - Emerging Innovations & Integrated Approaches.		
Unit - III	**WATER MANAGEMENT AND SMART IRRIGATION IN AGRICULTURE**	**9**
Soil Water Dynamics in Climate - Plant Yield Response to Water & Water Productivity - Reducing Evaporation - Enhancing Soil Moisture Conservation - Rainwater Harvesting & Nature-Based Solutions - Irrigation Scheduling , Decision Support System - Improving Agricultural Water Productivity - Localized & Micro-Irrigation Systems - Fertigation - Nutrient–Water Integration - Advanced Irrigation Systems & Sustainable Water Use Innovations.		
Unit – IV	**ENERGY AND AGRICULTURAL WASTE MANAGEMENT**	**9**
Introduction to Agricultural Wastes - Composition and Characterization of Agricultural Wastes - Sustainable Technologies for Waste Management - Value-Added Products from Agricultural Wastes - Renewable Energy from Agricultural Wastes - Advanced Waste-to-Energy Technologies - Circular Economy & Resource Optimization - Case Studies & Emerging Trends.		
Unit - V	**EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS**	**9**
Introduction to Sustainability in Agriculture - Principles and Dimensions of Sustainable Agriculture - Indicators of Sustainability in Agriculture - On-Farm Evaluation of Agro ecosystem Sustainability - Alternative Agriculture: Concepts & Approaches - Alternative Farming Techniques - Community Food Systems: Goals & Components - Sustainable Agriculture to Community Food Systems – Case Studies.		
	Total Periods:	**45**

On completion of the course, the student can

COs	Statements	K - Level
CO1	Discuss ecosystem structure, sustainability principles, and agricultural systems supporting ecological farming practices.	K2
CO2	Apply principles of sustainable soil, nutrient, and pest management to improve agroecosystem productivity and resilience.	K3
CO3	Implement water management and smart irrigation techniques to enhance water use efficiency and crop productivity.	K3
CO4	Analyze agricultural waste and energy strategies to promote circular economy and renewable energy applications.	K4
CO5	Assess alternative agriculture practices and community food system components to determine their role in sustainable development.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create.

CO - PO Matrix

CO Code	Programme Outcome (PO)											PSO		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	2	2	1	2	1	2	3	2	1	-	-	2	1	2
CO2	2	3	2	2	2	2	3	2	1	-	-	2	2	2
CO3	2	3	2	2	3	2	3	1	1	-	-	3	3	2
CO4	2	2	2	2	2	3	3	2	1	1	1	3	2	3
CO5	2	3	2	3	2	3	3	2	2	1	1	2	2	3
Avg.	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**1**	**2**	**2**	**2**

Text Books

1	Sustainable Agriculture for Food Security: A Global Perspective, Balkrishna, A., CRC Press, 2021.
2	Principles of Agronomy for Sustainable Agriculture, Villalobos, F.J. & Fereres, E., Springer, 2016.
3	Agriculture Waste Management and Bioresource: The Circular Economy Perspective — Suruchi Singh, Pardeep Singh, Anu Sharma & Moharana Choudhury, John Wiley & Sons, ISBN 978-1119808138, 2022.

Reference Books

1	Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020.
2	Principles of Sustainable Soil Management in Agroecosystems – Edited by Rattan Lal & B.A. Stewart , CRC Press, ISBN 978-1466513464, 2013.

3	Farm Irrigation Management: Principles and Practices — Latief Ahmad, Kahkashan Qayoom & Sameera Qayoom (CRC Press, 2026).
4	Sustainable Energy Solutions in Agriculture, Bundschuh, J. & Chen, G., CRC Press, 2014.
5	Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

U24GE5Z03	**SUSTAINABLE BIOMATERIALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Course Objectives:	To Impart knowledge of biomaterials and their properties. To learn about Fundamentals aspects of Biopolymers and their applications. To learn about bioceramics and biopolymers. To introduce the students about metals as biomaterials and their usage as implants. To make the students understand the significance of bionanomaterials and its applications.				

