PANIMALAR
ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

CURRICULUM & SYLLABUS

REGULATION 2023

for the students admitted during 2024-25

B.E - MECHANICAL ENGINEERING

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PANIMALAR ENGINEERING COLLEGE
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Bangalore Trunk Road, Varadharajapuram,
Poonamallee, Chennai – 600 123

Department of Mechanical Engineering
B.E- Mechanical Engineering

CURRICULUM AND SYLLABUS
REGULATION-2023
(Students admitted 2024-25 onwards)

B.E- Mechanical Engineering
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

1. **PEO1: Technical Competence and Problem-Solving:** Achieve success in careers that deal with the design, simulation and analysis of engineering systems, experimentation and testing, manufacturing, technical services, and research to implement effective solutions for real-world engineering challenges.
2. **PEO2: Career Growth and Leadership:** To actively embrace impactful leadership roles in the practice of Mechanical Engineering in industry and government organizations (including both traditional and emerging technical areas) as well as in public service organizations.
3. **PEO3: Innovation, Research and Ethical Excellence:** Conduct multi-disciplinary research and development (via graduate study or industry) resulting in tangible applications that advance technology and foster innovation in order to compete successfully in the global economy.
4. **PEO4: Lifelong Learning and Societal Contribution:** Commit to continuous learning, adapting core knowledge, and competing in the ever-changing multicultural global enterprise to ethically contribute to society.

PROGRAM OUTCOMES (PO)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including designof experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: 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. (WK1, WK5, and WK7)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

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

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

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

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

PROGRAMME SPECIFIC OUTCOMES (PSO)

PSO 1: Fundamental Domain Knowledge: Design mechanical systems in various fields of machine elements, thermal, manufacturing, industrial and inter disciplinary fields using engineering/technological tools.

PSO 2: Usage of software programs: Resolve new challenges in Mechanical Engineering using modern computer tools and software programs.

PSO 3: **Continual learning and Research:** Develop intellectual and technical solution to complex mechanical problems through continual learning and research.

B.E. - MECHANICAL ENGINEERING

CHOICE BASED CREDIT SYSTEM (CBCS)

I - VIII SEMESTERS CURRICULUM AND SYLLABI (REGULATION 2023)

(For the Students admitted during 2024-25)

Semester I							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23MA1101	Matrices and Calculus	BS	3/1/0	4	4	60/40
2.	23ES1106	Programming in C	ES	3/0/0	3	3	60/40
Theory Cum Practical Courses							
3.	23HS1103	Communicative English and Language Skills I	HS	2/0/2	4	3	50/50
4.	23PH1103	Engineering Physics	BS	2/0/2	4	3	50/50
Laboratory Courses							
5.	23ES1113	Programming in C Laboratory	ES	0/0/4	4	2	40/60
6.	23ES1115	Computer Aided Engineering Graphics	ES	0/0/4	4	2	40/60
Mandatory Course							
7.	23TA1101	தமிழர்மரபு/ Heritage of Tamils	HS	1/0/0	1	1	60/40
8.	23HS1104	Interpersonal Communication skills I	EEC	0/0/2	2	0	0/100
9.	23HS1105	Quantitative Aptitude Practices I	EEC	0/0/1	1	0	0/100
			TOTAL		**27**	**18**	

Semester II							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23MA1201	Complex Variables and Laplace Transform	BS	3/1/0	4	4	60/40
2.	23ME1201	Engineering Mechanics	PC	3/0/0	3	3	60/40
3.	23ES1205	Basic Electrical Engineering	ES	3/0/0	3	3	60/40
Theory Cum Practical Courses							
4.	23HS1203	Communicative English and Language Skills II	HS	2/0/2	4	3	50/50
5.	23ES1203	Fundamentals of Python programming	ES	2/0/2	4	3	50/50
Laboratory Courses							
6.	23ES1212	Technical Skills Practices -I	EEC	0/0/2	2	0	0/100
7.	23ES1213	Product Development Laboratory	ES	0/0/4	4	2	40/60
8.	23ES1214	Electrical Engineering Laboratory	ES	0/0/4	4	2	40/60
Mandatory Course							
9.	23TA1201	தமிழரும்தொழில் நுட்பமும் / Tamils and Technology	HS	1/0/0	1	1	60/40
10.		Mandatory Course I	MC	2/0/0	2	0	0/100
11.	23HS1204	Interpersonal Communication skills II	EEC	0/0/2	2	0	0/100
12.	23HS1205	Quantitative Aptitude Practices II	EEC	0/0/1	1	0	0/100
			TOTAL		**34**	**21**	

Semester III							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23MA1303	Transforms and Partial Differential Equations	BS	3/1/0	4	4	60/40
2.	23ME1301	Strength of Materials	PC	3/0/0	3	3	60/40
3.	23ME1302	Manufacturing Processes	PC	3/0/0	3	3	60/40
4.	23ME1303	Engineering Thermodynamics	PC	3/0/0	3	3	60/40
5.	23ME1304	Engineering Materials and Metallurgy	PC	3/0/0	3	3	60/40
6.	23ME1305	Fluid Mechanics and Machinery	PC	3/0/0	3	3	60/40
Laboratory Courses							
7.	23ME1311	Manufacturing Processes Laboratory	PC	0/0/4	4	2	40/60
8.	23ME1312	Strength of Materials and Fluid Mechanics and Machinery Laboratory	PC	0/0/4	4	2	40/60
Mandatory Course							
9.	23HS1301	Skills for Career Building and Development I	EEC	0/0/2	2	0	0/100
10.	23HS1302	Quantitative Aptitude Practices III	EEC	0/0/1	1	0	0/100
			TOTAL		**30**	**23**	

Semester IV							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23MA1408	Statistics and Numerical Methods	BS	3/1/0	4	4	60/40
2.	23ME1401	Kinematics of Machinery	PC	3/0/0	3	3	60/40
3.	23ME1402	Thermal Engineering	PC	3/0/0	3	3	60/40
4.	23ME1403	Metal Cutting and Machine Tools	PC	3/0/0	3	3	60/40
5.	23ML1401	Introduction to Artificial Intelligence for Mechanical Engineering	PC	3/0/0	3	3	60/40
Laboratory Courses							
6.	23ME1411	Metal Cutting and Machine Tools Laboratory	PC	0/0/4	4	2	40/60
7.	23ME1412	Computer Aided Design Laboratory	PC	0/0/4	4	2	40/60
8.	23ME1413	Heat Engines Laboratory	PC	0/0/4	4	2	40/60
Mandatory Course							
9.		Mandatory Course -II	MC	2/0/0	2	0	0/100
10.	23HS1401	Skills for Career Building and Development II	EEC	0/0/2	2	0	0/100
11.	23HS1402	Quantitative Aptitude Practices IV	EEC	0/0/1	1	0	0/100
			TOTAL		**33**	**22**	

Semester V							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23ME1501	Design of Machine Elements	PC	3/0/0	3	3	60/40
2.	23ME1502	Metrology and Measurements	PC	3/0/0	3	3	60/40
3.	23ME1503	Heat and Mass Transfer	PC	3/0/0	3	3	60/40
4.	23ME1504	Dynamics of Machines	PC	3/0/0	3	3	60/40
5.	23AD1506	Fundamental of Data Science for Mechanical Engineering	PC	3/0/0	3	3	60/40
6.		Professional Elective - I	PE	3/0/0	3	3	60/40
Laboratory Courses							
7.	23ME1511	Metrology and Dynamics Laboratory	PC	0/0/4	4	2	40/60
8.	23ME1512	Thermal Engineering Laboratory	PC	0/0/4	4	2	40/60
			TOTAL		**26**	**22**	

Semester VI							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23ME1601	Design of Transmission Systems	PC	3/0/0	3	3	60/40
2.	23ME1602	Finite Element Analysis	PC	3/0/0	3	3	60/40
3.	23ME1603	CAD CAM and CIM	PC	3/0/0	3	3	60/40
4.	23ME1604	Hybrid and Electric Vehicles	PC	3/0/0	3	3	60/40
5.		Professional Elective - II	PE	3/0/0	3	3	60/40
6.		Professional Elective - III	PE	3/0/0	3	3	60/40
Laboratory Courses							
7.	23ME1611	Computer Aided Manufacturing Laboratory	PC	0/0/4	4	2	40/60
8.	23ME1612	Design and Fabrication Project	EEC	0/0/4	4	2	40/60
			TOTAL		**26**	**22**	

Semester VII							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.	23ME1701	Industrial Engineering	PC	3/0/0	3	3	60/40
2.	23ME1702	Mechatronics	PC	3/0/0	3	3	60/40
3.		Open Elective - I	OE	3/0/0	3	3	60/40
4.		Professional Elective - IV	PE	3/0/0	3	3	60/40
5.		Professional Elective - V	PE	3/0/0	3	3	60/40
6.		Professional Elective - VII	PE	3/0/0	3	3	60/40
Laboratory Courses							
7.	23ME1711	Mechatronics Laboratory	PC	0/0/4	4	2	40/60
8.	23ME1712	Simulation And Analysis Laboratory	PC	0/0/4	4	2	40/60
9.	23ME1713	Identification of Project Work	EEC	0/0/4	4	2	40/60
Employment Enhancement Courses							
10.	23ME1703	Industrial training/Internship #	EEC	-	-	2	0/100
			TOTAL		**30**	**26**	

The students shall undergo One 4-Week or Two 2-Week internship/industrial Training during the summer/winter vacation from semester 03 to 06. The same will be evaluated in semester 07. Two weeks of internship/industrial training carries one credit.

Semester VIII							
S. No	**COURSE CODE**	**COURSE TITLE**	**Category**	**L/T/P**	**Contact Hours**	**Credit**	**Ext / Int Weightage**
Theory Courses							
1.		Open Elective - II	OE	3/0/0	3	3	60/40
2.		Professional Elective - VII	PE	3/0/0	3	3	60/40
Laboratory Courses							
3.	23ME1811	Project Work	EEC	0/0/16	16	8	60/40
			TOTAL		**22**	**14**	

Total Number of Credits: 168

Professional Elective courses-Vertical

Vertical I	Vertical II	Vertical II	Vertical IV	Vertical V	Vertical VI	Vertical VII
23ME1901-Surface Engineering and Tribology	23ME1909-Welding Technology	23ME1917-Renewable Energy Resources	23ME1925-Advanced Internal Combustion Engines	23ME1932-Engineering Ethics	23ME1939-Operations Research	23ME1945-Thermal Power Engineering
23ME1902-Optimization Techniques in Engineering	23ME1910-Modern Machining Processes	23ME1918-Energy conservation and waste heat recovery	23ME1926-Automotive Technology	23ME1933-Production Planning and Control	23ME1913-Automation in Manufacturing	23ME1946-Selection of Materials
23ME1903-Design of Jigs and Fixtures	23ME1911-Hydraulics and Pneumatics	23ME1919-Nuclear Engineering	23ME1927-Automotive Electrical and Electronics	23ME1934-Total Quality Management	23ME1940-Warehousing Automation	23ME1947-Internet of Things for Mechanical Engineers
23ME1904-Composite Materials and Mechanics	23ME1912-Additive Manufacturing	23ME1920-Turbo Machinery Systems	23ME1928-Vehicle Body Engineering	23ME1935-Industrial safety and Maintenance	23ME1941-Material Handling Equipment, Repair and Maintenance	23ME1948-Machine Vision
23ME1905-Testing of Materials	23ME1913-Automation in Manufacturing	23ME1921-Gas Dynamics and Jet Propulsion	23ME1929-Vehicle Dynamics	23ME1936-Process Planning and Cost Estimation	23ME1942-Plant Layout Design and Ergonomics	23ME1949-Advanced Vehicle Engineering
23ME1906-Design concepts in Engineering	23ME1914-Digital Manufacturing	23ME1922-Solar Energy Engineering	23ME1930-Vehicle Maintenance and Safety	23ME1937-Entrepreneurship Development	23ME1943-Logistics in Manufacturing, Supply Chain and Distribution	23ME1950-Non-Destructive Testing and Evaluation
23ME1907-Noise, vibration and Harshness	23ME1915-Industrial Robotics	23ME1923-Refrigeration and Air Conditioning	23ME1931-Thermal Management of Batteries and Fuel Cells	23ME1938-Quality and Reliability Engineering	23ME1944-Supply chain Management	
23ME1908-New Product Development	23ME1916-Nano Technology	23ME1924-Computational Fluid Dynamics				

PROFESSIONAL ELECTIVES

Vertical I **Area of Specialization: Design**

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1901	Surface Engineering and Tribology	PE	3	3	0	0	3
2.	23ME1902	Optimization Techniques in Engineering	PE	3	3	0	0	3
3.	23ME1903	Design of Jigs and Fixtures	PE	3	3	0	0	3
4.	23ME1904	Composite Materials and Mechanics	PE	3	3	0	0	3
5.	23ME1905	Testing of Materials	PE	3	3	0	0	3
6.	23ME1906	Design concepts in Engineering	PE	3	3	0	0	3
7.	23ME1907	Noise, vibration and Harshness	PE	3	3	0	0	3
8.	23ME1908	New Product Development	PE	3	3	0	0	3

Vertical II **Area of Specialization: Robotics and Automation**

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1909	Welding Technology	PE	3	3	0	0	3
2.	23ME1910	Modern Machining Processes	PE	3	3	0	0	3
3.	23ME1911	Hydraulics and Pneumatics	PE	3	3	0	0	3
4.	23ME1912	Additive Manufacturing	PE	3	3	0	0	3
5.	23ME1913	Automation in Manufacturing	PE	3	3	0	0	3
6.	23ME1914	Digital Manufacturing	PE	3	3	0	0	3
7.	23ME1915	Industrial Robotics	PE	3	3	0	0	3
8.	23ME1916	Nano Technology	PE	3	3	0	0	3

Vertical III **Area of Specialization: Thermal Sciences**

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1917	Renewable Energy Resources	PE	3	3	0	0	3
2.	23ME1918	Energy conservation and waste heat recovery	PE	3	3	0	0	3
3.	23ME1919	Nuclear Engineering	PE	3	3	0	0	3
4.	23ME1920	Turbo Machinery Systems	PE	3	3	0	0	3
5.	23ME1921	Gas Dynamics and Jet Propulsion	PE	3	3	0	0	3
6.	23ME1922	Solar Energy Engineering	PE	3	3	0	0	3
7.	23ME1923	Refrigeration and Air Conditioning	PE	3	3	0	0	3
8.	23ME1924	Computational Fluid Dynamics	PE	3	3	0	0	3

Vertical IV **Area of Specialization: Modern Mobility Systems**

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1925	Advanced Internal Combustion Engines	PE	3	3	0	0	3
2.	23ME1926	Automotive Technology	PE	3	3	0	0	3
3.	23ME1927	Automotive Electrical and Electronics	PE	3	3	0	0	3
4.	23ME1928	Vehicle Body Engineering	PE	3	3	0	0	3
5.	23ME1929	Vehicle Dynamics	PE	3	3	0	0	3
6.	23ME1930	Vehicle Maintenance and Safety	PE	3	3	0	0	3
7.	23ME1931	Thermal Management of Batteries and Fuel Cells	PE	3	3	0	0	3

Vertical V **Area of Specialization: Industrial Management**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1932	Engineering Ethics	PE	3	3	0	0	3
2.	23ME1933	Production Planning and Control	PE	3	3	0	0	3
3.	23ME1934	Total Quality Management	PE	3	3	0	0	3
4.	23ME1935	Industrial safety and Maintenance	PE	3	3	0	0	3
5.	23ME1936	Process Planning and Cost Estimation	PE	3	3	0	0	3
6.	23ME1937	Entrepreneurship Development	PE	3	3	0	0	3
7.	23ME1938	Quality and Reliability Engineering	PE	3	3	0	0	3

Vertical VI **Area of Specialization: Logistics and Supply Chain Management**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1939	Operations Research	PE	3	3	0	0	3
2.	23ME1913	Automation in Manufacturing	PE	3	3	0	0	3
3.	23ME1940	Warehousing Automation	PE	3	3	0	0	3
4.	23ME1941	Material Handling Equipment, Repair and Maintenance	PE	3	3	0	0	3
5.	23ME1942	Plant Layout Design and Ergonomics	PE	3	3	0	0	3
6.	23ME1943	Logistics in Manufacturing, Supply Chain and Distribution	PE	3	3	0	0	3
7.	23ME1944	Supply Chain Management	PE	3	3	0	0	3

Vertical VII **Area of Specialization: Diversified Group**

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23ME1945	Thermal Power Engineering	PE	3	3	0	0	3
2.	23ME1946	Selection of Materials	PE	3	3	0	0	3
3.	23ME1947	Internet of Things for Mechanical Engineers	PE	3	3	0	0	3
4.	23ME1948	Machine Vision	PE	3	3	0	0	3
5.	23ME1949	Advanced Vehicle Engineering	PE	3	3	0	0	3
6.	23ME1950	Non Destructive Testing and Evaluation	PE	3	3	0	0	3

OPEN ELECTIVES

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23GE1001	Disaster Management	OE	3	3	0	0	3
2.	23GE1006	Intellectual Property Rights	OE	3	3	0	0	3
3.	23ME1001	Energy Auditing	OE	3	3	0	0	3
4.	23ME1002	Lean Six Sigma	OE	3	3	0	0	3
5.	23ME1003	Sensors for Automation	OE	3	3	0	0	3
6.	23ME1004	Industrial Pollution and Prevention	OE	3	3	0	0	3
7.	23ME1005	Hospital Management	OE	3	3	0	0	3
8.	23ME1006	Systems Engineering	OE	3	3	0	0	3
9.	23ME1007	Marketing Management	OE	3	3	0	0	3
10.	23CS1003	Cloud computing	OE	3	3	0	0	3
11.	23EE1004	Micro Electro Mechanical Systems	OE	3	3	0	0	3

EMPLOYMENT ENHANCEMENT COURSES (EEC)

S. No	Course Code	Course Title	Credits	Category	SEMESTER
1.	23ME1613	Design and Fabrication Project	2	EEC	VI
2.	23ME1713	Identification Of Project Work	2	EEC	VII
3.	23ME1703	Industrial training/Internship	2	EEC	VIII
4.	23ME1811	Project Work	8	EEC	VIII

VALUE ADDED COURSE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	23VA1018	Computer Aided Design using CATIA V5	VAC	30	0	0	2	1
2.	23VA1019	Hypermesh	VAC	30	0	0	2	1
3.	23VA1020	Industrial Automation	VAC	30	0	0	2	1
4.	23VA1021	MAT LAB & Control Concepts	VAC	30	0	0	2	1

CREDIT DISTRIBUTION

S.No.	Subject Area	Credits Per Semester								Credits Total	Percentage
	Semester	I	II	III	IV	V	VI	VII	VIII		
1.	Humanities and Social Studies (HS)	4	4	-	-	-	-	-	-	8	4.76
2.	Basic Sciences (BS)	7	4	4	4	-	-	-	-	19	11.31
3.	Engineering Sciences(ES)	7	10	-	-	-	-	-	-	17	10.12
4.	Professional Core (PC)	-	3	19	18	19	14	10		83	49.40
5.	Professional Electives (PE)	-	-	-	-	3	6	9	3	21	12.50
6.	Open Electives (OE)	-	-	-	-	-	-	3	3	6	3.57
7.	Project Work (PR/EEC)	-	0	-	-	-	2	4	8	14	8.33
8.	Non-Credit/ (Mandatory)	-	0	-	0	-	-	-	-	0	0
	Total	**18**	**21**	**23**	**22**	**22**	**22**	**26**	**14**	**168**	**100**

SEMESTER - I

23MA1101	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- Matrix algebra can be readily applied to the structural properties of graphs from an algebraic point of view
- To introduce the concepts of limits, continuity, derivatives and maxima and Minima
- To familiarize the functions of two variables and finding its extreme points
- To provide understanding of various techniques of integration
- To introduce integral ideas in solving areas, volumes and other practical problems

UNIT I MATRICES 9+3

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

UNIT II DIFFERENTIAL CALCULUS 9+3

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (Sum, Product & Quotient rule, Chain rule, logarithmic and implicit differentiation) - Maxima and Minima of functions of one variable and its applications.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial differentiation - Total derivative - Change of variables –Jacobian"s- Taylor"s series for functions of two variables - Maxima and minima of functions of two variables - Lagrange"s method of undetermined multipliers

UNIT IV INTEGRAL CALCULUS 9+3

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts - Bernoulli"s formula- Integration of rational functions by partial fraction - Improper integrals.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals in Cartesian and polar coordinates - Change of order of integration in Cartesian coordinates - Area enclosed by plane curves - Change of variables in double integrals -Triple integrals - Volume of Solids.

TOTAL :60 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Determine Eigen values and Eigen vectors, diagonalization of a matrix, symmetric matrices, positive definite matrices.
CO2: Apply limit definition and rules of differentiation to differentiate functions.
CO3: Apply the knowledge of Maxima and Minima, Jacobian, Taylor series and apply the problems involving Science and Engineering.

CO4: Apply the knowledge of Integration by parts, Integration of rational functions by partial fraction

CO5: Apply the knowledge of Area enclosed by plane curves, Change of variables in double integrals, Triple integrals, Volume of Solids.

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44rd Edition, 2018.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 9th Edition, New Delhi, 2015.
3. Bali N., Goyal M. and Walkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvtt. Ltd.,), New Delhi, 7th Edition, 2015.

REFERENCE BOOKS

1. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd. Chennai, 2007.
2. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics "Oxford University Press,2015.
3. B.V. Ramana "Higher Engineering Mathematics", McGraw Hill Education, India.
4. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley sons, 10th Edition,2015.
5. Sivaramakrishna Dass, C. Vijayakumari, "Engineering Mathematics", Pearson Education India, 4th Edition 2019.
6. Sundar Raj. M and Nagarajan. G , "Engineering Mathematics-I",3rd Edition, Sree Kamalamani Publications, Chennai, 2020.

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ma60/preview
2. https://onlinecourses.nptel.ac.in/noc21_ma58/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO2	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO3	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO4	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO5	3	3	3	-	-	-	-	-	-	-	1	-	-	1

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ES1106	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

To impart Knowledge on the following topics

- Syntax for C programming
- Develop C Programs using basic programming constructs
- Develop C programs using arrays and strings
- Develop applications in C using functions, pointers
- Develop applications using structures and union

UNIT - I BASICS OF C PROGRAMMING 9

Introduction to programming paradigms – Algorithms – Flowchart - Structure of C program - C programming: Data Types — Storage classes - Constants — Enumeration Constants - Type Conversion Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Format specifiers, Assignment statements – Decision making statements - Switch statement – Break – Continue - Goto statement - Looping statements – Pre-processor directives - Compilation process.

UNIT - II ARRAYS AND STRINGS 9

Introduction to Arrays: Declaration, Initialization — One dimensional array — Example Program: Computing Mean, Median and Mode - Two dimensional arrays — Example Program: Matrix Operations (Addition, Multiplication, Determinant and Transpose) - String operations: length, compare, concatenate, copy, Reverse and Palindrome — Selection sort, Insertion sort - linear and binary search

UNIT - III FUNCTIONS AND POINTERS 9

Introduction to functions: Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion – Example Program: Computation of Sine series, Scientific calculator using built-in functions, Binary Search using recursive functions – Pointers – Pointer operators — Pointer arithmetic — Arrays and pointers — Array of pointers — Example Program: Sorting of names — Parameter passing: Pass by value, Pass by reference — Example Program: Swapping of two numbers and changing the value of a variable using pass by reference.

UNIT - IV STRUCTURES AND UNION 9

Structure - Nested structures– Pointer and Structures– Array of structures – Example Program using structures and pointers – Self-referentials structures – Dynamic memory allocation – Singly linked list– typedef and Union.

UNIT - V FILE PROCESSING 9

Files — Types of file processing: Sequential access, Random access — Sequential access file - Example Program: Finding average of numbers stored in sequential access file - Random access file - Example Program: Transaction processing using random access files — Command line arguments.

TOTAL : 45 PERIODS

COURSE OBJECTIVE:

Upon completion of the course, students will be able to:

CO1: Learn the syntax for C programming
CO2: Develop simple applications in C using basic constructs
CO3: Design and implement applications using arrays and strings
CO4: Develop and implement applications in C using functions and pointers.
CO5: Develop applications in C using structures and union.
CO6: Design applications using sequential and random access file processing

TEXT BOOKS:

1. Reema Thareja, —Programming in C, Oxford University Press, Second Edition, 2016
2. Kernighan, B.W and Ritchie,D.M, —The C Programming language, Second Edition, Pearson Education, 2006.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, —– C How to Program, Seventh edition, Pearson Publication, 2015
2. Juneja, B. L and Anita Seth, —Programming in C, CENGAGE Learning India pvt. Ltd.,2011
3. Pradip Dey, Manas Ghosh, —Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2009
4. Anita Goel and Ajay Mittal, —Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011
5. Byron S. Gottfried, "Schism"s Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996

WEB REFERENCES: (Only accessible Links)

1. https://github.com/tscheffl/ThinkC/blob/master/PDF/Think-C.pdf
2. https://freecomputerbooks.com/langCBooks.html

ONLINE COURSES / RESOURCES:

1. https://www.programiz.com/c-programming
2. https://www.tutorialspoint.com/cprogramming/index.htm
3. https://www.javatpoint.com/c-programming-language-tutorial
4. https://www.geeksforgeeks.org/c-programming-language/
5. https://en.wikibooks.org/wiki/C_Programming
6. https://www.cprogramming.com/tutorial/c-tutorial.html?inl=hp

CO – PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	1	1	1		1	-	-	-	-	-	-	-	-
CO2	2	1	1	1	2	1	-	-	-	-	-	-	-	-
CO3	3	2	2	1	3	1	-	-	-	-	-	-	-	-
CO4	3	2	2	1	3	1	-	-	-	-	-	-	-	-
CO5	2	1	1	1	2	1	-	-	-	-	-	-	-	-

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23HS1103	COMMUNICATIVE ENGLISH AND LANGUAGE SKILLS I	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

- To induce the basic reading and writing skills among the first year engineering and technology students.
- To assist the learners to develop their listening skills, which will enable them listening to lectures and comprehend them by asking questions and seeking clarifications
- To succure the learners to develop their speaking skills and speak fluently in real contexts.
- To motivate the learners to develop vocabulary of a general kind by developing their reading skills for meeting the competitive exams like GATE, TOFEL, GRE, IELTS, and other exams conducted by Central and State governments

UNIT I INFORMAL COMMUNICATION 6

Listening: Listening and filling details, Listening to Speeches by Specialists and Completing Activities such as Answering Questions, Identifying the Main Ideas, Style, etc. Speaking: Introducing One-self — Introducing a Friend/ Family. Reading: Descriptive Passages (From Newspapers / Magazines).Writing: Autobiographical Writing, Developing Hints. Grammar: Noun, Pronoun & Adjective. Vocabulary Development: One Word Substitution.

ACTIVITY: Listening to self -introduction before the interview committee after listening modules.

UNIT II CONVERSATIONAL PRACTICE 6

Listening: Listening to Conversations (Asking for and Giving Directions).Speaking: Making Conversation Using (Asking for Directions, Making an Enquiry), Role Plays, and Dialogues. Reading: Reading a Print Interview and Answering Comprehension Questions. Writing: Writing a Checklist, Dialogue Writing Grammar: Tenses and Voices, Regular and Irregular Verbs. Vocabulary Development: Prefix &Suffix, Word formation.

ACTIVITY: Listening to conversation and performing role play and Writing dialogues on various work context.

UNIT III **OFFICIAL COMMUNICATIONS** **6**

Listening: Listening for specific information. Speaking: Giving Short Talks on a given Topic. Reading: Reading Motivational Essays on Famous Engineers and Technologists (Answering Open-Ended and Closed Questions).Writing:Writing Permission Letters/Editor, Complaint, and Invitation. Emails and Review Writing-Books, Films. Grammar: Adverb, Prepositions & Conjunctions. Vocabulary Development: Collocations ―Fixed Expressions.

ACTIVITY: Preparing Permission letters and short talks and presentation on various topics related to professions.

UNIT IV **COMMUNICATION AT WORK PLACE** **6**

Listening: Listening to Short Talks (5 Minutes Duration and Fill a Table, Gap-Filling Exercise) Note Taking/Note Making .Speaking: Small Group Discussion, Giving Recommendations. Reading: Reading Problem ―Solution Articles/Essays Drawn from Various Sources .Writing: Making Recommendations. Grammar: Subject-Verb Agreement, Framing Questions. Vocabulary Development: Infinitives and Gerunds, Reference Words, Technical Vocabulary.

ACTIVITY: Listening to Group Discussion and sharing recommendation.

UNIT V **DEFINITIONS AND PRODUCT DESCRIPTION** **6**

Listening: Listening to a Product Description (labeling and Gap Filling) Exercises. Speaking: Describing a Product and Comparing and contrasting it with Other Products. Reading: Reading Graphical Material for Comparison (Advertisements).Writing: Essay Writing. Compare and Contrast Paragraphs, Essay writing. Grammar: Phrasal Verbs – Cause and Effect Sentences –Compound Nouns and Definitions. Vocabulary Development: Use of Discourse Markers**.**

ACTIVITY: Reading about the modern gadgets and describing them.

TOTAL :30 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 : Comprehend conversation and short talks delivered in English.

CO2 : Participate effectively in informal conversation; introduce themselves and their friends and express opinions English.

CO3 : Read articles of a general kind in magazines and newspaper.

CO4 : Write short essays of a general kind and personal letters and emails in English.

CO5 : Recognize the use of grammar in speech and writing.

TEXT BOOKS:

1. N P Sudharshana & C Savitha. English for Technical Communication Delhi: CUP, 2019.
2. Board of Editors. English for Engineers and Technologists Volume 1 Orient Black Swan Limited, 2020

REFERENCE BOOKS:

1. Board of Editors. Using English-A course book for Undergraduate engineers and Technologists Orient Black Swan Limited, 2017
2. Bailey, Stephen. Academic Writing: A Practical Guide for Students. New York: Rutledge, 2011.
3. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011 3. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA:2007
4. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005.

WEB REFERENCES:

1. https://learnenglishteens.britishcouncil.org/exams/grammar-and-vocabulary-exams/wordformation
2. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018/02/20180316 21.pdf
3. http://xn--englishclub-ql3f.com/grammar/parts-of-speech.htm
4. https://www.edudose.com/english/grammar-degree-of-comparison-rules/

ONLINE COURSES / RESOURCES:

1. https://basicenglishspeaking.com/wh-questions/
2. https://agendaweb.org/verbs/modals-exercises.html
3. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018/02/2018031621.pdf
4. https://www.ego4u.com/en/cram-up/grammar/prepositions

LANGUAGE SKILLS LAB **30 Hours**

LIST OF EXPERIMENTS

1. Listen to lectures- articulate a complete idea as opposed to producing fragmented utterances- Tedtalks, Science Fiction- My Fair Lady
2. Listening – following, responding to explanations, giving directions and instructions in academic and business contexts- IELTS,TOEFL.
3. Listening to transcripts and answer to the questions.
4. Listening for specific information: accuracy and fluency – BEC.
5. Reading: Different Text Type.
6. Reading: Predicting Content using pictures and titles.
7. Reading: Use of Graphic Organizers to review.
8. Reading: Aid Comprehension.
9. Reading: Speed Reading Techniques.
10. Reading and Comprehending the passages in the competitive exams like GATE, TOEFL, GRE, IELTS, and other exams conducted by Central and state governments.

REFERENCE:

1. Suresh Kumar.E and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Blackswan: Hyderabad,2012
2. Davis, Jason and Rhonda Liss. Effective Academic Writing (level 3) Oxford University Press: Oxford,2006
3. Withrow, Jeans and et al. Inspired to write. Reading and Tasks to develop writing skills. Cambridge University Press: Cambridge,2004

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2	-	-	-

Assessment (40% weightage) (Theory Component)		**Assessment** (60% weightage) (Laboratory Component)		**End Semester Examination**
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Evaluation of Laboratory Observation, Record**	**Test**	**Written Examination**
40	**60**	**75**	**25**	
100				**100**
50 %				**50 %**

23PH1103	ENGINEERING PHYSICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

- To impart knowledge in basic concepts of physics relevant to engineering applications
- To introduce advances in technology for engineering applications

UNIT – I PROPERTIES OF MATTERS 6

Elasticity: Stress, strain, Hooke's law and elastic moduli – stress-strain diagram – twisting couple per unit twist for solid cylinder – torsional pendulum (theory) – bending moment of beam – non-uniform and uniform bending (theory)**–** I-shape girders

Thermal Physics: Mode of heat transfer: conduction, convection and radiation – thermal expansion of solids – bimetallic strips – thermal conductivity –Lee's disc method; theory and experiment – thermal insulation – applications

UNIT – II SEMICONDUCTING AND MAGNETIC MATERIALS 6

Semiconducting Materials: Density of Energy State - Intrinsic Semiconductors – energy band diagram – carrier concentration in intrinsic semiconductors – extrinsic semiconductors (theory) – application – Hall effect

Magnetic Materials: Origin of magnetism – Basic definitions – Classifications of Magnetic Materials- Ferromagnetic Domain theory – M versus H Behaviour- Hard and Soft Magnetic materials – applications

UNIT – III MODERN OPTICS 6

Laser: Population of energy levels, Einstein's A and B coefficients derivation – optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction**–** industrial applications

Fiber Optics: components and principle of fiber optics – numerical aperture and acceptance angle derivation – types (material, refractive index, and mode) – losses associated with optical fiber – applications - pressure and displacement sensors

UNIT –IV QUANTUM PHYSICS AND NANOSCIENCE 6

Quantum Physics: Blackbody radiation – Planck's hypothesis and derivation – wave particle duality of light: concepts of photon – de Broglie hypotheses – concept of wave function and its physical significance – Schrödinger's time independent and time dependent wave equations

Nanoscience: Introduction – Classification of nanomaterials (0D, 1D, 2D and 3D) – preparation (bottom up and top down approaches) - carbon nanotubes: types - mechanical, optical and electrical properties - applications

UNIT –V ELECTROMAGNETIC WAVES 6

Divergence – curl – integral calculus – Gauss divergence theorem – Stoke's theorem – equation of continuity – displacement current – Maxwell's equations – Gauss's laws – Faraday's law –Ampere-Maxwell law – Hertz observation – production and detection of electromagnetic wave – mechanism of electromagnetic wave propagation – properties of electromagnetic waves

TOTAL : 30 PERIODS

COURSE OUTCOME(S):

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

CO1 : Understand the basics properties of materials, especially elastic and thermal properties of materials.

CO2 : Have adequate knowledge on the concepts of semiconducting and magnetic materials and their applications in memory storage.

CO3 : Acquire the knowledge on the concepts of lasers, fiber optics and their technological applications.

CO4 : Get knowledge on fundamental concepts of quantum theory, nanoscience its applications.

CO5 : Gain knowledge on the basics of electromagnetic waves and its properties.

TEXT BOOKS:

1. Ajoy Ghatak, Optics, 5th Ed., Tata McGraw Hill, 2012
2. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2014
3. B. K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt Ltd., New Delhi, 2017
4. Karl.F.Reck, Basics of laser physics: for students of science and engineering, Second edition, Springer Publications

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J.—Principles of Physics, Wiley, 2015.
2. Tipler, P.A. & Mosca, G. — Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
3. Ruby Das, C.S. Robinson, Rajesh Kumar, Prashant Kumar Sahu, A Textbook of Engineering Physics Practical, University Science Press, Delhi, II Edition (2016), ISBN 978-93-80386-86-7

LIST OF EXPERIEMENTS

30 HOURS

1. Determination of Moment of Inertia of the disc and Rigidity Modulus of the material of the wire – Torsional Pendulum

2. Determination of Young's Modulus – Non - Uniform Bending

3. Determination of Thermal Conductivity of the Bad Conductor – Lee's Disc Method

4. Determination of thickness of a thin wire – Air wedge method

5. (i) Determination of wavelength of Laser using Grating and Particle size determination
(ii) Determination of Numerical Aperture and Acceptance angle of an Optical Fibre
6. Determination of Velocity of ultrasonic waves in a liquid and compressibility of the liquid – Ultrasonic Interferometer
7. Determination of wavelength of Hg source using Grating by normal incidence method using spectrometer
8. Determine the energy band gap of a semiconductor

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	1	1	-	-	-	-	-	1	-	-
CO2	3	3	2	1	2	1	-	-	-	-	-	1	-	-
CO3	3	3	2	2	2	1	-	-	-	-	-	1	-	-
CO4	3	3	1	1	2	1	-	-	-	-	-	1	-	-
CO5	3	3	1	1	2	1	-	-	-	-	-	1	-	-

Assessment (40% weightage) (Theory Component)		**Assessment** (60% weightage) (Laboratory Component)		**End Semester Examination**
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Evaluation of Laboratory Observation, Record**	**Test**	**Written Examination**
40	**60**	**75**	**25**	
100				**100**
50 %				**50 %**

23ES1113	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

To impart Knowledge on the following topics:

- Write, test, and debug simple C programs
- Implement C programs with conditional and looping statement
- Develop applications in C using strings, pointers, functions
- Implement C programs with structures and union
- Develop applications in C using file processing
- Develop an application in real time situation

LISTOFEXPERIMENTS

1. Programs using I/O statements and expressions
2. Programs using decision-making constructs
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication,division and square of a number
5. Check whether a given number is Armstrong number or not?
6. Given a set of numbers like <10, 36, 54, 89, 12, 27>,
find sum of weights based on the following conditions
   a) if it is a perfect cube
   b) if it is a multiple of 4 and divisible by 6
   c) if it is a prime number
   d) Sort the numbers based on the weight in the increasing order as shown below <10,its weight>,<36,its weight><89,its weight>
7. Populate an array with height of persons and find how many persons are above the averageheight.
8. Given a string —a$bcd./fg‖ find its reverse without changing the position of special characters. (Example input:a@gh%;j and output:j@hg%;a)
9. Convert the given decimal number into binary, octal and hexadecimal numbers using userdefined functions
10. From a given paragraph perform the following using built-in functions:
    a) Find the total number of words.
    b) Capitalize the first word of each sentence.
    c) Replace a given word with another word
11. a) Sort the list of numbers using Selection sort and insertion sort
    b) Sort the list of numbers using pass by reference
12. Search an element from an unsorted array using linear search Search an element in an array using Binary search recursion call

13. Generate salary slip of employees using structures and pointers

Programs using Pointers

14.
a. Pointer demonstration the use of & and *
b. Access Elements of an Array Using Pointer
c. Perform the string operations like Length of the String ,
d. Concatenation of string and compare the string using Pointer
e. Count number of words, digits, vowels using pointers
f. Add two matrices using Multidimensional Arrays with pointers
g. Multiply two matrices using pointers
h. Multiply two numbers using Function Pointers

15. Compute internal marks of students for five different subjects using structures and functions

16. Program to demonstrate the difference between unions and structures

17. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file

18. Count the number of account holders whose balance is less than the minimum balance usingsequential access file

MINI PROJECT

Create a Railway reservation system with the following modules

19.
a. Booking
b. Availability checking
c. Cancellation
d. Prepare chart

TOTAL: 60 PERIODS

COURSE OUTCOME(S): Upon successful completion of the course, students will be able to:

CO1 : Write, test, and debug simple C programs
CO2 : Implement C programs with conditionals and loops
CO3 : Develop C programs for simple applications making use arrays and strings
CO4 : Develop C programs involving functions, recursion, pointers, and structures and union
CO5 : Design applications using sequential and random access file processing
CO6 : Perform task as an individual and / or team member to manage the task in time

WEB REFERENCES

1. https://www.programiz.com/c-programming/examples
2. https://beginnersbook.com/2015/02/simple-c-programs/
3. https://www.programmingsimplified.com/c-program-examples
4. https://www.tutorialgateway.org/c-programming-examples/
5. https://www.javatpoint.com/c-programs
6. https://www.tutorialspoint.com/learn_c_by_examples/simple_programs_in_c.htm

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	2	1	3	-	-	-	-	-	-	-	3	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	-
CO4	3	2	2	1	3	-	-	-	-	-	-	-	3	-
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	-
CO6	3	2	2	1	3	-	-	-	-	-	-	-	3	-

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ES1115	COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To familiarize students with technical drawing standards and drafting software for precise part modelling to enhance their skill set.
- To develop proficiency in orthographic and isometric projections for communicating engineering concepts, contributing to their technical expertise.
- To enhance drawing skills for clear and precise technical communication in engineering product design, enabling students to effectively convey their ideas.
- To utilize pictorial views proficiently for accurate isometric visualization of engineering objects, adding depth to their understanding of spatial relationships.
- To enable students to translate engineering concepts into tangible designs, fostering creativity and innovation in graphics and design to broaden their practical experience.

UNIT - I INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CONIC SECTIONS 12

Introduction to Engineering Drawing - Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout – Lettering and dimensioning.
Introduction to Drafting Packages – Coordinate Systems – Tools
Introduction to Conic curves - Ellipse, Parabola and Hyperbola by Eccentricity method.

List of Experiments:

1. Drawing of a title block with necessary text, projection symbol and lettering using drafting software.
2. Drafting of Conic curves - Ellipse, Parabola and Hyperbola

UNIT - II ORTHOGRAPHIC PROJECTION 12

Visualization concepts and Orthographic Projection - Layout of views – Orthographic Projection- Conversion of pictorial diagram into orthographic views.

List of Experiments:

1. Drawing orthographic view of simple solids like Prism, Pyramids, Cylinder, Cone, etc, and dimensioning.
2. Drawing of orthographic views from the given pictorial diagram like machine parts, electrical vehicle layout, PCB Diagrams.

UNIT - III PROJECTION OF PLANES 12

Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method.

List of Experiments:

1. Drawing of plane Surface inclined to HP.
2. Drawing of plane Surface inclined to VP.

UNIT - IV PROJECTION OF SOLIDS 12

Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to HP by rotating object method.