Unit - I	**INTRODUCTION TO BIOMATERIALS**	**9**
Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials-Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types-crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials – strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials		
Unit - II	**BIO POLYMERS**	**9**
Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials Polyethylene - Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications		
Unit - III	**BIO CERAMICS AND BIOCOMPOSITES**	**9**
Study of the general properties and classifications of bioceramics including silicate glass, alumina (Al_2O_3), zirconia (ZrO_2), carbon, and calcium phosphates (CaP)- Focus on Resorbable Ceramics- surface reactive ceramics- Biomedical Composites Polymer Matrix Compsite (PMC)-Ceramic Matrix Composite (CMC)-Metal Matrix Composite (MMC) glass ceramics - Applications in orthopedic implants and tissue		

engineering scaffolds are emphasized - The role of composites in enhancing mechanical and biological performance		
Unit – IV	**METALS AS BIOMATERIALS**	**9**
Overview of biomedical metals - their types - properties, and performance in biological environments. Detailed study of stainless steel, cobalt–chromium alloys - titanium alloys – tantalum - Nitinol, and magnesium - based biodegradable metals - Discussion on surface modification for osteointegration, corrosion behavior, and biological tolerance of implant metals - highlights clinical applications in medical implants and devices - Performance evaluation of metals in biological environments.		
Unit - V	**NANOBIOMATERIALS**	**9**
Introduction to Meatllicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites-Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and coats-Applications nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor Bioimaging/Molecular Imaging- Challenges, safety concerns, and future perspectives of nanobiomaterials		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the definition, classification, properties, and biocompatibility requirements of biomaterials and relate them to implant performance and tissue response.	K2
CO2	Describe the structure, properties, polymerization methods, and biomedical applications of major biopolymers including biodegradable and natural polymers.	K2
CO3	Apply knowledge of bioceramics and biocomposites to identify suitable materials for orthopedic implants and tissue engineering applications.	K3
CO4	Apply the properties and behavior of metallic biomaterials to select appropriate metals for specific biomedical implants and devices.	K3
CO5	Explain the characteristics, synthesis, and biomedical applications of nanobiomaterials and their role in advanced diagnostics and therapy.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	2	-	-	-	2	1	-	-	-	1	1	2	1
CO2	3	2	-	-	-	-	-	-	-	-	1	1	1	2
CO3	3	3	2	1	2	2	-	-	-	-	1	2	2	2
CO4	3	3	2	1	2	2	-	-	-	-	1	2	2	2
CO5	3	2	1	1	2	2	1	-	-	-	2	3	3	2
CO	**3**	**2**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani, “Introduction to Biomaterials: Basic Theory with Engineering Applications”, Cambridge University Press, 2014.
2	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, Third Edition, Academic Press, 2013.
3	Joon Park, R. S. Lakes, “Biomaterials: An Introduction”, Third Edition, Springer, 2007.
4	Vasif Hasirci, Nesrin Hasirci, “Fundamentals of Biomaterials”, Springer, 2018.
5	Sujata V. Bhat, “Biomaterials”, Narosa Publishing House, 2002.

Reference Books

1	Donglu Shi, “Introduction to Biomaterials”, Tsinghua University Press, 2006.
2	M. Jaffe, W. Hammond, P. Tolias, T. Arinzeh, “Characterization of Biomaterials”, Woodhead Publishing, 2013.

3	Leopold Javier Rios Gonzalez, “Handbook of Research on Bioenergy and Biomaterials: Consolidated and Green Processes”, Apple Academic Press, 2021.
4	Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad, “Functional Bionanomaterials”, Springer, 2020.
5	Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, Fourth Edition, Elsevier, 2020.