List of Experiments:

1. Drawing of simple solids like prism and pyramids when the axis is inclined to HP.
2. Drawing of simple solids like cylinder and cone when the axis is inclined to HP.

UNIT - V ISOMETRIC DRAWING 12

Principles of Isometric View – Isometric Views of simple solids – Prism, Pyramid, Cylinder and Cone.

List of Experiments:

1. Drawing Isometric View of simple solids.
2. Modeling of 2D to 3D objects using drafting software.

TOTAL :60 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Draw the engineering curves, draw orthographic projections of lines and planes.
CO2: Draw orthographic views of 3D primitive objects.
CO3: Apply and draw the sections and development of the surfaces of objects.
CO4: Apply projection concepts and drafting tools for solid projections.
CO5: Analyse and sketch free hand sketching of basic geometrical shapes, multiple views of objects.

SOFTWARE TOOLS

- AutoCAD
- Solid Works

TEXT BOOKS:

1. Natarajan,K.V.,"AtextbookofEngineeringGraphics", 3 4 thEd.,Dhanalakshmi Publishers, Chennai, 2021.

2. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", 14th Ed, New Age Publications, 2016

REFERENCE BOOKS:

1. Bhatt, N.D.,Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 54th Edition, 2023.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015
3. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, N.Delhi, 3rd Edition 2019

WEB REFERENCES:

1. https://nptel.ac.in/courses/105/104/105104148/

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112/103/112103019/

CO –POMAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	1	-	-	-	-	-	2	3	1	2
CO2	3	3	3	2	1	-	-	-	-	-	2	3	1	2
CO3	3	3	3	2	1	-	-	-	-	-	2	3	1	2
CO4	3	3	3	2	1	-	-	-	-	-	2	3	1	2
CO5	3	3	3	2	1	-	-	-	-	-	2	3	1	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23TA1101	HERITAGE OF TAMIL	L	T	P	C
		1	0	0	1

UNIT – I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language - ClassicalLiterature 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 N ayanmars - Forms of minor Poetry - Development of Modernliterature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

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

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

UNIT – III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT –IV THINAI CONCEPT OF TAMILS 3

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

UNIT –V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

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

Total : 15 PERIODS

TEXT-CUM REFERENCE 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 சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை)
5. Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: InternationalInstitute of Tamil Studies
7. Historical by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23TA1101	தமிழர் மரபு	L	T	P	C
		1	0	0	1

UNIT – I **மொழி மற்றும் இலக்கியம்** **3**

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

UNIT – II **மரபு - பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை** **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

UNIT – III **நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்** **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

UNIT –IV **தமிழர்களின் திணைக் கோட்பாடுகள்** **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்கப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு - சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

UNIT –V **இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு** **3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

Total : 15 PERIODS

TEXT-CUM REFERENCE 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 சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை)
5. Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: InternationalInstitute of Tamil Studies
7. Historical by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)

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

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

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23HS1104	INTERPERSONAL COMMUNICATION SKILLS I	L	T	P	C
		0	0	2	0

COURSE OBJECTIVE:

- To understand and control emotions, promoting personal growth, self-confidence, and a positive mind-set.
- To strengthen skills in navigating relationships, staying motivated, adapting to new situations, and communicating effectively.
- To teach methods for organizing tasks, meeting deadlines, and resolving disputes to improve productivity and relationships.
- To develop abilities in creative problem-solving and thoughtful decision-making using structured techniques for innovative solutions.
- To collaborate effectively, lead with confidence, and inspire others in group and professional settings.

Unit I

Self-Analysis -Growth Mind-set- Empathy for Self

Unit II

Attitude Reengineering- Motivation- Interpersonal Skills

Unit III

Time Management(Deadlines management, Prioritisation)- Conflict Resolution - Change Management

Unit IV

Decision Making - Creative Thinking Skills - Six Thinking Hats Technique -

Unit V

Leadership- Collaborative Skills- Teamwork- Presentation Skills

TOTAL : 30 PERIODS

TEXT BOOKS

1. Covey, Stephen R. The 7 Habits of Highly Effective People: 30th Anniversary Edition. Simon &Schuster, 2020.
2. Goleman, Daniel. Emotional Intelligence: Why It Can Matter More Than IQ. 10th anniversary ed., Bantam Books, 2005.

REFERENCE BOOKS

1. Dweck, C. S. (2006). Mindset: The New Psychology of Success. Random House.
2. De Bono, E. (2017).Six Thinking Hats (Revised Edition). Penguin Books.

WEB REFERENCES

1. https://casel.org/what-is-the-casel-framework/
2. https://ggie.berkeley.edu/sel-for-students-self-awareness-and-self-management/

ONLINE COURSES / RESOURCES

1. https://www.coursera.org/learn/emotional-intelligence-leadership
2. https://www.coursera.org/learn/critical-thinking-skills

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 : Manage emotions effectively, embrace a growth-oriented mind-set, and build stronger self -confidence.

CO2 : Demonstrate strong interpersonal skills, motivation, and adaptability, fostering effective communication across diverse settings.

CO3 : Prioritize tasks and handle conflicts constructively, enhancing their productivity and interpersonal interactions.

CO4 : Make informed decisions and address challenges creatively using structured problem-solving approaches.

CO5 : Excel in teamwork, exhibit leadership, and positively influence others in group and community initiatives.

CO&PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								3	3		2
CO2								3	3		2
CO3								2	3		2
CO4								2	3		2
CO5								2	3		2
CO6								3	3		2

23HS1105	QUANTITATIVE APTITUDE PRACTICES I	L	T	P	C
		0	0	1	0

COURSE OBJECTIVE:

- To strengthen students understanding of number systems, algebra and assist them in developing their problem-solving skills.
- To get the abilities needed to address challenges with quantitative aptitude.

Module 1 Number system **3**

Numbers - HCF and LCM- simplification - square root - cube root.

Module 2 Algebra **3**

Algebra - decimal fraction - arithmetic progression - geometric progression.

Module 3 Blood relations **3**

Blood relations - pattern sequence - alphabet test question – clocks-calenders.

Module 4 Data Interpretation **3**

Table chart- pie chart - bar chart - line charts

TOTAL : 12 PERIODS

COURSE OUTCOME:

Upon completion of the course, students will be able to:

CO1 Demonstrate solid understanding to address number system and algebraic problems.

CO2 Handle problems with the blood relations and data interpretation.

TEXT BOOKS:

1. Aggarwal R.S.(2017).Quantitative Aptitude for Competitive Examinations 3rd edition New Delhi: S.Chand Publishing.
2. Abhijit guha(2016). Quantitative Aptitude for All Competitive Examinations, 6th edition. Noida : Mc GrawHill Education Pvt .Ltd.
3. FACE.(2016).Aptipedia Aptitude Encyclopedia1(Ed.).New Delhi: Wiley Publications.

REFERENCE BOOK:

1. Sharma arun. (2016).Quantitative aptitude,7th(Ed.).Noida : McGrawHill Education Pvt. Ltd.
2. Praveen. R.V 3rd edition, Quantitative aptitude and reasoning, PHI learning publication.

Mode of Evaluation: Online Test

SEMESTER - II

23MA1201	COMPLEX VARIABLES AND LAPLACE TRANSFORM	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To solve the linear differential equations with constant coefficients.
- To help the engineering students with vectors as it gives the insight into how to trace along the different types of curves.
- To develop an understanding of the standard technique of a complex variable theory in particular of analytics functions and its mapping property.
- Complex variable techniques have been used in wide areas of engineering.
- Laplace Transform gives the basic idea to solve the problems in engineering and technology.

UNIT - I ORDINARY DIFFERENTIAL EQUATIONS 9+3

Higher order linear differential equations with constant coefficients -Method of variation of parameters – Homogenous equation of Euler"s and Legendre"s type – System of simultaneous first order linear differential equations with constant coefficients

UNIT - II VECTOR CALCULUS 9+3

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane - Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes, rectangular parallelopiped,.

UNIT - III ANALYTIC FUNCTIONS 9+3

Functions of a complex variable–Analytic functions -Cauchy-Riemann equations – Necessary and sufficient conditions–Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions by Milne Thomson method– Conformal mapping: w =z+c, cz, 1/z and bilinear transformation.

UNIT - IV COMPLEX INTEGRATIONS 9+3

Line integrals- Cauchy's integral theorem-Cauchy's integral formula - Singularities – Residues– Cauchy's residue theorem - Taylor's and Laurent's series expansions —– Application of residue theorem for evaluation of real definite integrals – Use of circular contour and semi- circular contour (excluding poles on the real axis).

UNIT - V LAPLACE TRANSFORM 9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties–Transforms of derivatives and integrals of functions-Derivatives and

integrals of transforms - Transforms of unit function, unit step function and unit impulse functions – Transform of periodic functions– Initial and final value theorems. Inverse Laplace transform -Convolution theorem–Solution of linear ODE of second order with constant coefficients using techniques of Laplace transformation.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Apply various techniques in solving differential equations.

CO2: Identify the gradient , divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.

CO3: Understand the concepts of analytic functions, harmonic functions and conformal mapping.

CO4: Determine the types of singularities, residues and contour integration.

CO5: Able to solve differential equations using Laplace transform.

TEXT BOOKS:

1. Grewel. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.
2. B.V. Ramana, " Higher Engineering Mathematics", McGraw Hill Education, India.
3. Bali N., Goyal M. and Walkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvtt. Ltd.,), New Delhi, 7th Edition, 2009.

REFERENCE BOOKS:

1.Kreyszig Erwin, Advanced Engineering Mathematics", John wiley and Sons, 10th Edition, New Delhi.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol.I& II, PHI LearnigPvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wyile, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt Ltd, 6thEdition, New Delhi, 2012.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO2	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO3	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO4	3	3	3	-	-	-	-	-	-	-	1	-	-	1
CO5	3	3	3	-	-	-	-	-	-	-	1	-	-	1

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1201	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the concepts of resultant force and moment of a particle and rigid body in 2D and 3D.
- To enable the students to be exposed of Analysis of Frames and Trusses.
- To understand the concepts of centroid, moment of inertia and mass moment of inertia.
- To understand the concepts of kinematics and kinetics of particles and rigid bodies.
- To develop capacity to predict the effect of frictional force and its applications.

UNIT I BASICS AND STATICS OF PARTICLES 9

Introduction - Units and dimensions – Fundamental laws of Mechanics - Principle of transmissibility - Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - Coplanar Forces - Rectangular components of force - Equilibrium of a particle - Lami's theorem – Forces in space system - Equilibrium of a particle in space – Equivalent systems of forces.

UNIT II STATICS OF RIGID BODIES AND ANALYSIS OF TRUSSES AND FRAMES 9

Moments and Couples – Moment of a force about a point and about an axis – Varignon's theorem – moment of a couple - resolution of a force into a force and a couple - reduction of a system of forces - Single equivalent force - Free body diagram – Types of supports and their reactions – Equilibrium of Rigid bodies in 2D and 3D – Case studies.

Simple trusses - Method of joints, method of sections - joints under special loading conditions - space trusses - Analysis of frames.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9

Centroid of areas – simple and composite areas - Theorems of Pappus and Guldinus – Centre of mass – simple and composite volumes - Moment of inertia - simple and composite areas - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia - Radius of gyration – Product of inertia - Principal moment of inertia of plane areas - Mass moment of inertia of simple solids.

UNIT IV FRICTION AND ITS APPLICATIONS 9

Friction -Laws of dry friction - Angle of friction - Coefficient of static and kinetic friction – Sliding friction - Wedges – Ladder Friction - Surface contact friction Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt drives – Friction in brakes- Band and Block brakes - case studies.

UNIT V DYNAMICS OF PARTICLES 9

Kinematics - Translation and Rotation of Rigid Bodies – Velocity and acceleration -General Plane motion of simple rigid bodies such as cylinder and sphere - Rectilinear Motion and Curvilinear Motion of Particles - Equations of Motions - Projectile Motion.

Kinetics - Newton's Second Law of Motion – D'Alembert's Principle – - Energy - potential energy - kinetic energy - conservation of energy - work done by a force - work energy method.

Concept of conservation of momentum - Impulse-Momentum principle - Impact - Direct central impact, oblique central impact, impact of a moving train on the spring board.

TOTAL :45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Analyze the resultant force and moment in 2D and 3D force systems.
CO2: Apply equilibrium principles to solve engineering problems involving particles and rigid bodies.
CO3: Analyze the centroid, moment of inertia, and mass moment of inertia for composite areas and volumes.
CO4: Evaluate the concepts of frictional force in practical engineering applications.
CO5: Apply the principles of particle kinetics to address real-world physical problems.

TEXT BOOKS:

1. Beer F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing Company, New Delhi, 2019.
2. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
3. Balasubramaniam T.V and Murugan R, "Engineering Mechanics", 1st Edition, Vijay Nicole Imprints, 2015.

REFERENCE BOOKS:

1. Irving H. Shames and Krishna MohanaRao G., "Engineering Mechanics - Statics and Dynamics", 4th Edition, Pearson Education, 2006.
2. Hibbeller R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education, 2010.
3. Meriam J.L and Kraige L.G, "Engineering Mechanics - Statics - Volume 1, Dynamics Volume 2", 3rd Edition, John Wiley & Sons,1993.
4. Bhavikatti S.S and Rajashekarappa, K.G, "Engineering Mechanics", New Age International (P) Limited Publishers, 2021.
5. Vela Murali, "Engineering Mechanics", Oxford University Press, 2018.

WEB REFERENCES:

1. http://www.iitg.ac.in/rkbc/me101/me101.htm
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-engineering-mechanics-i-fall-2007/index.htm
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html.

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/122/104/122104015/
3. https://www.coursera.org/learn/engineering-mechanics-statics
4. https://www.edx.org/course/engineering-mechanics-2

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	1	-	-	-	-	-	2	3	1	2
CO2	3	3	3	3	1	-	-	-	-	-	2	3	1	2
CO3	3	3	3	3	1	-	-	--	-	-	2	3	1	2
CO4	3	3	3	3	1	-	-	-	-	-	2	3	1	2
CO5	3	3	3	3	1	-	-	-	-	-	2	3	1	2

Internal Assessment			
Assessment I (100 Marks)		**Assessment II (100 Marks)**	
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**
40	60	40	60
100%			

23ES1205	BASIC ELECTRICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

1. To learn the concepts related with Electrical circuits and Wiring.
2. To understand basics of Semiconductor Devices and Instrumentation
3. To Study the working principles of Special machines.
4. To study the concept of DC and AC Drives.
5. To understand the concepts of Solar PV system and Hybrid Electric Vehicle

UNIT - I BASIC CIRCUITSAND WIRING 9

Electrical quantities, Ohms Law, Kirchhoff's Laws -Series and Parallel Connections - Single phase and three phase system, Earthing and its types- Basic house wring and its types – safety measures at home and industry.

UNIT - II SEMICONDUCTOR DEVICES AND MEASURING INSTRUMENTS 9

PN junction diode,-Zener diode–Half wave and Full wave rectifier,- Bipolar Junction transistors. Classification of instruments –Operating Principles of indicating Instruments– Moving iron, Moving coil and wattmeter.

UNIT - III DC DRIVES 9

Construction and working Principles of DC Motors, Starters, Armature and Field control, Speed control using controlled rectifiers and DC choppers

UNIT - IV AC DRIVES AND SPECIAL MACHINES 9

AC Drives: Construction and working Principles of Three phase Induction motor and synchronous Motor, voltage / frequency control. Special Machines: Construction and working of Brushless dc motor, Permanent magnet DC Motor, stepper motor

UNIT - V SOLAR PV SYSTEM AND ELECTRIC VEHICLE 9

Solar PV system- Introduction-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs-Solar and Battery powered Electric Vehicles

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 : Acquire basic knowledge on Basic Electrical circuits and House Wiring

CO2 : Acquire basic knowledge on semiconductor devices and Measuring Instruments

CO3 : Explain the working principle and applications of DC and AC Drives

CO4 : Explain the working principle of Special Electrical Machines

CO5 : Illustrate the concepts related in the Solar PV system and Hybrid Electric Vehicles

TEXT BOOKS:

1. A.K. Sawhney, Puneet Sawhney‗ A Course in Electrical &Electronic Measurements &49 Instrumentation', Dhanpat Rai and Co,NewDelhi,2015.
2. KothariDP and I.JNagrath,—Basic Electrical and Electronics Engineering ‖, Second Edition, McGraw Hill Education,2020.
3. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, First edition 2017.
4. Vedam Subrahmaniam, —Electric Drives (Concepts and Applications) ‖, Tata McGraw-Hill, 2010
5. Nagrath.I.J.&Kothari.D.P,—Electrical Machines ‖,TataMcGraw-Hill,2006

REFERENCE BOOKS:

1. Pillai.S.K—A First Course on Electric Drives ‖,Wiley Eastern Limited,2012.
2. Singh.M.D.,K.B.Khanchandani,—PowerElectronics‖,TataMcGrawHill,2012.
3. KothariDP and I.JNagrath,—Basic Electrical Engineering ‖, Fourth Edition, McGrawHill Education,2019.
4. Mehrdad Ehsani,YiminGao, SebastianE. Gay, Ali Emadi, 'Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design', CRCPress,2004

WEB REFERENCES:

1. https://electrical-engineering-portal.com/download-center/books-and-guides/electrical- engineering/basic-course
2. https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/117/106/117106108/
2. https://archive.nptel.ac.in/courses/108/105/108105155/3.
3. https://archive.nptel.ac.in/courses/108/104/108104140/
4. https://onlinecourses.nptel.ac.in/noc22_ee53/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	1	1	-	-	-	-	1	-	-	1
CO2	3	2	2	2	1	1	-	-	-	-	1	-	-	1
CO3	3	2	2	2	1	1	-	-	-	-	1	-	-	1
CO4	3	2	2	2	1	1	-	-	-	-	1	-	-	1
CO5	3	2	2	2	2	1	-	-	-	-	2	-	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23HS1203	COMMUNICATIVE ENGLISH AND LANGUAGE SKILLS II	L	T	P	C
		2	0	2	3

COURSE OBJECTIVE:

- To develop linguistic and strategic competence in workplace context and to enhance language proficiency and thereby the employability of budding engineers and technologists.

- Toimprovetherelevantlanguageskillsnecessaryforprofessionalcommunication
- To help learners to develop their listening skills, which will, enable them to listen to lectures and comprehend them by asking questions; seeking clarification and developing their speaking skills and to speak fluently in real contexts.

- To improve the verbal ability skill and communicative skill of the students.
- Topreparethemforvariouspublicandprivatesectorexams&placementdrives.

UNIT I INTERPERSONAL COMMUNICATION 6

Listening: Listening to Telephone Etiquettes and Conversations. **Speaking**: Role Play ExercisesBased on Workplace Contexts, Introducing Oneself - PEP Talks. **Reading**: Reading the Interview of an Achiever and Completing Exercises (Skimming, Scanning and Predicting). **Writing**: Writing aShort Biography of an Achiever Based on Given Hints, **Grammar**: Punctuation, Numerical Expressions and Sentence pattern. **Vocabulary Development**: Idioms and Phrases

ACTIVITY: Writing and speaking about achievements of eminent personalities

UNIT II TECHNICAL COMMUNICATION 6

Listening: Listening to Talks/Lectures Both General and Technical and Summarizing the Main Points. **Speaking**: Participating in Debates, TED Talks.**Reading**: Reading Technical Essays/ Articles and Answering Comprehension Questions.**Writing**: Summary Writing, Minutes of the meeting. **Grammar**: Prepositional Phrases and Relative Clauses.**Vocabulary Development:** Abbreviations and Acronyms.

ACTIVITY: Reading transcripts of TED Talks and presenting them

UNIT III PROCESS DESCRIPTION 6

Listening: Listening to a Process Description and Drawing a Flowchart. **Speaking**: Participating in

Group Discussions, Giving Instructions, Presentation. **Reading**: Reading Instruction Manuals **Writing**: Process Descriptions – Writing Instructions **Grammar**: Use of Imperatives, Order of Adjectives, Impersonal Passive Voice and Phrasal verbs **Vocabulary Development**: Misspelt words. Homophones and Homonyms.

ACTIVITY: Reading Newspaper articles and presenting them

UNIT IV **REPORT WRITING** **6**

Listening: Listening to a Presentation and Completing Gap-Filling Exercises. **Speaking**: Making Formal Presentations, **Reading**: Reading and Interpreting Charts/Tables and diagrams. **Writing**: Interpreting Charts/Tables and Diagrams, Writing a Report. **Grammar**: Reported Speech; Interrogatives- Question Tags and Articles – omission of articles **Vocabulary Development**: Technical Jargon

ACTIVITY: Presentation on Technical and non-technical topics of interests with reference to IELTS

UNIT V **INTERVIEW SKILLS** **9**

Listening: Listening to a Job Interview and Completing Gap-Filling Exercises **Speaking**: Mock Interview, Telephone Interviews & Etiquette, and Group Discussion. **Reading: Reading** a Job Interview, SOP, Company Profile and Completing Comprehension Exercises **Writing**: Job Applications and Resume. **Grammar**: Conditional Clauses, Modal verbs, Verbal Analogy.**Vocabulary Development:** Technical Vocabulary, Purpose Statement

ACTIVITY: Preparing an effective Resume' and participating in Mock interview.

TOTAL :30 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Recognise the need for life skills; apply them to different situations, the basic communication practices in different types of communication.

CO2: Gain confidence to communicate effectively in various situations to acquire employability skills.

CO3: Develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others

CO4: Communicate effectively & appropriately in real life situation and enhance student's problem solving skill

CO5: Prepare for various public and private sector exams & placement drives.

TEXT BOOKS:

1. Board of Editors. English for Engineers and Technologists Volume 2 Orient Black Swan Limited, 2020

2. Richards, C. Jack. Interchange, New Delhi: CUP, 2017

3. Aggarwal R.S. (2017). Quantitative Aptitude for Competitive Examinations 3rd (Ed.) New Delhi: S.Chand Publishing

REFERENCE BOOKS:

1.Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015

2. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.

3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.

4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges.

Cengage Learning, USA: 2007.

WEB REFERENCES:

1. https://learnenglishteens.britishcouncil.org/exams/grammar-and-vocabulary exams / word formation

2. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018

3. http://xn--englishclub-ql3f.com/grammar/parts-of-speech.htm

4. https://www.edudose.com/english/grammar-degree-of-comparison-rules/

ONLINE COURSES / RESOURCES:

1. https://basicenglishspeaking.com/wh-questions/

2. https://agendaweb.org/verbs/modals-exercises.html

LANGUAGE SKILLS LAB **30 Hours**

LIST OF EXPERIMENTS

1. Speaking- Sharing personal information- Self introduction

2. Speaking- Group Discussion, Small talk or Peb Talk

3. Speaking- Presentation- Formal and Informal

4. Speaking- Mock Interview

5. Speaking- FAQ"s on Job Interview

6. Speaking – JAM

7. Speaking- Debate and Story Narration

8. Writing: Error Detection- Spotting and reasoning the errors from the passages in competitive exams.

9. Writing: Letter of recommendation

10. Writing: Elements of a good essay

11. Writing: Types of essays. Descriptive – Narrative-Issue based.

REFERENCE:

1. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015

2. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.

3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.

4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007.

5. Sharma Arun.(2016). Quantitative Aptitude, 7th (Ed.). Noida: McGraw Hill Education Pvt. Ltd.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO6	-	-	-	-	-	-	-	3	1	-	3	-	-	-

Assessment I (40% weightage) (Theory Component)		**Assessment II** (60% weightage) (Laboratory Component)		**End Semester Examination**
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Evaluation of Laboratory Observation, Record**	**Test**	**Written Examination**
40	**60**	**75**	**25**	
100				**100**
50 %				**50 %**

23ES1203	FUNDAMENTALS OF PYTHON PROGRAMMING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVE:

- To know the basic programming constructs
- To use control structures in python
- To use python collections–Lists, Tuples and Dictionary
- To define Python functions and use Strings
- To learn about strings and its manipulations in Python

UNIT I INTRODUCTIONTOPYTHONPROGRAMMING 6

Introduction to Python, Demo of Interactive and script mode, Tokens in Python — Variables,Keywords,Comments,Literals,Datatypes,Indentation,Operatorsanditsprecedence,Expressions,InputandPrintfunctions,TypeCasting.

UNIT II CONTROLSTRUCTURES 6

Control Structures: Selective statements– if, if -else, nested if, if–elif ladder statements; Iterative statements -while, for, range functions, nested loops, else in loops, break, continue and pass statements.

UNIT III COLLECTIONS 6

List: Create, Access, Slicing, Negative Indices, List Methods, and comprehensions
Tuples: Create, Indexing and Slicing, Operations on tuples.

Dictionary: Create, add, and replace values, operations on dictionaries. Sets: Create and operations on set.

UNIT IV FUNCTIONS 6

Functions: Types, parameters, arguments: positional arguments, keyword arguments, parameters with default values, functions with arbitrary arguments, Scope of variables: Local and global scope, Recursion functions.

UNIT V STRINGS 6

Strings: Formatting, Comparison, Slicing, Splitting, Stripping, Negative indices, String functions, Regular expression: Matching the patterns, Search and replace**.**

TOTAL :30 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 : Understand the basic python programming constructs
CO2 : Develop and execute simple Python programs

CO3 : Write simple Python programs using conditionals and loops for solving problems.
CO4 : Represent compound data using Python lists, tuples, dictionaries etc.
CO5 : Develop programs using functions.
CO6 : Develop programs using string functions.

TEXT BOOKS:

1. Paul Deitel and Harvey Deitel,— Python for Programmers ‖, Pearson Education, 1st Edition, 2021.
2. Reema Thareja,‖ Problem Solving and Programming with Python‘‘, 2nd edition, Oxford University Press, New Delhi,2019.

REFERENCE BOOKS:

1. MartinC.Brown,—Python: The Complete Reference ‖, 4thEdition,Mc-GrawHill,2018
2. Eric Matthes, —Python Crash Course, A Hands - on Project Based Introduction to Programming‖, 2ndEdition, No StarchPress,2019

ONLINE COURSES / RESOURCES:

1. https://docs.python.org/3/tutorial/
2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/index.htm
4. https://www.javatpoint.com/python-tutorial
5. https://nptel.ac.in/courses/

LANGUAGE SKILLS LAB **30 Hours**

LIST OF EXPERIMENTS

1. Basic Python Programs
2. Write programs to demonstrate different number data types in python
3. Develop python programs to demonstrate various conditional statements
4. Implement user defined functions using python
5. Develop pythons cripts to demonstrate built-in functions
6. Develop python programs to perform various string operations like slicing, indexing &formatting
7. Develop python programs to perform operations on List & Tuple
8. Demonstrate the concept of Dictionary with python programs
9. Develop python programs to perform operations on Sets.
10. Write a python program to find and replace all occurrences of one word with another

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	2	2	-	2	-	-	3	-	-	2	-	2	-
CO2	2	2	2	-	2	-	-	3	-	-	2	-	2	-
CO3	2	2	2	-	2	-	-	2	-	-	2	-	2	-
CO4	2	2	2	-	2	-	-	2	-	-	2	-	2	-
CO5	2	2	2	-	2	-	-	2	-	-	2	-	2	-
CO6	2	2	2	-	2	-	-	3	-	-	3	-	2	-

Assessment I (40% weightage) (Theory Component)		**Assessment II** (60% weightage) (Laboratory Component)		**End Semester Examination**
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Evaluation of Laboratory Observation, Record**	**Test**	**Written Examination**
40	**60**	**75**	**25**	
100				**100**
50 %				**50 %**

23ES1212	TECHNICAL SKILL PRACTICES I	L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

- To impart essential problem solving skills through general problem solving concepts.
- To provide basic knowledge on programming essentials using C as implementation tool.
- To introduce various programming methods using C.

LIST OF EXPERIMENTS

1. Data Types, Variables, Operators
2. Expressions, Precedence , Operators
3. Conditional Statements , Switch Statements
4. Looping, Nested Loops
5. Problems on Bit Manipulation
6. Patterns
7. Number Problems
8. Array Basics , Static vs Dynamic Array, Two Dimensional Matrix
9. Structure , Union ,Storage Classes
10. Function , Parameters passing
11. Recursion
12. Strings
13. Pointers
14. Command Line Arguments, Pre-processors
15. File Handling & Exception Handling.

TOTAL: 30 PERIODS

COURSE OUTCOME(S):

Upon successful completion of the course student will be able to**:**

CO1: Propose solutions for a given problem.

CO2: Infer the fundamental programming elements in C language and learn to apply basic control structures in C.

CO3: Demonstrate the applications of structures and unions.

CO4: Visualize the capabilities of modular programming approach in C.

CO5: Understand the basic principles of pointers and their association during implementations.

CO6: Apply various input, output and error handling functions in C.

TEXT BOOKS:

1. ReemaThareja, ``Programming in C"", 2nd edition, OXFORD University Press, New Delhi, 2019.
2. Paul Deitel and Harvey Deitel, “C How to Program”, Seventh edition, Pearson Publication,2016.

REFERENCES BOOKS:

1. Stephen G. Kochan, “Programming in C”, 3rd edition, Pearson Education,2014.
2. Herbert Schildt, “C: The Complete Reference”, Fourth Edition, McGraw Hill, 2000.

ONLINE COURSES / RESOURCES:

1. https://www.javatpoint.com/c-programming-language-tutorial
2. https://www.tutorialspoint.com/cprogramming/
3. https://nptel.ac.in/Courses/

CO – PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	-	-	-	-	-	3	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	3	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	3	-	-	-
CO4	3	3	3	3	3	-	-	-	-	-	3	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	3	-	-	-
CO6	3	3	3	3	3	-	-	-	-	-	3	-	-	-

23ES1213	PRODUCT DEVELOPMENT LABOATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- Fabrication of pipe line with various pipe fittings and Making simple Joints in woods.
- Making joints in wood materials used in common household wood work.
- Create simple mechanical operations like welding, machining and sheet metal fabrications.
- Identifying various parts of simple mechanical machines like centrifugal pump and Window Air conditioner and learning foundry operations.
- Understanding basics of Electrical and Electronics Engineering.

GROUP – A **CIVIL & ELECTRICAL ENGINEERING**

CIVIL ENGINEERING PRACTICES **15**

Plumbing Work:

1) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
2) Preparing plumbing line sketches.
3) Laying pipe connection to the suction side and delivery side of a pump
4) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

Wood Work:

1) Introduction to Tools and Equipments
2) Simple Planning and sawing practice
3) Making Half Lap, Dovetail, Mortise and Tenon joints

Wood Work Study:

1) Studying joints in door panels and wooden furniture
2) Studying common industrial trusses using models.

ELECTRICAL ENGINEERING PRACTICES **15**

1) Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2) Fluorescent lamp wiring.
3) Stair case wiring
4) Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.

5) Measurement of energy using single phase energy meter.

6) Soldering practice – Components Devices and Circuits – Using general purposePCB.

GROUP – B MECHANICAL AND ELECTRONICS

MECHANICAL ENGINEERING PRACTICES 15

Sheet Metal Work:

1) Demonstrating basic sheet metal operations
2) Making simple sheet metal objects like trays, funnels etc.

Basic Machining Work:

1) Introduction to Lathe, Dilling machine, Tools and Equipments
2) Simple Turning and facing
3) Step turning
4) Simple Drilling and Tapping of flat plate using drilling machine

Foundry Work:

1) Introduction to tools, equipments and basic operations used in Foundry

Welding Work:

1) Introduction to Arc welding and Gas welding Tools and Equipment
2) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

Introduction to 3D Printing

1) Introduction to layer thickness, wall thickness and nozzle temperature
2) Making a simple box

GROUP – B MECHANICAL AND ELECTRONICS

ELECTRONICS ENGINEERING PRACTICES 15

1) Study of Electronic components and equipments – Resistor colour coding
2) Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
3) Design of Half wave and Full wave Rectifier.
4) 2D & 3D Electrical wiring Model using suitable Software.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

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

CO1 : Understand tools and equipment's with making different joints

CO2 : Analyze Sheet Metal Tools , and its mechanism to make objects for day to day usages

CO3 : Understand Welding process and implement it to join two objects

CO4 : Making wood into a useful household objects with help of carpentry tools and Connecting various basic pipe fittings and other components

CO5 : Connect out basic home electrical works and appliances and measure the electrical quantities.

TEXT BOOKS

1. Jeyapoovan T., Saravanapandian M. &Pranitha S., "Engineering Practices Lab Manual", VikasPuplishing House Pvt.Ltd, (2014)
2. Kannaiah P. &Narayana K.L., "Manual on Workshop Practice", Scitech Publications, (2011).
3. Jeyachandran K., Natarajan S. &Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, (2007).

REFERENCE BOOKS

1. K.C. John, "Mechanical workshop practice", Second edition, PHI learning Pvt Ltd, New Delhi.(2010)
2. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, (2017)

WEB REFERENCES

1. https://nptel.ac.in/courses/112/107/112107090/
2. https://nptel.ac.in/courses/112/107/112107084/

CO – PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	2	1	1	-	1	-	-	-	-	2	2	-	2
CO2	2	2	1	1	-	1	-	-	-	-	2	2	-	2
CO3	2	2	1	1	-	1	-	-	-	-	2	2	-	2
CO4	2	2	1	1	-	1	-	-	-	-	2	2	-	2
CO5	2	2	1	1	-	1	-	-	-	-	2	2	-	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ES1214	ELECTRICAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To understand the characteristics of semiconductor devices
- To determine the characteristics of DC and AC machines
- To enable the students to be familiar with the speed control of DC Motors

LISTOFEXPERIMENTS

1. Load test on DC Shunt and Series motor.
2. Load test on compound Motor
3. Speed control of DC shunt motor.
4. V curves and inverted V curves of synchronous Motor
5. Load test on three phases quirrel cage Induction motor.
6. Study of DC & AC Starters
7. Characteristics of Semiconductor diode and Zener diode
8. Characteristics of a NPN Transistor under common emitter, common collector and common base configurations
9. Simulation on motoring operation of DC motor
10. Simulation of Speed control of Dc motors using controlled rectifiers
11. Simulation of Speed control of Dc motors using DC choppers

TOTAL: 60 PERIODS

COURSE OUTCOME(S):

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

CO1 : Infer the characteristics of BJT.

CO2 : Compute performance characteristics of DC and AC Machines with various loads.

CO3 : Analyze the speed characteristic of DC and AC Machines.

CO4 : Analyze the characteristics of DC motor using Simulation software.

CO5 : Simulate the Speed control of DC motors using controlled rectifiers and DC choppers

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	-	-	-	-	-	1	-	-	1
CO2	3	2	2	2	2	-	-	-	-	-	1	-	-	1
CO3	3	2	2	2	2	-	-	-	-	-	1	-	-	1
CO4	3	2	2	2	2	-	-	-	-	-	1	-	-	1
CO5	3	2	2	2	2	-	-	-	-	-	1	-	-	1

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23TA1201	TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT–I WEAVINGAND CERAMIC TECHNOLOGY 3

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

UNIT–II DESIGNANDCONSTRUCTION TECHNOLOGY 3

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

UNIT–III MANUFACTURING TECHNOLOGY 3

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

UNIT–IV AGRICULTUREAND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry -Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries —Pearl-Conchediving-AncientKnowledgeofOcean-KnowledgeSpecificSociety.

UNIT–V SCIENTIFICTAMIL & TAMIL COMPUTING 3

DevelopmentofScientificTamil-Tamilcomputing–DigitalizationofTamilBooks–DevelopmentofTamil Software — Tamil Virtual Academy — Tamil Digital Library — Online Tamil Dictionaries —Sorkuvai Project.

Total : 15 PERIODS

TEXT-CUM REFERENCE BOOKS:

1. தமிழகவரலாறு – மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை)
5. Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL–(in print)
6. Social Life of the Tamils-The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies Historical by: International Institute of Tamil Studies).
7. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
8. Keeladi- 'Sangam City Civilization on the banks of river Vaigai '(Jointly Published by: Department of Archaeology & TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)
9. Studies in the History of India with Special Reference to TamilNadu (Dr.K.K.Pillay) (Published by:The Author)
10. Porunai Civilization (Jointly Published by: Department of Archaeology & TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)
11. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23TA1201	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		1	0	0	1

UNIT–I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்** **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

UNIT–II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்** **3**

சங்ககாலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்ககாலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்ககாலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச்சிற்பங்களும், கோவில்களும் – சோழர்காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத்தலங்கள் – நாயக்கர் காலக்கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலைநாயக்கர் மஹால் – செட்டிநாடு வீடுகள் – பிரிட்டிஷ்காலத்தில் சென்னையில் இந்தோ-சாரோசோனிக் கட்டிடக்கலை.

UNIT–III **உற்பத்தி தொழில்நுட்பம்** **3**

கப்பல் கட்டும் கலை - உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்கநாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண்மணிகள் - சங்குமணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

UNIT–IV **வேளாண்மை மற்றும் நீர்பாசனத் தொழில்நுட்பம்** **3**

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு - மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

UNIT–V **அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்** **3**

அறிவியல் தமிழின் வளர்ச்சி - கணினித்தமிழ் – தமிழ்நூல்களை மின்பதிப்புசெய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக்கல்விக்கழகம் – தமிழ் மின்நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

Total : 15 PERIODS

TEXT-CUM REFERENCE BOOKS:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகரநாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை)
5. Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL–(in print)
6. Social Life of the Tamils-The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies Historical by: International Institute of Tamil Studies).
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10. Porunai Civilization (Jointly Published by: Department of Archaeology & TamilNadu Text Book and Educational Services Corporation, Tamil Nadu)
11. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL)

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23HS1204	INTERPERSONAL COMMUNICATION SKILLS II	L	T	P	C
		0	0	2	0

COURSE OBJECTIVE:

- To enhance their vocabulary through understanding synonyms, antonyms, and word formation techniques..
- To identify and correct grammatical errors and use precise word choices in sentences.
- To apply grammar rules, including subject-verb agreement, pronouns, tenses, and sentence structure
- To effectively rearrange sentences and solve para jumbles to improve coherence and logical flow in writing
- To foster reading comprehension and creative storytelling abilities through structured activities and practice.

Unit I

Introduction to Verbal-Word Building- Synonyms & Antonyms

Unit II

Common Confusables- Oneword Substitution- Sentence Completion

Unit III

Error Spotting- Sentence Correction

Unit IV

Sentence Rearrangement- Para jumbles

Unit V

Reading Comprehension- Story Building Activity

TOTAL : 30 PERIODS

TEXT BOOKS:

. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Learners of English. 5th ed., Cambridge University Press, 2019.
2. Wren, P. C., and H. Martin. High School English Grammar and Composition.Revised ed., S. Chand Publishing, 2017.

REFERENCE BOOKS:

1. Leech, G., &Svartvik, J. (2013). A Communicative Grammar of English (3rd ed.).Routledge.
2. Azar, B. S., & Hagen, S. A. (2016). Understanding and Using English Grammar (5th ed.). Pearson Education.

WEB REFERENCES:

1. https://learnenglish.britishcouncil.org/grammar
2. https://owl.purdue.edu/owl/general_writing/grammar/index.html

ONLINE COURSES / RESOURCES:

1. https://www.edx.org/course/english-grammar-and-style
2. https://www.coursera.org/learn/careerdevelopment

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Demonstrate an expanded vocabulary and accurately use synonyms, antonyms, and word building techniques in communication. .

CO2: Identify and correct common grammatical errors and apply one-word substitutions and sentence completion strategies effectively.

CO3: Construct grammatically correct sentences, ensuring proper use of subject-verb agreement, pronouns, tenses, and modifiers.

CO4: Rearrange sentences and para jumbles to create coherent and logically structured texts.

CO5: Excel in reading comprehension and create engaging stories, showcasing improved analytical and creative writing skills.

CO&PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO6	-	-	-	-	-	-	-	3	3	-	2	-	-	-

23HS1205	QUANTITATIVE APTITUDE PRACTICES II	L	T	P	C
		0	0	1	0

COURSE OBJECTIVE:

- To improve students comprehension of geometry and mensuration, average as well as help them hone their problem-solving abilities
- To develop students ability to use the techniques for resolving riddles, streams, boats, and coding problems.

Module 1 Geometry and Mensuration **3**

Lines and angles – circles – triangles – quadrilaterals – polygons - coordinate geometry area &volume of 2D and 3D figures.

Module 2 Average, Time, Work **3**

Logarithm - Average - time and work - time and distance

Module 3 Boats and streams **3**

Relative speed – problems on trains – boats and streams – races and games

Module 4 Logical Reasoning - I **3**

Odd man out and series – venn diagram - seating arrangement – decision making

TOTAL : 12 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Acquire knowledge of solving geometry and mensuration, average, percentage, time and work questions effortlessly.

CO2: Understand and exhibit sound knowledge to the boats and streams, venn diagram and decision making.

TEXT BOOKS:

1. Aggarwal R.S.(2017). Quantitative Aptitude for Competitive Examinations 3rd edition New Delhi: S. Chand Publishing.
2. Abhijitguha (2016). Quantitative Aptitude for All Competitive Examinations, 6th edition. Noida: McGraw Hill Education Pvt. Ltd.
3. FACE.(2016).Aptipedia Aptitude Encyclopedia1(Ed.).New Delhi: Wiley Publications.

REFERENCE BOOK:

1. Sharma arun.(2016).Quantitative aptitude,7th(Ed.).Noida : McGraw Hill Education Pvt.Ltd.
2. Praveen. R.V 3rd edition, Quantitative aptitude and reasoning, PHI learning publication.

Mode of Evaluation: Online Test

SEMESTER – III

23MA1303	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To understand the concepts of solving partial differential equation.
- To understand the concepts of Fourier series analysis.
- To apply the concept of Fourier series techniques in wave and heat flow problems.
- To introduce the basic concepts of Fourier transform techniques.
- To introduce the Z transform techniques for discrete time systems.

UNIT - I PARTIALDIFFERENTIALEQUATIONS 9+3

Formation of partial differential equations - Solutions to standard types of first order partial differential equations - Lagranges linear equation - Second and higher order with constant coefficients of homogeneous linear partial differential equations.

UNIT - II FOURIER SERIES 9+3

Dirichlet's conditions – General Fourier series - Odd and even functions - Change ofinterval-Halfrangesineseries–Halfrangecosineseries–RMSvalues-Parseval'sidentity– Harmonicanalysis

UNIT - III APPLICATIONSOFPARTIALDIFFERENTIAL EQUATIONS 9+3

Fourier Series Solutions of one dimensional wave equation –One dimensional equation of heat conduction— Steady state solution of two dimensional equation of heat conduction in Cartesian coordinates.

UNIT - IV FOURIERTRANSFORMS 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 –Initial and final value theorems- Inverse Z-transform (Using partial fraction method and Residue method)-Convolution theorem– Formation of difference equation-Solution of difference equations using Z –transform.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 : Understand the concepts of partial differential equations and their solutions.
CO2 : Utilise the principles of Fourier series in real life situation.
CO3 : Develop one dimensional and two dimensional equations using Fourier series techniques..
CO4 : Develop the mathematical principles on Fourier transforms.
CO5 : Utilise the basic knowledge in solving difference equations using Z-transforms.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi,2014
2. NarayananS., Manicavachagom Pillay.T.K and Ramanaiah.G" Advanced Mathematics for Engineering Students",Vol.II & III, S.Viswanathan Publishers Pvt.Ltd, Chennai,1998.
3. Veerarajan T., "Transforms and Partial Differential Equations", Tata McGrawHillEducationPvt.Ltd.,NewDelhi,Secondreprint,2012.
4. NagarajanG.andSundarRajM.,"TransformsandPartialDifferentialEquations",Sreekamalamani Publications 6th edition,Chennai,2021.

REFERENCE BOOKS:

1. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9thEdition, Laxmi Publications Pvt.Ltd, 2014.
2. ErwinKreyszig,"AdvancedEngineeringMathematics",10th Edition,JohnWiley,India,2016
3. Ramana.B.V.”HigherEngineeringMathematics",McGrawHillEducationPvt.Ltd,New Delhi.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	-	-	-	-	-	-	-	3	3	-	-
CO2	3	2	3	-	-	-	-	-	-	-	1	3	-	-
CO3	3	3	3	-	-	-	-	-	-	-	1	3	-	-
CO4	3	2	1	-	-	-	-	-	-	-	2	3	-	-
CO5	3	2	1	-	-	-	-	-	-	-	2	3	-	-
CO6	3	3	2	-	-	-	-	-	-	-	3	3	-	-

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1301	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the concepts of stress, strain, principal stresses and principal planes
- To understand the concepts of stresses on circular shafts and springs due to torsion and on cylinders due to internal pressures..
- To understand the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To analyse the deflections and slope of beam under variable load conditions and theory of columns and perfect frames.

UNIT - I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

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

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

Beams – types, transverse loading on beams – Shear force and bending moment in beams – Cantilevers, Simply supported beams and overhanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shearing Stress at a Section in a Loaded Beam, Distribution of Shearing Stress over various cross section

UNIT - III TORSION 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses and Deflection in helical and leaf springs.

UNIT - IV DEFLECTION OF BEAMS 9

Deflection of beams - Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam method

UNIT - V THEORY OF COLUMNS, THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Euler's column theory – Euler's formula for various end conditions - Rankine's Formulae for Columns, Stresses in thin cylindrical and thick cylindrical shell due to internal pressure - circumferential and longitudinal stresses and deformation – Spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Apply the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes

CO2: Apply the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.

CO3: Apply the basic equation of simple torsion , stresses in shafts and helical spring.

CO4: Apply different methods to find the slope and deflection in beams.

CO5: Analyse the buckling and crippling load of columns and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2018
2. R. Narayan and S. Ramamrutham," Strength of Materials", Dhanpat Rai Publishing Co.,

New Delhi, 19th editon, 2017.

REFERENCE BOOKS:

1. Egor. P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi, 2019
2. Ferdinand P. Beer, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013.
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.
5. Gere & Timoshenko, "Mechanics of materials" Mcmillan company, 2009.

WEB REFERENCES:

1. https://mechanicalc.com/reference/strength-of-materials
2. https://www.springer.com/journal/11223
3. https://www.engineersedge.com/strength_of_materials.htm
4. https://mechanicalbasics.com/strength-of-materials/
5. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/strength-of-materials

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/105105108
2. https://www.digimat.in/nptel/courses/video/112107147/L01.html
3. https://www.youtube.com/watch?v=GkFgysZC4Vc
4. https://nptel.ac.in/courses/112107146
5. https://www.nptelvideos.com/mechanical/strength_of_materials.php

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	2	-	-	-	-	3	3	-	3
CO2	3	3	1	1	-	2	-	-	-	-	3	3	-	3
CO3	3	3	3	3	-	2	-	-	-	-	3	3	-	3
CO4	3	3	3	3	-	2	-	-	-	-	3	3	-	3
CO5	3	3	3	3	-	2	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1302	MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the basic concept in various metal casting processes.
- To understand the various types of metal joining techniques used for different materials.
- To understand the principles and processes of hot and cold working of metals, including forging, drawing, extrusion, and rolling, along with the common defects in rolled parts.
- To understand the various sheet metal characteristics and forming processes.
- To understand the types and characteristics of plastics, various molding techniques, and the manufacture of composite materials and powder metallurgy.

UNIT - I METAL CASTING PROCESSES 9

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Mouldings and Properties and testing – Cores –Types and applications – Melting furnaces : Blast and Cupola Furnaces; Moulding machines– Types and applications; Principle of special casting processes : Shell - Investment – Ceramic mould – Pressure die casting - Centrifugal Casting - CO2process – Stir casting - Defects in Sand casting

UNIT - II JOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding- Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure. Case studies on welding in marine

UNIT - III METAL FORMING PROCESSES 9

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

UNIT - IV SHEET METAL PROCESSES 9

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

UNIT - V MANUFACTURE OF POLYMERS AND COMPOSITES 9

Types and characteristics of plastics – Moulding of thermoplastics – working principles and

typical applications – injection moulding – Plunger and screw machines – Compression moulding, Transfer Moulding –applications – introduction to blow moulding –Rotational moulding –Film blowing – Extrusion – Thermoforming – Bonding of Thermoplastics; Manufacture of Composite materials - Powder metallurgy - Process, Compacting, Sintering, Vacuum processing- high energy compaction. Introduction to Additive Manufacturing

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 Analyse different metal casting processes, associated defects, merits and demerits.
CO2 Analyse the different metal joining processes for various applications
CO3 Analyse various hot working and cold working methods of metals.
CO4 Apply the concepts of various sheet metal making processes
CO5 Analyse the concepts for manufacturing various polymer and composite components..

TEXT BOOKS:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology",volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2021.
2. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition,TMH-2018.

REFERENCE BOOKS:

1. Kalpakjian. S, “Manufacturing Engineering and Technology”, Pearson Education India Edition,2013

WEB REFERENCES:

1. http://www.iitg.ac.in
2. https://ocw.mit.edu/courses
3. http://hyperphysics.phy-astr.gsu.edu/hbase

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105306
2. https://nptel.ac.in/courses/112105233
3. https://nptel.ac.in/courses/112104189https://www.coursera.org/learn/manufacturing-process-fusion-360?

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	1	1	-	-	-	-	-	-	3	3	-	3
CO2	3	-	1	1	-	-	-	-	-	-	3	3	-	3
CO3	3	-	1	1	-	-	-	-	-	-	3	3	-	3
CO4	3	-	2	2	-	-	-	-	-	-	3	3	-	3
CO5	3	-	2	2	-	-	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1303	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the fundamental concepts of thermodynamics.
- To understand the basics of flow processes.
- To understand the application of second law of thermodynamics.
- To understand the performance of vapour power cycle and properties of pure substances
- Analyze the thermodynamic behaviour of real gases, gas mixtures, and moist air systems.

UNIT - I BASIC CONCEPTS AND FIRST LAW 9

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work .P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics –application to closed and open systems – steady and unsteady flow processes.

UNIT - II SECOND LAW AND AVAILABILITY ANALYSIS 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. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Irreversibility. I and II law Efficiency.

UNIT - III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

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. Simple Calculations.

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 chart and expressions. Psychrometric process –adiabatic

saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing, Simple Applications.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Apply the fundamentals of thermodynamics.

CO2: Apply the first law of thermodynamics for steady and unsteady flow process.

CO3: Apply second law of thermodynamics to heat engine, heat pump and refrigerator.

CO4: Analyse the properties of pure substance, performance of vapour power cycle.

CO5: Analyse thermodynamic relations for real gases, properties of gas mixtures and moist air.

TEXT BOOKS:

1. Nag.P.K.,“Engineering Thermodynamics”, 6thEdition, Tata McGraw-Hill, New Delhi, 2017.
2. R.K. Rajput, "Thermal Engineering", 10th Edition, Laxmi Publications (P) LTD, 2020.
3. Domkundwar, Kothandaraman, "A Course in Thermal Engineering", Dhanpat Rai & Co, 2016.

REFERENCE BOOKS:

1. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 7th Edition, TataMcGraw Hill, 2010.
2. Holman.J.P., "Thermodynamics", 3rd Edition, McGraw-Hill, 1995.
3. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall ofIndia Pvt. Ltd, 2006
4. Natarajan E., "Engineering Thermodynamics: Fundamentals and Applications", AnuragamPublications, 2012.
5. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.
6. Arora C.P, “Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
7. Kau-Fui Vincent Wong, "Thermodynamics for Engineers", CRC Press, 2010 Indian Reprint.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=1_InUUX5-LE
2. https://nptel.ac.in/courses/127106135

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105220
2. https://www.youtube.com/watch?v=0jXeNaSM5Xc
3. https://www.youtube.com/watch?v=xQwi9fveGTQ

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	3	3	-	3
CO2	3	3	-	-	-	-	-	-	-	-	3	3	-	3
CO3	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO4	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO5	3	3	3	3	-	1	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1304	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the classification of materials and its various mechanical properties.
- To understand the concepts of CCT Diagrams and the principles of various heat treatment process.
- To understand the effects of alloying elements on the steel and various steel types.
- To understand the properties and applications of the non-ferrous metal and non-metallic materials..
- To understand the concept of various strengthening mechanisms.

UNIT - I MATERIALS AND MECHANICAL PROPERTIES 9

Classification of Materials - alloys types - Intermediate Alloy Phase/Compound , Solid Solutions - Mechanical Properties - Strength , Homogeneity, Isotropy, Anisotropy, Elasticity, Plasticity, Ductility, Malleability, Machinability, Brittleness, Embrittlement, Hardness, Toughness, Stiffness, Impact strength, Resilience, Proof Resilience, Modulus of Resilience, Damping, Creep, Fatigue, Cohesion , Rupture - Iron carbon equilibrium diagram - Classification of steel and cast Iron and its microstructure, properties and applications.

UNIT - II HEAT TREATMENT 9

Definition – Full annealing, stress relief, recrystallization and spheroidising – normalising, hardening and Tempering of steel- Austempering, martempering – Hardenability, Jominy end quench test - cooling curves superimposed on I.T. diagram CCR - case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

UNIT - III STEEL AND ITS CLASSIFICATIONS 9

Specification of steel - Effect of alloying additions on steel- α and β stabilizers – Alloy Steels-Ni Steel, Cr Steels, Nickel -Chromium Steels, Mn Steels, Mo Steels, W Steel, V Steels, and Si Steels - Stainless Steel - Tool steels - Dual Phase Steel – TRIP - HSLA - Maraging steels - properties and applications.

UNIT - IV NON FERROUS METALS AND NON METALLIC MATERIALS 9

Copper and copper alloys – Aluminium and Aluminium Alloys and Al-Cu – precipitation strengthening treatment – Bearing alloys - Magnesium alloys - Super alloys and its types - Titanium alloys. Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers - Engineering Ceramics – Properties and applications - Composites and its types - Applications of Composite.

UNIT - V STRENGTHENING MECHANISMS 9

Basic concepts: Dislocations and plastic deformations - Solid solution strengthening - strengthening by grain size reduction - Precipitation hardening - Particle and fiber dispersion strengthening- Strain hardening – Recovery - Recrystallisation and grain growth.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Apply the various material classification and its properties, Iron-Iron carbon diagram and its microstructures

CO2: Apply key heat treatment processes for steel as well as the concepts of hardenability and related testing techniques.

CO3: Apply the basic concepts of material specifications and properties of various alloy steels, including the effects of various alloying elements.

CO4: Analyse the properties, types, and applications of various non ferrous materials, polymers, ceramics, and composites.

CO5: Analyse key material strengthening methods, including dislocations, grain size reduction, and processes like precipitation hardening and recrystallization.

TEXT BOOKS:

1. Avner, S.H., “Introduction to Physical Metallurgy”, McGraw Hill Book Company,2017.
2. Williams D Callister, “Material Science and Engineering” Wiley India Pvt Ltd, Revised Indian Edition 2018

REFERENCE BOOKS:

1. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 2015.
2. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd., 2015.
3. U.C.Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012
4. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, Viva Books Pvt. Ltd., New Delhi, 2006.

WEB REFERENCES:

1. https://www.theengineerspost.com/heat-treatment-of-steel/
2. https://unacademy.com/lesson/iron-carbon-equilibrium-diagram/KP6BFSGT
3. https://www.iqsdirectory.com/articles/powder-metal-parts/powder-metallurgy.html

ONLINE COURSES / RESOURCES:

1. NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112: related web and video resources under Mechanical Engineering &Metallurgy and Material Science categories.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO2	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO3	3	3	2	2	-	1	-	-	-	-	3	3	-	3
CO4	3	3	2	2	-	1	-	-	-	-	3	3	-	3
CO5	3	3	2	2	-	1	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1305	FLUID MECHANICS AND MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the properties of fluids such as mass density, viscosity, surface tension, and compressibility, and explain their significance in fluid mechanics.
- To Understand the principles of fluid statics, including Pascal's Law, pressure variations in a fluid at rest, and the concepts of absolute, gauge, and atmospheric pressures
- To Understand the concepts of laminar flow, boundary layers, and the Darcy-Weisbach equation, and describe the flow characteristics
- To Understand the need for dimensional analysis and its methods and their application in model analysis.
- To Understand the working principles of hydraulic pumps and turbines, including centrifugal and reciprocating pumps, as well as Pelton, Francis, and Kaplan turbines.

UNIT - I FLUID PROPERTIES AND FLOW CHARACTERISTICS 9

Units and dimensions- Properties of fluids - mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity.

Fluid Statics: Pascal's Law – Pressure Variation in a Fluid at Rest– Absolute Pressure – Gauge Pressure – Atmospheric Pressure - Vacuum Pressures.

Flow characteristics - application of continuity equation, energy equation and momentum equation.

UNIT - II FLOW THROUGH CIRCULAR CONDUITS 9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – Types of boundary layer thickness – Darcy-Weisbach equation –friction factor- Moody diagram- Commercial pipes- Minor losses – Flow through pipes in series and parallel

UNIT - III DIMENSIONAL ANALYSIS 9

Need for dimensional analysis – Methods of Dimensional Analysis – Similitude –Types of similitude - Dimensionless parameters- Application of dimensionless parameters – Model analysis

UNIT - IV HYDRAULIC PUMPS 9

Impact of jets - Euler's equation - Theory of Roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles –

Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.

UNIT - V HYDRAULIC TURBINES 9

Classification of turbines - Axial, radial and mixed flow turbines – Heads and efficiencies – Velocity triangles. Pelton wheel, Francis turbine and Kaplan turbines- Working principles - Work done by water on the runner – Draft tube. Specific speed - unit quantities – Performance curves for turbines - Governing of turbines

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Apply the fundamental properties of fluids and their importance in fluid mechanics applications.
CO2: Apply the principles of fluid statics, and continuity, energy and momentum equation.
CO3: Analyze flow through circular conduits and pipelines.
CO4: Analyze the need for dimensional analysis to solve engineering problems.
CO5: Analyze the performance of hydraulic pumps and turbines.

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 2013**.**

REFERENCE BOOKS:

1. Hibbeler R.C., “Fluid Mechanics in SI units”, 1st Edition, Pearson India Education Services Pvt. Ltd., Noida, 2017.
2. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
3. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
4. Robert W.Fox, Alan T. McDonald, Philip J. Pritchard, “Fluid Mechanics and Machinery”, 2011.
5. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
6. Yunus A. Cengel, and John M. Cimbala, Fluid Mechanics, Third edition, Mc Graw Hill Education (India) Pvt. Ltd, 2014.

WEB REFERENCES:

1. https://energyeducation.ca/encyclopedia/Pelton_turbine
2. https://www.sciencedirect.com/topics/engineering/fluid-mechanics
3. https://www.annualreviews.org/journal/fluid
4. https://madhavuniversity.edu.in/fluid-mechanics-and-its-use.html
5. https://theconstructor.org/practical-guide/centrifugal-pump-working-types/2917/

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105183/.
2. https://nptel.ac.in/courses/112104118
3. https://nptel.ac.in/courses/105103192
4. https://nptel.ac.in/courses/112105171
5. https://onlinecourses.nptel.ac.in/noc21_ce56/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1							3	3	-	3
CO2	3	3	1	1							3	3	-	3
CO3	3	3	2	2		1					3	3	-	3
CO4	3	3	2	2		1					3	3	-	3
CO5	3	3	2	2		1					3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1311	MANUFACTURING PROCESSES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To understand the process of preparing green sand molds with solid
- To understand the sheet metal fabrication techniques
- To understand the principles and techniques of Gas Metal Arc Welding (GMAW) to fabricate lap
- To understand the process of taper turning and thread cutting on a center lathe
- To understand the process of knurling and external and internal thread cutting

LISTOFEXPERIMENTS

1. Fabrication of sheet metal tray using shearing and bending operations.
2. Fabrication of a funnel using shearing and bending operations.
3. Fabrication of Lap Joint using Gas Metal Arc Welding
4. Fabrication of Butt Joint using Gas Metal Arc Welding
5. Fabrication of T-Joint using Gas Metal Arc Welding
6. Taper turning using Center Lathe - compound rest, Tailstock set over
7. Single and Multi start thread cutting - External and Internal
8. Knurling using Center Lathe
9. Eccentric Turning using Center Lathe
10. Square Head Shaping

Demonstration

11. Preparation of green sand mould with Solid Pattern / core
12. Brazing
13. Gas Welding
14. Manufacturing of sheet metal components using metal spinning on a lathe

TOTAL: 60 PERIODS

COURSE OUTCOME(S):

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

CO1 : Apply the techniques for preparing green sand molds with solid, split, and loose-piece patterns and their application in casting processes.

CO2 : Analyze sheet metal fabrication methods, including shearing and bending operations.

CO3 : Apply the principles of Gas Metal Arc Welding (GMAW) to fabricate lap, butt, and T-joints.

CO4 : Apply turning, thread cutting, knurling operations and shaping operations on a center lathe for precision manufacturing.

CO5 : Evaluate the effectiveness of different fabrication technique to use most suitable approach for specific industrial applications.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	1	-	2	-	-	2	3	-	2
CO2	3	2	-	-	-	1	-	2	-	-	2	3	-	2
CO3	3	2	-	-	-	1	-	2	-	-	2	3	-	2
CO4	3	2	-	-	-	1	-	2	-	-	2	3	-	2
CO5	3	2	-	-	-	1	-	2	-	-	2	3	-	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ME1312	STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE

- Understand the mechanical properties of materials through tests like tension, shear, torsion, and impact tests.
- Understand the effects of hardening and tempering on the mechanical properties of steels through hardness and impact resistance testing.
- Understand the concept of beam deflection and strain measurement using a rosette strain gauge.
- Understand the principles of fluid flow and determine the coefficient of discharge for orifice meters, venturimeters, and the rate of flow using a rotameter.
- Understand the working principles of different pumps and turbines by studying and analyzing their characteristic curves in experiments.

LISTOFEXPERIMENTS

STRENGTH OF MATERIALS

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    a) Unhardened specimen
    b) Quenched Specimen and
    c) Quenched and tempered specimen.
11. Microscopic Examination of
    a) Hardened samples and
    b) Hardened and tempered samples.

FLUID MECHANICS AND MACHINERY

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Determination of friction factor for a given set of pipes.
4. Conducting experiments and drawing the characteristic curves of centrifugal pump
5. Conducting experiments and drawing the characteristic curves of reciprocating pump.

6. Conducting experiments and drawing the characteristic curves of Gear pump.
7. Conducting experiments and drawing the characteristic curves of Pelton wheel.

TOTAL: 60 PERIODS

COURSE OUTCOME(S):

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

CO1 : Understand basic material tests and their role in material strength.
CO2 : Apply fluid mechanics principles to test pumps and turbines.
CO3 : Analyze hardening and tempering affect the strength and toughness of steels.
CO4 : Analyze the deflection and strain in materials using beam tests and strain gauges.
CO5 : Evaluate the performance of fluid to determine flow rate and discharge.

TEXT BOOKS:

1. R. K. Rajput, "A text book of Strength of Materials', S. Chand & Co. Ltd., 2018
2. R. K. Rajput, "A Textbook of Fluid Mechanics and Hydraulic Machines', S. Chand & Co. Ltd., 2015.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	-	-	2	-	-	2	3	-	2
CO2	3	3	3	3	-	1	-	2	-	-	2	3	-	2
CO3	3	3	3	3	-	1	-	2	-	-	2	3	-	2
CO4	3	3	3	3	-	1	-	2	-	-	2	3	-	2
CO5	3	3	3	3	-	1	-	2	-	-	2	3	-	2

Internal Assessment		End Semester Examination
Evaluation of Laboratory Observation, Record	Test	Practical
75	25	100
60 %		40%

23HS1301	Skills For Career Building And Development I	L	T	P	C
		0	0	2	0

COURSE OBJECTIVE:

- To improve language accuracy through error spotting, sentence correction, and text completion.
- To build critical thinking by analysing arguments and organizing ideas.
- To create a strong personal brand and effective self-introduction using social media.
- To develop persuasion, negotiation, and business planning skills.
- To enhance teamwork, empathy, and feedback skills for better interpersonal relations.

CONTENTS

Unit I

Error Spotting- Sentence Correction- Subject Verb Agreement- Pronouns- Tense- Comparisons – Modifiers- Parallelism

Unit II

Sentence Equivalence and Text completion: Grammar- Single, Double and Triple blanks

Unit III

Para jumble – Para Completion.

Unit IV

Critical Reasoning – Facts – Inference – Judgement – Strengthening and Weakening an Argument

Unit V

Reading Comprehension

TOTAL : 30 PERIODS

TEXT BOOKS:

1. Powers, L., and T. Knapp. The Official Guide to the GRE General Test. 3rd ed., McGraw-Hill
2. Gallo, Carmine. Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds. St. Martin’s Press, 2016.

REFERENCE BOOKS:

3. Manhattan Prep. (2021). GRE Reading Comprehension & Essays (7th ed.). Manhattan Prep Publishing.
4. Cialdini, R. B. (2021). Influence, New and Expanded: The Psychology of Persuasion. Harper Business.

WEB REFERENCES:

1. https://www.ets.org/gre/test-takers/general-test/prepare/practice-questions/verbal-reasoning.html
2. https://www.linkedin.com/learning/building-your-personal-bran

ONLINE COURSES / RESOURCES:

1. https://www.coursera.org/learn/critical-thinking-skills
2. https://www.coursera.org/learn/negotiation

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Proficiently spot and correct advanced errors, complete texts, and achieve sentence equivalence with accuracy

CO2: Demonstrate strong critical reasoning by analysing arguments, making judgments, and organizing coherent paragraphs.

CO3: Create impactful self-introductions and personal brands, leveraging social media for effective profiling.

CO4: Apply persuasion and negotiation skills to develop and market business plans successfully convince others and create solid business plans.

CO5: Exhibit strong interpersonal skills, empathy, and synergy, delivering constructive feedback to enhance team dynamics.

CO&PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2	-	-	-

23HS1302	QUANTITATIVE APTITUDE PRACTICES III	L	T	P	C
		0	0	1	0

COURSE OBJECTIVE:

- Students can refine their problem solving skills by using ratio and proportion, simple and compound interest.
- To improve students ability to use strategies for addressing logical reasoning, surds and indices problems.

Module 1 Simple and Compound interest **3**

Simple interest - compound interest - problems on ages - simplification and approximation

Module 2 Ratio and Proportion **3**

Chain rule – percentage - ratio and proportion -profit and loss

Module 3 Surds and Indices **3**

surds and indices – clock – cubes – dices – direction - sense.

Module 4 Logical Reasoning II **3**

Puzzles – series – coding - decoding – classifications.

TOTAL : 12 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Solve problems using ratio and proportion, simple and compound interest, and ease

CO2: Comprehend and demonstrate solid knowledge for the surds and indices, as well as logical reasoning exercises.

TEXT BOOKS:

1. Aggarwal R.S.(2017). Quantitative Aptitude for Competitive Examinations 3rd edition New Delhi: S. Chand Publishing.
2. Abhijitguha (2016). Quantitative Aptitude for All Competitive Examinations, 6th edition. Noida: McGraw Hill Education Pvt. Ltd.
3. FACE.(2016).Aptipedia Aptitude Encyclopedia1(Ed.).New Delhi: Wiley Publications.

REFERENCE BOOK:

1. Sharma arun.(2016).Quantitative aptitude,7th(Ed.).Noida : McGraw Hill Education Pvt.Ltd.
2. Praveen. R.V 3rd edition, Quantitative aptitude and reasoning, PHI learning publication.

Mode of Evaluation: Online Test

SEMESTER – IV

23MA1408	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVE:

- To provide necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations

UNIT - I TESTING OF HYPOTHESIS 9+3

Large sample test based on Normal distribution for single mean and difference of two means - Tests based on students t test , Chi-Square and F- distributions (without Proofs) for testing means and variances – Contingency table (Test for Independency)-Goodness of fit.

UNIT - II DESIGN OF EXPERIMENTS 9+3

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

UNIT - III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Solution of algebraic and transcendental equations-Newton Raphson method –Solution of linear system of equations -Gauss elimination method – Gauss Jordan methods – Iterative method of Gauss Seidel method – Eigen values of a matrix by power method.

UNIT - IV INTERPOLATION AND NUMERICAL DIFFERENTIATION 9+3

Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials.

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 ordinary differential equations.

Multi step method : Milne's predictor corrector methods for solving first order ordinary differential equations

TOTAL : 60PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Understand the concept of testing hypotheses for small and large samples in real life problems..

CO2: Understand the basic concepts of classifications of design of experiments in the field of

agriculture.

CO3: Apply the algebraic and transcendental equations in various engineering applications..

CO4: Apply the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation..

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

TEXT BOOKS:

1. Dr. S.P. Gupta “Statistical Methods” Sultan Chand & Sons Educational Publishers New Delhi , Forty Sixth Revised Edition, 2021.
2. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
3. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
4. Kandasamy, P., Thilagavathy, K.,and Gunavathy,S., Numerical Methods, Chand and Co.,2016.

REFERENCE BOOKS:

1. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
2. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.
3. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖,Cengage Learning, New Delhi, 8th Edition, 2014.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	2	-	-	-	-	-	-	1	3	-	2
CO2	3	3	1	2	-	-	-	-	-	-	1	3	-	2
CO3	3	3	1	-	1	-	-	-	-	-	1	3	-	2
CO4	3	3	1	-	1	-	-	-	-	-	1	3	-	2
CO5	3	3	1	-	1	-	-	-	-	-	1	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1401	KINEMATICS OF MACHINERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand basic mechanisms, kinematic concepts, and how to analyze mobility and degrees of freedom.
- To understand how to calculate displacement, velocity, and acceleration in linkage mechanisms using basic methods
- To understand the types of cam mechanisms, their motion profiles, and how to design cam layouts
- To understand the basics of gears, gear action, and how gear trains work.
- To understand the importance of friction in machine elements.

UNIT - I BASICS OF MECHANISMS 9

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Grubler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT - II KINEMATICS OF LINKAGE MECHANISMS 9

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method–Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration –Introduction to linkage synthesis problem.

UNIT - III CAM MECHANISMS 9

Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams –Pressure angle and undercutting – sizing of cams.

UNIT - IV GEARS AND GEAR TRAINS 9

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.

UNIT - V FRICTION IN MACHINE ELEMENTS 9

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives – Friction in brakes - Band and Block brakes.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Analyze the classification of mechanisms , basic kinematic concepts, and degrees of freedom.

CO2: Evaluate displacement, velocity, and acceleration in linkage mechanisms and their application.

CO3: Apply the principles of cam mechanisms to design displacement diagrams and cam profiles for different motion types.

CO4: Apply the knowledge of gears and gear trains to analyze gear actions, contact ratios, and solve related engineering problems.

CO5: Evaluate the Friction in clutch, bearings, brakes and belt drives.

TEXT BOOKS:

1. S. S. Rattan, “Theory of Machines”, McGraw Hill Publication, 5th edition, 2019
2. Uicker. J. J, Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, Oxford University Press, 2017

REFERENCE BOOKS:

1. Amitabha Ghosh and Ashok Kumar Mallik, “Theory of Mechanisms and Machines”, Affiliated East-West Pvt. Ltd., 2006.
2. Rao.J.S. and Dukkipati. R.V. “Mechanism and Machine Theory”, New Age International Pvt. Ltd., 2006.
3. F.B. Sayyad, “Kinematics of Machinery”, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
5. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
6. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014

WEB REFERENCES:

1. https://ekeeda.com/degree-courses/mechanical-engineering/kinematics-of-machinery
2. https://freevideolectures.com/course/2359/kinematics-of-machines
3. https://www.cloudkampus.com/course-details.php?course_id=232&c=Kinematics+of+Mechanisms+and+Machines+online-training-course

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_me25/preview
2. https://www.coursera.org/courses?query=kinematics

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	-	-	2	3	2	2
CO2	3	3	2	2	-	-	-	-	-	-	2	3	2	2
CO3	3	3	3	3	-	1	-	-	-	-	2	3	2	2
CO4	3	3	3	3	-	1	-	-	-	-	2	3	2	2
CO5	3	3	3	3	-	1	-	-	-	-	2	3	2	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1402	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of Gas power cycles
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam nozzles, Gas Turbines, Compressors.
- To understand working of different refrigeration ,air conditioning and load calculation

UNIT - I GAS POWER CYCLES 9

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency-Comparison of cycles.

UNIT - II INTERNAL COMBUSTION ENGINES 9

Classification - Components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Simple and complete Carburetor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Lubrication and Cooling systems. Performance calculation.

UNIT - III STEAM NOZZLES AND TURBINES 9

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and Reaction principles, compounding, velocity diagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT - IV AIR COMPRESSOR 9

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling–work of multistage air compressor.

UNIT - V REFRIGERATION AND AIR CONDITIONING 9

Refrigerants - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia – Water, Lithium bromide – water systems (Description only). Air conditioning system - Processes, Types and Working Principles. - Concept of RSHF, GSHF, ESHF- Cooling Load calculations.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Analyze the concepts and working of air standard cycles, IC engines.
CO2: Analyze the performance calculations of air standard cycles and IC engines.
CO3: Apply the working of steam nozzles and gas turbines.
CO4: Analyze the working principle of single and multistage compressors.
CO5: Analyze refrigeration and air conditioning systems, including cycle processes, refrigerants, and cooling load calculations.

TEXT BOOKS:

1. R.K. Rajput, "Thermal Engineering", 10th Edition, Laxmi Publications (P) LTD, 2020
2. Domkundwar, Kothandaraman, "A Course in Thermal Engineering", Dhanpat Rai & Co, 2016

REFERENCE BOOKS:

1. Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 2008
2. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata Mcgraw-Hill 2012
3. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
5. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
6. Rakesh Kumar Maurya, "Characteristics and Control of Low Temperature Combustion Engines: Employing Gasoline, Ethanol and Methanol"(Mechanical Engineering Series)- Springer 2017.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=NakOoD-G0IY
2. https://www.youtube.com/watch?v=cT9UN1XENNk
3. https://www.youtube.com/watch?v=Hdy0il9nvl8

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112103275
2. https://nptel.ac.in/courses/112106133

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO4	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	2	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1403	METAL CUTTING AND MACHINE TOOLS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the mechanics of chip formation, cutting tool materials, tool wear, and the effects of cutting fluids on machinability in metal cutting processes.
- To understand the construction, operations, and specifications of turning machines, including taper turning and thread cutting methods.
- To understand the types of operations and construction methods for shapers, milling machines, and gear cutting processes, including gear milling and hobbing.
- To understand the types of abrasive processes, such as grinding and broaching, and their applications in machining, including cylindrical and surface grinding.
- To understand the basic principles of CNC machining, including the types of CNC machines, part programming fundamentals, and their applications in micromachining.

UNIT - I THEORY OF METAL CUTTING 9

Mechanics of chip formation, single point cutting tool, forces in machining, cutting tool materials, tool wear, tool life, Types of chips, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, 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, machining time and power estimation.

Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.

UNIT - III SHAPER, MILLING AND GEAR CUTTING 9

Shaper - Types of operations. Drilling, reaming, boring, Tapping. Gear cutting – forming and generation principle and construction of gear milling, Hobbing and gear shaping processes –finishing of gears.Milling operations-types of milling cutter. Case studies about machining centers used in car manufacturing companies.

UNIT - IV ABRASIVE PROCESS AND BROACHING 9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process, construction and application – cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines.

UNIT - V CNC MACHINING 9

Numerical Control (NC) machine tools – CNC types, constructional details, specialfeatures, machining centre, part programming fundamentals CNC – manual part programming – micromachining – Generation of Codes for simple components – Introduction to Additive Manufacturing

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Analyze the mechanism of material removal processes.
CO2: Apply the principles of lathes / special purpose machines for various applications.
CO3: Analyze the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.
CO4: Apply the concepts about the types of grinding and other super finishing processes.
CO5: Analyse the basic principles of numerical control/CNC machine tools in part programming.

TEXT BOOKS:

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2021.
2. Rao. P.N “Manufacturing Technology - Metal Cutting and Machine Tools", 3rdedition, Tata McGraw-Hill, New Delhi, 2018.

REFERENCE BOOKS:

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White “MachineTool Practices”, Prentice Hall of India, 1998
2. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984.

WEB REFERENCES:

1. http://www.iitg.ac.in/rkbc/me101/me101.htm
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-engineering-mechanics-i-fall-2007/index.htm
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112104195
2. https://nptel.ac.in/courses/112104301
3. https://nptel.ac.in/courses/112107219

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	-	-	-	-	-	2	3	-	2
CO2	3	3	1	1	-	-	-	-	-	-	2	3	-	2
CO3	3	3	2	2	-	1	-	-	-	-	2	3	-	2
CO4	3	3	2	2	-	1	-	-	-	-	2	3	-	2
CO5	3	3	2	2	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ML1401	INTRODUCTION TO ARTIFICIAL INTELLIGENCE FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- Understand the importance, principles, and search methods of AI.
- Provide knowledge on predicate logic and Prolog.
- Introduce machine learning fundamentals.
- Study of supervised learning algorithms.
- Study about unsupervised learning algorithms.

UNIT - I INTELLIGENTAGENT AND UNINFORMEDSEARCH 9

Introduction- Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI –Comparison of AI with Data Science, Need of AI in Mechanical Engineering Intelligent Agents- Nature of Environment - Structure of Agent - Problem Solving Agents - FormulatingProblems-UninformedSearch-BreadthFirstSearch-Dijkstra'salgorithmoruniform-costsearch-Depth First Search-Depth Limited Search

UNIT - II PROBLEM SOLVINGWITH SEARCHTECHNIQUES 9

InformedSearch-GreedyBestFirst-A*algorithm-AdversarialGameandSearch-Gametheory -Optimal decisions in game-Min Max Search algorithm-Alpha-betap runing-Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT - III LEARNING 9

Machine Learning: Definitions — Classification - Regression - approaches of machine learningmodels - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductivebias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, BiasandVariance-**Regression**:LinearRegression-LogisticRegression

UNIT - IV SUPERVISED LEARNING AND DEVELOPMENT OF ML MODEL 9

Neural Network: Introduction, Perceptron Networks — Adaline - Back propagation networks –**DecisionTree:** Entropy–Informationgain- GiniImpurity- classification algorithm -Rule basedClassification-**NaïveBayesianclassification**-**SupportVectorMachines**(SVM)

Problem identification: Ranking. Steps in ML modeling, Data Collection, Data pre-processing, Model Selection, Model training.

UNIT - V UNSUPERVISED LEARNING AND APPLICATIONS 9

Unsupervised Learning– Principle Component Analysis - **Neural Network**: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – **Clustering**: Definition - Types ofClustering–Hierarchicalclusteringalgorithms–k-meansalgorithmApplications-Human Machine Interaction, Predictive Maintenance and Health Management, Fault Detection, Dynamic System Order Reduction, Image based part classification, Process Optimization, Material Inspection, Tuning of control algorithms

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Understand and apply AI, knowledge of intelligent agents, their structure, and problem-solving agents. Uninformed search techniques BFS, DFS to solve computational problems efficiently.

CO2: Apply informed search techniques like Greedy Best First, A* algorithm, and Adversarial Game and Search.

CO3: Demonstrate knowledge of machine learning, including classification, regression, and evaluation techniques.

CO4: Apply supervised learning,development of ML models, and identify steps in ML modelling.

CO5: Analyse unsupervised learning, Neural Network and clustering Algorithms.

TEXT BOOKS:

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, Prentice Hall, FourthEdition,2021.
2. S.N.Sivanandam andS.N.Deepa, Principlesofsoftcomputing-WileyIndia.3rded,
3. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
4. B Joshi, Machine Learning and Artificial Intelligence, Springer, 2020.
5. 3. Parag Kulkarni and Prachi Joshi, “Artificial Intelligence – Building Intelligent Systems”, PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015.

REFERENCE BOOKS:

1. MachineLearning.TomMitchell. FirstEdition,McGraw- Hill, 1997.
2. Bratko, “Prolog:ProgrammingforArtificial Intelligencell,Fourthedition, Addison-WesleyEducationalPublishersInc.,2011.
3. C.Muller&SarahAlpaydin,Ethem.Introductiontomachinelearning.MIT press,2020.

WEB REFERENCES:

1. http://nptel.ac.in/courses/111101003/
2. https://nptel.ac.in/courses/106/106/106106202/
3. https://nptel.ac.in/courses/112/103/112103280/\
4. https://www.analyticsvidhya.com/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	1	-	-	1	-	-	-	-	-	2	-	-	2
CO2	2	1	-	-	1	-	-	-	-	-	2	-	-	2
CO3	2	1	-	-	1	-	-	-	-	-	2	-	-	2
CO4	2	2	-	-	1	-	-	-	-	-	2	-	-	2
CO5	2	2	-	-	1	-	-	-	-	-	2	-	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1411	METAL CUTTING AND MACHINE TOOLS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To understand the process and techniques of eccentric turning, drilling operations, and contour milling using various machines such as center lathe, radial drilling machine, and vertical milling machine.
- To understand the principles of spur gear cutting, key way cutting, and the basics of surface grinding, cylindrical grinding, and centerless grinding operations.
- To understand the methods for measuring cutting forces in lathe and milling machines and their impact on machining performance.
- To understand the basics of CNC machining, including part programming and operations like turning, facing, and contour milling using CNC lathe and CNC mill.

LISTOFEXPERIMENTS

1. Various drilling operations using Radial drilling machine
2. Contour milling using Vertical milling machine
3. Spur gear cutting in Milling machine
4. Measurement of cutting forces in Lathe and Milling machine
5. Key way cutting using Slotting machine
6. Plain Surface grinding
7. Cylindrical grinding and Centerless grinding
8. Grinding of Single point cutting tool
9. Introduction to CNC Part Programming
10. Simple turning and facing using CNC Lathe
11. Contour milling using CNC Mill

DEMONSTRATION

1. Turret and Capstan Lathe
2. Helical Gear Cutting in Hobbing machine
3. Spur Gear generation in Gear shaping machine

TOTAL: 60 PERIODS

COURSE OUTCOME(S):

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

CO1 : Analyze basic machining operations like turning, drilling, milling, and gear cutting on conventional machines.

CO2 : Apply grinding techniques for plain surface, cylindrical, and centerless grinding.

CO3 : Analyze cutting forces in lathe and milling machines and their effects on machining.

CO4 : Analyze keyway cutting and slotting methods, and compare different grinding processes.

CO5 : Evaluate CNC programming for turning, facing, and milling operations on CNC machines.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	-	-	1	-	-	2	3	-	2
CO2	3	3	1	1	-	-	-	1	-	-	2	3	-	2
CO3	3	3	1	1	-	-	-	1	-	-	2	3	-	2
CO4	3	3	3	3	-	2	-	1	-	-	2	3	-	2
CO5	3	3	3	3	-	2	-	1	-	-	2	3	-	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ME1412	COMPUTER AIDED DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To understand the basics and standards used in 3D drawing.
- To understand the Assembly of the machine components.
- To understand the rendering module, layouts and printing.
- To apply the concepts of Topology optimization and Generative design

UNIT - I GEOMETRY CREATION AND MODIFICATION 10

Introduction to Computer Aided Design**,** Sketch Geometry - Create: Circle, Arc, Line, Rectangle, Ellipse, Spline, Text by using different option, Geometric construction option, Geometric selection method - Set working directory - Sketch Modification: Fillet, Chamfer, Offset - Datum plane Construction.

UNIT - II 3D SOLID GEOMETRY CREATION 10

Introduction about working window of Solid Creation, 3D solid geometry command: Extrude, Revolve, Sweep, Variable sweep, Helical sweep, Swept blend and 3D Geometric modification - Creation of components in part Module : Support Brackets, Wall Brackets, Bearing Brackets, Flanges, etc.