U24GE5Z04	MATERIALS FOR ENERGY SUSTAINABILITY	L	T	P	C
		3	0	0	3
Course Objectives:	To familiarize students with the challenges and demands of energy sustainability by providing fundamental knowledge of electrochemical devices, various types of fuel cells, novel photovoltaic materials, and supercapacitors, along with the materials used in these energy systems and their practical applications in modern energy technologies.				
Unit - I	**SUSTAINABLE ENERGY SOURCES**				**9**
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy.					
Unit - II	**ELECTROCHEMICAL DEVICES**				**9**
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).					
Unit – III	**FUEL CELLS**				**9**
Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) – Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton conducting and anion conducting) – Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).					
Unit – IV	**PHOTOVOLTAICS**				**9**
Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application – Crystalline silicon solar cells – thin film silicon solar cells – multijunction solar cells – amorphous silicon based solar cells – photovoltaic concentrators – Cu(InGa)Se2 solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells – Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials .					
Unit - V	**SUPERCAPACITORS**				**9**
Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) – design of supercapacitor-three and two electrode cell-parameters of supercapacitor-Faradaic and non – Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials – Polyaniline (PANI), a ternary hybrid compositeconductive polypyrrole hydrogels.					
	Total Periods:				**45**

Course Outcomes

On completion of the course, the student can

COs	Statements	K-Level
CO1	Explain the basic concepts and importance of energy sustainability.	K2
CO2	Interpret the principles of different electrochemical devices.	K2
CO3	Explain the working of fuel cells and their application.	K2
CO4	Illustrate various Photovoltaic applications and the materials used in them.	K2
CO5	Interpret the types of supercapacitors and the performance of various materials.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	3	-	2	-	-	2	1	-	-	1	2	-	1	-
CO2	3	-	2	-	1	2	-	-	-	1	2	-	1	1
CO3	3	-	2	-	1	2	-	-	-	1	1	-	1	1
CO4	3	-	2	-	1	2	1	-	-	1	2	-	2	1
CO5	3	-	2	-	1	2	1	-	-	1	1	-	1	-
CO	**3**	-	2	-	1	2	**1**	-	-	**1**	**2**	-	**1**	1

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	John A Kilner, Stephen J Skinner, Stuart J C Irvine and Peter P Edwards –- Functional materials for sustainable energy applications, Woodhead Publishing, Elsevier, 2012.
2	Wolf Vielstich, Arnold Lamm, Hubert A Gasteiger and Harumi Yokokawa –- Handbook of Fuel Cells: Fuel Cell Technology and Applications, Wiley, 2003.
3	Conway B E –- Electrochemical Supercapacitors: Scientific Fundamentals and Technological Applications, Kluwer Academic / Plenum Publishers, New York, 1999.
4	Parnia Forouzandeh, Vignesh Kumaravel and Suresh C Pillai –- Electrode Materials for Supercapacitors: A Review of Recent Advances, Catalysts, 2020.
5	Viswanathan B and Aulice Scibioh M –- Materials for Supercapacitor Applications, CRC Press, 2013.

Reference Books

1	Amanda Ndubuisi, Sara Abouali, Kalpana Singh and Venkataraman Thangadurai –- Recent Advances, Practical Challenges, and Perspectives of Intermediate Temperature Solid Oxide Fuel Cell Cathodes, J. Mater. Chem. A, 2022.
2	Crompton T R –- Batteries reference book, Newners, 3rd Edition, 2002.
3	Neeraj Kant and Pushpendra Singh –- Review of Next Generation Photovoltaic Solar Cell Technology and Comparative Materialistic Development, Materials Today Proceedings, 2022.
4	Peter Wurfel and Uli Wurfel –- Physics of Solar Cells: From Principles to New Concepts, Wiley-VCH, 2016.
5	François Beguin and Elzbieta Frackowiak –- Handbook of Supercapacitors, Wiley-VCH, 2013.