UNIT - III ASSEMBLY MODELLING 20

Assemble Part With Constrains - Creation of 3D assembly model using 3D Modelling software: Flange Coupling, Plummer Block, Screw Jack, Universal Joint, Machine Vice, Stuffing box , Safety Valves, Connecting rod, Piston - Create Animation for Assemble and Disassemble - Drawing Creation from 3D models.

UNIT - IV RENDERING MODULE, LAYOUTS, PRINTING AND OUTPUTS 10

Rendering in Drawing Layouts - Creation of main view and projection view - Model scale and sheet size - View style, View display and Visible area - Section view creation and view states - Different view and add new model in sheet - Creation of Dimension in Drawing View - Generating bill of material.

UNIT - V TOPOLOGY OPTIMIZATION AND GENERATIVE DESIGN 10

Objective function, Optimization variables, Constraints, Methods to quantify and compute objective function and constraints, Structural optimization - Topology optimization of components.

Note: Plotting of drawings must be made and attached to the records written by students.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1 : Understand the basics of CAD, including creating and modifying simple geometry like circles, lines, and text.

CO2 : Understand to create 3D solid shapes using commands like extrude, revolve, and sweep.

CO3 : Apply assembly modeling techniques to create and animate 3D assemblies with constraints.

CO4 : Apply rendering and drawing techniques to create views, dimensions, and bills of materials in CAD.

CO5 : Evaluate the use of topology optimization and generative design to find the best design solutions.

TEXT BOOKS:

1. Sandeep Dogra, "Creo Parametric 8.0: A Power Guide for Beginners and Intermediate Users", CADArtifex, 2021.
2. Michael Rider, "Designing with Creo Parametric 7.0", Taylor & Francis Group, August 2020.
3. Goutam Pohit, Goutam Ghosh, “Machine Drawing with AutoCAD”, Pearson, 2007.
4. Jasbir S. Arora, " Introduction to Optimum Design", 3rd Edition, Elsevier Academic Press, 2012.

REFERENCE BOOKS:

1. Matt Lombard, "Mastering SolidWorks", Wiley, 2018.
2. Bhatt N.D. and Panchal V.M, “Machine Drawing”, Charotar Publishing House, 46th Edition, 2011.
3. Bendsoe, M. P. and Sigmund, O., "Topology Optimization: Theory, Methods, and Applications," Springer, 2003.

WEB REFERENCES:

1. http://support.ptc.com/help/creo/creo_pma/usascii/index.html#page/tutorials_pma%2Ftutorials_overview.html%23
2. https://mecheng.iisc.ac.in/suresh/me260/notes.html - Topology optimization

ONLINE COURSES / RESOURCES:

1. https://www.classcentral.com/subject/creo

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	3	3	3	1	-	2	-	-	2	3	3	2
CO2	3	-	3	3	3	1	-	2	-	-	2	3	3	2
CO3	3	-	3	3	3	1	-	2	-	-	2	3	3	2
CO4	3	-	3	3	3	1	-	2	-	-	2	3	3	2
CO5	3	-	3	3	3	1	-	2	-	-	2	3	3	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ME1413	HEAT ENGINES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To impart knowledge on working of petrol and diesel engines.
- To understand valve timing and port timing of petrol and diesel engines.
- To improve the knowledge of understanding the heat balance test and performance test.
- To understand the performance of multi cylinder engine.
- To understand the performance and heat balance of Steam boiler and turbine.

LIST OF EXPERIMENTS

I.C. ENGINES LAB

1. Valve timing and port timing diagrams
2. Actual p-v diagrams of IC engines using Data Acquisition system
3. Performance test on 4-stroke diesel engine
4. Heat balance test on 4-stroke diesel engine
5. Morse test on Multi-cylinder petrol engine
6. Retardation test on a diesel engine
7. Determination of Flash point and Fire point of various fuels/lubricants

STEAM LAB

8. Study on steam generators and turbines
9. Performance and energy balance test on a steam generator
10. Performance and energy balance on steam turbine.

TOTAL: 60 PERIODS

COURSE OUTCOME(S):

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

CO1 : Understand knowledge in working of SI and CI engines.

CO2 : Apply the performance characteristics of an IC engine.

CO3 : Analyze the heat balance and retardation test on Diesel engine.

CO4 : Determine the properties of fuels and lubricating oils.

CO5 : Analyze the performance and Energy balance of steam power unit.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	1	-	1	-	-	1	3	-	1
CO2	3	3	2	2	-	1	-	1	-	-	1	3	-	1
CO3	3	3	2	2	-	1	-	1	-	-	1	3	-	1
CO4	3	3	2	2	-	1	-	1	-	-	1	3	-	1
CO5	3	3	2	2	-	1	-	1	-	-	1	3	-	1

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23HS1401	Skills For Career Building And Development II	L	T	P	C
		0	0	2	0

COURSE OBJECTIVE:

- To equip students to develop profiles and understand the nuances of resume creation.
- To employ group discussion activities to exhibit expertise and abilities.
- To Gain insight into effective interview techniques and acquire hands-on experience through mock interviews.
- To improve presentation skills while exploring potential career opportunities.
- To foster networking skills and build professional connections to enhance career prospects and industry engagement.

CONTENTS

Unit I

Professional Ethics- Etiquette- E-Mail Writing

Unit II

Personal Branding- Resume Building and Cover Letter - SOP

Unit III

Purpose and Role of GD in recruitment- GD preparation - Types of GD topics- Mock GDs

Unit IV

Introduction to personal interview- Types of Interviews- PI preparation- Mock Interviews

Unit V

Crafting STAR (Situation, Task, Action, Result) responses- Video Profile

TOTAL : 30 PERIODS

TEXT BOOKS:

1. Carnegie, Dale. How to Win Friends and Influence People.Revised ed., Simon & Schuster, 2010.
2. Bolles, Richard N. What Color Is Your Parachute? 2021: A Practical Manual for Job-Hunters and Career-Changers. Ten Speed Press, 2021.

REFERENCE BOOKS:

1. Adler, L. (2013). The Essential Guide for Hiring & Getting Hired. Work bench Media.
2. Yate, M. (2020). Knock 'em Dead Job Interview: How to Turn Job Interviews into Job Offers (10th ed.). Adams Media

WEB REFERENCES:

1. https://www.mindtools.com/pages/article/professionalism.html
2. https://www.themuse.com/advice/interviewing

ONLINE COURSES / RESOURCES:

1. https://www.linkedin.com/learning/developing-your-professional-presence-and-influence
2. https://www.coursera.org/learn/career-networking-interviewing

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Develop a distinctive personal brand and craft a compelling, impactful resume.
CO2: Engage actively in group discussions to maximize their value and outcomes
CO3: Tackle personal and technical interviews with confidence and clear preparation.
CO4: Articulate ideas and perspectives in a structured, coherent manner.
CO5: Gain insight into industry expectations and explore potential career pathways.

CO&PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO2	-	-	-	-	-	-	-	3	3	-	2	-	-	-
CO3	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	2	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2	-	-	-

23HS1402	QUANTITATIVE APTITUDE PRACTICES IV	L	T	P	C
		0	0	1	0

COURSE OBJECTIVE:

- Students can improve their problem-solving abilities by applying permutation and combination, probability, alligation, and mixture.
- To improve students ability to use strategies for addressing day sequence and data sufficiency problems.

Module 1 Permutation and Combination, Probability **3**

Permutation – combination – probability– Partnership.

Module 2 Alligation, Mixture and Analogy **3**

Alligation and mixture – stocks and shares – analogy – symbols and notations.

Module 3 Time and work (advanced) **3**

Relative speed - work equivalence - division of wages – multiple pipe problems.

Module 4 Day sequence and Data sufficiency **3**

Day sequence - decision making - statement and assumptions - data sufficiency.

TOTAL : 12 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to:

CO1: Understand the basic concepts of permutation and combination, probability, alligation and mixture.

CO2: Assist in understanding and exhibiting strong understanding for the advanced problems in relative speed and data sufficiency tasks.

TEXT BOOKS:

1. Aggarwal R.S.(2017). Quantitative Aptitude for Competitive Examinations 3rd edition New Delhi: S. Chand Publishing.
2. Abhijitguha (2016). Quantitative Aptitude for All Competitive Examinations, 6th edition. Noida: McGraw Hill Education Pvt. Ltd.
3. FACE.(2016).Aptipedia Aptitude Encyclopedia1(Ed.).New Delhi: Wiley Publications.

REFERENCE BOOK:

1. Sharma arun.(2016).Quantitative aptitude,7th(Ed.).Noida : McGraw Hill Education Pvt.Ltd.
2. Praveen. R.V 3rd edition, Quantitative aptitude and reasoning, PHI learning publication.

Mode of Evaluation: Online Test

SEMESTER - V

23ME1501	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To learn the key fundamentals about the machine element Design.
- To learn the design of shaft, key, and coupling for the various applications.
- To learn the design of various temporary and permanent fasteners.
- To learn the design of energy storing elements
- To learn the design and selection of bearings for applications.

UNIT I DEISGN FOR STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

Design process - Factors influencing Machine Design - Selection of materials based on Mechanical properties - Preferred numbers – Direct, Bending and torsional stresses in Machine members – Impact and shock loading – Modes of failure - Calculation of Principle stresses for various load Combinations - Eccentric loading – Curved beams – Crane hook and 'C' frame - Factor of safety - Theories of failure – Stress Concentration –Variable Stresses - Endurance limit –Design for finite and infinite life under variable loading.

UNIT II DESIGN OF SHAFTS, KEYS AND COUPLINGS 9

Design of solid and hollow shafts -Based on strength, rigidity and critical speed – Design of various Keys and splines – Design of Rigid and flexible couplings – Selection of Flexible coupling.

UNIT III DESIGN Of TEMPORARY AND PERMANENT JOINTS 9

Design of Knuckle joints - Cotter joints – Design of Screwed joints for commercial and leak proof joints including eccentric loading - Design of Welded joints - Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads – Design of Riveted joints.

UNIT IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9

Design of Compression and Tension Helical springs – Leaf Springs – Design of Flywheels considering stresses in rims and arms for engines and Punching machines- solid and rimmed flywheels-Design of Connecting Rods and Crank shafts.

UNIT V DESIGN OF BEARINGS 9

Design of Sliding contact bearings - Hydrodynamic Journal bearings - Sommerfeld Number, Raimondi and Boyd graphs -- Selection of Rolling Contact bearings.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the influence of steady and variable stresses in machine component design.

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

CO3: Apply the concepts of design to temporary and permanent joints.

CO4: Analyze the concepts of design to energy absorbing members, connecting rod and crank shaft

CO5: Apply the concepts of bearing design and selection of bearings.

TEXT BOOKS

1. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 10th Edition, Tata McGraw-Hill, 2015.
2. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.

REFERENCE BOOKS

1. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co.(Schaum’s Outline), 2010
2. AnselUgural, “Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
3. P.C. Gope, “Machine Design – Fundamental and Application”, PHI learning private ltd, New Delhi, 2012.
4. R.B. Patel, “Design of Machine Elements”, MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
5. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley, 2017.
6. Sundararajamoorthy T. V. Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2015.

WEB REFERENCES

1. https://www.purdue.edu/freeform/me354/wp-content/uploads/sites/28/2022/06/220607_ME354_LectureNotes_BHess.pdf
2. https://methodist.edu.in/web/uploads/files/DME%20ALL%20UNITS%20NOTES%20(1).pdf

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105129
2. https://nptel.ac.in/courses/112106133

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO2	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO4	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	2	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1502	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To provide knowledge on various Metrological equipment's available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
- To provide a suitability of measuring instruments, their calibration, and the quality control of manufactured components.
- To describe application of principle of metrology and measurements in industries.

UNIT I BASICS OF METROLOGY 9

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types ofstandards. Static and dynamic characteristic of an instruments.

UNIT II LINEAR AND ANGULAR MEASUREMENTS 9

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly .Electronic comparator and pneumatic comparator– Angular measuring instruments – Types – Bevel protractor .– Angle alignment telescope – Autocollimator – Applications.

UNIT III ADVANCES IN METROLOGY 9

Laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM– Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System -machine vision system in robotics and electronic components.–Elements of visual perception, Lenses: Pinhole cameras, cameras-computer interface Element – Applications. computer aided inspection

UNIT IV FORM MEASUREMENT 9

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V MEASUREMENT OF POWER, FLOW AND TEMPERATURE 9

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the concepts of measurements to apply in various metrological instruments.

CO2: Analyze the principles of linear and angular measurement tools used for industrial applications.

CO3: Analyze the procedure for conducting computer aided inspection.

CO4: Distinguish the various techniques of form measurement used for industrial components.

CO5: Analyze and compare various techniques for measuring mechanical properties in industrial applications.

TEXT BOOKS

1. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", Khanna Publishers, 2009.
3. K. Duraivelu, "Engineering Metrology & Measurements" university press India pvt Ltd, 2018.

REFERENCE BOOKS

1. Alan S. Morris, "The essence of Measurement", Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th edition,Cengage LearningEMEA,1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra,Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.
6. A course in Electrical and Electronic Measurements and Instrumentation, AK Sawhney, DhanpatRai& Co. (P) LimitedYear: 1985.

WEB REFERENCES

1. http://www.infocobuild.com/education/audio-video-courses/mechanical-engineering/MechanicalMeasurements-IIT-Madras/lecture-26.html
2. https://archive.nptel.ac.in/courses/112/104/112104250/

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112106179
2. https://archive.nptel.ac.in/courses/108/105/108105064/
3. https://www.youtube.com/watch?v=Hlvbr5DCEfM
4. https://onlinecourses.nptel.ac.in/noc23_ee39/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	3	-	-	1	-	-	-	-	-	2	-	1	2
CO4	3	3	1	1	-	-	-	-	-	-	2	3	-	2
CO5	3	3	1	1	-	-	-	-	-	-	2	-	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1503	HEAT AND MASS TRANSFER	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To impart knowledge on the theoretical and analytical concepts to analyze the modes of heat transfer.
- To enable the students to apply various laws of heat transfer in engineering applications.
- To enable the students to analyze heat exchangers using LMTD and NTU methods.
- To interpret the concepts underlying the types of mass transfer.

UNIT I CONDUCTION 9

Fourier Law of Conduction, General Differential equation of Heat Conduction- Cartesian Coordinates, 1-D Steady State Heat Conduction (Plane Wall, Cylinders) Composite Systems, Conduction with Internal Heat Generation, Extended Surfaces (Circular, Rectangular) Lumped parameter Analysis in unsteady state heat transfer.

UNIT II CONVECTION 9

Boundary Layer Concept – Types of Convection – Forced Convection –External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar, Turbulent and Combined flows – Flow over Bank of tubes – Free Convection– Flow over Vertical, Horizontal and Inclined Plates, Cylinders and Spheres.Nano Fluids for Heat Transfer.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9

Nusselt's theory of condensation and Regimes of boiling, ,heat Transfer Enhancement Techniques Heat Exchangers- Classification of heat exchangers, LMTD & NTU Approach for parallel & Counter flow heat exchangers - Fouling Factors. Mini and Micro Channel heat exchangers.

UNIT IV RADIATION 9

Black Body Radiation – Grey body radiation –radiation shield - Shape Factor Algebra (Plates, parallel, perpendicular, parallel circular disc) -Electrical Analogy.Data study from Infra-Red Thermography Images.

UNIT V MASS TRANSFER 9

Basic Concepts – Diffusion Mass Transfer – Fick’s Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the basic concepts of heat conduction problems for composite systems and fins.
CO2: Analyze the heat transfer coefficient in natural and forced convection for internal and external flows.
CO3: Determine the effectiveness of heat exchanger using LMTD and NTU methods.
CO4: Analyze radiation shape factors for various geometries.
CO5: Analyze the phenomenon of diffusion and convective mass transfer.

TEXT BOOKS

1. Kothandaraman, C. P. Fundamentals of heat and mass transfer. New Age International, 5th Edition, 2018.
2. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer” New Age International, 5th Edition, 2017.

REFERENCE BOOKS

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", .John Wiley & Sons, 1998.
2. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002.
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015.

WEB REFERENCES

1. https://hyominsite.files.wordpress.com/2015/03/fundamentals-of-heat-and-mass-transfer-6th-edition.pdf
2. https://edisciplinas.usp.br/pluginfile.php/5464110/mod_book/chapter/23393/Heat%20and%20Mass%20Transfer%20by%20kothadaraman.pdf

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/?subjectid=112108149
2. http://www.digimat.in/nptel/courses/video/112105248/L12.html
3. http://www.digimat.in/nptel/courses/video/103103034/L01.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	-	-	-	-	-	2	3	-	2
CO2	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO4	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1504	DYNAMICS OF MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To apply the effect of Dynamics of undesirable vibrations.
- To evaluate the mechanisms used for speed control and stability control.

UNIT I FORCE ANALYSIS 9

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines– Gas forces, Inertia effect of connecting rod– Bearing loads – Crank shaft torque, Turning moment diagrams –Fly Wheels, Flywheels of punching presses.

UNIT II BALANCING 9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines.

UNIT III FREE VIBRATION 9

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration. Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems. Introduction to multi degree of freedom system vibration. Discrete and continuous systems.

UNIT IV FORCED VIBRATION 9

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation.

UNIT V MECHANISM FOR CONTROL 9

Governors – Types – Centrifugal governors – Gravity controlled and centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Determine the torque on the crankshaft, maximum fluctuation of energy of flywheel in internal combustion engines and machines.

CO2: Determine the required balancing rotating masses for single cylinder engine, multi

cylinder inline engine and V engine

CO3: Calculate the natural frequency of longitudinal, transverse and torsional vibration systems and also to find critical speed of crankshaft

CO4: Calculate the maximum amplitude of forced vibration and caused by unbalance, support motion and transmissibility ratio for proper vibration isolation

CO5: Determine the effective range of speed governor and effects of gyroscopic couple on automobile, ship & aeroplane

TEXT BOOKS

1. Rattan, S.S, “Theory of Machines”, 4th Edition, Tata McGraw-Hill, 2019.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”,6th Edition, Oxford University Press, 2023.
3. Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2020.

REFERENCE BOOKS

1. V. Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.
2. Rao.J.S. and Dukkipati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", 5th edition Tata McGraw-Hill, 2012.
4. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
5. F. B. Sayyad, “Dynamics of Machinery”, McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
6. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014.

WEB REFERENCES

1. https://openlibrary.org/search?q=DYNAMICS+OF+MACHINES&mode=everything
2. https://openlibrary.org/search?q=THEORY+OF+MACHINES&mode=everything
3. https://1lib.in/s/Dynamics%20of%20Machines

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112104114
2. NPTEL :: Mechanical Engineering - NOC:Engineering Mechanics Statics and Dynamics
3. https://archive.nptel.ac.in/corses/112/106/112106180/
4. NPTEL :: Mechanical Engineering - Dynamics of Machines
5. https://archive.nptel.ac.in/courses/112/101/112101096/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	1	-	-	-	-	2	-	-	2
CO4	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	1	-	-	-	-	2	-	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23AD1506	FUNDAMENTAL OF DATA SCIENCE FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the fundamental concepts of data science and its applications in mechanical engineering.
- To enable students to collect, preprocess, and analyze data from mechanical systems.
- To provide an understanding of essential statistical and machine learning techniques relevant to mechanical engineering.
- To equip students with skills to develop predictive maintenance models for mechanical systems.
- To teach optimization techniques for solving mechanical design and manufacturing problems.

UNIT I Introduction to Data Science 9

Definition and Scope of Data Science in Mechanical Engineering -Importance in Mechanical Engineering -Data Science Process: Data Collection, Cleaning, Analysis, and Visualization-Tools and Technologies: Python (focus), R, MATLAB

UNIT II Essential Statistics and Probability 9

Descriptive Statistics: Mean, Median, Mode, Standard Deviation-Probability Distributions: Normal, Binomial, Poisson-Hypothesis Testing: t-test, ANOVA with examples in mechanical engineering (e.g., material strength testing)-Regression Analysis

UNIT III Data Collection and Preprocessing 9

Types of Data in Mechanical Systems (Sensors, IoT Devices)-Data Cleaning Techniques: Handling Missing Data, Outlier Detection-Feature Engineering for Mechanical Applications-Data Transformation and Normalization

UNIT IV Machine Learning for Mechanical Systems 9

Introduction to Machine Learning-Supervised Learning: Linear Regression, Decision Trees, SVM-Unsupervised Learning: Clustering (K-means, Hierarchical Clustering)-Neural Networks and Deep Learning (Basics)

UNIT V Predictive Maintenance and Condition Monitoring 9

Concept of Predictive Maintenance-Condition Monitoring Techniques (Vibration Analysis, Thermal Imaging)-Time Series Analysis for Predictive Maintenance with real-world examples-Fault Detection and Diagnosis

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Understand the fundamentals of data science and its relevance to mechanical engineering

CO2: Apply statistical and machine learning techniques to analyse mechanical systems

CO3: Use data-driven methods for predictive maintenance and condition monitoring

CO4: Utilize optimization techniques for mechanical design and manufacturing processes

CO5: Leverage programming tools (Python/R) to solve real-world engineering problems

TEXT BOOKS

1. "Data Science for Engineers" by Reddy and Agrawal, Publisher: Wiley , Publication Year: 2020,ISBN-13: 978-1119675347
2. "Python for Data Analysis" by Wes McKinney, Publisher: O'Reilly Media Publication Year: The first edition was published in 2012, and the second edition was published in 2018. ISBN-13: 978-1491957660 (for the second edition)
3. "Introduction to Statistical Learning" by Gareth James, Daniela Witten, Trevor Hastie, and Robert Tibshirani, Publisher: Springer,Publication Year: 2013,ISBN-13: 978-1461471370
4. "Machine Learning for Beginners: A Guide to Data Science and Machine Learning" by Chris Sebastian, Publisher: Independently published ,Publication Year: 2020, ISBN-13: 978-1697024223

REFERENCE BOOKS

1. "Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow" by AurélienGéron , Publisher: O'Reilly Media, Publication Year: 2019 (Second Edition), ISBN-13: 978-1492032649
2. "Data Science for Business" by Foster Provost and Tom Fawcett, Publisher: O'Reilly Media ,Publication Year: 2013 ,ISBN-10: 1449361323.
3. "Data Science for Mechanical Engineers" by M. S. S. Srinivasan, Publisher: Springer, Year:2020.
4. "Practical Guide to Predictive Maintenance" by Toni M. Doolen and David A. R. McGinnis, Publisher: Elsevier, Year: 2020, ISBN: 978-0128190622.

WEB REFERENCES

1. Kaggle - Data Science and Machine Learning Resources
2. Coursera - Data Science and Machine Learning Courses
3. Towards Data Science Blog

ONLINE COURSES / RESOURCES:

1. **Coursera**: "Data Science for Engineers" by IIT Madras
2. **edX**: "Machine Learning for Engineering and Science Applications" by Delft University of Technology
3. **Udemy**: "Python for Data Science and Machine Learning Bootcamp" by Jose Portilla

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	2	-	-	2
CO2	3	2	2	2	1	-	-	-	-	-	2	-	-	2
CO3	3	2	2	2	1	-	-	-	-	-	2	-	-	2
CO4	3	2	2	2	1	-	-	-	-	-	2	-	-	2
CO5	3	2	2	2	1	-	-	-	-	-	2	-	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1511	METROLOGY AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To study the various measuring instruments and measurement techniques for industrial components.
- To calibrate various measuring instruments and inspect industrial components.
- To familiar the principles learnt in dynamics of machinery.
- To analyse the measuring devices are used for dynamic testing.

METROLOGY LAB **30**

LIST OF EXPERIMENTS

1. Calibrate the Linear measuring instruments (Vernier height gauge ,Micrometer, Depth Gauge, Inside Micrometer)
2. Calibrate the Angular measuring instruments (Sine bar, Bevel Protractor)
3. Measurement of linear dimensions using Comparators (Mechanical/Electronics)
4. Measurement of screw thread parameters –(floating carriage micrometer/ Tool Makers Microscope)
5. Measurement of Dimensions of Gear tooth (Gear tooth verniercaliper/ Profile Projector)
6. Measurement of Flatness and Straightness using Autocollimator/ Surface Measuring instruments.
7. Measurement of Force, Torque and Temperature.
8. Study the CMM and CNC

DYNAMICS LABORATORY **30**

LIST OF EXPERIMENTS

1. Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus.
2. Determination of Mass Moment of Inertia using bifilar suspension
3. Determination of MI by oscillation - Connecting rod and flywheel
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Determination of torsional natural frequency of single and Double Rotor systems.
6. Vibration Absorber – Tuned vibration absorber.
7. Vibration of Equivalent Spring mass system – undamped and damped vibration.
8. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
9. Determine the transmissibility ratio using the given universal vibrating table apparatus.
10. Transverse vibration of Free-Free beam – with and without concentrated masses.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

CO1: Apply the knowledge of Linear and Angular Measurements, gear tooth dimensions, Geometrical tolerances in various applications.

CO2: Determine mass moment of inertia of mechanical element, governor effort and range of sensitivity

CO3: Determine the natural frequency and damping coefficient, critical speeds of shafts

CO4: Select the critical speed of shaft with unbalanced rotors and basic working principle of measuring devices

CO5: Identify the gyroscopic couple or effect for stabilization of ship, aeroplane

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	1	-	-	2	3	-	2
CO2	3	2	2	2	-	2	-	1	-	-	2	3	-	2
CO3	3	2	2	2	-	2	-	1	-	-	2	3	-	2
CO4	3	2	2	2	-	2	-	1	-	-	2	3	-	2
CO5	3	2	2	2	-	2	-	1	-	-	2	3	-	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ME1512	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To impart knowledge on thermal conductivity measurement using various apparatus.
- To analyze the heat transfer coefficient under natural convection and forced convection.
- To determine the Stefan boltzmann constant and emission of a grey surface.
- To evaluate the effectiveness heat exchanger and volumetric efficiency of air compressor.
- To determine the COP and performance of a vapour compression refrigeration system.
- To understand the performance of fluidized bed cooling tower.

LIST OF EXPERIMENTS

A. Heat Transfer lab

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of thermal conductivity of composite wall.
6. Determination of thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)
8. Determination of Stefan-Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Effectiveness of parallel/counter flow heat exchanger.

B. Refrigeration and Air conditioning lab

1. Determination of COP of a refrigeration system.
2. Performance test on Air conditioning system (Psychrometric processes)
3. Performance test on a reciprocating air compressor.
4. Performance test in HC refrigeration system.
1. Performance test in a Fluidized Bed cooling tower.

TOTAL : 60 PERIODS

COURSE OUTCOME

CO1: Understand knowledge in thermal conductivity of different materials.
CO2: Apply the basics in the measurement of heat transfer coefficient of natural and forced convection.
CO3: Analyze the determination of Stefan Boltzmann constant and emissivity of a grey surface.
CO4: Analyze the effectiveness of Parallel flow and counter flow heat exchangers and performance of air compressor.
CO5: Analyze the performance of a refrigeration system and air conditioning system.

TEXT BOOKS

1. Kothandaraman, C. P. Fundamentals of heat and mass transfer. New Age International, 5th Edition, 2018
2. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer” New Age International, 5th Edition, 2017.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	-	-	1	-	-	1	2	-	1
CO2	3	3	2	2	-	1	-	1	-	-	1	2	-	1
CO3	3	3	2	2	-	1	-	1	-	-	1	2	-	1
CO4	3	3	2	2	-	1	-	1	-	-	1	2	-	1
CO5	3	3	2	2	-	1	-	1	-	-	1	-	-	1

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

SEMESTER VI

23ME1601	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To gain knowledge on the principles and procedures for the design of mechanical power transmission components.
- To understand the standard procedures available for design of transmission elements.
- To apply the various design procedure for gears, clutch and brakes
- To examine the design of gear box and Screws.

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 DESIGN OF SPUR GEARS AND 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 DESIGN OF 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 DESIGN OF GEAR BOX AND POWER SCREWS 9

Geometric progression - Standard step ratio - Ray diagram, kinematics layout - Design of multi speed gear box for machine tool applications (6 speed, 9speed, 12speed, 14speed, 18speed) – Constant mesh gear box –Speed reducer unit. - Power Screws - Terminology of Power Screw - Torque Requirement—Lifting Load and Lowering Load - Self-locking Screw - Efficiency of Square Threaded Screw - Coefficient of Friction - Design of Screw Jack.

UNIT V DESIGN OF CLUTCHES AND BRAKES 9

Design of single and multi-plate clutches –axial clutches-cone clutches-Internal expanding rim clutches-Electromagnetic clutches. Design of Brakes. External shoe brakes – Single and Double Shoe, Internal expanding shoe brakes and Band brakes

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Design the flexible elements like belt, ropes and chain drives for engineering

applications

CO2: Design the spur and helical gear drives for power transmission

CO3: Design the bevel and worm drives for power transmission

CO4: Design the multi speed gear box for machine tool and automotive applications

CO5: Design the clutch and brake systems for engineering applications

TEXT BOOKS

1. Bhandari V, "Design of Machine Elements", 5th Edition, Tata McGraw-Hill Book Co, 2020.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008

REFERENCE BOOKS

1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2018.
2. GitinMaitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Bernard Hamrock, Steven Schmid, Bo Jacobson, "Fundamentals of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co., 2013.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	-	1	-	2	-	-	2	3	-	2
CO2	3	3	3	2	-	1	-	2	-	-	2	3	-	2
CO3	3	3	3	2	-	1	-	2	-	-	2	3	-	2
CO4	3	3	3	2	-	1	-	2	-	-	2	3	-	2
CO5	3	3	3	2	-	1	-	2	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1602	FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To understand the mathematical and physical principles underlying the Finite Element Method (FEM).
- To apply mathematical modelling in one-dimensional and two-dimensional variables..
- To analyse the Quadrilateral elements, Isoparametric elements, solid mechanics, heat transfer and fluid flow problems.

UNIT I INTRODUCTION 9

Historical Background - Discrete and continuous models – Boundary, Initial and Eigen Value problems – Mathematical Modeling of field problems in Engineering – Governing Equations – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II ONE-DIMENSIONAL PROBLEMS 9

One Dimensional Second Order Equations – Discretization – Element types – Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors – Assembly of Matrices – Solution of problems from solid mechanics, heat transfer and fluid mechanics. Longitudinal vibration frequencies.

Not for the Examination: Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9

Variational formulation – Second Order 2D Equations involving Scalar Variable Functions – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts – Higher Order Elements.

UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9

Equations of elasticity – Plane stress, plane strain and axi-symmetric problems – Stress calculations, Body forces and temperature effects.

Not for the Examination: Introduction to Plate and shell elements.

UNIT V ISOPARAMETRIC FORMULATION 9

Natural co-ordinate systems – Quadrilateral elements – Iso-parametric elements – Shape functions for iso-parametric elements in One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems.

Not for the Examination: Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the mathematical models for Boundary Value Problems and their numerical solution

CO2: Apply the concepts of Finite Element Analysis to solve one dimensional problem in structural analysis.

CO3: Apply the concepts of Finite Element Analysis to solve one dimensional problem in Heat transfer and Dynamics

CO4: Apply the concepts of Finite Element Analysis to solve two dimensional problems in structural analysis

CO5: Apply the Iso-parametric transformation and the use of numerical integration for various analysis

TEXT BOOKS

1. Reddy. J.N., "An Introduction to the Finite Element Method", 4h Edition, Tata McGraw-Hill, 2020.
2. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2013.

REFERENCE BOOKS

1. David Hutton, —Fundamentals of Finite Element Analysis‖, Tata McGraw Hill, 2017.
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 5th Edition, Prentice Hall College Div, 2021.
3. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, Indian Reprint 2013.
4. Rao, S.S., "The Finite Element Method in Engineering", 6th Edition, Butterworth Heinemann, 2018.
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, 2007.
6. Zienkiewicz O.C and Taylor R. L, "The Finite Element Method: Volume 1 The Basics", Fifth Edition, Butterworth-Heinemann, Oxford. Reprint 2011.

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1. https://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-analysis-ofsolids-and-fluids-i-fall-2009/lecture-notes/
2. https://ocw.mit.edu/courses/2-094-finite-element-analysis-of-solids-and-fluids-ii-spring-2011/pages/lecture-notes/
3. https://ocw.mit.edu/courses/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112104193
2. https://nptel.ac.in/courses/112104116/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	1	-	-	-	-	2	3	-	2
CO2	3	3	3	3	1	1	-	-	-	-	2	3	1	2
CO3	3	3	3	3	1	2	-	-	-	-	2	3	1	2
CO4	3	3	3	3	1	2	-	-	-	-	2	3	1	2
CO5	3	3	3	3	1	2	-	-	-	-	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1603	CAD CAM AND CIM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To explore the use of computers in mechanical component design for improved accuracy and efficiency.
- To understand the role of computers in design, planning, cost estimation, layout, and material handling in manufacturing.
- To study CAD standards and CNC part programming for precise and compatible manufacturing practices.
- To learn the concepts of Computer-Integrated Manufacturing (CIM) and its integration of design and production processes.
- To examine the application of computer technology to optimize manufacturing systems and enhance automation.

UNIT I INTRODUCTION 9

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems - homogeneous coordinates - 2D and 3D transformations - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – CAD/CAM concepts - Manufacturing Planning, Manufacturing control –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance.

UNIT II GEOMETRIC MODELING AND INTRODUCTION TO VISUAL REALISM 9

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves- Techniques for surface modelling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep, Introduction to visual realism.

UNIT III CAD STANDARDS 9

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Data exchange standards - IGES, STEP, CALS etc. - communication standards - Open Graphics Library (OpenGL).

UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMING 9

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- 2D and 3D machining on CNC ,Introduction of CAM package. Various Cutting tools in CNC machines.

UNIT V **COMPUTER INTEGRATED MANUFACTURING SYSTEMS** **9**

Evolution of CIM – CIM wheel and cycle - Group Technology(GT),Part Families – Parts Classification and coding–OPITZ, DCLASS, MICLASS coding systems with examples– Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS. Introduction to Industrial Internet of Things (IIoT), Digital Twin Technology, Artificial Intelligence (AI) and Machine Learning (ML) in CIM.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the computer-aided design (CAD) process and understand the development of manufacturing models and performance metrics.

CO2: Apply the fundamentals of parametric curves, surfaces, and solids used in CAD systems.

CO3: Apply CAD standards to create computer graphics, ensuring compliance with industry specifications.

CO4: Apply NC and CNC programming principles to develop part programs for Lathe and Milling Machines.

CO5: Analyze the concepts and systems in Computer-Integrated Manufacturing (CIM) to evaluate their impact on manufacturing efficiency.

TEXT BOOKS

1. Ibrahim Zeid “Mastering CAD CAM”, McGraw-Hill Education, 2014.
2. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, 5th edition, Pearson, 2020.
3. Radhakrishnan P, SubramanyanS. andRaju V., “CAD/CAM/CIM”, 4th Edition, New Age International (P) Ltd, 2016.
4. Donald Hearn and M. Pauline Baker “Computer Graphics”, Pearson, 2014.

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1. Chris McMahon and Jimmie Browne “CAD/CAM Principles - Practice and Manufacturing management “ Second Edition, Harlow Addison Wesley, 2000.
2. John F Hughes, Kurt Akeley, David F Sklar, Morgan McGuire, James D. Foley, Steven K. Feiner and Andries van Dam - "Computer graphics principles & practice" 3/e, Pearson Education, 2019.
3. William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, 2nd edition, Pearson, 2014.
4. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat , "Industrial Internet of Things: Cybermanufacturing Systems", CRC press, 2017.
5. R. Jayaraman, J. S. R. Jang, and A. C. Santos,“Artificial Intelligence for Industrial Applications: Practical Applications of AI for Smart Manufacturing", CRC press, 2020.

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1. https://ocw.mit.edu/courses/mechanical-engineering/2-092-finite-element-analysis-ofsolids-and-fluids-i-fall-2009/lecture-notes/
2. https://ocw.mit.edu/courses/2-094-finite-element-analysis-of-solids-and-fluids-ii-spring-2011/pages/lecture-notes/
3. https://ocw.mit.edu/courses/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/
4. https://edutechwiki.unige.ch/en/Computer-aided_design_and_manufacturing
5. https://www.brainkart.com/article/CAM%2C-CAD-CAM%2C-and-CIM_6433
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2. https://onlinecourses.nptel.ac.in/noc23_me13/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO2	3	3	2	2	3	1	-	-	-	-	3	3	3	3
CO3	3	3	2	2	3	1	-	-	-	-	3	3	3	3
CO4	3	3	2	2	3	1	-	-	-	-	3	3	3	3
CO5	3	3	2	2	3	1	-	-	-	-	3	3	3	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1604	HYBRID AND ELECTRICAL VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the concept of hybrid and electric drive trains.
- To elaborate on the types and utilisation of hybrid and electric drive trains.
- To expose on different types of AC and DC drives for electric vehicles.
- To learn and utilise different types of energy storage systems.
- To analyze energy management strategies and drive sizing.

UNIT I INTRODUCTION 9

Basics of vehicle performance, vehicle power source characterization, transmission characteristics,History of hybrid and electric vehicles, social and environmental importance of hybrid and electricvehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE TRAINS 9

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flowcontrol in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept ofelectric traction, introduction to various electric drive-train topologies, power flow control in electricdrive-train topologies, fuel efficiency analysis.

UNIT III CONTROL OF AC & DC DRIVES 9

Introduction to electric components used in hybrid and electric vehicles, Configuration, and control -DC Motor drives, Induction Motor drives, Permanent Magnet Motor drive, and Switch ReluctanceMotor drives, drive system efficiency.

UNIT IV ENERGY STORAGE AND MANAGEMENT STRATEGIES 9

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Energy storage and its analysis - Battery based, Fuel Cell based, and Super Capacitor based, Hybridization of different energy storage devices. Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification, and comparison of energy management strategies, Implementation issues.

UNIT V THERMAL MANAGEMENT IN BATTERIES AND FUEL CELLS 9

Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Tesla Model-S Battery Module-bonding techniques, thermal management, .Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the Characterize and configure hybrid drive trains requirement for a vehicle.

CO2: Design and apply appropriate hybrid and electric drive trains in a vehicle.

CO3: Design and install suitable AC and DC drives for electric vehicles.

CO4: Analyze suitable energy storage system for a hybrid / electric vehicle.

CO5: Analyze energy management strategies to ensure better economy and efficiency.

TEXT BOOKS

1. Iqbal Husain, ―Electric and Hybrid Vehicles: Design Fundamentals‖, Third Edition, 2021.
2. Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles by John G. Hayes and A. Goodarzi, Wiley Publication, 2018.
3. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2018.
4. Tom Denton, “Electric and Hybrid Vehicles”, 1st edition, Routledge Publishers, 2017.

REFERENCE BOOKS

1. Ron HodKinson, “Light Weight Electric/ Hybrid Vehicle Design”, Butterworth Heinemann Publication, 2005.
2. Ronald . Jurgen, “Electric and Hybrid-Electric Vehicles: Engines and Powertrains”, SAE International, 2015.
3. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Soft cover reprint of the original 1st ed, Springer, 2013.

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1. https://en.wikipedia.org/wiki/Electric_vehicle
2. https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ee112/course
2. https://www.udemy.com/course/electric-vehicles-comprehensive-course/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	3	-	-	-	-	3	3	-	2
CO2	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO4	3	3	3	3	-	1	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1611	COMPUTER AIDED MANUFACTURING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To expose the students to the techniques of CNC programming and cutting tool path generation by using G-Codes and M-codes.
- To understand the simulation of CNC Turning part programming.
- To understand the simulation of CNC Milling part programming.
- To study the features of Computer Aided Part Programming.
- To understand the workflow of digital manufacturing from modelling to printing.

UNIT I INTRODUCTION TO MANUAL PART PROGRAMMING 5

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines– Gas forces, Inertia effect of connecting rod– Bearing loads – Crank shaft torque, Turning moment diagrams –Fly Wheels, Flywheels of punching presses.

UNIT II PART PROGRAMMING - CNC TURNING 15

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines.

UNIT III PART PROGRAMMING - CNC MILLING 15

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration– Equations of motion – Natural frequency – Types of Damping – Damped vibration. Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems. Introduction to multi degree of freedom system vibration. Discrete and continuous systems.

UNIT IV COMPUTER AIDED PART PROGRAMMING 15

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation.

UNIT V DIGITAL MANUFACTURING (Additive Manufacturing) 10

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL :60 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the techniques of CNC programming and cutting tool path generation by using G-Codes and M-codes.

CO2: Analyze the simulation of CNC Turning part programming.

CO3: Analyze the simulation of CNC Milling part programming.

CO4: Execute Computer Aided Part Programming to forced vibration.

CO5: Apply the workflow of digital manufacturing from modelling to printing.

TEXT BOOKS

1. PawanNegi, Mangey Ram, Om PrakashYadav, "Basics of CNC Programming", River Publishers, 2019.
2. Kaushik Kumar, ChikeshRanjan, J. Paulo Davim, "CNC Programming for Machining", Springer International Publishing, 2020.
3. S. K Sinha, "CNC Programming Using Fanuc Custom Macro B", McGraw-Hill Education, 2010.
4. De Gruyter, "Manufacturing in Digital IndustriesProspects for Industry 4.0", 2020.

REFERENCE BOOKS

1. Peter Smid, "CNC Programming Handbook - A Comprehensive Guide to Practical CNC Programming", Industrial Press, 2008.
2. DivyaZindani, J. Paulo Davim, Kaushik Kumar, "Digital Manufacturing and Assembly Systems in Industry 4.0, 2019.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	-	-	2	-	-	2	3	3	2
CO2	3	3	2	2	3	-	-	2	-	-	2	3	3	2
CO3	3	3	2	2	3	-	-	2	-	-	2	3	3	2
CO4	3	3	2	2	3	-	-	2	-	-	2	3	3	2
CO5	3	3	2	2	3	-	-	2	-	-	2	3	3	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

ME1612	DESIGN AND FABRICATION PROJECT	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To encourage teamwork and effective collaboration by grouping students to work on a project under the guidance of a supervisor.
- To develop hands-on skills in designing, fabricating, and testing devices, systems, or components in alignment with industry standards.
- To enable students to document their project progress and outcomes through well-structured project reports.
- To prepare students for professional evaluation through oral presentations and interactions with internal and external examiners.