<table>
<tr><td>U24GE5Z05</td><td colspan="2">GREEN TECHNOLOGY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td colspan="3"></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>Course Objectives:</td><td colspan="6">To impart knowledge of green chemistry and green engineering principles, pollution control, waste management, and green synthesis, and to develop skills for designing safe, energy-efficient, and sustainable chemical processes using green metrics and nanotechnology.</td></tr>
<tr><td>Unit - I</td><td colspan="2">PRINCIPLES OF GREEN CHEMISTRY</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.</td></tr>
<tr><td>Unit - II</td><td colspan="2">POLLUTION TYPES</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Pollution – types, causes, effects, and abatement. Waste – sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling</td></tr>
<tr><td>Unit - III</td><td colspan="2">GREEN REAGENTS AND GREEN SYNTHESIS</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions</td></tr>
<tr><td>Unit – IV</td><td colspan="2">DESIGNING GREEN PROCESSES</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Safe design, process intensification, in process monitoring. Safe product and process design – Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention.</td></tr>
<tr><td>Unit - V</td><td colspan="2">GREEN NANOTECHNOLOGY</td><td colspan="4">9</td></tr>
<tr><td colspan="7">Nanomaterials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology.</td></tr>
<tr><td colspan="3">Total Periods:</td><td colspan="4">45</td></tr>
</table>

Course Outcomes

On completion of the course, the student can

COs	**Statements**	**K-Level**
CO1	Experiment with the principles of green chemistry and green engineering, including historical concepts and green metrics.	K3
CO2	Solve problems related to pollution, waste management, and chemical hazards using sustainable approaches.	K3
CO3	Construct chemical processes and products using environmentally benign methods, alternate solvents, and energy-efficient techniques.	K3
CO4	Design safe and sustainable chemical processes and products with real-time monitoring and process intensification.	K3
CO5	Utilize advanced technologies, including nanotechnology, for green synthesis, environmental remediation, and renewable energy applications.	K3

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO – PSO Articulation Matrix

	Programme Outcomes											**PSO**		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	3	3	2	2	3	2	2	3	3	2	3	3	3	3

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO2	2	3	3	3	3	2	3	3	3	2	2	3	3	2
CO3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO	2.80	3.00	2.80	2.80	3.00	2.00	2.80	3.00	3.00	2.00	2.80	3.00	3.00	2.80

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Samir B. Billatos and Nadia A. Basaly, Green Technology and Design for the Environment, First Edition, Taylor & Francis (CRC Press), 2017
2	Green Chemistry – An introductory text - M. Lancaster, RSC,2016.
3	Green Chemistry metrics - Alexi Lapkin and david Constable (Eds) , Wiley publications,2008.

Reference Books

1	Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017.

U24GE5Z06	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3
Course Objectives:	To provide comprehensive knowledge of environmental standards, regulations, and monitoring frameworks, develop understanding of air and water sampling and monitoring techniques, familiarize students with analytical and instrumental methods, introduce environmental monitoring programmes and risk assessment approaches, and expose learners to automated data acquisition systems and modern environmental data management practices.				