GUIDELINES FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

Internal Assessment		End Semester Examination
Evaluation of Laboratory Observation, Record	Test	Practical
75	25	100
60 %		40%

SEMESTER – VII

23ME1701	INDUSTRIAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand production management principles, planning, and control for efficient operations.
- To learn product and process planning with focus on value analysis and system optimization.
- To master production scheduling techniques to align resources with demand efficiently.
- To develop cost estimation skills for labor, materials, and overhead in various shop processes.
  To explore machining time calculations and modern industrial engineering trends like JIT and ERP.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect- aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II 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-Prerequisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT III PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual Loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems- Periodic batch control- Material requirement planning, Kanban – Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT IV COST ESTIMATION 9

Importance of costing and estimation- Types of estimates – Estimating procedure-Methods of costing-elements of cost estimation – Estimation of labour cost, material cost- allocation of overhead charges- Calculation of depreciation cost, Estimation of Different Types of Jobs - Estimation of Sheet metal Shop, Forging Shop, Welding Shop and Foundry Shop.

UNIT V MACHINING TIME CALCULATION & RECENT TRENDS IN INDUSTRIAL ENGINEERING 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time

Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

Introduction to computer integrated production planning systems- elements of Just In Time systems- Fundamentals of MRP-II and ERP.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the principles of production and operations management, including planning, control, and product development.

CO2: Apply the process planning and routing techniques to optimize production systems in batch and continuous operations.

CO3: Analyze the scheduling techniques, such as Gantt charts and material requirement planning, to improve production efficiency

CO4: Evaluate cost estimation methods for labour, materials, and overhead across various manufacturing processes.

CO5: Develop machining time calculations and integrate modern trends like JIT, ERP, and MRP II into production systems.

TEXT BOOKS

1. Martand T Telsang, “Industrial Engineering and Production Management”, Third Revised edition, S. Chand and Company, 2018.
2. Narang GBS and Kumar V, Production and Costing, Khanna Publishers, 2014.
3. T.R. Banga and S.C. Sharma, "Industrial Engineering and Management", Khanna Publishers, 2016.

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1. Panneerselvam. R, Production and operations Management, PHI, 3rd Edition, 2012
2. James. B. Dilworth,” Operations management – Design, Planning and Control for manufacturing and services” McGraw Hill International edition 1992.
3. William J Stevenson, Operations Management, McGraw Hill,13th Edition,2018.
4. Chary. S.N., “Production and Operations Management”, Tata McGraw Hill, 6thEdition, 2019.
5. Banga T R and Sharma S C, Estimating and Costing, Khanna Publishers, 2001.

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2. https://www.managementstudyguide.com/production-and-operations-management.htm
3. https://www.slideshare.net/zimbar/product-and-process-planning
4. https://nulab.com/learn/project-management/production-scheduling-important/
5. https://www.smartsheet.com/ultimate-guide-project-cost-estimating
6. https://ocw.mit.edu/courses/15-760a-operations-management-spring-2002/
7. https://sebokwiki.org/wiki/Systems_Engineering_and_Industrial_Engineering

ONLINE COURSES / RESOURCES:

1. https://www.digimat.in/nptel/courses/video/110107141/L01.html
2. https://www.digimat.in/nptel/courses/video/110101132/L01.html
3. https://onlinecourses.nptel.ac.in/noc20_me43/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	3	3	2	2	1	-	-	-	1	2	3	3	-	3
CO3	3	3	2	2	1	-	-	-	1	2	3	3	-	3
CO4	3	3	2	2	1	-	-	-	1	2	3	3	-	3
CO5	3	3	2	2	1	-	-	-	1	2	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1702	MECHATRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- Substantiate the need for interdisciplinary study of Mechatronics in technology education.
- Understand the advancement and growth of Mechatronics as a discipline.
- Define the principles of sensors, actuators, micro-controllers, and Programmable Logic control, Arduino, Raspberry Pi and IOT.
- Evaluate the performance of mechatronic systems.

UNIT I INTRODUCTION – SENSORS AND ACTUATORS 9

- To understand electronics, electrical systems, and mechanical systems work together in a Mechatronics application.
- To identify the components of a microprocessor and microcontroller, including pin diagrams and basic addressing modes.
- To configure 8255 for interfacing with different devices (e.g., sensors, actuators).
- To clarify the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronics engineering.
- To apply PLC programming to a simple industrial automation problems and case studies in mechatronic system design.

UNIT II MICROPROCESSOR, MICROCONTROLLER AND PLC 9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes – Instruction set, Concepts of 8051 microcontroller – Block diagram. Introduction to Programmable Logic Controller – Basic structure of PLC – Input and output processing – Programming – Mnemonics – Timers, counters, internal relays, shift register, Jump controls – Data handling – Selection of PLC.

UNIT III 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 ARDUNIO AND RASPBERRY PI 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. Interfacing and Controlling I/O devices by Arduino and Raspberry Pi

UNIT V MECHATRONIC SYSTEM DESIGN 9

Mechatronics systems: Aerial 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 : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Ability to recognize and analyze suitable sensors and actuators to develop Mechatronics systems.

CO2: Develop appropriate ladder logic programming circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.

CO3: Elucidate the fundamentals of IoT and Embedded Systems.

CO4: Implement Arduino and Raspberry Pi as controllers for automated systems

CO5: Design and develop an appropriate mechatronics/IoT based system for the given real- time application.

TEXT BOOKS

1. Bolton W., “Mechatronics”, Pearson Education, 2019.
2. Bradley D.A., Burd N.C., Dawson D., Loader A.J., “Mechatronics: Electronics in Products and Processes”, Routledge, 2017.
3. Sami S.H and Kisheen Rao G, “The Internet of Mechanical Things: The IoT Framework for Mechanical 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: Networking Technologies, 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”, McGraw Hill, 2005. 5. Bell C., “Beginning Sensor Networks with Arduino and Raspberry Pi”, Apress, 2013.

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1. https://mechatronics.colostate.edu/resources/

ONLINE COURSES / RESOURCES:

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CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	3	1	1	2	1	-	2	-	-	2	3	1	2
CO4	3	3	1	1	2	1	-	2	-	-	2	3	1	2
CO5	3	3	1	1	2	1	-	2	-	-	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1711	MECHATRONICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To understand the basic hydraulic circuits for actuator systems
- To understand the concepts of programming in microprocessor and its interfacing with other application.
- To identify and understand the concept of PLC for designing of automated systems.
- To understand and analyse the operations carried using 8085 microprocessor for various applications.

LIST OF EXPERIMENTS

1. Design and testing of fluid power circuits using hydraulic linear actuation system
2. Deviselogic gates using Electro pneumatic trainer kits.
3. Design of fluid power circuits using Electro pneumatic trainer kits.
4. Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.
5. Stepper motor interfacing with 8051 Micro controller
6. Computerized data logging system with control of flow in process
7. Computerized data logging system with control of pressure in process
8. Computerized data logging system with control of temperature in process.
9. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
10. Traffic light interface.
11. Speed control of DC motor using PID controller
12. Study of hydraulic, pneumatic and electro-pneumatic circuits.
13. Study of PLC and its applications.
14. Study of image processing technique.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

CO1: Apply the concept of mechatronics in designing and modelling of basic electrical Systems .

CO2: Apply the concept of mechatronics in hydraulic Systems

CO3: Apply the concepts of pneumatic Systems to design a mechatronics system.

CO4: Apply the Programming concepts in 8085 microprocessor to perform basic arithmetic and logic functions.

CO5: Apply the functions of PLC with its industrial applications.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	1	-	1	-	-	2	3	-	2
CO2	3	3	2	2	3	1	-	1	-	-	2	3	3	2
CO3	3	3	2	2	3	1	-	1	-	-	2	3	3	2
CO4	3	3	2	2	1	1	-	1	-	-	2	3	1	2
CO5	3	3	2	2	2	1	-	1	-	-	2	3	2	2

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ME1712	SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To understand the software tools needed to analyze engineering problems.
- To understand and simulate the concepts of mechanisms using MAT lab.
- To identify the role of stress and vibrations in Mechanical components.
- To identify and understand the concepts of heat transfer for analysis of simple problems.

LIST OF EXPERIMENTS

A. SIMULATION No. of Hours : 20

1. MATLAB basics, dealing with matrices, Graphing-Functions of one variable and two variables.
2. Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms and simple problems in vibration using MATLAB.
3. Mechanism Simulation using Multi-body Dynamic software.

B. ANALYSIS No. of Hours :40

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axisymmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL : 60 PERIODS

COURSE OUTCOME(S):

CO1: Simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB.
CO2: Analyze the stresses and strains induced in plates, brackets and beams.
CO3: Analyze the stresses and strains induced in axisymmetric problems.
CO4: Analyze the stresses and strains induced in heat transfer problems.
CO5: Evaluate the natural frequency and mode shape analysis of 2D components and beams.

TEXT BOOKS

1. Rao V Dukkipati, "MatlabFor Mechanical Engineers by Rao V Dukkipati", New Age International (P) Ltd, 2007.
2. SaeedMoaveni, “Finite Element Analysis Theory And Application With ANSYS”, Pearson, 2011.
3. Kent Lawrence , “ANSYS Tutorial Release 2020”, SDC publications, 2020.
4. ErdoganMadenci, Ibrahim Guven. "The Finite Element Method and Applications in Engineering Using ANSYS", 2nd edition, Springer, 2015.

REFERENCE BOOKS

1. Huei-Huang Lee, "Finite Element Simulations with ANSYS Workbench 2021: Theory, Applications, Case Studies", SDC publications, 2021.
2. Simulation and Analysis Laboratory Manual prepared by Department of Mechanical Engineering Panimalar Engineering College.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	-	-	-	-	-	3	3	3	3
CO2	3	3	2	2	2	1	-	-	-	-	3	3	2	3
CO3	3	3	2	2	2	1	-	-	-	-	3	3	2	3
CO4	3	3	2	2	3	1	-	-	-	-	3	3	3	3
CO5	3	3	2	2	3	1	-	-	-	-	3	3	3	3

Internal Assessment		**End Semester Examination**
Evaluation of Laboratory Observation, Record	**Test**	**Practical**
75	**25**	**100**
60 %		**40%**

23ME1713	IDENTIFICATION OF PROJECT WORK	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To provide students with opportunities to apply theoretical concepts in real-world situations.
- To promote teamwork, communication, and collaboration among students.
- To expose students to real-world challenges and situations, allowing them to experience industry-specific issues.
- To encourage students to consider the ethical implications and societal impact of their projects.

GUIDELINES FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The students have an idea of the project which will be coming in 8th semester. In this, students have to choose the domain and have to work on the literature for finding the gaps. A project report to be submitted by the group along with the methodology of doing their work which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report by the examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

Internal Assessment		End Semester Examination
Evaluation of Laboratory Observation, Record	Test	Practical
75	25	100
60 %		40%

SEMESTER - VIII

23ME1811	PROJECT WORK	L	T	P	C
		0	0	16	8

COURSE OBJECTIVE:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To provide students with opportunities to apply theoretical concepts in real-world situations.
- To promote teamwork, communication, and collaboration among students.
- To expose students to real-world challenges and situations, allowing them to experience industry-specific issues.
- To encourage students to consider the ethical implications and societal impact of their projects.

GUIDELINES FOR REVIEW AND EVALUATION

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 240 PERIODS

Internal Assessment		End Semester Examination
Evaluation of Laboratory Observation, Record	Test	Practical
75	25	100
60 %		40%

PROFESSIONAL ELECTIVES

23ME1901	SURFACE ENGINEERING AND TRIBOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To provide students with a comprehensive understanding of the fundamental principles of tribology, including the study of friction, wear, and lubrication mechanisms in engineering materials.
- To analyze different types of wear (abrasive, adhesive, corrosive, etc.) and their mechanisms and to understand how these wear processes affect material performance in real-world applications.
- To examine the role of lubrication in reducing friction and wear, and to explore the types, properties, and selection criteria of lubricants used in different applications.
- To explore surface engineering techniques, such as coating, hardening, and other treatments, used to improve the wear resistance of materials.
- To investigate how the mechanical, thermal, and chemical properties of materials influence their tribological performance in contact situations.

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 non-metals – 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 non-metals – 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

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the theories of friction related with metals and non-metals
CO2: Analyze the different kinds of wear mechanisms and their standard measurements.
CO3: Analyze the various forms of corrosion and the preventative treatments available.
CO4: Investigate the various surface qualities and surface modification approaches.
CO5: Explore the various materials employed in friction and wear applications

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.

REFERENCE BOOKS

1. Fontana G., “Corrosion Engineering”, McGraw Hill, 1985.
2. Halling, J. (Editor), “Principles of Tribology “, MacMillian, 1984.
3. Rabinowicz.E., “Friction and Wear of materials”, John Willey &Sons,1995.
4. Williams J.A., “Engineering Tribology”, Oxford University Press, 1994.
5. Joseph R. Davis, Corrosion: Understanding the Basics, ASM International, 2000.

WEB REFERENCES

1. https://www.wiley.com/en-us/Materials+and+Surface+Engineering+in+Tribology-p-9781848210677
2. https://www.elsevier.com/books-and-journals/book-series/tribology-and-surface-engineering

ONLINE COURSES / RESOURCES:

1. https://www.udemy.com/course/surface-roughness-texture-and-tribology-full-course/
2. https://onlinecourses.nptel.ac.in/noc20_me68/preview
3. https://www.ntnu.edu/studies/courses/TMM4205/#tab=omEmnet

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	1	-	-	-	-	2	3	-	2
CO2	3	3	1	1	-	1	-	-	-	-	2	3	-	2
CO3	3	3	2	2	-	1	-	-	1	-	2	3	-	2
CO4	3	3	2	2	-	1	-	-	1	-	2	3	-	2
CO5	3	3	2	2	-	1	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1902	OPTIMIZATION TECHNIQUES IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To provide students with a solid foundation in the basic principles of optimization, including mathematical formulations, problem types, and solution strategies.
- To understand the fundamental principles and mathematical formulations of optimization problems in engineering.
- To teach students to apply classical optimization methods such as linear programming, nonlinear programming, and integer programming to solve engineering optimization problems.
- To provide students with hands-on experience in implementing optimization algorithms using modern computational tools to solve real-world engineering problems.

UNIT - I INTRODUCTION 9

Introduction to optimum design - General concepts of optimization – Problem formulation & their types– Classical optimization techniques - Single variable and multivariable optimization.

UNIT - II UNCONSTRAINED OPTIMIZATION TECHNIQUES 9

Techniques of unconstrained optimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT - III CONSTRAINED OPTIMIZATION TECHNIQUES 9

Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions.

UNIT - IV UNCONVENTIONAL OPTIMIZATION TECHNIQUES 9

Genetic algorithms, Simulated Annealing and Ant Colony algorithm. Robust and dynamic optimization application.

UNIT - V MATERIAL AND PROCESSES IN DESIGN 9

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the fundamental concepts of optimization and its relativity to the design process.
CO2: Apply the unconstrained methods in improving the solution finding process.
CO3: Apply the role of constrained methods and their various sub-divisions in problem solving.
CO4: Analysis of various unconventional optimization methods as an alternative methodology to traditional optimization methods.
CO5: Analyze the different optimization methods in various engineering applications.

TEXT BOOKS

1. Rao Singaresu.S, “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 5th Edition, 2020.
2. Kalyanamoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. Ltd. 2014.

REFERENCE BOOKS

1. Johnson Ray C, “Optimum design of mechanical elements”, Wiley, John & Sons, Digitized, 4th Edition, 2021.
2. Goldberg.D.E, “Genetic algorithms in search, optimization and machine”, Barnen, AddisonWesley, New York, 1989.
3. Rao.C.S, “Optimization Techniques”, Dhanpat Rai & Sons, New Delhi, 5th Edition, 2020.
4. Fox.R.L, “Optimization methods for Engineering Design”, Addison Wesley Pub, Digitized 2007.
5. Garret N. Vanderplaats, “Numerical optimization techniques for engineering design: with applications”, McGraw-Hill Ryerson, Limited, Digitized 2007.

WEB REFERENCES

1. https://www.springer.com/journal/11081
2. https://www.tandfonline.com/journals/geno20
3. https://paperpile.com/s/engineering-optimization-citation-style/

ONLINE COURSES / RESOURCES:

1. https://www.udemy.com/course/optimization-for-engineering-students/
2. https://www.edx.org/course/mathematical-optimization-for-engineers
3. https://in.coursera.org/courses?query=optimization

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	-	-	-	-	-	-	2	3	-	2
CO2	3	3	1	1	1	1	-	-	-	-	2	3	-	2
CO3	3	3	1	1	1	1	-	-	1	-	2	3	-	2
CO4	3	3	1	1	1	1	-	-	1	-	2	3	-	2
CO5	3	3	1	1	1	1	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1903	DESIGN OF JIGS AND FIXTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the locating and clamping principles.
- To design and develop jigs and fixtures for a given component.
- To understand press working terminologies and elements of cutting dies..
- To design and develop bending and forming dies.
- To develop knowledge in other forming techniques.

UNIT - I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT - II JIGS AND FIXTURES 9

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures..

UNIT - III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT - IV BENDING AND DRAWING DIES 9

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT - V FORMING TECHNIQUES AND EVALUATION 9

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the various ways of locating jigs and fixtures, as well as clamping

concepts.

CO2: Develop jigs and fittings for a particular component.
CO3: Review press working stipulations and cutting die components.
CO4: Distinct between bending and drawing dies.
CO5: Examine the various sorts of forming processes

TEXT BOOKS

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996.

REFERENCE BOOKS

1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Donaldson, Lecain and Goold “Tool Design”, 5th Edition, Tata McGraw Hill, 2017.
4. Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5. Kempster, “Jigs and Fixture Design”, Third Edition, Hoddes and Stoughton, 1974.
6. Venkataraman. K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.

WEB REFERENCES

1. https://iopscience.iop.org/article/10.1088/1757-899X/551/1/012028/pdf
2. https://www.researchgate.net/publication/281006514_The_Design_and_Need_for_Jigs_and_Fixtures_in_Manufacturing

ONLINE COURSES / RESOURCES:

1. https://virtual-engineering.com/courses/course-on-jigs-fixture-design-theory-practical-design-exercises/
2. https://www.tvsts.com/jigsandfixtures
3. https://www.teacheron.com/online-jigs_and_fixtures_design-tutors

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	3	3	1	-	-	-	-	-	2	3	-	2
CO3	3	3	1	-	-	-	-	-	-	-	2	3	-	2
CO4	3	3	1	-	-	-	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	-	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1904	COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the fundamentals of composite materials and its properties
- To have the fundamental knowledge of the Polymer matrix composites and its manufacturing methods
- To have the fundamental knowledge of the Metal matrix composites and its manufacturing methods
- To have knowledge about the Ceramic matrix composites and its manufacturing processes
- To possess knowledge on laminate constitutive equation and its application to various types of laminates.

UNIT - I INTRODUCTION TO COMPOSITE MATERIALS 9

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites-Rule of mixtures - problems-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites.

UNIT - II MANUFACTURING OF COMPOSITES 9

Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquidstate,vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) –hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces

UNIT - III INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS 9

Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates

UNIT - IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES 9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

UNIT - V THERMO-STRUCURAL ANALYSIS 9

Fabrication stresses/Residual stresses in FRP laminated composites- Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's -Stress and Moment Resultants due cooling of the laminates during fabrication-Calculations for thermo-mechanical stresses in FRP laminates. Case studies: Implementation of CLT for evaluating residual stresses in the components made with different isotropic layers such as electronic packages etc.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the fundamentals of composite materials in various engineering fields.
CO2: Developing the FRP and other composites by different manufacturing methods.
CO3: Analyzing mechanical strength of the composite material.
CO4: Evaluating the stresses in the lamina of the laminate using different failure theories.
CO5: Analyzing thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

TEXT BOOKS

1. Gibson R F, Principles of Composite Material Mechanics, McGraw-Hill, 1994, CRC press, 4th Edition, 2015.
2. Mallick PK, Fiber – Reinforced Composites: Materials, Manufacturing and Design, CRC Press, 3rdEdition, 2007.

REFERENCE BOOKS

1. Agarwal, B. D. and Broutman, L. J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
2. Halpin, J. C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
3. Hyer M. W., and Scott R White, "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.

WEB REFERENCES

1. https://onlinelibrary.wiley.com/doi/full/10.1002/9781118985960.meh110
2. https://www.elsevier.com/books/mechanics-of-composite-materials/sendeckyj/978-0-12-136502-8

ONLINE COURSES / RESOURCES:

1. https://www.udemy.com/course/composite-materials/
2. https://onlinecourses.nptel.ac.in/noc19_me67/preview
3. https://onlinecourses.nptel.ac.in/noc22_me40/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	2	2	-	-	-	-	-	-	2	3	-	2
CO3	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO4	3	3	2	2	-	-	-	-	-	-	2	3	-	2
CO5	3	3	2	2	-	-	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1905	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the fundamentals of material testing and its standards..
- To understand the various mechanical testing methods for materials.
- To provide various non destructive testing methods for materials.
- To analyze different types of microscope equipments and its working principles.

To identify advanced material testing equipments and its working principles.

UNIT I INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid Penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V OTHER TESTING 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Introduction to mass spectrometry, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the various testing methods and its standards.
CO2: Apply the mechanical testing methods for suitable applications.
CO3: Apply the non destructive testing methods for suitable applications.
CO4: Examine the microstructure obtained from microscopes.
CO5: Analyze the composition of the materials using advanced techniques.

TEXT BOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

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1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

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2. https://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8059.pdf
3. https://www.thermofisher.com/in/en/home/materials-science/learning-center/applications/sem-tem-difference.html
4. https://www.twi-global.com/technical-knowledge/faqs/what-is-non-destructive-testing#:~:text=Non%2Ddestructive%20testing%20(NDT),damage%20to%20the%20original%20part.
5. https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx

ONLINE COURSES / RESOURCES:

1. https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-
2. https://onlinecourses.nptel.ac.in/noc20_mm07/preview
3. https://www.twi-global.com/locations/india/courses/non-destructive-testing-online-live-courses
4. https://www.asminternational.org/news/industry/-/journal_content/56/10180/42035275/NEWS

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	-	1	-	-	-	-	1	-	2	3	-	2
CO3	3	3	-	1	-	-	-	-	1	-	2	3	-	2
CO4	3	3	1	1	-	-	-	-	1	-	2	3	-	2
CO5	3	3	1	1	-	-	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1906	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the Fundamentals of design engineering.
- To design processes of mechanical engineering components.
- To provide creativity, problem solving and lateral thinking of design process.
- To find a solution by attributing Human and societal aspects of new product development.
- To influence of manufacturing and assembly process in new design.

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

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 mapTheory 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).

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the various design requirements and get acquainted with the processes involved in product development.
CO2: Apply the design processes to develop a successful product.
CO3: Analyze the lateral thinking and problem solving in designing a new product.
CO4: Examine the human and societal influence of new product development.
CO5: Analyze the design for manufacturing and design for assembly concepts.

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.

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1. Dhillon, B. S., Advanced Design Concepts for Engineers, Technomic Publishing Co., 1998.
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.

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2. https://www.d.umn.edu/itss/training/online/webdesign/books.html
3. https://www.sciencedirect.com/topics/materials-science/engineering-design

ONLINE COURSES / RESOURCES:

1. https://www.classcentral.com/course/edx-introduction-to-engineering-and-design-12329
2. https://www.careers360.com/courses-certifications/engineering-design-courses-brpg
3. https://www.edx.org/course/introduction-to-engineering-and-design

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-		-	2	3	-	2
CO2	3	2	2	-	1	-	-	-	2	-	2	3	1	2
CO3	3	2	2	2	1	-	-	-	2	-	2	3	1	2
CO4	3	2	2	2	1	2	-	-	2	-	2	3	1	2
CO5	3	-	-	-	-	-	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1907	NOISE VIBRATION AND HARSHNESS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the various types of vibration with damping and without damping
- To understand the various types of noise and its measurement and analysis techniques.
- To understand the various sources of noise from automobiles.
- To understand the various noise controlling techniques.
- To understand the various noise from mechanical components and its suppressing techniques.

UNIT - I FUNDAMENTALS OF NOISE, VIBRATION, AND HARSHNESS 9

Theory of sound - Predictions and measurement, Sound sources, Sound propagation in the Atmosphere, Sound radiation from structures and their response to sound, Introduction to vibration, free and forced vibration, undamped and damped vibration, Vibration of simple discrete and continuous systems, Torsional vibration, Determination of natural frequencies., Definition of Harshness, Its effect and acceptable degree of Harshness,

UNIT - II VIBRATIONS MEASUREMENT TECHNIQUES AND CONTROL 9

Vibration measuring Instruments: Vibration pick-up, Types of transducers, Vibrometer for measurement of Frequency of vibrations, Period, Amplitude, Velocity and Acceleration parameters, Vibrations isolation, Different types of vibration absorber.

UNIT - III TRANSPORTATION NOISE AND VIBRATION - SOURCES, PREDICTION, AND CONTROL 9

Introduction to Transportation noise and vibration sources, Internal combustion engine noise prediction and control - Diesel, Exhaust and Intake noise and Acoustical design of mufflers, Tire/Road Noise - Generation, Measurement, and Abatement, Aerodynamic sound sources in vehicles - Prediction and Control, Transmission and Gearbox noise and vibration prediction and control, Brake noise prediction and control, Perception of Ride comfort

UNIT - IV INTERIOR TRANSPORTATION NOISE AND VIBRATION SOURCES - PREDICTION AND CONTROL 9

Introduction to Interior transportation noise and vibration sources, Automobile, Bus and Truck Interior noise and vibration prediction and control, Noise and Vibration in Off-Road vehicle Interiors - Prediction and control

UNIT - V NOISE AND VIBRATION ANALYSIS EQUIPMENT, SIGNAL PROCESSING, AND MEASURING TECHNIQUES 9

General Introduction to noise and vibration measuring equipment, Signal acquisition and processing, Acoustical transducer principles and Types of microphones, Sound level meters, Noise Dosimeters, Analyzers and signal generators, Equipment for data acquisition. Determination of sound power level and emission sound pressure level, Sound intensity measurements, Noise and vibration data analysis. Calibration of measurement microphones, Calibration of shock and vibration transducers, Metrology and traceability of vibration and shock measurements.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Understand the fundamentals of noise and vibration characteristics.
CO2: Discuss the various techniques available to measure and control the automotive vibrations.
CO3: Describe the effects of transportation noise and its control techniques.
CO4: Describe the effects of interior transportation noise and its control techniques
CO5: Summarize the signal measuring and processing techniques in Automobiles

TEXT BOOKS

1. David A.Bies and Colin H.Hansen, “Engineering Noise Control: Theory and Practice”, Spon Press, London, 2009.
2. Mathew Harrison, “Vehicle refinement Controlling Noise and vibration in road vehicles”, SAE International, Elsevier Butterworth-Heinemann, 2008.
3. Xu Wang, “Vehicle Noise and Vibration Refinement”, Woodhead Publishing Limited, 2010.

REFERENCE BOOKS

1. Allan G. Piersol, Thomas L. Paez, Harris, “Shock and Vibration Handbook”, McGraw-Hill, New Delhi, 2010.
2. Clarence W. de Silva, “Vibration Monitoring, Testing, and Instrumentation”, CRC Press, 2007.
3. Colin H Hansen, “Understanding Active Noise Cancellation”, Spon Press, London 2003.
4. Kewal Pujara, “Vibrations and Noise for Engineer”s, Dhanpat Rai & Sons, 1992.
5. Matthew Harrison, “Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles”, Elsevier Butterworth-Heinemann, Burlington, 2004.

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2. https://www.researchgate.net/publication/277705941_Drivetrain_Noise_Vibration_and_Harshness

ONLINE COURSES / RESOURCES:

1. https://umdearborn.edu/cecs/graduate-programs/certificates/automotive-noise-vibration-harshness-nvh
2. https://onlinecourses.nptel.ac.in/noc19_me72/preview
3. https://www.udemy.com/course/automotive-engineering-nvh-essentials/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	1	1	1	1	1	-	-	1	-	2	3	1	2
CO3	3	1	1	1	1	1	-	-	1	-	2	3	1	2
CO4	3	1	1	1	1	1	-	-	1	-	2	3	1	2
CO5	3	1	1	1	1	1	-	-	1	-	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1908	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- Understand the basic principles and concepts of new product development strategies, the product life cycles.
- Know the modern tools, techniques and methods for product design and development
- Design and develop new products according to the application needed.
- Analyse the product economics in the commercial world.
- Design the product development through case studies, and the ability to address costs issues through better design decisions.

UNIT - I INTRODUCTION TO PRODUCT DEVELOPMENT 9

Introduction and design thinking - Tools for brainstorming - Customer need analysis and factor analysis

UNIT - II NETWORK EFFECT, STANDARDS AND PRODUCT SPECIFICATIONS 9

Product life cycle, innovation diffusion and crossing the chasm - Disruptive innovation and the innovator's dilemma - Network effects and standards - Product specifications

UNIT - III PRODUCT ARCHITECTURE AND PROTOTYPING 9

Product architecture and modularity - Mass customization and platforms - Agile development: Scrum; Kanban - Prototyping

UNIT - IV PRODUCT MARKETING 9

Forecasting and business case development - Marketing strategy and cluster analysis/ discriminant analysis - Pricing and conjoint analysis - Go to market plans

UNIT - V CONTEMPORARY TOPICS IN NPD 9

Open innovation; User innovation; Crowd sourcing; Free innovation - Continuous innovation and creating a culture of innovation

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze and discuss the key concepts and principles concerning the role of product strategies and services.

CO2: Analyze the competencies and product architecture involved in new product development.

CO3: Apply the range of tools and methods to manage new product design.

CO4: Analyze the set of potential innovation triggers and strategically select those opportunities fit with the organizational resources and strategies.

CO5: Critically evaluate the role of design in product development through case studies, and ability to address costs issues through better design decisions.

TEXT BOOKS

1. Ulrich, K. and Eppinger, S.; Product Design and Development; McGraw Hill; ISBN: 978-0-07- 802906-

REFERENCE BOOKS

1. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 2018
2. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 2014.
3. James G. Bralla, —Design for Manufacturability Handbook, McGraw Hill Professional, 1999
4. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark, The Free Press, 1992
5. Kelley, T.; The Art of Innovation; Doubleday; Bantam Doubleday Dell Publishing Group, 2001
6. Blank, S.; The Four Steps to the Epiphany; Successful Strategies for Products That Win K&S Ranch; 2013
7. Cross, N.; Design Thinking; Understanding how designers think and work, 2nd Edition, Bloomsbury Academic; 2023
8. Sutton, R.I.; Weird Ideas That Work; How to Build a Creative Company, The Free Press, 2007

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1. https://hbr.org/1965/11/exploit-the-product-life-cycle
2. http://www.dw.com/en/network-effects-helped-facebook-win/a-40418818
3. https://www.fastcompany.com/3001702/rules-successful-skunk-works-projects

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/110104084

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	-	2	2	-	-	-	-	-	2	3	2	2
CO4	3	2	2	2	-	-	-	-	-	-	2	3	-	2
CO5	3	2	2	2	2	2	-	-	-	-	2	3	2	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1909	WELDING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To identify and describe the construction and working principles of gas and arc welding processes.
- To explain the construction, operational mechanisms, and applications of resistance welding processes.
- To apply the principles of solid-state welding processes in practical welding applications.
- To implement various special welding techniques in different industrial settings based on their working principles.
  To analyse the design of weld joints, evaluate weldability, and apply appropriate testing methods to assess the quality of weldments.

UNIT I GAS AND ARC WELDING PROCESSES 9

Introduction to metal joining processes-Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG and MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.

UNIT II RESISTANCE WELDING PROCESSES 9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications

UNIT III SOLID STATE WELDING PROCESSES 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT IV OTHER WELDING PROCESSES 9

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT V DESIGN OF WELD JOINTS, WELDABILITY 9

Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, Steels and Stainless steels.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the fundamentals of gas and arc welding processes.
CO2: Analyze the fundamentals of resistance welding processes.
CO3: Apply the solid state the welding processes for suitable applications.
CO4: Apply the modern welding techniques for suitable applications.
CO5: Examine weld joint design, weldability, and testing methods to assess the quality of weldments.

TEXT BOOKS

1. Little R.L., Welding and welding Technology, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.
2. 2.Parmer R.S., Welding Engineering and Technology, 1st Edition, Khanna Publishers, New Delhi, 2008.
3. Parmer R.S., Welding Processes and Technology, Khanna Publishers, New Delhi, 1992.

REFERENCE BOOKS

1. AWS- Welding Hand Book. 8th Edition. Vol- 2. Welding Process.
2. Christopher Davis. Laser Welding- Practical Guide. Jaico Publishing House.
3. Davis A.C., The Science and Practice of Welding, Cambridge University Press, Cambridge, 1993.

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1. https://ewi.org/
2. https://www.fronius.com/en-in/india/welding-technology/references
3. https://awo.aws.org/category/resource-library/podcast/
4. https://www.twi-global.com/technical-knowledge
5. https://theweldinginstitute.com/

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/113/106/113106087/
2. https://archive.nptel.ac.in/courses/112/103/112103305/
3. https://archive.nptel.ac.in/courses/112/103/112103244/
4. https://archive.nptel.ac.in/courses/113/106/113106082/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-		-	2	3	-	2
CO2	3	-	-	-	-	-	-	-		-	2	3	-	2
CO3	3	3	-	-	-	2	-	-	2	-	3	3	-	3
CO4	3	3	-	-	-	2	-	-	2	-	3	3	-	3
CO5	3	3	2	2	-	2	-	-	2	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1910	MODERN MACHINING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand tool-workpiece interaction and select the appropriate machining process based on energy source.
- To apply mechanical and thermal energy-based processes, optimizing parameters for desired product characteristics.
- To utilize electrical and chemical energy-based processes with appropriate parameters for high-quality production.
- To analyze nano-finishing processes and their applications in precision machining.
- To evaluate and select suitable hybrid non-traditional machining processes based on application needs.

UNIT - I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications- Material removal in traditional and non-traditional machining process - considerations in process selection.

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – Effect of process parameters - MRR- Applications, Limitation and case studies.

UNIT - II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM), Working principle, Pulse generator circuit – RC and Controlled pulse generator – Analysis of RC circuit - Selection of process parameters, tool electrode, dielectric fluid, Machining characteristics of spark eroded surface – Recent development in EDM process - Wire Electrical discharge machining (WEDM) – working principle, process variables, characteristics, applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM), Electron Beam Machining (EBM) and Ion beam machining(IBM). Principles – Equipment –Types - Beam controltechniques – Applications.

UNIT - III CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process ParametersECG and ECH - Advantages, limitations and applications.

UNIT - IV ADVANCED NANO-FINISHING PROCESSES 9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipments, effect of process parameters, Mechanism of material removal (word alteration), applications, advantages and limitations.

UNIT - V HYBRID NON-TRADITIONAL MACHINING PROCESSES 9

Introduction - Various hybrid non-traditional machining processes, their working principles, equipments, effect of process parameters, Process capabilities and applications. Selection and comparison of different non-traditional machining processes, case studies.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the tool-workpiece interaction and determine the appropriate machining process based on the source of energy for the desired end product.

CO2: Apply mechanical and thermal energy-based machining processes, selecting relevant process parameters to achieve optimal product characteristics.

CO3: Utilize electrical and chemical energy-based machining processes with the appropriate process parameters to produce high-quality products.

CO4: Analyze and explain various nano-finishing processes and their applications in precision machining.

CO5: Evaluate and select suitable hybrid non-traditional machining processes, and differentiate between various non-traditional machining techniques based on specific application requirements.

TEXT BOOKS

1. VK Jain, “Advanced machining processes”, Allied publishers, New Delhi,2005.
2. Anand Pandey, “Modern Machining Processes”, Ane Books Pvt. Ltd., New Delhi, India, 2019.
3. P Pandey and H Shan, Modern Machining Processes, McGraw Hill Education, 2017.

REFERENCE BOOKS

1. M. Adithan, “Unconventional Machining Processes” -Atlantic, New Delhi, India, 2014.
2. McGeough, J. A, “Advanced Methods of Machining” Springer publisher; 1988
3. Kapil Gupta, Neelesh K. Jain and Laubscher R.F., “Hybrid Machining Processes: Perspectives on Machining and Finishing”, 1st edition, Springer International Publishing., Switzerland, 2016.
4. H. El-Hofy, Fundamentals of Machining Processes: conventional and non-conventional, 2ndedition, CRC press, Taylor & Francis group, 2014.
5. Jagadeesha T., “Non-Traditional Machining Processes”, I.K. International Publishing House Pvt. Ltd., New Delhi, India, 2017.

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1. https://www.twi-global.com/technical-knowledge/faqs/faq-what-is-advanced-manufacturing

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/112/104/112104028/
2. https://archive.nptel.ac.in/courses/112/105/112105212/
3. https://archive.nptel.ac.in/courses/112/103/112103202/
4. https://www.udemy.com/course/non-conventional-machining-processes

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	3	2	-	-	-	-	-	-	-	-	3	3	-	3
CO3	3	2	-	-	-	1	-	-	1	-	3	3	-	3
CO4	3	2	2	2	-	1	-	-	1	-	3	3	-	3
CO5	3	2	2	2	-	1	-	-	1	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1911	HYDRAULICS AND PNEUMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the principles and components of fluid power systems, including hydraulic pumps and their industrial applications.
- To analyze the design and function of hydraulic motors, cylinders, and flow control valves in fluid power systems.
- To design and develop hydraulic circuits and systems for specific applications, ensuring performance and safety.
- To explore the principles and components of pneumatic power systems, including compressors, actuators, and valves.
  To develop troubleshooting skills for diagnosing and resolving issues in hydraulic and pneumatic systems.

UNIT - I FLUID POWER PRINICIPLES 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 – Principles of flow - Friction loss - Work, Power and Torque - Problems

Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT - II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9

Hydraulic Actuators: Cylinders – Types and construction, Rodless Cylinder, Application, Hydraulic cushioning –Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Case studies - Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems in Actuators.

UNIT - III DESIGN OF HYDRAULIC CIRCUITS 9

Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Accumulator - Construction and Applications, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed-Control, Sizing of hydraulic systems, Hydrostatic transmission, Electro-hydraulic circuits – Servo and Proportional valves – Applications-Mechanical and Hydraulic servo systems.

UNIT - IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control valves, Quick exhaust valves, Pneumatic actuators

Design of Pneumatic circuit – Cascade method – Electro-Pneumatic system – Elements – Ladder diagram – Problems, Introduction to Fluidics and Pneumatic Logic Circuit

UNIT - V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids

Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications, Automatic Reciprocation of Cylinders using Limit Switches /Pressure

Valve

Design of Pneumatic circuits for metal working, Material handling, Clamping, Counter and Timer circuits - Low-cost Automation – Hydraulic and Pneumatic power packs.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Understanding of the working principles of fluid power systems, including hydraulic pumps, and apply this knowledge to practical scenarios

CO2: Analyze the design, operation, and performance characteristics of hydraulic motors, cylinders, and flow control valves in fluid power systems.

CO3: Design and develop efficient hydraulic circuits and systems tailored to specific industrial applications, ensuring optimal performance and safety.

CO4: Explain the working principles of pneumatic power systems and critically evaluate the role and functionality of key pneumatic components.

CO5: Evaluate common troubleshooting techniques for hydraulic and pneumatic systems and apply problem-solving skills to design solutions for diverse system applications.

TEXT BOOKS

1. Srinivasan. R., Hydraulic and Pneumatic Control, Tata McGraw-Hill Education, 2012.
2. Shanmugasundaram. K. “Hydraulic and Pneumatic Controls”. Chand & Co, 2006.

REFERENCE BOOKS

1. Anthony Esposito, Fluid Power with Applications, Pearson Education, 7th edition, 2009.
2. Majumdar S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw- Hill, 2001.
3. Majumdar, S.R., Pneumatic Systems-Principles and Maintenance, Tata McGraw-Hill, 2007.
4. Jagadeesha. T., “Pneumatics Concepts, Design and Applications “, Universities Press, 2015.
5. James A. Sullivan, “Fluid Power Theory and Applications”, Fourth Edition, Prentice Hall, 1997.

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1. Hydraulics and Pneumatics. A Technician's and Engineer's Guide, https://doi.org/10.1016/C2009-0-64113-1

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106300/
2. https://archive.nptel.ac.in/courses/112/105/112105047/
3. https://www.coursera.org/learn/fluid-power

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	1	-	-	1	-	2	3	-	2
CO4	3	3	3	3	-	1	-	-	1	-	2	3	-	2
CO5	3	3	2	2	-	1	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1912	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To explain the concepts and significance of Additive Manufacturing in modern manufacturing.
- To describe the working principles of Additive Manufacturing technologies and their role in design and production.
- To apply Additive Manufacturing methods for product development and prototyping.
- To select appropriate Additive Manufacturing processes and analyze case studies on mass customization.
- To design, optimize, and fabricate products using Additive Manufacturing techniques.

UNIT I INTRODUCTION 9

Overview – Need - Development of Additive Manufacturing Technology -Principle – AM Process Chain- Classification –Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications in various industries -Benefits –Case studies.

UNIT II MATERIAL EXTRUSION AND SHEET LAMINATION PROCESSES 9

Extrusion Based System: FDM - Principle – Process - Materials – Advantages and Limitations - Applications – Bio extrusion. Sheet Lamination Process: LOM- Gluing or Adhesive bonding – Thermal bonding - Principle – Process - Materials – Advantages and Limitations - Applications – Case studies.