Unit - I	ENVIRONMENTAL STANDARDS AND MONITORING FRAMEWORK	9
Introduction to environmental monitoring - scope, objectives, and importance in environmental protection and sustainable development. Concept and need for environmental standards. Classification of environmental standards. Overview of global environmental standards and guidelines prescribed by international agencies such as WHO, UNEP, USEPA, and ISO. Environmental regulatory framework in India with reference to MoEF & CC, Central Pollution Control Board (CPCB), and State Pollution Control Boards (SPCBs). National Ambient Air Quality Standards (NAAQS) and their significance. Water quality standards for drinking water, surface water, groundwater, and wastewater discharge. Role of environmental standards - Emerging trends in environmental monitoring and regulation.		
Unit - II	**MONITORING OF ENVIRONMENTAL PARAMETERS AND SAMPLING TECHNIQUES**	**9**
Overview of current environmental issues including air pollution, water pollution, climate change, and waste management. International environmental conventions and protocols related to environmental protection. Applications of environmental monitoring in pollution control, environmental impact assessment, and public health protection. Significance of environmental sampling and basic principles of sampling design. Sampling strategies - grab sampling, composite sampling, random sampling, and systematic sampling. Techniques for water sampling including surface water, groundwater, and wastewater. Ambient air sampling methods and monitoring networks. Stack and flue gas sampling techniques and their applications.		
Unit - III	**ANALYTICAL AND INSTRUMENTAL METHODS FOR ENVIRONMENTAL ANALYSIS**	**9**
Classification of analytical and instrumental methods used in environmental monitoring. Principles and applications of spectrophotometric methods for environmental analysis. Analysis of organic and inorganic pollutants in environmental samples. Determination of important water quality parameters such as nitrogen, phosphorus, chemical oxygen demand (COD), and biochemical oxygen demand (BOD) in sewage and wastewater. Analysis of particulate matter and gaseous air pollutants including oxides of nitrogen, oxides of sulfur, carbon monoxide, and hydrocarbons. Introduction to advanced analytical instruments such as gas chromatography, atomic absorption spectroscopy, and mass spectrometry.		
Unit – IV	**ENVIRONMENTAL MONITORING PROGRAMMES AND RISK ASSESSMENT**	**9**
Concept and components of Environmental Monitoring Programme (EMP). Planning and implementation of environmental monitoring programmes. Water quality monitoring programmes at national and regional levels. National Water Quality Monitoring Programme (NWQMP) in India. Monitoring protocols, data interpretation, and reporting methods. Introduction to environmental risk assessment and its significance. Steps involved in risk assessment including hazard identification, exposure assessment, dose–response assessment, and risk characterization. Application of risk assessment in environmental management and decision-making.		
Unit - V	**AUTOMATED DATA ACQUISITION, SENSORS, AND DATA MANAGEMENT**	**9**
Introduction to automated and real-time environmental monitoring systems. Data acquisition for environmental process monitoring and control. Components and working principle of a Data Acquisition System (DAS). Sensors and transducers used in environmental monitoring and their classification. Types of data acquisition systems including offline and online monitoring systems. Implementation of real-time monitoring, control, and telemetry systems. Environmental data management systems including data		

collection, storage, processing, and visualization. Data quality assurance, validation, and quality control techniques. Regulatory overview and role of digital technologies such as IoT, remote sensing, and GIS in modern environmental monitoring.
Total Periods: 45

On completion of the course, the student can

COs	Statements	K - Level
CO01	Explain the concepts, classification, and regulatory framework of environmental standards at national and international levels.	K2
CO02	Apply appropriate environmental monitoring and sampling techniques for air, water, and industrial emissions.	K3
CO03	Analyze environmental samples using conventional and instrumental analytical methods to determine key pollution parameters.	K4
CO04	Evaluate environmental monitoring programmes and conduct environmental risk assessment for informed decision-making.	K5
CO05	Analyze automated environmental data acquisition and management systems considering regulatory requirements.	K4

Knowledge Level: K1 – Remember, K2 – Understand, K3 - Apply

CO - PO Matrix

CO Code	**Programme Outcome (PO)**											**PSO**		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	3	1				2	3	1			1			
CO2	3	2	2	2	1	2	3				1			
CO3	3	3	2	3	2		2				1			
CO4	2	3	2	2		3	3	2			1			
CO5	2	2	3	2	3	2	3				2			
Avg.	3	2	**2**	**2**	**1**	2	3	1			1			

Text Books

1	Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2	Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc
3	Peavy, H.S., Row, R., and Tchobanoglous, G., *Environmental Engineering*, McGraw Hill, New York.
4	Metcalf & Eddy, *Wastewater Engineering: Treatment and Reuse*, McGraw Hill.

Reference Books

1	Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.
2	H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3	Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.