UNIT III VAT PHOTO POLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Vat Photo polymerization: SLA – Principle – Process - Photo curable Materials – Advantages and Limitations - Applications. Powder Bed Fusion: SLS – Principle – Process - Materials – Advantages and Limitations - Applications. Electron Beam Melting – Principle – Process - Materials – Advantages and Limitations - Applications - Case studies.

UNIT IV JETTING PROCESSES AND DIRECT ENERGY DEPOSITION PROCESSES 9

Material Jetting - Principle – Process - Materials – Droplet formation technologies : Continuous mode – Drop on Demand mode - Advantages and Limitations - Applications. Binder Jetting Principle – Process - Materials – Advantages and Limitations - Applications - Bio-plotter - Direct Energy Deposition Process: LENS - Principle – Process - Materials – Advantages and Limitations - Applications – Case studies.

UNIT V DESIGN FOR ADDITIVE MANUFACTURING 9

Design tools: Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing –Tool path generation - Design for Additive Manufacturing: Concepts and objectives - AM unique capabilities – DFAM for part quality improvement- Customized design and fabrication for medical applications.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the concepts and significance of Additive Manufacturing (AM) in modern manufacturing.

CO2: Analyze the working principles of various Additive Manufacturing technologies and their potential in supporting design and production processes.

CO3: Apply Additive Manufacturing concepts to product development and prototyping for specific requirements.

CO4: Select the most appropriate additive manufacturing process and analyze case studies related to mass customization in manufacturing.

CO5: Design, optimize, and fabricate products using Additive Manufacturing processes and devices, focusing on functionality and efficiency.

TEXT BOOKS

1. Ian Gibson, David W.Rosen, Brent Stucker "Additive Manufacturing Technologies: RapidPrototyping to Direct Digital Manufacturing" Springer, 2010.
2. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third edition, World Scientific Publishers, 2010.

REFERENCE BOOKS

1. Andreas Gebhardt "Understanding Additive Manufacturing: Rapid Prototyping, RapidManufacturing" Hanser Gardner Publication 2011.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
4. Tom Page "Design for Additive Manufacturing" LAP Lambert Academic Publishing, 2012.

WEB REFERENCES

1. https://home.iitk.ac.in/~nsinha/Additive_Manufacturing%20I.pdf
2. https://www.youtube.com/watch?v=t7yv4gSnNkE&list=PLwdnzlV3ogoWI8QEu4hsT-n_r8UbWbquy

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/112/103/112103306/
2. https://www.coursera.org/specializations/3d-printing-additive manufacturing
3. https://www.coursera.org/learn/additive-manufacturing-3d-printing
4. https://unacademy.com/course/complete-course-on-additive-manufacturing-andpowder-metallurgy/X0KPO4SE
5. https://archive.nptel.ac.in/courses/112/104/112104312/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	3	2	2	-	1	-	-	2	-	2	3	-	2
CO4	3	3	2	2	-	1	-	-	2	-	2	3	-	2
CO5	3	3	2	2	-	1	-	-	2	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1913	AUTOMATION IN MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the principles, strategies, and levels of automation in production systems and their impact on manufacturing economics.
- To understand the various components, functions, and types of automated control systems, including sensors, actuators, ADC/DAC, and PLCs.
- To understand the design, applications, and analysis of automated production lines, including buffer and assembly line balancing.
- To understand the basics of NC, CNC, DNC, and robotics, including anatomy, programming, and industrial uses.
  To understand the working of automated guide3d vehicles, storage systems, bar code technology, and cellular manufacturing.

UNIT I MANUFACTURING OPERATIONS 9

Automation in production systems - principles and strategies - Product/production relationships - Production concepts and mathematical models - manufacturing economics - Advanced Automation Functions, Levels of Automations

UNIT II CONTROL TECHNOLOGIES 9

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

UNIT III TRANSFER LINES 9

Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.

UNIT IV NUMERICAL CONTROL AND ROBOTICS 9

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications –End effectors – Industrial applications.

UNIT V AUTOMATED HANDLING AND STORAGE 9

Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology - Cellular manufacturing.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the principles and levels of automation and their impact on manufacturing economics..

CO2: Analyze the components and functions of automated control systems like sensors, actuators, and PLCs.

CO3: Apply ladder logic programs for basic industrial applications using PLCs.

CO4: Apply the concepts of NC, CNC, and DNC programming to create basic part programs for machining operations..

CO5: Analyze the performance of automated production lines, considering buffer configurations and line balancing for efficiency improvement.

TEXT BOOKS

1. Mikell P.Groover, Automation, “Production Systems and Computer Integrated Manufacturing” PHI, 2008.

REFERENCE BOOKS

1. Mikell P.Groover, Emory W. Zimmers, Jr., “CAD/CAM: Computer - Aided Design and Manufacturing”, PHI, 2007.
2. Roger S.Pressman and John Ernest wiliams, “Numerical Control and Computer Aided Manufacturing”,John wiley& sons,1977.

WEB REFERENCES

1. https://archive.nptel.ac.in/courses/112/104/112104288/

ONLINE COURSES / RESOURCES:

1. https://www.udemy.com/course/factory-automation-using-plclogics/?couponCode=ST18MT12125
2. https://www.udemy.com/course/certification-in-production-and-manufacturingautomation/?couponCode=ST18MT12125
3. https://www.udemy.com/course/industrial-automation-itselements/?couponCode=ST18MT12125
4. https://www.udemy.com/course/manufacturing-operations-planningmanagement-and-control/?couponCode=ST18MT12125

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	1	1	1	-	-	-	-	-	2	3	1	2
CO4	3	2	1	1	1	-	-	-	-	-	2	3	1	2
CO5	3	2	1	1	1	1	-	-	-	-	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1914	DIGITAL MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the concepts and foundational framework essential for smart manufacturing systems.
- To analyze current trends in manufacturing and evaluate their impact at the system level within organizations.
- To select and utilize appropriate sensors for various manufacturing applications.
- To design and implement IoT-based manufacturing systems for improved production capabilities.
- To examine the role of Industry 4.0 concepts in transforming manufacturing systems and processes.

UNIT I SENSORS SMART MANUFACTURING 9

Introduction – Role of sensors in manufacturing automation – operation principles of different sensors – electrical, optical, acoustic, pneumatic, magnetic, electro-optical and vision sensors. Condition monitoring of manufacturing systems – principles – sensors for monitoring force, vibration and noise, selection of sensors and monitoring techniques. Automatic identification techniques for shop floor control – optical character and machine vision sensors – smart / intelligent sensors – integrated sensors, Robot sensors, Micro sensors, Nano sensors.

UNIT II DATA ANALYTICS 9

Introduction to Data and Analytics in a Digital Context (Internet of Things), Product Data Management for Design and Manufacturing (PLM Tools), Typical data challenges (data quality, enrichment, integration of ERP & PLM data), Preparing data for analytics (techniques to improve data quality, integration - ETL). Advances in data visualization & related tools-Statistical Techniques for Analytics, Descriptive Statistics Inferential statistics, Regression and ANOVA

UNIT III CYBER PHYSICAL SYSTEMS & IOT 9

Concept of Cyber Physical Systems (CPS) and Cyber Physical Production System (CPPS), System Architecture for implementation of CPPS, Components for CPPS, Communication for CPPS

Introduction, overview of IOT enabled manufacturing system, Real-time and multi-source manufacturing information sensing system, IOT enabled smart assembly station, cloud computing based manufacturing resources configuration method, Real-time key production performances analysis method, Real-time information driven production scheduling system.

UNIT IV GREEN MANUFACTURING & E- MANUFACTURING 9

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing. World energy consumption – Greenhouse effect, Global warming. Energy conservation and measurement principles with their applicability in engineering and process industries.

Introduction of Agent based manufacturing- Difference between green manufacturing and E manufacturing. Agent based Manufacturing, Cloud Based Manufacturing Information technology-based Supply chain, Concept of agile manufacturing and E-manufacturing.

UNIT V INDUSTRY 4.0 9

Evaluation of industries, Introduction to Industry 4.0, Challenges in industry 4.0, Impact of Industry 4.0, Case studies on industry 4.0, Introduction to Internet of Things (IoT) and its applications, Smart supply chain and Case studies. Industry 5.0

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the concepts and foundational framework required for smart manufacturing systems.

CO2: Analyze current trends and their impact at the system level within manufacturing organizations.

CO3: Utilize sensors and select appropriate sensor types for various manufacturing applications.

CO4: Develop and articulate IoT-based manufacturing systems for enhanced production capabilities.

CO5: Examine the significance of Industry 4.0 concepts in transforming manufacturing systems and processes.

TEXT BOOKS

1. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014, ISBN: 978-0996025515.
2. Bahga and V. Madisetti, Cloud Computing, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2013, ISBN: 978-1494435141.
3. M. Skilton and F. Hovsepian, The 4th Industrial Revolution: Responding to the Impact of Artificial Intelligence on Business, Springer Nature, 2017, ISBN: 978-3-319-62479-2.
4. M. P. Grover “Automation, Production Systems and Computer-Integrated Manufacturing” Pearson Education, 4th Edition, 2016, ISBN: 978-0133499612.
5. M. P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas and G. Odrey, Industrial Robotics Technology, Programming and Applications, McGraw Hill, 2nd Edition, 2017 ISBN: 978- 1259006210 .
6. Yingfeng Zhang and Fei Tao, “Optimization of Manufacturing Systems Using the Internet of Things

REFERENCE BOOKS

1. Gilchirst, Industry 4.0: The Industrial Internet of Things, Apress (Springer), 1st Edition, 2016, ISBN: 978-1-4842-2046-7.
2. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017, ISBN: 978-3319425580.
3. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st edition, 2013, ISBN: 978-0133387520.
4. N. Viswanandham, Y. Narhari “Performance Modeling of Automated Manufacturing Systems” Prentice-Hall, 1st Edition, 1994, ISBN: 978-8120308701.
5. S. K. Saha, Introduction to Robotics, Tata Mcgraw Hill Education Private Limited, 2nd Edition, ISBN: 978-9332902800.
6. Rao P.N., “CAD/CAM”, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2012, ISBN-13: 978-0070681934.
7. Davim J Paulo, Green Manufacturing Processes and Systems, Springer, 2013

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1. https://openlibrary.org/search?q=DYNAMICS+OF+MACHINES&mode=everything
2. https://openlibrary.org/search?q=THEORY+OF+MACHINES&mode=everything
3. https://1lib.in/s/Dynamics%20of%20Machines

ONLINE COURSES / RESOURCES:

1. https://www.youtube.com/watch?v=YHyBy9WXnwo
2. https://www.youtube.com/watch?v=mEhzsuDltsE

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3		-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	2	-	-	-	1	-	-	-	-	2	3	-	2
CO3	3	3	-	-	1	1	-	-	-	-	2	3	1	2
CO4	3	3	3	3	1	1	-	-	1	-	2	3	1	2
CO5	3	3	3	3	1	1	-	-	1	-	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1915	INDUSTRIAL ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the fundamentals and types of industrial robots and their applications.
- To analyze the mechanics of robot motion, including kinematics and singularities.
- To design and evaluate end-effectors for diverse industrial tasks.
- To assess the selection, performance, and economic impact of robots.
- To explore robotic vision systems and their role in inspection and specialized applications.

UNIT I INTRODUCTION 9

History and evolution of industrial robotics. Emerging trends in robotics - collaborative robots - AI integration.Standards and safety protocols in robotic systems.Types of industrial robots – Load handling capacity -general considerations in Robotic material handling – material transfer – machine loading and unloading – CNC machine tool loading – Robot centered cell.

UNIT II MECHANICS OF ROBOT MOTION 9

Translational and rotational velocities - Velocity Transformations - The Manipulator Jacobian - Forward and inverse kinematics of velocity - Singularities of robot motion.

UNIT III END EFFECTORS 9

Gripper force analysis and gripper design - design of multiple degrees of freedom - active and passive grippers. SELECTION OF ROBOT: Factors influencing the choice of a robot - robot performance testing -economics of robotization, Impact of robot on industry and society.

UNIT IV ROBOTS FOR INSPECTION 9

Robotic vision systems –image representation –object recognition and categorization – depth measurement – image data compression - visual inspection –software considerations.

UNIT V OTHER APPLICATIONS 9

Application of Robots in continuous arc welding - Spot welding - Spray painting - assembly operation –cleaning – robot for under water applications- `Robots for Inspection.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the various types of industrial robots and their applications in material handling and specialized tasks.

CO2: Analyze the mechanics of robot motion, including kinematics, Jacobian matrices, and singularities.

CO3: Design suitable end-effectors for specific industrial applications, considering force analysis and degrees of freedom.

CO4: Analyze the factors influencing robot selection, performance, and economic feasibility in an industrial setting.

CO5: Develope innovative robotic solutions for tasks such as inspection, welding, assembly, and underwater operations using vision systems and software.

TEXT BOOKS

1. Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering – An integrated Approach” Prentice Hall India, New Delhi, 2001.
2. Mikell P. Groover,”Automation, Production Systems, and Computer Integrated Manufacturing“, 2nd Edition, John Wiley & sons, Inc, 2007.

REFERENCE BOOKS

1. James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 2009
3. S.K. Saha, “Introduction to Robotics”, Tata McGraw-Hill, 2014.
4. A. Ghosal, “Robotics: Fundamental Concepts and Analysis”, Oxford University Press, 2009.

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1. https://education.vex.com/stemlabs/workcell/stemlab/industrial-robotics/what-are-industrial-robots?lng=en
2. https://www.mhi.org/fundamentals/robots
3. https://link.springer.com/referenceworkentry/10.1007/978-3-540-30301-5_43
4. https://robotsdoneright.com/Articles/what-is-an-industrial-robot.html
5. https://ifr.org/industrial-robots

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105249 - Robotics
2. https://www.emerald.com/insight/publication/issn/0143-991x
3. https://www.automate.org/robotics

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	3	3	-	2
CO2	3	1	-	-	-	-	-	-	-	-	3	3	-	2
CO3	3	3	2	2	1	-	-	-	-	-	3	3	1	2
CO4	3	3	2	2	1	2	-	-	-	-	3	3	1	2
CO5	3	3	2	2	1	2	-	1	1	1	3	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1916	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand fundamentals of nano-technology and its constituents.
- To understand fabrications and characterization of nanomaterial.
- To apply microscopic techniques for nano materials properties measurement.
- To apply basics of nano materials to know nanostructures for various applications.
- To analyse the capabilities of nano technology for various applications.

UNIT - I INTRODUCTION TO NANOTECHNOLOGY 9

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size, and shape of nanoparticles - one-dimensional and two dimensional nanostructures - clusters of metals and semiconductors, bio nano-particles.

UNIT - II FABRICATION AND CHARACTERIZATION OF NANOMATERIALS 9

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes) - Gas, liquid, and solid–phase synthesis of nano-materials - Lithography techniques (Photolithography, Dip-pen and Electron beam lithography) - Thin film deposition – Electrospinning - Bio-synthesis of nanomaterials.

UNIT - III PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Optical Properties: Absorption, Fluorescence, and Resonance - Methods for the measurement of nanomaterials - Microscopy measurements: SEM, TEM, AFM and STM - Confocal and TIRF imaging.

UNIT - IV NANO STRUCTURES 9

Carbon Nanotubes - Fullerenes - Nanowires - Quantum Dots - Applications of nanostructures - Reinforcement in Ceramics - Drug delivery - Giant magneto-resistance - Cells response to Nanostructures.

UNIT - V APPLICATIONS OF NANOTECHNOLOGY 9

Nano electronics - Nano sensors - Nanotechnology in Diagnostics applications - Environmental and Agricultural Applications of nanotechnology - Nano technology for energy systems - Nanotechnology and AI integration.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the fundamental characteristics of Nano materials.
CO2: Apply the characterization as well as fabrication aspects of nano-materials and the various methodologies.
CO3: Analyze the optical properties and the nano-material measurement.
CO4: Identify the nano-structures and their myriad applications in various engineering realms.
CO5: Evaluate the numerous applications of nanotechnology in various engineering applications.

TEXT BOOKS

1. Springer Handbook of Nanotechnology by Bharat Bhushan, 4th Edition, Springer,

2017.
2. Encyclopedia of Nanoscience and Nanotechnology - Hari Singh Nalwa, American Scientific Publishers, 2004.

REFERENCE BOOKS

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects,D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

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2. https://www.sciencedirect.com/journal/nano-today
3. https://www.rsc.org/journals-books-databases/about-journals/nanoscale-horizons/
4. https://www.sciencedaily.com/news/matter_energy/nanotechnology/
5. https://www.nanowerk.com/
6. https://iopscience.iop.org/article/10.1088/0957-4484/24/45/452002

ONLINE COURSES / RESOURCES:

1. https://www.udemy.com/topic/nanotechnology/
2. https://www.edx.org/learn/nanotechnology
3. https://www.coursera.org/courses?query=nanotechnology
4. https://onlinecourses.nptel.ac.in/noc19_mm21/preview
5. https://coursesity.com/free-tutorials-learn/nanotechnology

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	3	3	-	2
CO2	3	2	1	1	-	-	-	-	-	-	3	3	-	2
CO3	3	2	-	-	-	-	-	-	-	-	3	3	-	2
CO4	3	2	1	1	-	2	-	-	-	-	3	3	-	2
CO5	3	2	1	1	-	2	-	-	-	-	3	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1917	RENEWABLE ENERGY RESOURCES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand radiation and its environmental impact to power.
- To understand various collectors used for storing solar energy.
- To apply solar heating and cooling techniques in various applications.
- To apply wind energy and biomass and its economic aspects in various application
- To analyse the geothermal energy with other energy sources

UNIT - I PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT - II SOLAR ENERGY COLLECTION 8

Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications. Recent advancements in solar power generation. Photovoltaic Devices and Systems. Types and usage of photovoltaic systems.

UNIT - III SOLAR ENERGY STORAGE AND APPLICATIONS 8

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications - solar heating/cooling technique, solar distillation and drying,

UNIT - IV WIND AND BIO ENERGY 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C-Engine operation and economic aspects.

UNIT - V OCEAN AND GEOTHERMAL ENERGY 9

Wave Energy - Tidal energy –OTEC - site selection, construction, environmental issues. Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications- Environmental impact.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the solar power radiation and their characteristics
CO2: Analyze the Flat plate and concentrating collectors and their classifications
CO3: Apply Sensible, latent heat to stratified storage, solar ponds photo voltaic energy conversion.
CO4: Analyze the performance characteristics of windmill and Bio-gas application
CO5: Analyze the OTEC and DEC methods for harnessing energy

TEXT BOOKS

1. Rai G.D., “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. 2. Ramesh R & Kumar K.U, “Renewable Energy Technologies”,Narosa Publishing House, 2004.

REFERENCE BOOKS

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Twidell&Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, P.H.I, New Delhi.

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1. https://www.pdfdrive.com/non-conventional-energy-systems-nptel-e17376903.html.
2. https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/proceeding_of_shortterm_training/diploma/hydropower_dev_engg_elec/lecture_notes/LECTURE_ON_RENEWABLE_ENERGY_SOURCES.pdf.
3. http://digimat.in/nptel/courses/video/103103206/L01.html..
4. https://onlinecourses.nptel.ac.in/noc20_ge06/preview.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	-	2	-	-	-	-	2	3	-	2
CO2	3	2	1	1	-	2	-	-	-	-	2	3	-	2
CO3	3	2	1	1	-	2	-	-	2	-	2	3	-	2
CO4	3	2	2	1	-	2	-	-	-	-	2	3	-	2
CO5	3	1	2	1	-	2	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1918	ENERGY CONSERVATION AND WASTE HEAT RECOVERY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the role, potential, and measurement of solar radiation and its environmental impact.
- To classify solar thermal collectors, photovoltaic systems, and advancements in solar energy.
- To understand methods of solar energy storage and basic solar energy applications.
- To understand wind energy sources, windmill types, and basics of bio-conversion and biogas.
  To analyze ocean and geothermal energy systems, their sources, and environmental impacts.

UNIT - I INTRODUCTION TO ENERGY CONSERVATION 9

Introduction to ENCON, Approach and modern techniques, benefits, trends. Energy Conservation Technology (Thermal Energy).Energy Conservation in Energy Intensive Industries. Techno-Economic evaluation of conservation technologies, Efficiency Improvements Thermal Utilities: Boilers, Steam System, Thermic Fluid Heating Systems, Furnaces, Heating and Melting Applications.

UNIT - II ENERGY EFFICIENT USED IN BUILDINGS 9

Introduction, Definition and concepts, Energy and Water as a resource, Criticality of resources and needs of modern living. Envelop heat loss and heat gain and its evaluation, Thermal Comport improvement methods, Optimum performance, other building comports, IAQ requirements, Electrical Energy Conservation, Opportunities and Techniques for energy conservation in Buildings. Adoption to sustainable resources, process and Technologies. Green Buildings, Intelligent Buildings, Rating of Buildings, Efficient Use of Buildings, Solar Passive Architecture.

UNIT - III ENERGY CONSERVATION AND ITS EFFICIENCY 9

Thermic fluid heaters, super critical boilers; Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment more details, installation, thermo-compressor, steam pipe insulation, condensate pumping, steam dryers; Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery.

UNIT - IV NEED FOR ENERGY STORAGE 9

Need and importance of Energy storage in Conventional and Nonconventional Energy Systems. Technical Aspects (Measurements, Quantify) various forms of Energy Storage: Thermal, Chemical, Mechanical, Electrical and Nuclear Techno Commercial Analysis (Economical aspects), Energy Storage: Devices and Systems.

UNIT - V WASTE HEAT RECOVERY 9

Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential. Sources of waste heat and its potential applications, Waste heat survey and measurements, Data collection, Limitations and affecting. Cogeneration:

Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the thermal heating systems.
CO2: Analyze the heat and heat gain in energy buildings.
CO3: Apply the energy saving opportunities in various thermal system
CO4: Analyze energy storage forms in conventional and non-conventional energy system
CO5: Analyze opportunities for waste heat recovery in economic aspect

TEXT BOOKS

1. Eastop T.D and Croft D.R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific and Technical, 1990.
2. Reay D.A, “Industrial Energy Conservation”, Pergamon Press, 1979.

REFERENCE BOOKS

1. Openshaw Taylor E, "Utilisation of Electric Energy", Orient Longman Ltd, 2003.
2. Donald R Wulfinghoff, “Energy Efficiency Manual”, Energy Institute Press, 1999.
3. Energy Audit Manual- The Practitioner’s Guide, EMC-Kerala and NPC 2017.
4. Bureau of Energy Efficiency -Energy Management Series, 2006.

WEB REFERENCES

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ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105221L

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	1	-	-	-	1	-	-	-	-	2	3	-	2
CO3	3	2	-	-	-	1	-	-	-	-	2	3	-	2
CO4	3	2	2	2	-	1	-	-	-	-	2	3	-	2
CO5	3	2	2	2	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1919	NUCLEAR ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To recall the structure of an atom, mass-energy equivalence, and concepts of radioactivity and half-life.
- To understand the mechanisms of fission, fusion, chain reactions, and characteristics of nuclear fuel cycles.
- To list the steps in nuclear fuel reprocessing and the role of solvent extraction techniques.
- To classify different types of reactors and explain their design, shielding, and heat transfer methods.
- To explain the safety systems, methods for waste disposal, and strategies for preventing radiation hazards in nuclear plants.

UNIT - I NUCLEAR PHYSICS 9

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-halflife-neutron interactions-cross sections.

UNIT - II NUCLEAR REACTIONS AND REACTION MATERIALS 9

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass andcomposition-nuclear fuel cycles and its characteristics-uranium production andpurification-Zirconium, thorium, beryllium.

UNIT - III REPROCESSING 9

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction inreprocessing-solvent extraction equipment.

UNIT - IV NUCLEAR REACTOR 9

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusionreactors.

UNIT - V SAFETY AND DISPOSAL 9

Safety and disposal: Nuclear plant safety-safety systems-changes and consequences ofaccident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the nuclear model, mass-energy equivalence, radioactivity, half-life, and neutron interactions.

CO2: Identify the mechanisms of fission, fusion, chain reactions, and nuclear fuel cycles.

CO3: Analyze nuclear fuel reprocessing and the role of solvent extraction.

CO4: Describe different nuclear reactors and their design and heat transfer methods.

CO5: Analyze safety systems, waste disposal, and radiation hazard prevention.

TEXT BOOKS

1. Brent J. Lewis, E,NihanOnder and Andrew A. Prudil, —Fundamentals of nuclear Engineering‖,
2. John Wiley, 2017Thomas J.Cannoly, “Fundamentals of nuclear Engineering” John Wiley 1978.
3. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemisphere86 publishing, New York. 1987

REFERENCE BOOKS

1. Collier J.G., and Hewitt G.F, —Introduction to Nuclear power‖, Hemisphere publishing, New York. 1987
2. Yassin A. Hassan, Robin A. Chaplin —Nuclear energy materials andreactors‖ Vol, 1, EOLSS Publications, oxford,UK, 2010.
3. S. Glasstone and A. Sesonske, —Nuclear Reactor Engineering:Reactor Design Basics‖, Vol. 1, Ed. 4, Chapman and Hall, London,2013
4. WakilM.M.El., —Power Plant Technology‖ – McGraw-Hill International, 1984

WEB REFERENCES

1. https://learningpath.org/articles/Free_Online_Nuclear_Engineering_Courses_from_Top_Universities.htmlttps://learningpath.org/articles/Free_Online_Nuclear_Engineering_Courses_from_Top_Universities.html.
2. https://www.classcentral.com/course/nuclearscience-479.

ONLINE COURSES / RESOURCES:

1. https://www.coursearena.io/topic/free-nuclear-engineering-courses
2. https://archive.nptel.ac.in/courses/112/101/112101007/
3. https://archive.nptel.ac.in/courses/112/103/112103243/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	1	-	-	-	-	2	3	-	2
CO2	3	1	-	-	-	1	-	-	-	-	2	3	-	2
CO3	3	1	1	1	-	1	-	-	-	-	2	3	-	2
CO4	3	1	1	1	-	1	-	-	-	-	2	3	-	2
CO5	3	1	1	1	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1920	TURBO MACHINERY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To identify the classification, dimensionless parameters, and applications of fluid machinery.
- To describe the types, design parameters, and performance characteristics of centrifugal fans and blowers.
- To understand the construction details, flow losses, and performance characteristics of centrifugal compressors.
- To explain stage velocity diagrams, efficiency, and design considerations of axial flow compressors.
  To describe the principles, losses, and performance characteristics of axial and radial flow turbines.

UNIT - I PRINCIPLES 9

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

UNIT - II CENTRIFUGAL FANS AND BLOWERS 9

Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

UNIT - III CENTRIFUGAL COMPRESSOR 9

Construction details, Pressure coefficient-Blade angles at root and eye tip. impeller flow losses, slip factor, diffuser analysis, surging of centrifugal compressors, losses and performance curves.

UNIT - IV AXIAL FLOW COMPRESSOR 9

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics. Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT - V AXIAL AND RADIAL FLOW TURBINES 9

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics. Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the classification and dimensionless parameters of fluid machinery and their applications.

CO2: Determine the losses, design parameters, and performance characteristics of centrifugal fans and blowers.

CO3: Analyze impeller flow losses, construction and flow analysis of centrifugal compressors.

CO4: Analyze the stage velocity diagrams, basic design problems and assess performance characteristics of axial flow compressors

CO5: Analyze the stage velocity diagrams, blade design principles, and performance characteristics of turbines.

TEXT BOOKS

1. Yahya, S.H., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 1996.
2. Dixon S.L, “Fluid Mechanics & Thermodynamics of Turbo machines”, Elsevier (2005).
3. Kadambi. V and Manohar Prasad, “An Introduction to Energy Conversion”, Volume III Turbo machinery, New International Publishes reprint (2008).

REFERENCE BOOKS

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992..
3. Shepherd, D.G., Principles of Turbomachinery, Macmillan, 1969.
4. Stepanpff, A.J., Blowers and Pumps, John Wiley and Sons Inc. 1965.
5. Ganesan, V., Gas Turbines, Tata McGraw Hill Pub. Co., 1999.
6. Gopalakrishnan .G and Prithvi Raj .D, A Treatise on Turbo machines, Scifech Publications (India) Pvt. Ltd., 2002.

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2. https://backbencher.club/turbo-machines/

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/112/106/112106303/
2. https://nptel.ac.in/courses/112106200
3. https://nptel.ac.in/courses/112106303

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO3	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO4	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO5	3	3	2	2	-	-	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1921	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To introduce the basic concepts of compressible flow and understand the impact of Mach number on compressibility and fluid properties.
- To explore the dynamics of flow through ducts, including the effects of heat transfer and friction on flow properties.
- To study the principles governing normal and oblique shocks and their applications in engineering systems.
- To gain insights into jet propulsion systems, their components, performance characteristics, and efficiency.
- To understand the fundamentals of rocket propulsion, including propellant systems, combustion, and performance evaluation for space applications.

(Use of Standard Gas Tables permitted)

UNIT - I **BASIC CONCEPTS AND ISENTROPIC FLOWS** **9**

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers

UNIT - II **FLOW THROUGH DUCTS** **9**

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow)– variation of flow properties.

UNIT - III **NORMAL AND OBLIQUE SHOCKS** **9**

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT - IV **JET PROPULSION** **9**

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT - V **SPACE PROPULSION** **9**

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory ofrocket propulsion – Performance study – Staging – Ion and Plasma Propulsion Systems and Additive Manufacturing in Rocket Engine Design –– Applications – space flights.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the fundamental principles of compressible fluid flow, including energy and momentum equations and the effects of Mach number on compressibility.

CO2: Analyze the behavior of flow through ducts under the influence of heat transfer (Rayleigh flow) and friction (Fanno flow).

CO3: Apply the governing equations to analyze variations in flow parameters across normal and oblique shocks and utilize Prandtl-Meyer relations.

CO4: Apply the thrust equation and analyze the performance characteristics of jet propulsion systems, including ramjets, turbojets, turbofans, and turboprops.

CO5: Analyze and Evaluate the design and performance of rocket propulsion systems, considering factors such as propellants, combustion, staging for space applications.

TEXT BOOKS

1. Yahya, S.M., "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", 6thEdition, New Age International Publishers, 2021.
2. Anderson, J.D., "Modern Compressible Flow: With Historical Perspective", 4th Edition, McGraw Hill, 2020.
3. Cumpsty, N.A., and Heyes, A., "Jet Propulsion: A Simple Guide to the Aerodynamics and Thermodynamic Design and Performance of Jet Engines", 3rd Edition, Cambridge University Press, 2015.

REFERENCE BOOKS

1. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,2019.
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2019.
3. Mattingly, J.D., and Boyer, K.M., "Elements of Propulsion: Gas Turbines and Rockets", 2nd Edition, AIAA Education Series, 2016.
4. Heister, S.D., Pratt, D.T., O'Brien, W.F., and Vigor Yang, "Rocket Propulsion", Cambridge Aerospace Series, 2019.
5. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.
6. Rathakrishnan E., "Gas Dynamics", PHI; 7th edition February 2017.

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2. https://www.iare.ac.in/sites/default/files/PPT/AD%20II%20PPT.pdf
3. https://www.brainkart.com/article/Concept-of-Gas-Dynamics_5082/

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112106196
2. https://nptel.ac.in/courses/112106166
3. https://nptel.ac.in/courses/101106044

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	1	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	3	3	-	-	-	-	-	-	2	3	-	2
CO4	3	2	3	3	-	-	-	-	-	-	2	3	-	2
CO5	3	2	3	3	-	-	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1922	SOLAR ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the solar radiation and various solar collectors.
- To understand the design and operation of solar heating, cooling, and thermal storage systems.
- To study semiconductor properties, solar cell physics, and performance characteristics.
- To familiar the design, optimization, and maintenance of solar PV systems.
- To explore passive heating, cooling, and energy-efficient design for thermal comfort.

UNIT - I **SOLAR RADIATION AND COLLECTORS** **9**

Solar angles – Sun path diagrams – Radiation – extraterrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT - II **SOLAR THERMAL TECHNOLOGIES** **9**

Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying-solar chimney-solar thermal electricity conversion..solarair heating system – configuration, collector design, air-preheating-solar industrial process heating: textile and milk processing.

UNIT - III **SOLAR PV FUNDAMENTALS** **9**

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetero junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photo voltaics.

UNIT - IV **SPV SYSTEM DESIGN AND APPLICATIONS** **9**

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - standalone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV.

UNIT - V **SOLAR PASSIVE ARCHITECTURE** **9**

Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling –Radiative cooling- application of wind, water and earth for cooling; shading - paints and cavity walls for cooling – roof radiation traps - earth air-tunnel – energy efficient landscape design - thermal comfort.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the basic of solar radiation and various solar collectors.
CO2: Analyze the various solar thermal energy technologies and their applications.
CO3: Analyze the various solar PV cell materials and conversion techniques.
CO4: Apply the various Solar SPV systems designs and their applications.
CO5: Analyze solar passive heating and cooling techniques for buildings.

TEXT BOOKS

1. G.D. Rai, “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
2. Twidell, J.W. & Weir, A., “Renewable Energy Resources”, EFN Spon Ltd., UK, 2015.
3. Sukhatme S P, Nayak J K, Solar Energy – Principle of Thermal Storage and collection, Tata McGraw Hill, 2008.

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1. Chetan Singh Solanki, Solar Photovoltatics – Fundamentals, Technologies and Applications, PHI Learning Private limited, 2011.
2. John A. Duffie, William A. Beckman, Solar Engineering of Thermal Processes, John Wiley & Sons, 2013.
3. Lovegrove K., Stein W., Concentrating Solar Power Technology, Woodhead Publishing Series in Energy, Elsevier, 1st Edition, 2012.
4. Solar Energy International, Photovoltaic – Design and Installation Manual, New Society Publishers, 2006.

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2. https://www.classcentral.com/course/solar-energy-basics-13794
3. https://asmedigitalcollection.asme.org/solarenergyengineering

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/115103123

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	1	-	2	3	-	2
CO2	3	1	-	-	-	-	-	-	1	-	2	3	-	2
CO3	3	1	1	1	-	1	-	-	1	-	2	3	-	2
CO4	3	2	3	3	-	1	-	-	1	-	2	3	-	2
CO5	3	2	3	3	-	1	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1923	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the refrigeration process and refrigerants properties.
- To understand the vapour compression refrigeration system.
- To apply the concepts of refrigeration to understand different refrigeration systems.
- To apply the psychometric properties to calculate refrigeration.
- To analyze the load estimation of refrigeration system.

UNIT - I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP. P- Introduction to HVAC – Classifications.

UNIT - II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure 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 PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT - V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the desirable properties of refrigerants.

CO2: Analyze the vapour compression refrigeration cycle.

CO3: Apply the concept of refrigeration cycle for different refrigeration effect.
CO4: Apply the refrigerant properties levels required for different refrigeration system
CO5: Analyse the capacity of different refrigeration systems.

TEXT BOOKS

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010.

REFERENCE BOOKS

1. ASHRAE Hand book, Fundamentals, 2010
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007.
3. Roy J. Dossat, "Principles of Refrigeration", 4th edition, Pearson Education Asia, 2009.
4. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

WEB REFERENCES

1. https://www.youtube.com/watch?v=nlsNmhiID74&list=PLfUUbFVTz-XcXbSUD0BXdPxGXFGkcdLXa
2. https://www.youtube.com/watch?v=4mWsRUr0A7A&list=PLWRz8VB-kZuX-diHNiRDhGAhA6JM7WZqk
3. https://www.youtube.com/watch?v=zqXgmVnI3L8&list=PL23E4BD7B6C0265B6

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/112/107/112107208/
2. www.Swayam.gov.in
3. www.Nptel.ac.in

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	-	-	-	-	-	-	-	-	-	2	3	-	2
CO3	3	2	-	-	-	-	-	-	1	-	2	3	-	2
CO4	3	2	2	2	-	-	-	-	1	-	2	3	-	2
CO5	3	2	2	2	-	-	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1924	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the physical boundary conditions and their significance in CFD.
- To apply finite volume methods to solve steady-state diffusion problems in one and two dimensions.
- To apply hybrid, power-law, and QUICK schemes to steady convection-diffusion problems.
- To solve flow field problems using the SIMPLE and PISO algorithms.
- To dfferentiate between structured and unstructured grid generation methods.

UNIT - I **GOVERNING EQUATIONS AND BOUNDARY CONDITIONS** **9**

Basics of computational fluid dynamics- introduction to Navier stokes system of equations – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions –Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT - II **FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION** **9**

Derivation of finite difference equations – Taylor's series –First and second order accuracy – Finite volume formulation for steady state One and Two dimensional diffusion problems – Parabolic equations – Explicit and Implicit schemes –Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT - III **FINITE VOLUME METHOD FOR CONVECTION DIFFUSION** **9**

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness- Hybrid, Power-law, QUICK Schemes.

UNIT - IV **FLOW FIELD ANALYSIS** **9**

Finite volume methods -Representation of the pressure gradient term and continuity equation– Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT - V **TURBULENCE MODELS AND MESH GENERATION** **9**

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation, Numerical grid generation, basic ideas, transformation and mapping.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the governing equations of fluid dynamics and their relevance in CFD.
CO2: Solve diffusion problems using finite difference and finite volume methods.
CO3: Apply central and upwind differencing schemes to convection-diffusion problems.
CO4: Analyze flow fields with staggered grid representation and finite volume methods.
CO5: Generate structured and unstructured grids for CFD simulations.

TEXT BOOKS

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw HillPublishing Company Ltd., 2017.
2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: Thefinite volume Method", Pearson Education Ltd. 2nd Edition, 2007.

REFERENCE BOOKS

1. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.
5. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation.

WEB REFERENCES

1. https://ocw.mit.edu/courses/2-29-numerical-fluid-mechanics-spring-2015/pages/lecture-notes-and-references/

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112105045

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	2	-	-	-	-	-	-	-	-	3	3	-	3
CO2	3	3	3	3	3	-	-	-	-	-	3	3	3	3
CO3	3	3	3	3	3	-	-	-	1	-	3	3	3	3
CO4	3	3	3	3	3	-	-	-	1	-	3	3	3	3
CO5	3	3	3	3	3	-	-	-	1	-	3	3	3	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1925	ADVANCED INTERNAL COMBUSTION ENGINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To acquire knowledge in stoichiometry calculations.
- To know usage of software for simulating the performance of IC engines.
- To analyse the cause and effect of pollutant gases of IC engine.
- To analyze alternate fuel usage and its application in IC engine
- To Understand Electronic engine management systems.

UNIT - I COMBUSTION OF FUELS 9

Chemical composition and molecular structure of hydrocarbon fuels, combustion stoichiometry of hydrocarbon fuels - chemical energy and heat of reaction calculations - chemical equilibrium and adiabatic flame temperature calculation, Theory of SI and CI engine combustion – Flame velocity and area of flame front, Fuel spray characteristics - droplet size, depth of penetration and atomization.

UNIT - II COMBUSTION MODELLING 9

Basic concepts of engine simulation - Governing equations, Classification of engine models-Thermodynamic models for Intake and exhaust flow process - Quasi steady flow - Filling and emptying - Gas dynamic Models, Thermodynamic based in cylinder models for SI engine and CI engines.

UNIT - III POLLUTANT FORMATION AND CONTROL 9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT - IV ALTERNATE FUELS 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. Fuel cell-types and working- introduction to fuel cell.

UNIT - V ELECTRONIC ENGINE MANAGEMENT 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).

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the stichiometric calculation of fuels.
CO2: Analyze the usage of simulation software in IC engine.
CO3: Analyze Engine pollution formation and control.
CO4: Analyze theeffective alternate fuel usage in IC engine.
CO5: Analyze the Electronic engine management systems as per recent trends.

TEXT BOOKS

1. Ganesan.V, “Internal Combustion Engines”, 4th edition, Tata McGraw Hill Publishing Co., 2012.
2. Heywood J.B, “Internal Combustion Engine Fundamentals”, 2nd edition, McGraw Hill Book Co., 2018.
3. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.

REFERENCE BOOKS

1. Ganesan.V, “Computer Simulation of Spark Ignition Engine Processes”, Universities Press (I) Ltd, Hyderabad, 2001.
2. Mathur R.B and Sharma R.P., “Internal Combustion Engines”, Dhanpat Rai & Sons 2007.
3. Benson R.S, Whitehouse, N.D, “Internal Combustion Engines”, Pergamon Press, Oxford, 1979.

WEB REFERENCES

1. https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017/pages/lecture-notes/
2. https://iopscience.iop.org/article/10.1088/1742-6596/1626/1/012139/pdf
3. https://www.petro-online.com/article/fuel-for-thought/13/koehler-instrument-company/latest-trends-in-new-internal-combustion-engines/3201

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112103262
2. https://nptel.ac.in/courses/112104033
3. https://onlinecourses.nptel.ac.in/noc22_me65/preview
4. https://www.youtube.com/watch?v=DjjbItLWNVQ
5. https://www.youtube.com/watch?v=npzdgE4eREU

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	1	-	-	-	-	3	3	-	3
CO2	3	3	3	3	2	1	-	-	-	-	2	3	2	2
CO3	3	3	3	3	-	2	-	-	2	-	2	3	-	2
CO4	3	3	3	3	-	2	-	-	2	-	2	3	-	2
CO5	3	3	3	3	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1926	AUTOMOTIVE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the construction and working principle of various parts of an automobile.
- To analyze engine electronics management systems.
- To understand various configuration of transmission and running systems used in vehicle.
- To understand types of fuel cell, Electric and hybrid vehicle functions and their requirements.
- To analyse the various modern systems usage in vehicle and its modifications required.

UNIT - I VEHICLE STRUCTURE AND ENGINES 9

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

UNIT - II ENGINE ELECTRONIC MANAGEMENT SYSTEM 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).

UNIT - III TRANSMISSION SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints,Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT - IV RUNNING SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types ofSuspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS),electronic brake force distribution (EBD) and Traction Control.

UNIT - V FUEL CELL, ELECTRIC AND HYBRID VEHICLE, SAFETY SYSTEMS 9

Hydrogen in Automobiles, Fuel cell, Types of fuel cells – AFC, PAFC, SOFC, MCFC, DMFC, PEMFC, relative merits and demerits, Electric and Hybrid Vehicles, Safety systems - seat belts, air-bag, speed sensing auto locking, OBD. HVAC system.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Recognize the various parts of the automobile and their functions and materials.
CO2: Discuss engine electronics and emission control system.
CO3: Distinguish the working of different types of transmission systems.
CO4: Distinguish the working of different types of running systems.
CO5: Analyze Fuel cell, electric and hybrid vehicles and safety systems in automobile.

TEXT BOOKS

1. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Seventh Edition, Standard Publishers, NewDelhi, New Edition 2021.
2. Ganesan V. “Internal Combustion Engines”, 4th Edition, Tata McGraw-Hill, 2017.
3. Jain K.K. and Asthana .R.B, “Automobile Engineering” Tata McGraw Hill Publishers, NewDelhi, 2017.

REFERENCE BOOKS

1. Mehrdad Ehsani, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles”, CRC Press, 2018.
2. Tom Denton, “Electric and Hybrid Vehicles”, 3rd edition, Routledge Publishers, 2024.
3. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
4. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 2016.

WEB REFERENCES

1. https://www.my-cardictionary.com/chassis.html
2. https://www.britannica.com/technology/automobile/Transmission
3. https://en.wikipedia.org/wiki/Hybrid_electric_vehicle
4. https://en.wikipedia.org/wiki/Electric_vehicle

ONLINE COURSES / RESOURCES:

1. https://archive.nptel.ac.in/courses/107/106/107106088/
2. https://www.udemy.com/course/automotive-engineering-automobile-fundamentals-and-advanced/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	1	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	1	-	-	-	-	2	3	-	2
CO3	3	3	1	-	-	-	-	-	-	-	2	3	-	2
CO4	3	3	1	-	-	-	-	-	-	-	2	3	-	2
CO5	3	3	2	2	-	1	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1927	AUTOMOTIVE ELECTRICAL AND ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the working of electrical and electronic systems in vehicle.
- To understand the working of starting system, charging system of an engine for smooth operation.
- To understand the working of ignition and injection system of an engine.
- To analyse sensor and microprocessor applications in vehicle control systems.
- To analyse modern safety systems used in vehicle.

UNIT - I INTRODUCTION TO ELECTRICAL AND ELECTRONICS ACCESSORIES 9

Basic electrical principles, electronic components and circuits, digital electronics, microprocessor systems, electrical wiring, terminals and switching, multiplexed wiring systems, circuit diagrams and symbols, dashboard instruments, horn, trafficator.

UNIT - II STARTING SYSTEM, CHARGING SYSTEM, LIGHTING SYSTEM 9

Starter motor characteristics drive mechanisms. DC Generators, Alternators and their characteristics, electronic regulators. Vehicle interior lighting system, vehicle exterior lighting system, lighting design.

UNIT - III ELECTRONIC IGNITION AND INJECTION SYSTEM 9

Spark plugs, advance mechanisms, different types of ignition systems, Electronic fuel injection systems, mono and multi point fuel injection system.

UNIT - IV SENSORS AND MICROPROCESSORS IN AUTOMOBILES 9

Basic sensor arrangements, Types of sensors – oxygen sensor, hot wire anemometer sensor, vehicle speed sensor, detonation sensor, accelerometer sensor, crank position sensor, Microprocessor and microcomputer controlled devices in automobiles such as voice warning system, travel information system, keyless entry system, and electronic steering system.

UNIT - V SAFETY SYSTEMS 9

Antilock braking system, air bag restraint system, voice warning system, seat belt system, road navigation system, anti-theft system.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the basic principles of electrical, electronics and automotive dashboard instruments.
CO2: Identify the requirements of the automotive starting system, charging system and lighting system.
CO3: Analyze of modern electronics system in automotive ignition and injection.
CO4: Analyze sensors and microcomputer controlled devices in automobiles.
CO5: Analyze the safety systems employed in vehicles.

TEXT BOOKS

1. Tom Denton," Automobile Electrical and Electronic Systems", 5th Edition, 2017.
2. Young, A.P. and Griffith, S.L., Automobile Electrical Equipments, ELBS and New Press. 8th Edition 1970.
3. Kholi .P.L.Automotive Electrical Equipment,Tata McGraw-Hill co ltd,New Delhi, 2017.

REFERENCE BOOKS

1. Crouse.W.H. Automobile Electrical Equipment, McGraw Hill Book Co Inc.NewYork,2005.
2. Judge.A.W.Modern Electrical Equipments of Automobiles,Chapman& Hall, London 2004.
3. Robert Bosch, Automotive Handbook, Bently Publishers,2004

WEB REFERENCES

1. https://www.sciencedirect.com/topics/engineering/automotive-electronics
2. https://www.elprocus.com/automotive-electronics-and-its-innovations/

ONLINE COURSES / RESOURCES:

1. https://skill-lync.com/electrical-engineering-courses/introduction-to-automotive-electronics

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	1	-	2	-	-	2	3	-	2
CO2	3	3	-	-	-	1	-	2	-	-	2	3	-	2
CO3	3	3	-	-	-	1	-	2	-	-	2	3	-	2
CO4	3	3	-	-	-	1	-	2	-	-	2	3	-	2
CO5	3	3	-	-	-	2	-	2	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1928	VEHICLE BODY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To impart the knowledge of construction of car body, bus body and commercial vehicles.
- To understand vehicle aerodynamics, design and safety.
- To understand the interior ergonomics.
- To analyze the design, safety and fatigue aspects of vehicle.

UNIT - I CAR BODY DETAILS 9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car. Visibility - Regulations, driver's visibility, tests for visibility, methods of improving visibility and space in cars, Driver seat design, Car body construction-Various panels in car bodies - Design criteria and initial tests, Body trim items, body mechanisms. Modern painting process of a passenger car body, Anti-corrosion methods

UNIT - II VEHICLE AERODYNAMICS 9

Objectives, Vehicle drag and types. Various types of forces and moments. Effects of forces and moments. Side wind effects on forces and moments.Various body optimization techniques for minimum drag. Wind tunnels – Principle of operation, Types. Wind tunnel testing such as: Flow visualization techniques, Airflow management test – measurement of various forces and moments by using wind tunnel balance.

UNIT - III INTERIOR ERGONOMICS 9

Introduction, seating dimensions, interior ergonomics, seat comfort, driver seat design, dash boardinstruments, electronicdisplays, commercial vehicle cabin ergonomics, mechanical package layout, goodsvehicle layout. Vehicle stability: Introduction, longitudinal, lateral stability, vehicle on a curvilinear path, criticalspeed for toppling and skidding, effect of operating factors on lateral stability, steering geometry andstabilization of steerable wheels, mass distribution and engine location on stability.

UNIT - IV BUS BODY AND COMMERCIAL VEHICLE DETAILS 9

Types of bus body: based on capacity, distance travelled and based on construction, Bus body layout for various types. Regulations – Constructional details: Conventional and integral, Driver seat design, Drivers cab design – Regulations. Commercial vehicle body technology, trends, Tipper body and Tanker body, special goods vehicle, special haulage vehicles. Buses and coaches, Passenger Specialty Vehicle (PSV) structural design, low floor and articulated buses, three wheelers and light weight trailers.

UNIT - V DESIGN, SAFETY AND FATIGUE ASPECTS 9

Types of materials used in body construction-Steel sheet, timber, plastics, Glass fiber reinforced plastics(GRP), properties of materials, Design for press working, design for spot welding, adhesives and sealants, goods vehicle structure design, chassis frame configuration, structural properties of chassis frame members, Safety aspects of car and body. Crash tests, forces in roll over, head on impact, plastic collapse and analysis, fatigue and vibration, structural vibration.

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the different types of car bodies, their safety aspects and regulations.

CO2: Analyze the various aerodynamic forces calculation of the vehicle body.
CO3: Apply the suitable interior ergonomics of vehicle body as per requirements.
CO4: Analyze the construction, operation of different typesbus body and commercial vehicle body and its regulations.
CO5: Analyze the vehicle body with respect to design, safety and comfort.

TEXT BOOKS

1. John Fenton, “Handbook of Automotive Body and Systems Design”, John Wiley & Sons, 2013.
2. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 1998.

REFERENCE BOOKS

1. Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London, 1997.
2. Dieler Anselm., "The Passenger Car Body", SAE International, 2000.
3. Giles, G.J., "Body Construction and Design", Illiffe Books Butterworth & Co., 1991.
4. James E Duffy, “Modern Automotive Technology”, Seventh Edition, Goodheart-Willcox, 2011.
5. John Fenton, “Handbook of Automotive Construction and Design Analysis”, John Wiley & Sons, 2014.

WEB REFERENCES

1. https://eqmsol.com/vehicle-body-engineering.php
2. https://learnmech.com/types-of-automobile-bodies-and-requirement-of-automobile-body/

ONLINE COURSES / RESOURCES:

1. https://eqmsol.com/vehicle-body-engineering.php
2. https://learnmech.com/types-of-automobile-bodies-and-requirement-of-automobile-body/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	1	-	-	-	-	3	3	-	3
CO2	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO3	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO4	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO5	3	3	3	3	-	2	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1929	VEHICLE DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To familiarize the procedure to find the stability and performance of the vehicle.
- To understand the fundamentals of vehicle vibrations.
- To understand the concepts of mathematical modeling and design of vehicle suspension system and its control methods.
- To understand the effect of tyres dynamics.
- To analyze the vehicle handling characteristics and its effects of the vehicle.

UNIT - I LONGITUDINAL DYNAMICS AND CONTROL 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Aerodynamic forces and moments, Equation of motion, Load distribution for three wheeler and four wheeler, Calculation of Maximum acceleration, Reaction forces for Different drives, Braking and Driving torque, Prediction of Vehicle performance, Anti-lock Braking System (ABS), Stability control, Traction control, Development of linear model using computer software.

UNIT - II CONCEPT OF VIBRATION 9

Free, Forced, Undamped and Damped Vibration, Response Analysis of Single Degrees of Freedom (DOF), Two DOF, Multi DOF, Magnification factor, Transmissibility, Vibration absorber, Vibration measuring instruments, Torsional vibration, Critical speed, Development of linear model using computer software.

UNIT - III VERTICAL DYNAMICS 9

Human response to vibration, Sources of Vibration, Design and analysis of Passive, Semi-active and Active suspension using Quarter car, Half car and Full car model, Influence of suspension stiffness, suspension damping, and tire stiffness, Control law for Linear Quadratic Regulator (LQR), H-Infinite, Skyhook damping, Air suspension system and their properties, Development of linear model using computer software.

UNIT - IV TIRES 9

Tire forces and moments, Tire structure, Longitudinal and Lateral force at various slip angles, rolling resistance, Tractive and cornering property of tire, Performance of tire on wet surface, Ride property of tires, Magic formulae of tire model, Estimation of tire road friction, Test on Various road surfaces, Tire vibration, Development of linear model using computer software.

UNIT - V LATERAL DYNAMICS 9

Steady state handling characteristics, Steady state response to steering input, Testing of handling characteristics, Transient response characteristics, Direction control of vehicles, Roll center, Roll axis, Vehicle under side forces, Stability of vehicle on banked road and during turn, Effect of suspension on cornering, Development of linear model using computer software.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the stability of vehicles, tractive efforts, prediction of vehicle performance and effects on braking and driving torque.
CO2: Analyze the suitable methods to determine the frequency and mode shapes of free, forced and damped vehicle vibrations.
CO3: Design vehicle suspension system and its control methods.
CO4: Explore the effects of tyre dynamics on the vehicle performance.
CO5: Analyze the vehicle handling characteristics and its effects.

TEXT BOOKS

1. Rajesh Rajamani, "Vehicle Dynamics and Control", 2nd edition, Springer, 2012.
2. Wong J. Y, "Theory of Ground Vehicles", 3rd Edition, Wiley-Interscience, 2022.

REFERENCE BOOKS

1. Dean Karnopp, "Vehicle Stability", 2nd edition, Marcel Dekker, 2013.
2. Hans B Pacejka, "Tire and Vehicle Dynamics", 3rd edition, SAE International, 2012.
3. Michael Blundell & Damian Harty, "The Multibody Systems Approach to Vehicle Dynamics", Elsevier, 2008.
4. Nakhaie Jazar. G., "Vehicle Dynamics: Theory and Application", 1st edition, Springer, 2008.
5. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992.

WEB REFERENCES

1. https://link.springer.com/book/10.1007/0-387-28823-6
2. https://www.sciencedirect.com/topics/engineering/longitudinal-dynamic
3. https://www.oreilly.com/library/view/integrated-vehicle-dynamics/9781118379998/c04.xhtml

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/107106080
2. https://www.udemy.com/course/fundamental-concepts-of-vehicle-dynamics/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO2	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO3	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO4	3	3	3	3	-	1	-	-	-	-	3	3	-	3
CO5	3	3	3	3	-	2	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1930	VEHICLE MAINTENANCE AND SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand Maintenance procedure.
- To understand Engine and subsystem maintenance.
- To understand Transmission system maintenance.
- To analyse steering, brake, suspension, tyre and wheel maintenance.
- To analyze electrical and air conditioning maintenance.

UNIT - I MAINTENANCE, WORKSHOP PRACTICES, SAFETY AND TOOLS 9

Maintenance – Need, importance, primary and secondary functions, policies, classification of maintenance work, vehicle insurance, basic problem diagnosis, automotive service procedures, Workshop operations, preparation of workshop forms, vehicle identification number. Safety – personnel, machines and equipment, vehicles, fire safety, first aid. Basic tools, special service tools, measuring instruments, condition checking of seals, gaskets and sealants.

UNIT - II ENGINE AND ENGINE SUBSYSTEM MAINTENANCE 9

General engine service, dismantling of engine components, engine repair, working on the underside, front, top, ancillaries, service of basic engine parts, cooling and lubricating system, fuel system, intake and exhaust system, electrical system, electronic fuel injection and engine management service, fault diagnosis, servicing emission controls.

UNIT - III TRANSMISSION AND DRIVELINE MAINTENANCE 9

Clutch- general checks, adjustment and service, dismantling, identifying, checking and reassembling transmission, transaxle, road testing, removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints, rear axle service points, removing axle shaft and bearings, servicing differential assemblies, fault diagnosis, maintenance and service of automatic transmission.

UNIT - IV STEERING, BRAKE, SUSPENSION, TYRE AND WHEEL MAINTENANCE 9

Inspection, maintenance and service of steering linkage, steering column, Rack and pinion steering, Recalculating ball steering service- Worm type steering, power steering system. Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, maintenance and service of Mc person strut, coil spring, leaf spring, shock absorbers. Inspection, maintenance and service of tyres and wheels, Tyre rotation, Tyre wear indicator, Wheel balancing.

UNIT - V AUTO ELECTRICAL AND AIR CONDITIOING MAINTENANCE 9

Starting system, charging system and body electrical, fault diagnosis using scan tools, Theory of automotive air-conditioning refrigerants, maintenance of air conditioning parts like compressor, condenser, expansion valve, and evaporator, replacement of hoses, leak detection, AC Charging, fault diagnosis.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply the service procedures and safety methods practiced in an automotive workshop.

CO2: Analyze the procedure for the fault diagnosis and service of engine and its subsystems.

CO3: Analyze the fault diagnosis and service of transmission and driveline components.

CO4: Analyze the fault diagnosis and service of comfort and safety components of vehicle.

CO5: Analyze fault diagnosis and service of automotive electrical and air-conditioning components.

TEXT BOOKS

1. Jigar A. Doshi, Dhruv U. Panchal, Jayesh P. Maniar, "Vehicle Maintenance and Garage Practice", Eastern Economy Edition, PHI Learning Private Limited, 2014.
2. William M. Metts, "Vehicle Maintenance Book", Independently Published, 2019.

REFERENCE BOOKS

1. Bosch Automotive Handbook, Tenth Edition,2018
2. William Crouse, Donald Anglin,"Automotive Mechanics", 9th Edition, Mc-graw Hill, US, 1984.
3. Ed May, "Automotive Mechanics - Volume One and Two", Mc Graw Hill Publications, 2006.

WEB REFERENCES

1. https://en.wikiversity.org/wiki/Automobile_Maintenance

ONLINE COURSES / RESOURCES:

1. https://alison.com/course/car-mechanic-training
2. https://internationalopenacademy.com/products/car-maintenance-online-course
3. https://kti.ac.in/courses/Certificate-Course-In-Four-Wheeler-Mechanic

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	-	3	-	-	-	-	3	3	-	3
CO2	3	3	1	1	-	3	-	-	-	-	3	3	-	3
CO3	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO4	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	2	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1931	THERMAL MANAGEMENT OF BATTERIES AND FUEL CELLS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the working principle of Li-ion Batteries and Battery Packs.
- To understand the thermal management system in Battery modules.
- To analyze different case studies in Battery Thermal Management System.
- To understand principle of Fuel Cells cooling methods.
- To analyze Thermal Management Systems in various famous Electric and Fuel Cell Electric Vehicles.

UNIT - I ADVANCED BATTERIES 9

Li-ion Batteries- chemistry, different formats, operating areas, efficiency, aging. Battery Management System- Configuration, Characteristics. Tesla Model S- 18650 Cell specifications, P85 Battery Pack mechanical structure, Texas Instruments BMS. Super capacitors Vs batteries. Diamond battery concepts.

UNIT - II THERMAL MANAGEMENT IN BATTERIES 9

Thermal Management Systems- impact, Types- Air, Liquid, Direct refrigerant, Dielectric liquid-based systems- Indirect liquid-cooled systems, Heat pipe, Thermo Electric, Phase Change Material Cooling methods. Solid-liquid PCM Types- Organic, Inorganic, Eutectics. PCM Thermal properties and applications.Tesla Model-S Battery Module- bonding techniques, Design aspects of thermal management systems.

UNIT - III BATTERY THERMAL MANAGEMENT CASE STUDIES 9

EV Battery Cooling- challenges and solutions. Heat Exchanger Design and Optimization Model for EV Batteries using PCMs- system set up, selection of PCMs. Chevrolet Volt Model Battery Thermal Management System- Case study. Modelling Liquid Cooling of a Li-Ion Battery Pack with COMSOL Multiphysics- simulation concepts.

UNIT - IV THERMAL MANAGEMENT IN FUEL CELLS 9

Fuel Cells- operating principle, hydrogen-air fuel cell system characteristics, other fuel cell technologies, polarization curves, applications.Fuel cell thermal management- basic model, energy balance, governing equations, characteristic curve, sizing, cooling methods, advantages, restrictions.

UNIT - V FUEL CELL THERMAL MANAGEMENT CASE STUDIES 9

Fuel cell system- balance of plant- components required. Fuel cell power plant sizing problems- Fuel Cell Electric Vehicle Fuel economy calculations-Battery EVs Vs Fuel Cell EVs. Toyota Mirai FCV- Operating principle, High pressure hydrogen tank, Boost convertor, NiMH Battery, Internal circulation system, Hydrogen refueling- Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the different Li-ion Batteries and Fuel Cell performances.

CO2: Design a Battery Pack with appropriate PCM.

CO3: Analyze Cooling Models by understanding different thermal management case studies.
CO4: Analyze the characteristics of fuel cell.
CO5: Utilize different Thermal Management System approaches during real world usage.

TEXT BOOKS

1. Ibrahim Dinçer, Halil S. Hamut, and Nader Javani, “Thermal Management of Electric VehicleBattery Systems’’, Wiley, 2017.
2. Jiuchun Jiang and Caiping Zhang, “Fundamentals and applications of Lithium-Ion batteriesinElectric Drive Vehicles’’, Wiley, 2015.
3. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles-Fundamentals, Theory, and Design’’, CRC Press, 2005.
4. John G. Hayes and G. Abas Goodarzi, “Electric Powertrain”, Wiley, 2018
5. Davide Andrea, “Battery Management Systems for Large Lithium-Ion Battery Packs” ARTECH House, 2010.

REFERENCE BOOKS

1. Jürgen Garche, Claudia L. Li, and Yushan Yan, "Thermal Management of Lithium-Ion Batteries" published by Wiley-VCH in 2014.
2. Xudong Zhao,"Fundamentals of Fuel Cell Technology",Wiley-VCH in 2012.

WEB REFERENCES

1. https://en.wikipedia.org/wiki/Electric_vehicle
2. https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ee112/course
2. https://www.udemy.com/course/electric-vehicles-comprehensive-course/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO3	3	3	3	3	-	2	-	-	-	-	2	3	-	2
CO4	3	3	3	3	-	-	-	-	-	-	2	3	-	2
CO5	3	3	3	3	-	2	-	-	-	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1932	ENGINEERING ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To instill core human values and foster ethical behavior in personal and professional life.
- To understand and apply principles of engineering ethics to resolve moral dilemmas.
- To promote responsibility and integrity in engineering as a social experiment.
- To enhance awareness of safety, rights, and responsibilities in professional practice.
- To address global ethical challenges and corporate social responsibilities effectively.

UNIT - I HUMAN VALUES 9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT - II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT - III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.

UNIT - IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT - V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the human values and engineering ethics to make morally and ethically sound decisions in professional practice.

CO2: Analyze and resolve ethical conflicts using established ethical theories and frameworks.

CO3: Exhibit responsibility and integrity in engineering design, experimentation, and

adherence to professional codes of ethics.

CO4: Assess safety risks, respect professional and employee rights, and ensure compliance with legal and ethical standards, including intellectual property rights.

CO5: Evaluate global ethical challenges like environmental sustainability, corporate social responsibility, and the role of engineers in diverse cultural and professional contexts.

TEXT BOOKS

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 5th Edition, 2022.

REFERENCE BOOKS

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey,4th Edition, 2012.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2019.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2017.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 5th Edition, 2025.
6. World Community Service Centre, "Value Education for Health happiness", Vethathiri publications, Erode, 2021.

WEB REFERENCES

1. https://www.asce.org/career-growth/ethics/code-of-ethics
2. https://www.nspe.org/resources/ethics/code-ethics
3. https://engineering.purdue.edu/MSE/academics/undergraduate/ethics.pdf
4. https://www.ieee.org/about/corporate/governance/p7-8.html

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/110105097
2. https://nptel.ac.in/courses/109106117
3. https://nptel.ac.in/courses/109104032
4. https://www.digimat.in/nptel/courses/video/110105097/L01.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	1	3	-	-	-	2	-	-	2
CO2	-	-	-	-	-	1	3	-	1	-	2	-	-	2
CO3	-	-	-	-	-	1	3	-	1	-	2	-	-	2
CO4	-	-	-	-	-	1	3	-	1	-	2	-	-	2
CO5	-	-	-	-	-	1	3	-	1	-	2	-	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1933	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To learn the basics and goals of production planning and control.
- To understand forecasting and inventory management for smoother production.
- Master routing, scheduling, and job sequencing to improve production flow.
- Apply strategies for balancing production lines and planning for demand.
- Understand dispatching, follow-up, and the use of computers in production control.

UNIT - I INTRODUCTION 9

Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Types of production – Organizationof production planning and control department – Internal organization of department.

UNIT - II PRINCIPLES FORECASTING & INVENTORY MANAGEMENT 9

Importance of forecasting –Types of forecasting, their uses –General principles of Forecasting –Forecasting techniques– qualitative methods- Jury/Expert Method , Survey of Expert opinion method , Sales force composite method, Survey of buyers intention method and quantitative methods-Simple average, moving average, smoothing coefficient, Least Square method. Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – EOQ model – Inventory control systems – P–Systems and Q-Systems- Introduction to MRP-I, MRP-II & ERP, JIT inventory, Kanban system.

UNIT - III ROUTING& SCHEDULING 9

Definition – Routing procedure –Route sheets – Bill of material – Factors affecting routing Procedure. Scheduling- Definition – Activities-Difference with loading, Scheduling types: Forward, Backward scheduling, Job shop scheduling methods – Arrival pattern, processing pattern, number of workers available, machine varieties available, Priority rules for job sequencing FIFO, SPT, SOT, EDD, STR, CR, LISO, Random Orders. Scheduling Techniques Gantt Charts, LOB, Johnson's job sequencing rules- n jobs on 2machines, n jobs on 3 machines, n jobs on m machines.

UNIT - IV PLANNING 9

LINE BALANCING: Introduction, objectives, terms related to line balancing, procedures, simple problems.

AGGREGATE PLANNING: Introduction, Inputs to aggregate planning, strategies- Line strategy, chase strategy, capacity options, demand options.

UNIT - V DISPATCHING 9

Centralized and Decentralized Dispatching- Activities of dispatcher – Dispatching procedure – follow-up – definition – Reason for existence of functions – types of follow up, applications of computer in production planning and control.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the objectives, functions, and organization of production planning and control.

CO2: Apply the forecasting techniques, inventory management models, and their applications in production systems.

CO3: Apply the routing, scheduling, and job sequencing techniques to optimize production processes.

CO4: Analyze the line balancing and aggregate planning strategies to address production challenges and capacity management.

CO5: Evaluate the effectiveness of dispatching and follow-up systems, and evaluate the role of computer applications in production planning and control.

TEXT BOOKS

1. Samuel Eilon, “Elements of Production Planning and Control”, Universal Publishing Corporation, 1991.
2. Baffa & Rakesh Sarin , “Modern Production & Operations management”, 8th edition, John Wiley, 1987.
3. S.K.Mukhopadhyay, “Production Planning & Control – Text and cases”, PHI learning Private Limited, 2015.

REFERENCE BOOKS

1. S.N. Chary, “Production & Operations Management”, 6th Edition, TMH, 2019.
2. Dr. C. Nadha Muni Reddy and Dr. K. Vijaya KumarReddy “Reliability Engineering &Quality Engineering”, Galgotia Publications, Pvt., Limited., 2014.
3. S.k Sharma, Savita Sharma, “A Course in Industrial Engineering and Operations Management”, Tata McGraw Hill publications, Reprint, 2024.

WEB REFERENCES

1. https://www.netsuite.com/portal/resource/articles/inventory-management/production-planning.shtml?utm_source=chatgpt.com
2. https://www.optiproerp.com/blog/what-are-the-steps-in-production-planning-and-control/?utm
3. https://journals.vilniustech.lt/index.php/Transport/article/download/1126/874

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112107143
2. https://archive.nptel.ac.in/courses/110/107/110107141/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	1	-	-	1	-	-	-	-	-	2	3	-	2
CO3	3	3	2	2	1	-	-	1	-	1	2	3	-	2
CO4	3	3	2	2	1	-	-	1	-	1	2	3	-	2
CO5	3	3	2	2	1	-	-	1	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1934	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- To explain the TQM Principles for application.
- To define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- To describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- To Illustrate and apply QMS and EMS in any organization.

UNIT - I INTRODUCTION 9

. Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT - II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT - III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT - IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

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 : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Apply TQM concepts in a selected enterprise

CO2: Apply TQM principles in a selected enterprise

CO3: Understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA

CO4: Analyze the Taguchi's Quality Loss Function, Performance Measures and apply QFD, TPM, COQ and BPR.

CO5: Apply QMS and EMS in any organization.

TEXT BOOKS

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, 5th Edition, 2019.

REFERENCE BOOKS

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality",8th Edition, 9th Edition Edition, Cengage Learning, 2019.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 4th Edition,2019.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2nd Edition,2017.
4. ISO 9001:2015 – —Quality management systems — Requirements", International Organization for Standardization (ISO) 2015.

WEB REFERENCES

1. https://www.iso.org/iso-9001-quality-management.html
2. https://www.sciencedirect.com/science/article/pii/B0122272404001854
3. https://www.researchgate.net/publication/312054032_TOTAL_QUALITY_MANAGEMENT

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/110104080
2. https://www.digimat.in/nptel/courses/video/110104080/L01.html
3. https://www.digimat.in/nptel/courses/video/110104085/L01.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	2	1	-	2	1	-	2	3	-	2
CO2	3	-	-	-	2	1	-	2	1	-	2	3	-	2
CO3	3	-	-	-	2	1	-	2	1	1	2	3	-	2
CO4	3	-	-	-	2	1	-	2	1	1	2	3	-	2
CO5	3	-	-	-	2	1	-	2	1	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1935	INDUSTRIAL SAFETY AND MAINTENANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the evolution of modern safety concepts and hazard prevention strategies.
- To recognize and mitigate chemical hazards, including toxic materials and radiation exposure.
- To assess industrial health hazards and apply noise and vibration control methods.
- To apply hazard analysis techniques like FTA, FMEA, and HAZOP to assess risk.
- To comprehend safety regulations, disaster management, and product safety laws, with case study analysis.

UNIT - I INTRODUCTION 9

. Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT - II CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT - III ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT - IV HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT - V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control, Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the key safety concepts and regulations related to industrial hazards and maintenance.

CO2: Analyze the causes and effects of mechanical, chemical, and environmental hazards in industrial settings

CO3: Apply the safety measures for chemical exposure, noise control, and hazard analysis techniques.

CO4: Analyse the industrial safety systems using techniques such as Fault Tree Analysis (FTA) and FMEA.

CO5: Evaluate safety regulations and their effectiveness in disaster management and industrial safety compliance.

TEXT BOOKS

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. C. Ray Asfahl, "Industrial Safety and Health Management", Prentice Hall, 6th edition, 2010.

REFERENCE BOOKS

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005.
3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

WEB REFERENCES

1. https://www.asme.org/codes-standards/publications-information/safety-codes-standards
2. https://www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/List-of-Codes-and-Standards
3. https://link.springer.com/chapter/10.1007/978-1-84882-472-0_22

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/110105094
2. http://www.nitttrc.edu.in/nptel/courses/video/110105094/L51.html
3. https://www.digimat.in/nptel/courses/video/110105094/L01.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	1	-	-	-	-	2	3	-	2
CO2	3	1	-	-	-	1	1	-	-	-	2	3	-	2
CO3	3	2	2	2	-	1	1	1	-	1	2	3	-	2
CO4	3	2	2	2	-	1	1	1	-	1	2	3	-	2
CO5	3	2	2	2	-	1	1	1	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1936	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the basics of process planning.
- To understand various Process Planning Activities.
- To understand fundamentals of costing and estimation.
- To apply the basics of estimation in different manufacturing processes.
- To analyse the production rate for different metal cutting operations.

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

UNIT - II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT - III INTRODUCTION TO COST ESTIMATION 9

Importance of costing and estimation –methods of costing-elements of cost estimation – Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Calculation of depreciation cost

UNIT - IV PRODUCTION COST ESTIMATION 9

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT - V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling,Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the selection of equipment and tools for various processes.
CO2: Analyze the the preparation of process planning activity chart.
CO3: Analyze the cost estimation procedure for different resources for jobs.
CO4: Apply the cost estimation procedure for forging, welding and foundry shop.
CO5: Analyze the machining time for different metal cutting processes.

TEXT BOOKS

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Sinh a 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. Os twalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.

3. Ru ssell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
4. Mik ell 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.

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1. http://ndl.ethernet.edu.et/bitstream/123456789/54967/1/83.pdf
2. https://www.researchgate.net/publication/284188843_Manufacturing_Process_Planning
3. http://alvarestech.com/temp/capp/0-livro-PrinciplesofProcessPlanningAlogica%20approach.pdf
4. https://www.pdfdrive.com/process-planning-and-cost-estimation-e34406789.html
5. https://www.pdfdrive.com/cost-estimation-methods-and-tools-e185217474.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	1	-	-	1	-	-	-	-	2	2	1	-	2
CO3	1	1	1	1	1	-	-	-	-	2	2	1	-	2
CO4	2	1	1	1	1	-	-	-	-	2	2	2	-	2
CO5	2	1	1	1	1	-	-	-	-	2	2	2	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1937	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To explain the types, characteristics of entrepreneurship and its role in economic development.
- To apply the theories of achievement motivation and the principles of Entrepreneurship development program to enterprise.
- To select the appropriate form of business ownership in setting up an enterprise.
- To apply the fundamental concepts of finance and accounting to enterprise.
- To Identifying sickness in industry, selecting the appropriate corrective measures, and identifying the growth strategies in enterprise.

UNIT - I ENTREPRENEURSHIP 9

Entrepreneur – Characteristics – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur – Role of Entrepreneurship in Economic Development – Factors Affecting Entrepreneurial Growth – Economic, Non-Economic, Government Actions.

UNIT - II MOTIVATION 9

Entrepreneurial Motivation: Theories and Factors, Achievement Motivation –Entrepreneurial Competencies – Entrepreneurship Development Programs – Need, Objectives – Business Game, Thematic Apperception Test, Self-Rating, Stress management.

UNIT - III BUSINESS 9

Small Enterprises – Definition, Characteristics, Project Identification and selection – Project Formulation: Significance, content, formulation of project report – Project Appraisal: Concept and method – Ownership Structures: Selection & Pattern.

UNIT - IV FINANCING AND ACCOUNTING 9

Finance: Need, Sources, Capital Structure, Term Loans – Accounting: Need, Objectives, Process, Journal, Ledger, Trial Balance, Final Accounts – Working Capital Management: Significance, Assessment, Factors, Sources, Management, Inflation adjusted decisions – procedure to adjust inflation.

UNIT - V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business: Concept, Signals, Symptoms, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in Small Scale Enterprise – Institutional Support to Entrepreneurs: Need and Support – Taxation Benefits to Small Scale Industry: Need, Depreciation, Rehabilitation, Investment.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the types, characteristics of entrepreneurship and its role in economic development.

CO2: Apply the theories of achievement motivation and the principles of entrepreneurship development program.

CO3: Select the appropriate form of business ownership in setting up an enterprise..

CO4: Apply the fundamental concepts of economics and accounting to enterprise.

CO5: Identify sickness in industry, select the appropriate corrective measures, and identify the growth strategies in enterprise.

TEXT BOOKS

1. S.S.Khanka, "Entrepreneurial Development" S.Chand& Co. Ltd. Ram Nagar NewDelhi, 5th Edition, 2020.
2. Donald F. Kuratko, —Entrepreneurship – Theory, process and practicesǁ, Cengage Learning, 10th edition, 2016.

REFERENCE BOOKS

1. Charantimath, P. M., Entrepreneurship Development and Small Business Enterprises, Pearson, 3rd Edition,2018.
2. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
3. Mathew J Manimala," Entrepreneurship theory at crossroads: paradigms and praxis" Dream tech, 10thedition,2016.
4. Rabindra N. Kanungo, "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
5. Singh, A. K., Entrepreneurship Development and Management, University Science Press, 2009.

WEB REFERENCES

1. https://www.slideshare.net/esmatullahamini1/entrepreneurial-developmentbook-pdf
2. https://www.academia.edu/10068660/ENTREPRENEURSHIP_DEVELOPMENT
3. http://eagri.org/eagri50/ARM402/index.html

ONLINE COURSES / RESOURCES:

1. https://www.digimat.in/nptel/courses/video/110106141/L01.html
2. https://www.digimat.in/nptel/courses/video/110105067/L01.html
3. https://nptel.ac.in/courses/127105007
4. https://onlinecourses.nptel.ac.in/noc21_mg70/preview

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	-	-	-	-	-	-	2	2	-	3	2	-	-	2
CO2	-	-	-	-	-	-	3	3	-	3	2	-	-	2
CO3	-	-	-	-	-	2	2	3	-	3	3	-	-	3
CO4	-	-	-	-	-	2	2	3	-	3	3	-	-	3
CO5	-	-	-	-	-	2	3	2	-	3	3	-	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1938	QUALITY AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To learn the basics of quality and control methods to improve processes.
- To use the control charts to monitor and stabilize processes.
- To understand and apply sampling methods to evaluate product quality.
- To analyze data from life tests to assess reliability and failure rates.
- To learn how to improve product reliability and design for better performance.

UNIT - I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

. Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation – Theory of control chart- uses of control chart –X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

UNIT - II PROCESS CONTROL FOR ATTRIBUTES 9

Control chart for attributes –control chart for non-conforming's– p chart and np chart – control chart for nonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT - III ACCEPTANCE SAMPLING 9

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling
Techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT - IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT - V QUALITY AND RELIABILITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development–Product life cycles.

Note: Use of approved statistical table permitted in the examination.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the key concepts and definitions related to quality, process control, and reliability engineering..

CO2: Analyze the use and significance of control charts, acceptance sampling, and reliability models in maintaining quality and system performance.

CO3: Apply statistical methods like control charts, life testing, and acceptance sampling to real-world problems in quality and reliability analysis.

CO4: Analyze process data and identify out-of- control conditions or reliability issues using control charts and reliability models.

CO5: Create the design strategies for improving product reliability and process quality, incorporating redundancy and optimization techniques for enhanced performance.

TEXT BOOKS

1. Douglas.C. Montgomery, “Introduction to Statistical quality control”, 8th edition, John Wiley, 2019.
2. Srinath. L.S., “Reliability Engineering”, Affiliated East west press, 2008.

REFERENCE BOOKS

1. Besterfield D.H., “Quality Control”, Prentice Hall, 2019.
2. Connor, P.D.T.O., “Practical Reliability Engineering”, JohnWiley, 2012
3. Danny Samson, “Manufacturing & Operations Strategy”, Prentice Hall, 1991
4. Grant, Eugene .L “Statistical Quality Control”, McGraw-Hill, 2017.
5. Gupta. R.C, “Statistical Quality control”, Khanna Publishers, 2001.

WEB REFERENCES

1. https://accendoreliability.com/resources/
2. https://alison.com/course/reliability-engineering-fundamentals-enhanced-performance-levels?utm
3. https://www.qualityduringdesign.com/home/resources/?utm=

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/110105088
2. https://nptel.ac.in/courses/116102019
3. https://nptel.ac.in/courses/112107259
4. https://nptel.ac.in/courses/105108128

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	1	-	-	-	-	-	-	-	-	2	1	-	2
CO3	3	3	2	2	1	-	-	1	-	1	2	3	-	2
CO4	3	3	2	2	1	-	-	1	-	1	2	3	-	2
CO5	3	3	2	2	1	-	-	1	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1939	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To apply linear programming and optimization techniques to solve real-world problems.
- To solve transportation, assignment, and network optimization problems.
- To develop and implement inventory control models for efficient management.
- To analyze queuing systems to optimize service and waiting times.
  To apply decision models such as game theory and replacement models for strategic decision-making.

UNIT I LINEAR MODELS **15**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS **8**

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS **6**

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS **6**

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS **10**

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life –Economic life– Single / Multi variable search technique.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the linear programming, graphical method, Simplex algorithm, duality, and sensitivity analysis..

CO2: Analyze the transportation/assignment models, Traveling Salesman, shortest route, minimal spanning tree, maximum flow, CPM/PERT, and sequencing models.

CO3: Analyze EOQ, quantity discount, stochastic inventory, multi-product models, and real-world inventory control

CO4: Analyze queueing systems, single/multi-server models, Poisson input, exponential service, constant rate, and simulation..

CO5: Analyze game theory, graphical/algebraic/LP solutions, replacement models, and optimization techniques.

TEXT BOOKS

1. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 10th Edition, 2016.
2. Frederick S. Hillier and Gerald J. Lieberman, —Introduction to Operations Researchǁ, 11th edition, McGraw-Hill Education, 2024.

REFERENCE BOOKS

1. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley, 2009.
2. Panneerselvam R., “Operations Research”, 3rd Edition, PHI Learning, 2023.
3. Philip D.T. and Ravindran A., “Operations Research”, JohnWiley, 1992.
4. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern, 2006.

WEB REFERENCES

1. http://www.nitttrc.edu.in/nptel/courses/video/112106134/lec1.pdf
2. https://www.slideshare.net/drrama/operational-research-50589320
3. https://link.springer.com/book/10.1007/978-1-4471-5577-5

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112106134
2. https://nptel.ac.in/courses/110106062
3. https://www.digimat.in/nptel/courses/video/110106062/L02.html
4. https://nptel.ac.in/courses/111107128

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	1	1	-	-	-	-	-	-	3	3	-	3
CO2	3	1	1	1	-	-	-	-	-	-	3	3	-	3
CO3	3	3	3	3	1	1	-	-	-	2	3	3	-	3
CO4	3	3	3	3	1	1	-	-	-	2	3	3	-	3
CO5	3	3	3	3	1	1	-	-	-	2	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1940	WAREHOUSING AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the role of warehouses, their operations, and the challenges faced by warehouse managers in a dynamic supply chain environment.
- To understand the processes involved in warehouse operations, including receiving, picking, replenishment, and despatch activities.
- To understand the need for Warehouse Management Systems (WMS), the process of selecting and implementing WMS, and the principles of warehouse layout design.
- To understand the types of storage and handling equipment, advancements in technology, and cost management approaches for warehouse maintenance.
- To understand the future trends in warehousing, including environmental considerations, energy usage, and emerging technologies.

UNIT I INTRODUCTION **9**

The role of the warehouse, Types of warehouse operation, Why do we hold stock? Warehouse location, Number of warehouses, Supply chain trends affecting warehouses, The growth of e-fulfilment and its effect on the warehouse, Specialized warehousing, Role of the warehouse manager, Warehouse trade-offs, The warehouse manager's challenges, Lean warehousing, People management and People challenges, Attracting and retaining warehouse employees, An ageing and constantly changing workforce, Operating hours, Training, Warehouse audit and Quality systems.

UNIT II PROCESS OF WAREHOUSE **9**

Receiving - Pre-receipt, In-handling, Preparation, Offloading, Cross docking, Recording, Quality control and put-away, pickup preparation and Warehouse pick area layout, Picker to goods, Goods to picker, Types of automated picking, Examples of automated picking systems and Order Picking methods. Replenishment - Value-adding services, Indirect activities, Stock management, Stock or inventory counting, Cycle counting or perpetual inventory, counts - The count itself, Security - Returns processing Despatch and Documentation, Role of the driver.

UNIT III WAREHOUSE MANAGEMENT SYSTEMS AND LAYOUT **9**

Why does a company need a WMS? Choosing a WMS - the process, selecting the right WMS, what to look for in a system, selecting a partner, before the final decision - Implementation, Warehouse layout - Data collection and analysis, Space calculations, Aisle width, Other space, Warehouse layout examples - Finding additional space.