4	Sawyer, C.N., McCarty, P.L., and Parkin, G.F., *Chemistry for Environmental Engineering and Science*, McGraw Hill.
5	CPCB and WHO Environmental Monitoring Guidelines.

U24GE5Z07	INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To make the students understand the global and Indian energy scenario, this course provides knowledge of conventional and renewable energy sources, energy efficiency, and the environmental impacts of energy utilization. It also introduces the concept of sustainable development, emphasizes the potential of renewable energy technologies, and familiarizes students with energy policies and planning for sustainable development.				

Unit - I	**ENERGY SCENARIO**	**9**
Comparison of energy scenario – India and World – energy sources – generation mix – consumption pattern – T&D losses – energy demand – per capita energy consumption – energy pricing – energy security – carbon emissions and climate impact – future energy outlook and challenges.		
Unit - II	**ENVIRONMENTAL EFFECTS OF ENERGY SYSTEMS**	**9**
Conventional energy sources – emissions from fuels – impact on air, water, and land – environmental standards and regulations – pollution measurement, monitoring, and control techniques – mitigation strategies for sustainable energy use.		
Unit - III	**SUSTAINABLE DEVELOPMENT**	**9**
Sustainable development – concepts and key stakeholders – Sustainable Development Goals (SDGs) – social development: poverty, its concepts, measures, and impacts – globalization and economic growth – economic development: income distribution, economic inequalities, and growth patterns.		
Unit – IV	**RENEWABLE ENERGY TECHNOLOGY**	**9**
Renewable energy – sources and potential – technologies for harnessing solar, wind, hydro, biomass, and ocean energy – working principles – benefits and limitations of each technology – energy storage and integration with the grid – role of renewable energy in sustainable development.		
Unit - V	**ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT**	**9**
Overview of national and state energy policies – objectives and implementation of the National Solar Mission – role and framework of the Central Electricity Authority – National Hydrogen Mission – energy and climate policy initiatives – State Energy Action Plans – strategies for renewable energy integration – roadmap for ethanol blending – approaches for improving energy efficiency – planning a balanced and sustainable energy mix.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the global and Indian energy scenarios.	K2
CO2	Explain the energy projects, evaluate their environmental impacts, and propose appropriate mitigation and control strategies.	K2
CO3	Illustrate the importance of sustainable development and assess its influence on human resource development.	K2
CO4	Interpret renewable energy technologies to promote sustainable development.	K2
CO5	Explain energy policies and planning approaches for achieving sustainable development.	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO

	Programme Outcomes											PSO		
	01	02	03	04	05	06	07	08	09	10	11	01	02	03
CO1	2	1	-	1	-	-	2	-	-	-	1	1	-	-
CO2	2	2	1	2	-	-	2	1	1	1	2	1	1	-
CO3	2	1	-	1	-	1	2	1	1	1	2	1	1	-
CO4	2	2	2	1	1	-	2	1	1	1	2	1	-	1
CO5	2	2	1	1	-	2	2	1	1	1	2	1	-	1
CO	**2**	**2**	**1**	**1**	**-**	**1**	2	**1**	**1**	**1**	2	**1**	**1**	**1**

Correlation levels 1, 2 and 3 are as defined below:

1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Rathore N S & Panwar, N L *Renewable Energy Sources for Sustainable Development,* New India Publishing Agency, **2007**
2	Mirjana Radovanovic, Sustainable Energy Management: Planning, Implementation, Control, and Strategy (2nd Edition),2022
3	Amjad Anvari-Moghaddam, Sustainable Energy Systems Planning, Integration and Management, MDPI AG, Basel, Switzerland,2020
4	David Borge-Diez & Enrique Rosales-Asensio, Sustainable Energy Planning in Smart Grids, Elsevier Science & Technology,2023.
5	John Joseph Puthenkulam, *Sustainable, Affordable, Reliable and Modern Energy: A Road Map for India,* Springer Nature Switzerland AG,2026.