UNIT IV HANDLING EQUIPMENT & COST FOR WAREHOUSE MAINTENANCE **9**

Storage equipment, Storage options, Shuttle technology with a difference, Very high bay warehouses, Other storage media, Warehouse handling equipment, Vertical and horizontal movement, Automated storage and retrieval systems (AS/RS), Specialized equipment, Recent technical advances. Warehouse costs - Return on investment (ROI), Traditional versus activity-based costing systems, Charging for shared-user warehouse services, Logistics charging methods - Hybrid.

UNIT V WAREHOUSE IN FUTURE ENVIRONMENT **9**

Legislation and other pressures, Warehouse energy usage, Energy production, The environment and waste, Packaging, Pallets, Stretch wrap, Cartons, Labelling, Product waste, Waste disposal, Hazardous waste, Forklift trucks - Equipment disposal, warehouse of the future - Views of the future: the landscape and the warehouse.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the role of Warehouse and their importance in the globalized competitive world.

CO2: Analyze the importance of process of warehouse.

CO3: Apply warehouse management techniques to optimize processes such as inventory control, picking, and despatch for efficient operations.

CO4: Apply storage equipment and handling systems to improve warehouse operations and manage costs effectively.

CO5: Analyze the environmental impact of warehouse operations, including energy use and waste management.

TEXT BOOKS

1. Gwynne Richards, "Warehouse management", 3rd Edition, Kogan Page Limited., 2011.
2. Balaji R Kannappan, Hari Shankar Tripathy, Vinay Krishna, "Warehouse Management with SAP EWM", Rheinwerk Publishing., 2016.

REFERENCE BOOKS

1. Stuart Emmett, " Excellence in Warehouse Management: How to Minimise Costs and Maximise Value ", John Wiley &Sons.,2011.
2. Ernst F. Bolten, "Managing Time and Space in the Modern Warehouse: With Ready-to-Use Forms, Checklists, & Documentation ", AMACOM, 1997.
3. Carter M.B., Lange J., Bauer F.-P., Persich C., Dalm T., SAP Extended Warehouse Management: Processes, Functionality and Configuration, Galileo press., 2010.

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1. https://archive.nptel.ac.in/courses/110/106/110106045/

ONLINE COURSES / RESOURCES:

1. https://www.udemy.com/course/basics-of-warehouse-management/?couponCode=ST18MT12125
2. https://www.udemy.com/course/warehouse-management-core-fundamentals-from-zero-to-hero/?couponCode=ST18MT12125
3. https://www.udemy.com/course/warehouse-management/?couponCode=ST18MT12125
4. https://www.coursera.org/learn/effective-inventory-management-and-optimization

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CO3	3	3	2	2	2	1	-	-	-	2	2	3	-	2
CO4	3	3	2	2	-	1	-	-	-	2	2	3	-	2
CO5	3	3	2	2	-	1	-	-	-	2	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1941	MATERIAL HANDLING EQUIPMENT, REPAIR AND MAINTENANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the materials handling concepts and their importance in the globalized competitive world.
- To understand the importance of using the materials equipments and their applications
- To apply the sources of repair and improve the reliability of the product.
- To apply the maintenance concepts in real-time applications
- To evaluate the various maintenance and replacement models for applying in real-time applications

UNIT I INTRODUCTION TO MATERIALS HANDLING **9**

Objectives and benefits of Material handling, Relationship between layout and Material handling, Principles of material handling, Unit load concept.

UNIT II MATERIAL HANDLING EQUIPMENT **9**

Classification of material handling equipments, Equipment selection, Packaging, material handling systems, handling of components and assemblies, Automated guided vehicle systems.

UNIT III REPAIR & RELIABILITY **9**

Analysis of downtime – Repair time distribution – Maintainability prediction – Measures ofmaintainability – Availability definitions – System Availability – Replacement decisions – Economic life. Analysis of downtime-Repair time distribution (exponential, lognormal)-MTTR- Reliability prediction-MTBF, MTTF-Reliability of series & parallel systems-Reliability Centred Maintenance. System repair time-Maintainability prediction.

UNIT IV MAINTENANCE CONCEPT **9**

Need for maintenance-Challenges in maintenance-Objectives of maintenance-Maintenance Organization- Scope of maintenance department- Maintenance management- Tero Technology-Five zero concept-Maintenance performance measurement- Maintenance costs-Maintenance audit.

UNIT V MAINTENANCE POLICIES & LOGISTICS **9**

Planned vs unplanned maintenance-Preventive maintenance vs Breakdown maintenance-Predictive maintenance-Corrective maintenance-Opportunistic maintenance-Design outmaintenance-Condition Based Maintenance (CBM)- Proactive and Reactive maintenance-Minimum vs Extensive maintenance-Work order form- Maintenance planning-Maintenance scheduling-Spare parts control & inventory management- Human factors in maintenance-Maintenance crew size-Replacement models.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the materials handling concepts and their importance in the globalized competitive world.
CO2: Analyze the importance of using the materials equipments and their applications.
CO3: Apply the sources of repair and improve the reliability of the product.
CO4: Apply the maintenance concepts in real-time applications.
CO5: Evaluate the various maintenance and replacement models for applying in real-time applications.

TEXT BOOKS

1. Tanmoy Deb, "Maintenance Management and Engineering", Ane Books Pvt.Ltd.,2023.
2. Roy Billington and Ronald N. Allan, “Reliability Evaluation of Engineering Systems”, Springer, 2013.
3. James, Apple, “Material Handling System design”, Ronald Press, 1980.

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1. Pannerselvam.R, “Production and Operations Management”, PHI, 2nd Edition, 2019.
2. Jiang, Renyan, "Introduction to Quality and Reliability Engineering", Springer, 2019.
3. Charles E.Ebeling, "An Introduction to Reliability and Maintaibaility Engineering", Mc Graw Hill Education (India) Pvt.Ltd, 2017.
4. Mishra.R.C. Pathak. K, "Maintenance Engineering and Management", Second Edition, PHI Learning, 2018.

WEB REFERENCES

1. https://mrcet.com/downloads/digital_notes/ME/IV%20year/PLMH%20NOTES.pdf
2. https://www.businessmanagementideas.com/materials-management-2/equipments-materials-management-2/material-handling-equipment-selection-and-maintenance/10772
3. https://www.davuniversity.org/images/files/study-material/MEC250-Production%20and%20Operations%20Management-Repair%20and%20Maintenance.pdf
4. https://gppanchkula.ac.in/wp-content/uploads/2022/04/PMMH-6th-Sem-E-CONTENTS.pdf

ONLINE COURSES / RESOURCES:

1. https://youtu.be/uiz4s6W6LMs
2. https://youtu.be/T_tDTuBgYws
3. https://youtu.be/uO4WfYDOWxo

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	-	-	-	-	-	-	-	-	-	2	1	-	2
CO3	3	2	2	2	-	1	-	-	-	1	2	3	-	2
CO4	3	2	2	2	-	1	-	-	-	1	2	3	-	2
CO5	3	2	2	2	-	1	-	-	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1942	PLANT LAYOUT DESIGN AND ERGONOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To learn how to choose the best location for a plant using different models.
- To design layouts that improve workflow and efficiency.
- To use computer tools to optimize plant layouts.
- To understand how to move materials efficiently and design packaging systems.
  To improve workspaces to make them safer and more comfortable for workers.

UNIT I PLANT LOCATION **9**

Introduction, Factors affecting location decisions, Qualitative models, Quantitative models, Break-Even analysis model, Brown & Gibbs model, Single facility location models, Gravity location models, Mini-Sum model, Mini-Max model, Multi facility location models, Covering model, Warehouse location model.

UNIT II FACILITIES LAYOUT DESIGN **9**

Need for layout study, Objectives of a good facility layout, Classification of layout, Layout procedure – Nadler's ideal system approach – Immer's basic steps – Apple's layout procedure – Reed's layout procedure, Layout planning – Systematic layout planning(SLP) – Information gathering, Flow analysis & Activity analysis, Relationship diagram, Space requirement and availability, Designing the layout.

UNIT III COMPUTERIZED LAYOUT PLANNING AND DESIGNING PRODUCT LAYOUT **9**

Designing the process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Group technology models – Production flow analysis (PFA) – Rank order clustering (ROC). Line balancing – Objectives, Line balancing techniques – Largest candidate rule (LCR) – Kilbridge & Wester method (KWM) – Rank Positional Weight method (RPW) – COMSOAL, Mixed model assembly line balancing

UNIT IV MATERIALS HANDLING AND PACKAGING **9**

Scope and definitions of material handling – Objectives, Principles of material handling, Unit load concept, Material handling system design, Classification of material handling equipments, Equipment selection & specification, JIT impact on facilities design, Packaging.

UNIT V ERGONOMICS **9**

Ergonomics – Interdisciplinary nature- Human–machine systems -Ergonomics and its areas of application in the work system - Future directions for ergonomics- Biostatic and Biodynamic Mechanics. Problems of body size- Anthropometry measures- Work posture– Design for standing and seated workers - Design of repetitive tasks - Design of manual handling tasks- VDT work stations – Hand tool design. Design and Assessment in Hot, cold workplaces and the design of the physical environment–Noise and vibration- Vision – Human errors and Accidents – OSHA: Ergonomics Safety and Health Management rules – Personal Protective Equipments.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the key concepts and models used in plant location decisions, layout designs, and ergonomic principles.

CO2: Analyze the importance of efficient plant layouts and ergonomics in improving productivity, safety, and comfort in the workplace.

CO3: Apply systematic layout planning and ergonomic principles to design functional and safe work environments in various industrial settings.

CO4: Analyze different material handling equipment and design efficient systems

CO5: Create an optimal plant layout and ergonomic workstation using advanced tools, models, and design principles to address real-world challenges..

TEXT BOOKS

1. Tompkins, J.A. and White J A et al., —Facilities planningll, John Wiley & Sons, 4th edition, 2010.
2. Martin Helander, “A guide to Ergonomics of Manufacturing”, TMH, 2006.
3. Mikell P. Groover, "Work Systems and the Methods, Measurement, and Management of Work", Pearson, 4th edition, 2016.

REFERENCE BOOKS

1. James, Apple, “Material Handling System Design”, Ronald Press, 1980.
2. Krajewski. J and Ritzman, “Operations management – Strategy and Analysis”, Addison –Wesley publishing company, 12th edition, 2020.
3. Pannerselvam.R, “Production and Operations Management”, PHI, 2017
4. Richard Francis. L. and John A. White, “Facilities Layout and location - an analytical approach”, PHI. 2002.
5. Bridger, R. S.”Introduction to Ergonomics”, 3rd ed. CRC Press, New York and London,2008

WEB REFERENCES

1. https://www.ilo.org/global/topics/safety-and-health-at-work/normative-instruments/code-of-practice/lang--en/index.htm
2. https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/instructionalmaterial/wcms_178593.pdf
3. https://www.ilo.org/global/topics/labour-administration-inspection/resources-library/publications/guide-for-labour-inspectors/machinery-plant-equipment/lang-en/index.htm

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/112107292
2. https://www.digimat.in/nptel/courses/video/107103004/L01.html
3. https://www.digimat.in/nptel/courses/video/112107238/L17.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	-	-	-	-	1	-	-	-	-	2	1	-	2
CO3	3	3	2	2	3	1	-	-	-	1	2	3	-	2
CO4	3	3	2	2	1	1	-	-	-	1	2	3	-	2
CO5	3	3	2	2	1	1	-	-	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1943	LOGISTICS IN MANUFACTURING, SUPPLY CHAIN AND DISTRIBUTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To learn logistics and supply chain basics, including objectives and performance.
- To understand decision-making in supply chain under risk and uncertainty.
- To Study inventory management, warehouse functions, and layout design.
- To explore transportation strategies, routing, and packaging design.
- To learn about logistics organization, management, and control systems.

UNIT - I INTRODUCTION 9

Business logistics and supply chain – importance, objectives and drivers. Strategy – planning, selecting proper channel, performance measurement. Outsourcing- Make vs buy approach – sourcing strategy.

UNIT - II MANAGING FLOWS 9

Planning Networks – Decision making under risk – Decision trees – Decision making under uncertainty. Distribution Network Design – Role - Factors Influencing Options, Value Addition.. Supply Chain Network optimization models. Logistics information system - Role of IT – Framework for IT adoption.

UNIT - III INVENTORY AND WAREHOUSING 9

Inventory–objectives, bullwhip effect, control - Probabilistic inventory models, Risk pooling, Vendor managed inventory, Multi-echelon inventory. Warehousing Functions – Types – Site Selection – Decision Model – Layout Design – Costing – Virtual Warehouse.

UNIT - IV TRANSPORTATION AND PACKAGING 9

Transportation – Drivers, Modes, Measures - Strategies for Transportation, 3PL and 4PL, Vehicle Routing and Scheduling. Packaging- Design considerations, Material and Cost. Packaging as Unitisation. Consumer and Industrial Packaging.

UNIT - V ORGANISATION AND CONTROL 9

Organization Structure – need and development. Organizational – Choices, Orientation and positioning. Inter functional and inter organizational management – alliances and partnerships. Control – Process framework, system details, information, measurement and interpretation.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the importance of logistics, supply chain strategies, and performance measurement

CO2: Apply the decision trees, optimize distribution networks, and leverage IT frameworks for efficient supply chain and logistics management

CO3: Apply inventory control techniques and design warehouse layouts, considering factors like site selection and costing.

CO4: Analyze the transportation strategies, vehicle routing, and packaging decisions to optimize logistics operations.

CO5: Create an organizational structure and control system for efficient logistics and supply chain management, fostering inter-functional collaboration.

TEXT BOOKS

1. Ronald H. Ballou and Samir K. Srivastava, Business Logistics and Supply Chain Management, Pearson education, Reprint 2007.
2. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation, PHI Learning / Pearson Education, 2007.

REFERENCE BOOKS

1. Bowersox Donald J, Logistics Management – The Integrated Supply Chain Process,Tata McGraw Hill, 6th Edition, 2023.
2. Vinod V. Sople, Logistics Management-The Supply Chain Imperative, Pearson, 3rd Edition, 2017.
3. Coyle et al., The Management of Business Logistics, Thomson Learning, 7th Edition, 2004.
4. Mohanty R.P and Deshmukh S.G, Supply chain theories and practices, Biztantra publications, 2009.
5. Leenders, Johnson, Flyn, Fearon, Purchasing and supply management, Tata McGraw Hill, 2010.

WEB REFERENCES

1. https://www.investopedia.com/terms/s/scm.asp
2. https://scm.ncsu.edu/scm-articles/article/what-is-supply-chain-management-scm
3. https://www.michiganstateuniversityonline.com/resources/supply-chain/what-is-supply-chain-management/

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc24_hs128/preview
2. https://nptel.ac.in/courses/110106045

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	1	-	-	1	-	-	-	-	2	2	1	-	2
CO3	3	3	2	2	1	-	-	-	-	2	2	3	-	2
CO4	3	3	2	2	1	-	-	-	-	2	2	3	-	2
CO5	3	3	2	2	1	-	-	-	-	2	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1944	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the role, scope, and strategic importance of logistics and supply chain management.
- To analyze and design supply chain networks and distribution systems.
- To study transportation's role and design transportation networks within the supply chain.
- To explore sourcing strategies, supplier relationships, and coordination challenges like the bullwhip effect.
- To examine the role of IT in enhancing customer and supplier relationships and the future of e-business in SCM.

UNIT - I INTRODUCTION 9

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT - II SUPPLY CHAIN NETWORK DESIGN 9

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT - III LOGISTICS IN SUPPLY CHAIN 9

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT - IV SOURCING AND COORDINATION IN SUPPLY CHAIN 9

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect – Effect of lack of coordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain.

UNIT - V SUPPLY CHAIN AND DISTRIBUTION TECHNOLOGY 9

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management – future of IT in supply chain – E-Business in supply chain.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the key concepts, scope, and strategic importance of logistics and supply chain management in business.

CO2: Analyze and design effective supply chain networks and distribution systems based on relevant factors and design options.

CO3: Apply transportation management principles to optimize transportation networks, routing, and scheduling in the supply chain.

CO4: Evaluate sourcing strategies, supplier selection, and coordination issues such as the bullwhip effect to improve supply chain performance.

CO5: Assess the role of Information Technology (IT) in supply chain management and develop solutions to integrate IT systems for enhanced customer and supplier relationships.

TEXT BOOKS

1. Sunil Chopra, Peter Meindl and D.V.Kalra, ―Supply Chain Management: Strategy, Planning, and Operation‖, 7th edition, Pearson, 2019.

REFERENCE BOOKS

1. Jeremy F. Shapiro, ―Modeling the Supply Chain‖, 2nd edition, Thomson Brooks/Cole, 2006.
2. G. Srinivasan , ―Quantitative models in Operations and Supply Chain Management, 2nd edition, PHI, 2018.
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, ―Logistics‖, PHI 2002.
4. James B. Ayers, ―Handbook of Supply Chain Management‖, 2nd edition, Auerbach Publications, 2006.

WEB REFERENCES

1. https://onlinecourses.nptel.ac.in/noc24_hs128/preview
2. https://nptel.ac.in/courses/110106045
3. https://ocw.mit.edu/courses/esd-273j-logistics-and-supply-chain-management-fall-2009/pages/lecture-notes/

ONLINE COURSES / RESOURCES:

1. https://www.coursera.org/specializations/supply-chain-management?
2. https://www.oxfordhomestudy.com/courses/supply-chain-courses-online/supply-chain-management-free-course?
3. https://my.uopeople.edu/pluginfile.php/57436/mod_book/chapter/121631/BUS5116.Lu.-Fundamentals.Supply.Chain.Mgmt.pdf

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	-	-	-	-	-	-	-	1	2	3	-	2
CO2	3	3	1	1	-	-	-	-	-	1	2	3	-	2
CO3	3	3	1	1	-	-	-	-	-	1	2	3	-	2
CO4	3	3	1	1	-	-	-	-	-	1	2	3	-	2
CO5	3	3	1	1	1	-	-	-	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1945	THERMAL POWER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To study the fuel properties and arrive at proximate and ultimate analysis of fuels.
- To study the different types of boilers and compute their performance parameters.
- To study the performance parameters of an air compressor.
- To study the working principles of various refrigeration systems and perform cop calculations.
- To study the psychometric properties and how they are utilized in arriving at calculations to determine heating loads.

UNIT – I FUELS AND COMBUSTION 9

Fuels - Types and Characteristics of Fuels - Determination of Properties of Fuels – Fuels Analysis – Proximate and Ultimate Analysis - Moisture Determination - Calorific Value - Gross & Net Calorific Values.

UNIT – II BOILERS 9

Types and comparison, Mountings and Accessories. Performance calculations, Types of Boilers – Merits & Limitations – Specialty of Fluid Bed Boilers – Basic design principles (Stoker, Travelling Grate etc). Boiler trial. IBR Regulations.

UNIT – III AIR COMPRESSORS 9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT – IV REFRIGERATION SYSTEMS 9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration.

UNIT – V PSYCHROMETRY AND AIR-CONDITIONING 9

Psychrometric properties – Property calculations using Psychrometric chart and expressions. Psychrometric processes – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

CO1: Determine the fuel properties and arrive at proximate and ultimate analysis of fuels

CO2: Analyze different types of boilers and compute their performance parameters.

CO3: Analyze the performance of reciprocating and rotating compressors.

CO4 Analyze the effects of superheating, sub-cooling, and perform performance calculations for different refrigeration systems.

CO5: Analyze air conditioning systems, and perform cooling load calculations.

TEXT BOOKS:

1. L. K. Kothari and N. S. Thakur Edition, “Thermal Power Plant Engineering", Tata McGraw-Hill Education 2nd Edition, 2010.
2. P.K. Nag, “Power Plant Engineering" McGraw-Hill Education, 4th Edition 2017.

3. Mahesh. M. Rathore, “Thermal Engineering”, 1st Edition, Tata McGraw Hill, 2010.
4. Balla ney. P, “ Thermal Engineering”, 25th Edition, Khanna Publishers, 2017.

REFERENCES BOOKS:

1. Ananthanarayanan P.N, “ Basic Refrigeration and Air-Conditioning”, 4th Edition, Tata McGraw Hill,2013.
2. Arora, “ Refrigeration and Air-Conditioning”, 2nd Edition, Prentice Hall of India, 2010.
3. Mathur M.L and Mehta F.S., “Thermal Science and Engineering”, 3rd Edition, Jain Brothers Pvt. Ltd, 2017.
4. Nag P.K, “ Basic and Applied Thermodynamics”, 2nd Edition, Tata McGraw Hill, 2010.
5. Soman. K, “Thermal Engineering”, 2nd Edition, Prentice Hall of India, 2011.

WEB REFERENCES

1. https://hyominsite.files.wordpress.com/2015/03/fundamentals-of-heat-and-mass-transfer-6th-edition.pdf
2. https://edisciplinas.usp.br/pluginfile.php/5464110/mod_book/chapter/23393/Heat%20and%20Mass%20Transfer%20by%20kothadaraman.pdf

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/?subjectid=112108149
2. http://kcl.digimat.in/nptel/courses/video/112107291/L07.html
3. http://sdnbvc.digimat.in/nptel/courses/video/112107208/L24.html
4. https://kristujayanti.digimat.in/nptel/courses/video/112107291/L31.html

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	3	3	-	3
CO2	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO3	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO4	3	3	2	2	-	-	-	-	-	-	3	3	-	3
CO5	3	3	2	2	-	-	-	-	-	-	3	3	-	3

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1946	SELECTION OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the Engineering materials and selection of materials for various applications.
- To understand the Mechanical, Electrical, Optical and Fabrication properties of materials.
- To understand the Manufacturability of materials with economic consideration.
- To understand the testing of Metallic, ceramic and plastic materials.
- To analyze the applications of materials in biomedical, sports and electronic field.

UNIT - I ENGINEERING MATERIALS 9

Introduction – classification of engineering materials –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials-smart materials - physical, metrical properties of metals - selection of materials for engineering purposes –selection of materials and shape

UNIT - II MATERIAL PROPERTIES 9

Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties - Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties , Corrosion properties –shape and size - Material Cost and Availability– failure analysis

UNIT - III MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS 9

Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials

UNIT - IV MATERIALS SELECTION CHARTS AND TESTING 9

Ashby material selection charts- Professional and Testing Organizations -Testing of Metallic Materials - Plastics Testing - Characterization and Identification of Plastics - Ceramics Testing - Non-destructive Inspection.

UNIT - V APPLICATIONS AND USES 9

Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Advanced Materials in Telecommunications - Materials Selection for Wear Resistance - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the material selection criteria based on physical and mechanical properties for specific engineering purposes.

CO2: Analyze the different types of properties to selection of materials for specific applications.

CO3: Apply the different types of manufacturing processing based on material properties..

CO4: Examine the different types of material testing processes

CO5: Analyze appropriate advanced materials for various applications, and understand their manufacturing and assembly processes.

TEXT BOOKS

1. Ashby, M. F., Materials selection in mechanical design, 3rd edition. Elsevier, 2005.
2. Ashby, M. F. and Johnson, K., Materials and design – the art and science of material selection in product design, Elsevier, 2002.
3. P. Field Foster, The Mechanical Testing of Metals and Alloys, 7thedition, Cousens Press, 2007.

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1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G., Selection and use of engineering materials, 3rd edition, Butterworth-Heinemann, 1997.
2. Myer Kutz, Handbook of Materials Selection, John Wiley & Sons, Inc., NewYork, 2002.
3. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.

WEB REFERENCES

1. http://www.utc.fr/~hagegebe/UV/MQ12/CORRECTIONS_TD/%5BASHBY99%5D%20-20Materials%20Selection%20In%20Mechanical%20Design %202Ed.pdf
2. https://uomustansiriyah.edu.iq/media/lectures/5/5_2016_05_01!08_27_09_PM.pdf

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_me59/preview
2. https://automaterials.files.wordpress.com/2018/09/selecting-material-for-engineering-applications.pdf

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO1	PSO2	PSO 3
CO1	1	-	-	-	-	-	-	-	-	-	2	3	-	2
CO2	3	3	2	2	-	1	-	-	-	-	2	3	-	2
CO3	3	3	2	2	-	1	-	-	-	1	2	3	-	2
CO4	3	3	2	2	-	1	-	-	-	1	2	3	-	2
CO5	3	3	2	2	-	1	-	-	-	1	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1947	INTERNET OF THINGS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To explain the applications, devices, protocols, and communication models used in IoT systems for mechanical engineering.
- To select and implement IoT simulation hardware platforms relevant to mechanical engineering applications.
- To apply interfacing and communication technologies in the integration of IoT devices within mechanical systems.
- To demonstrate the process of IoT application development and ensure the security of the IoT ecosystem in mechanical engineering.
- To evaluate the current and future domain-specific applications of IoT in the field of mechanical engineering.

UNIT - I INTRODUCTION TO THE INTERNET OF THINGS (IOT) 9

.Overview, History, Definition and Characteristics, Connectivity Terminologies, Building blocks, Types of technologies used in IoT System, Baseline Technologies (Machine-to-Machine (M2M) communications, Cyber-Physical-Systems (CPS)), IoT Vs M2M, IoT enabled Technologies, IoT Levels and Templates, Design Methodology, The Physical Design Vs Logical Design of IoT, Functional blocks of IoT and Communication Models/Technologies, Development Tools used in IoT, IoT Architecture and Protocols, Various Platforms for IoT, Real time Examples of IoT, Challenges in IoT, The process flow of an IoT application, Evolution of Connected Devices, Applications of IoT, IoT Enablers, Overview of Governance, Privacy and Security Issues.

UNIT - II IOT SIMULATION ENVIRONMENT HARDWARE PLATFORMS AND ENDPOINT INTERFACING 9

IoT supported Hardware platforms: Introduction to IoT Simulation Environment and Devices (Raspberry Pi, Espressif Processors, Arduino), Architecture, Setup, IDE, Installation, Interfaces (serial, SPI, I2C), Programming with focus on interfacing for reading input from pins, connecting external gadgets/sensors/actuators, Controlling and Displaying Output, Libraries, Basics of Embedded C programming, Interfacing: Interfacing Input, Intermediate, Output and Display Sensors, Converters, Actuators, Controlling Hardware, Controllers and Network Devices, IoT Architecture: Building architecture and Open source architecture (OIC), Main design principles and needed capabilities, An IoT architecture outline, Standards Considerations

UNIT - III INTERFACING AND COMMUNICATION FOR BUILDING IOT APPLICATIONS 9

Communication: Overview and Working of Controlled Systems, Connectivity models - TCP/IP Vs OSI model, IoT Communication Models, IoT Communication APIs, Serial Vs Parallel Communication, Wires Vs Wireless Communication, their Technologies and Hardware

IoT Communication Protocols: Protocol Standardization for IoT, Role of M2M in IoT, M2M Value Chains, IoT Value Chains, M2M and WSN Protocols (SCADA and RFID)

Physical Servers and Cloud Platforms: Web server, Posting sensor(s) data to web server, Introduction to Cloud Storage models and Communication APIs Webserver, API Virtualization concepts and Cloud Architecture, Advantages and limitations of Cloud

computing, IoT Cloud platforms, Cloud services.

UNIT - IV IOT APPLICATION DEVELOPMENT AND SECURITY OF IOT ECOSYSTEM **9**

Application Protocols: MQTT, REST/HTTP, SQL Back-end Application Designing (Designing with Apache, MySQL, HTML, CSS), Non SQL Back-end Application Designing (MongoDB Object Type Database, jQuery for UI Designing), JSON lib for data processing.

Security: Need of security in IoT, Security & Privacy during development, Privacy for IoT enabled devices, IoT security for consumer devices, Security levels, protecting IoT devices, Security, Privacy and Trust in IoT-Data-Platforms

UNIT - V PRESENT AND FUTURE DOMAIN SPECIFIC APPLICATIONS OF IOT ECOSYSTEM **9**

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, Business, Manufacturing, Smart Homes/Home automation, Surveillance applications, Connected Vehicles, Agriculture, Healthcare, Activity Monitoring, Retail, Logistics, Security, Health and Lifestyle, Legal challenges, IoT in Environmental Protection Modern Day IoT Applications, Smart Grid, Smart Cities - Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities

Future: Future IoT ecosystem, Need of powerful core for building secure algorithms, Examples for new trends (AI, ML penetration to IoT)

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the Applications/Devices, Protocols and Communication Models of IoT.
CO2: Analyze and Select commonly used IoT Simulation Hardware platforms.
CO3: Analyze the Application of Interfacing and Communication Technologies for IoT.
CO4: Analyze the IoT Application development and Security of IoT Ecosystem.
CO5: Analyze the Present and Future Domain specific Applications of IoT Ecosystem.

TEXT BOOKS

1. Bahga, A. and Madisetti, V., (2015), “Internet of Things - A Hands-on Approach,” Universities Press, ISBN: 9788173719547.
2. Hajjaj, S S H. and Gsangaya, K. R., (2022), “The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers,” CRC Press, ISBN: 9781032110950.
3. Raj, P. and Raman, A. C., (2017), “The Internet of Things: Enabling Technologies, Platforms, and Use Cases,” Auerbach Publications/CRC Press, ISBN: 9781498761284
4. Adrian McEwen, A. and Cassimally, H., (2013), “Designing the Internet of Things,” John Wiley and Sons, ISBN:
5. Veneri, G., Capasso, A., (2018), “Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0,” Packt Publishing, ISBN: 9781789537222.
6. Hersent, O, Boswarthick, D., Elloumi, O., (2012), “The Internet of Things: Key Applications and Protocols”, Wiley, ISBN: 9781119994350 .
7. Uckelmann, D., Harrison, M., Michahelles, F., (2011), “Architecting the Internet of

Things," Springer, ISBN: 9781119994350.

REFERENCE BOOKS

1. DaCosta, F., (2013), "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications, ISBN: 9781430257417.
2. Waher, P., (2015), "Learning Internet of Things," Packt Publishing, ISBN: 9781783553532.
3. Ida, N., (2020), "Sensors, Actuators and Their Interfaces," SciTech Publishers, ISBN: 9781785618352.
4. Pfister, C., (2011), "Getting Started with the Internet of Things," O'Reilly Media, ISBN: 9781449393571.
5. Elangovan, U., (2019), "Smart Automation to Smart Manufacturing: Industrial Internet of Things," Momentum Press, ISBN: 9781949449266.
6. Jha, S., Tariq, U., Joshi, G. P., Solanki, V. K., (2022), "Industrial Internet of Things: Technologies, Design, and Applications," CRC Press, ISBN: 9780367607777
7. Schwartz, M., (2016), "Internet of Things with Arduino Cookbook," Packt Publishing, ISBN: 9781785286582.
8. Kurniawan, A., (2019), "Internet of Things Projects with ESP32: Build exiting and powerful IoT projects using the all-new Expresif ESP32," Packt Publishing, ISBN: 9781789956870.

WEB REFERENCES

1. http://playground.arduino.cc/Projects/Ideas
2. http://www.megunolink.com/articles/arduino-garage-door-opener
3. http://www.willward1.com/arduino-wifi-tutorial
4. http://www.toptechboy.com/arduino-lessons
5. https://www.eprolabs.com
6. http://www.makeuseof.com/tag/pi-overdose-heres-5-raspberry-pi-alternatives

ONLINE COURSES / RESOURCES:

1. https://nptel.ac.in/courses/106105166
2. https://www.udemy.com/internet-of-things-iot-for-beginners-getting-started/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	2	1	-	-	-	-	2	3	-	2
CO2	2	-	-	-	2	1	-	-	-	-	2	3	-	2
CO3	2	-	-	-	2	1	-	-	1	-	2	3	-	2
CO4	2	-	-	-	2	1	-	-	1	-	2	3	-	2
CO5	2	-	-	-	2	1	-	-	1	-	2	3	-	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1948	MACHINE VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand machines to visually inspect objects for quality control, sorting, or measurement tasks.
- To understand the fundamental principles of colour systems, light sources, and lighting techniques.
- To understand techniques for processing binary and gray scale images.
- To understand and compare different classification methods.
- To explore the applications of imaging and classification technologies in various industries.

UNIT - I INTRODUCTION TO MACHINE VISION 9

Machine Vision use of machine vision – tasks for a vision system – relation to other fields – place of vision in CIM.

UNIT - II IMAGE ACQUISITION AND CONVERSION 9

Colour systems – light sources – lighting techniques – image formation by lensing – image scanning – television cameras – sensors, charge coupled devices – camera and system interface – frame buffers and frame grabbers – digital and smart cameras.

UNIT - III PATTERN RECOGNITION 9

Processing of binary images – thresholding, geometrical properties, topological properties – processing of gray scale images statistical operations, spatial operations, segmentation edgedetection, morphological operations – image analysis – factors extraction – decision making.

UNIT - IV MACHINE VISION APPLICATIONS 9

Fundamentals – parametric classifiers – nonparametric, classifiers nearest neighbour CART, neural networks, generic classifiers.

UNIT - V ISOPARAMETRIC FORMULATION 9

Applications in user industries automotive, semiconductor, electronic manufacturing, printingindustries etc. – generic applications founding manufacturing metrology, inspection assemblyverification – application analysis and implementation.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the basics of machine vision.
CO2: Analyze the image acquisition and conversion techniques.
CO3: Apply the image processing techniques.
CO4: Apply the machine vision techniques to pattern recognizing.
CO5: Apply the machine vision in manufacturing industries in process implementation, assembly.

TEXT BOOKS

1. Milan Sonka, Vaclav Hlavac, Roger Boyie, "Image Processing Analysis and machine vision" Cengage Learning India Pvt Ltd (2008)

REFERENCE BOOKS

1. Richard O.Duda, Peter E. Hurt, Pattern Classification and Scene Analysis Publisher, 1973
2. Rafael C. Gonzaies, Richard E. Woods, Digital Image processing publisher, 1992
3. Nellazuech, 'Understanding & applying machine vision Marceldekker Inc. 2000.

WEB REFERENCES

1. https://nptel.ac.in/courses/106105216
2. https://nptel.ac.in/courses/108103174
3. https://www.coursera.org/courses?query=computer%20vision management/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	1	1	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	1	-	-	-	-	-	-	-	-	2	1	-	2
CO3	3	3	2	2	1	-	-	1	1	1	2	3	1	2
CO4	3	3	2	2	1	-	-	1	1	1	2	3	1	2
CO5	3	3	2	2	1	-	-	1	1	1	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1949	ADVANCED VEHICLE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand the basic concepts of electric vehicle and their characteristics.
- To understand different types of motors and the selection of motor for vehicle applications.
- To understand different sensors and systems used in autonomous andconnected vehicles.
- To analyze networking with sensors and systems.
- To analyze the modern methods of diagnosing on-board the vehicle troubles.

UNIT - I ELECTRIC VEHICLES 9

EV architectures, advantages and disadvantages, Electrical and mechanical energy storagetechnologies, battery management. Performance of Electric Vehicles, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving.

UNIT - II ELECTRIC VEHICLE MOTORS 9

Electric Propulsion basics, motor capacity determination, Induction motor, DC motor, Permanent Magnet Motor, Switch Reluctance Motor, Configuration, Characteristics, Performance and control of Drives.

UNIT - III AUTONOMOUS AND CONNECTED VEHICLES 9

Vehicle-to-Vehicle Technology, Vehicle to Road and Vehicle to Vehicle Infrastructure, Basic Control System, Surroundings Sensing Systems, Role of Wireless Data Networks, Advanced Driver Assistance Systems, Basics of Radar System, Ultrasonic Sonar Systems, Lidar System, Camera Technology, Basics of Wireless Technology, Receiver System.

UNIT - IV AUTOMOTIVE NETWORKING 9

Bus Systems – Classification, Applications in the vehicle, Coupling of networks, networked vehicles, Buses - CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces.

UNIT - V ON-BOARD TESTING 9

Integration of Sensor Data to On-Board Control Systems (OBD), OBD requirements, certification, enforcement, systems, testing, Catalytic converter and Exhaust Gas Recirculation system monitoring, Introduction to Cyber-physical system.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the electric vehicles and their importance in automotive.
CO2: Analyze the characteristics and the selection of traction motor.
CO3: Analyze the vehicle-to-vehicle and autonomous technology.
CO4: Analyze networking of various modules in automotive systems, communication protocols.
CO5: Analyze the modern methods of diagnosing on-board the vehicle troubles.

TEXT BOOKS

1. John G Hayes and G AbaasGoodarzi, Electric Powertrain -, 1st Edition, John Wiley &SonsLtd., 2018.
2. Hussain T Mouftah, Melike Erol-kantarci and Samesh Sorour, “Connected and AutonomousVehicles in Smart Cities”, CRC Press, 1st Edition, 2020.

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1. Dominique Paret, Multiplexed Networks for Embedded Systems, John Wiley & Sons Ltd., 2007.
2. Hong Cheng, —Autonomous Intelligent Vehicles: Theory, Algorithms &Implementation‖, Springer, 2011
3. Advanced Technology Vehicles Manufacturing (ATVM) Loan Program (Energy Science.
4. Engineering and Technology: Congressional Policies, Practices and Procedures)by Andrew MWright and Harrison R Scott | 5 September 2012
5. Advanced Vehicle Technology by Heinz Heisler MSc BSc FIMI MIRTE MCIT | 17 July 2002.
6. Advanced Motorsport Engineering: Units for Study at Level 3by Andrew Livesey | 1 September 2011.

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1. https://en.wikipedia.org/wiki/Electric_vehicle

ONLINE COURSES / RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ee112/course
2. https://www.udemy.com/course/electric-vehicles-comprehensive-course/

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	1	-	-	-	-	2	1	-	2
CO2	3	3	2	2	-	1	-	-	-	-	2	1	-	2
CO3	3	3	2	2	-	1	-	-	-	-	2	3	1	2
CO4	3	3	2	2	-	1	-	-	-	-	2	3	1	2
CO5	3	3	2	2	-	1	-	-	-	-	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**

23ME1950	NON DESTRUCTIVE TESTING AND EVALUATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

- To understand NDT methods and how they detect defects and characterize materials.
- To understand liquid penetrant and magnetic particle testing, including their procedures and limitations..
- To understand thermography and eddy current testing methods and their applications.
- To understand ultrasonic testing and acoustic emission methods and how data is represented.
- To understand radiography principles, imaging techniques, and safety precautions.

UNIT - I OVERVIEW OF NDT 9

NDT Versus Mechanical testing - Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation - Relative merits and limitations - Various physical characteristics of materials and their applications in NDT - Visual inspection – Unaided and aided.

UNIT - II SURFACE NDE METHODS 9

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants - Developers - Advantages and limitations of various methods - Testing Procedure - Interpretation of results - Case study.

Magnetic Particle Testing- Theory of magnetism - Inspection materials - Magnetisation methods - Interpretation and evaluation of test indications - Principles and methods of demagnetization - Residual magnetism.

UNIT - III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 9

Thermography - Principles - Contact and non-contact inspection methods - Techniques for applying liquid crystals - Advantages and limitations - Infrared radiation and infrared detectors - Instrumentations and methods - Applications.

Eddy Current Testing - Generation of eddy currents - Properties of eddy currents - Eddy current sensing elements - Probes - Instrumentation - Types of arrangement - Applications, advantages, Limitations - Interpretation/Evaluation.

UNIT - IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 9

Ultrasonic Testing - Principle - Transducers - Transmission and pulse-echo method - Straight beam and angle beam - Instrumentation - Data representation - A/Scan, B-scan, C-scan. Phased Array Ultrasound - Time of Flight Diffraction - Case study.

Acoustic Emission Technique – Principle - AE parameters - Applications.

UNIT - V RADIOGRAPHY (RT) 9

Principle - Interaction of X-Ray with matter - Imaging - film and film less techniques - types and use of filters and screens - Geometric factors - Inverse square law - Characteristics of films - graininess, density, speed, contrast - Characteristic curves - Penetrameters - Exposure charts - Radiographic equivalence - Fluoroscopy- Xero-Radiography - Computed Radiography -Precautions against radiation hazards.

TOTAL : 45 PERIODS

COURSE OUTCOME(S):

Upon completion of the course, students will be able to

CO1: Analyze the principles and applications of NDT methods for detecting defects and material characterization.

CO2: Analyze the procedures and limitations of liquid penetrant and magnetic particle testing.

CO3: Apply thermography and eddy current testing to inspect materials.

CO4: Apply ultrasonic testing and acoustic emission methods to evaluate materials.

CO5: Analyze radiographic images to assess material integrity and identify defects.

TEXT BOOKS

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2014.
2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010.

REFERENCE BOOKS

1. ASNT, American Society for Non-Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing
2. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.
3. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005.

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ONLINE COURSES / RESOURCES:

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2. https://www.udemy.com/topic/nondestructive-testing-ndt/?srsltid=AfmBOoqW8Gs4eV0HnHnq6vNPVp4ICfHSVX4qyHfiJAfOMaf0_u6D1Cse
3. https://www.udemy.com/course/introduction-to-ultrasonic-inspection/
4. https://www.edx.org/learn/engineering/purdue-university-fundamentals-of-non-destructive-testing

CO-PO MAPPING

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CO1	1	-	-	-	-	-	-	-	-	-	2	1	-	2
CO2	1	-	-	-	1	-	-	-	-	-	2	1	-	2
CO3	3	2	2	2	1	-	-	-	-	1	2	3	1	2
CO4	3	2	2	2	1	-	-	-	-	1	2	3	1	2
CO5	3	2	2	2	1	-	-	-	-	1	2	3	1	2

Internal Assessment				**End Semester Examinations**
Assessment I (100 Marks)		**Assessment II (100 Marks)**		
Individual Assignment / Case Study / Seminar / Mini Project	**Written Test**	**Individual Assignment / Case Study / Seminar / Mini Project**	**Written Test**	**Written Examinations**
40	60	40	60	100
40%				**60 %**