Reference Books

1	Robert Ristirer and Jack P. Kraushaar, “Energy and the environment”, Willey,2025.
2	Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford UniversityPress,U.K.,2012.
3	Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.
4	Dhandapani Alagiri, Energy Security in India Current Scenario, The ICFAI University Press, 2006.
5	M.H. Fulekar,Bhawana Pathak, R K Kale,“Environment and Sustainable Development” Springer,2016.

U24GE5Z08	ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT	L	T	P	C
		3	0	0	3
Course Objectives:	To understand the types of energy sources, to create awareness on energy audit, to acquaint the techniques adopted for performance evaluation of thermal, to familiarize on the procedures adopted for performance evaluation of electrical utilities and to learn the concept of sustainable development and the implication of energy usage.				

Unit - I	**ENERGY AND ENVIRONMENT**	**9**
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, International frame works: UNFCCC, COP Start Contents here – Sustainable energy alternatives: Solar, Wind, biomass, hydrothermal, geothermal.		
Unit - II	**ENERGY AUDITING**	**9**
Need and types of energy audit: preliminary, detailed, targeted and investment-grade Audits - Energy management (audit) approach - understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments.		
Unit - III	**ENERGY EFFICIENCY IN THERMAL UTILITIES**	**9**
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters - Insulation and Refractories - Commercial waste heat recovery devices: recuperators, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermo compression – case studies and applications.		
Unit – IV	**ENERGY CONSERVTION IN ELECTRICAL UTILITIES**	**9**
Demand side management: concept, strategies and benefits - Power factor improvement: causes, methods and benefits – Energy efficient transformers: loses, design improvement and Maintenance practices - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers.		
Unit - V	**SUSTAINABLE DEVELOPMENT**	**9**
Sustainable Development: Concepts and Stakeholders - Sustainable Development Goal (SDG). Globalization and Economic growth: positive impact, negative impacts and case studies - Economic development: Economic inequalities, Income and growth - Social development: Poverty, conceptual issues and measures, impact of poverty.		
	Total Periods:	**45**

Course Outcomes

On completion of the course, the student can

CO	Statements	K-Level
CO1	Explain the prevailing energy scenario	K2
CO2	Apply and familiarize on energy audits and its relevance	K3
CO3	Apply the concept of energy audit on thermal utilities	K3
CO4	Explain relevant techniques for energy improvement in electrical utilities	K2
CO5	Interpret the development on human resource development	K2

Knowledge Level: K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

CO – PO– PSO Mapping Matrix

	Programme Outcomes											PSO		
	01	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**01**	**02**	**03**
CO1	2	1	-	-	-	-	-	-	-	-	2	2	2	-
CO2	2	1	-	-	-	1	-	-	-	-	2	2	2	-
CO3	3	2	-	1	1	-	-	-	-	-	2	2	2	-
CO4	3	2	2	2	2	2	-	-	-	-	2	2	3	2
CO5	3	2	2	2	3	3	2	2	2	2	3	2	3	3
CO	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

Correlation levels 1, 2 and 3 are as defined below: 1. Slight 2. Moderate 3. Substantial (High)

Text Books

1	Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4th Edition,Wiley,2022
2	Pratap Bhattacharyya, "Climate Change and Greenhouse Gas Emission", New India Publishing Agency- Nipa,2020
3	Matthew John Franchetti , Defne Apul "Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies" CRC Press,2012

Reference Books

1	M.H. Fulekar,Bhawana Pathak, R K Kale,"Environment and Sustainable Development" Springer,2016.
2	Energy Manager Training Manual (4Volumes) available at http://www.em-ea.org/gbook1.asp, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004.
3	Sustainable development in India: Stocktaking in the run up to Rio+20: Report prepared by TERI for MoEF, 2011.
4	W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987.
5	Eastop.T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific &Technical, ISBN-0-582-03184, 1990.