SYLLABUS

B. Tech.

MECHANICAL ENGINEERING

2024 SCHEME

ST. JOSEPH'S
COLLEGE OF ENGINEERING AND TECHNOLOGY, - PALAI -
AUTONOMOUS

Vision

Developing into a world class, pace setting institute of Engineering and Technology with distinct identity and character, meeting the goals and aspirations of the society.

Mission

- To maintain a conducive infrastructure and learning environment for world class education.
- To nurture a team of dedicated, competent and research-oriented faculty.
- To develop students with moral and ethical values, for their successful careers, by offering variety of programs and services.

Department of
Mechanical Engineering

Vision

To develop into a center for imparting knowledge and technical skills of international standards, in Mechanical Engineering.

Mission

- To follow a teaching-learning process, with the support of qualified and committed faculty, in undergraduate and post graduate Mechanical Engineering programs.
- To establish an infrastructure and academic ambience for collaborating with Industry, Academia and Community to serve local and national enterprises.
- To make the students self-learners and socially committed engineers, for individual and collective accomplishments.

Program Specific Outcomes (PSOs):

Graduates of the program will be able to:

- Apply Mechanical Engineering knowledge and skills to develop optimum solutions to problems in the areas of Design, Thermal, Manufacturing, Industrial Engineering and Management.
- Identify and adopt advancements in Mechanical engineering for academic, industrial and societal applications.

Programme Outcomes (POs)

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 analyse 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 design of 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: Analyse 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)

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Semester III

THIRD SEMESTER (July-December)														
Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./ Week
						L	T	P	R		CIE	ESE		
1	A	24SJGYMAT301	BSC	GC	Mathematics for Electrical Science and Physical Science -3	3	0	0	0	4.5	40	60	3	3
2	B	24SJPCMET302	PC	PC	Mechanics of Solids	3	1	0	0	5	40	60	4	4
3	C	24SJPCMET303	PC	PC	Fluid Mechanics and Machinery	3	1	0	0	5	40	60	4	4
4	D	24SJPBMET304	PC-PBL	PB	Manufacturing Processes	3	0	0	1	5.5	60	40	4	4
5	F	24SJGYEST305	ESC	GC	Introduction to Artificial Intelligence and Data Science	3	1	0	0	5	40	60	4	4
6	G S3/ S4	24SJICHUT346	HMC	IC	Economics for Engineers	2	0	0	0	3	50	50	2	2
		24SJICHUT347			Engineering Ethics and Sustainable Development									
7	L	24SJPCMEL307	PCL	PC	Computer Aided Machine Drawing and Modelling	0	0	3	0	1.5	50	50	2	3
8	Q	24SJPCMEL308	PCL	PC	Material Testing Lab	0	0	3	0	1.5	50	50	2	3
9	R/M		VAC		REMEDIAL / MINOR COURSE	3	1	0	0	5			4*	4*
Total										**31 /36**			**25 /29***	**27 /31***

MATHEMATICS FOR ELECTRICAL SCIENCE AND PHYSICAL SCIENCE – 3

Course Code	24SJGYMAT301	**CIE Marks**	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	**ESE Marks**	60
Credits	3	**Exam Hours**	2 Hrs. 30 Min.
Pre-requisites (if any)	Basic knowledge in complex numbers	**Course Type**	Theory

Course Objectives:

- To introduce the concept and applications of Fourier transforms in various engineering fields.
- To introduce the basic theory of functions of a complex variable, including residue integration and conformal transformation, and their applications

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		**Bloom's Knowledge Level (KL)**
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	K3
CO2	Understand the analyticity of complex functions and apply it in conformal mapping.	K3
CO3	Apply Cauchy's integral theorem and Cauchy's integral formula to compute complex integrals.	K3
CO4	Understand the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	K3

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

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**
CO1	3	3	-	2	-	-	-	-	-	-	2	1	-
CO2	3	3	-	2	-	-	-	-	-	-	2	1	-
CO3	3	3	-	2	-	-	-	-	-	-	2	1	-
CO4	3	3	-	2	-	-	-	-	-	-	2	1	-

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Fourier Integral, From Fourier series to Fourier Integral, Fourier Cosine and Sine integrals, Fourier Cosine and Sine Transforms, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative. *(Text 1: Relevant topics from sections 11.7, 11.8, 11.9)*	9	1
2	Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of w= z^2 , $w=e^z$, $w = \frac{1}{z}$, $w= sinz$. *(Text 1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)*	9	2
3	Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof). *(Text 1: Relevant topics from sections 14.1, 14.2, 14.3)*	9	3
4	Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of cosθ and sinθ. *(Text 1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)*	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Advanced Engineering Mathematics	Erwin Kreyszig	John Wiley & Sons	10th edition, 2016

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Complex Analysis	Dennis G. Zill, Patrick D. Shanahan	Jones & Bartlett	3rd edition, 2015
2	Higher Engineering Mathematics	B. V. Ramana	McGraw-Hill Education	39th edition, 2023
3	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	44th edition, 2018
4	Fast Fourier Transform - Algorithms and Applications	K.R. Rao, Do Nyeon Kim, Jae Jeong Hwang	Springer	1st edition, 2011

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Fourier series & Fourier Transforms	https://onlinecourses.nptel.ac.in/noc23_ma89/unit?unit=95&lesson=96
2	Complex function, Cauchy Riemann Equations	https://onlinecourses.nptel.ac.in/noc25_ma02/preview

MECHANICS OF SOLIDS

Course Code	24SJPCMET302	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- To acquaint with the basic concepts of stress and deformation in solids.
- To practice the methodologies to analyse stresses and strains in simple structural members, and to apply the results in simple design problems.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Determine the stresses and strains in deformable bodies subjected to different types of external loads and thermal effects.	K3
CO2	Analyse the torsion of circular bars and draw the shear force and bending moment diagrams for beams.	K4
CO3	Determine the stresses and deflections in beams subjected to transverse loads.	K3
CO4	Determine analytically and graphically the principal stresses and planes for structural members subjected to loads and analyse the strength of columns.	K4

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2	-	-	-	-	-	-	-	-	3	2
CO2	3	3	2	-	-	-	-	-	-	-	-	3	2
CO3	3	3	2	-	-	-	-	-	-	-	-	3	2
CO4	3	3	2	-	-	-	-	-	-	-	-	3	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Introduction to analysis of deformable bodies**. Stress – Stresses due to normal, shear, and bearing loads. Strain – Linear and Shear strains. Hooke's law, Stress-Strain diagrams, concepts of isotropy, orthotropy, anisotropy. Young's Modulus, Bulk Modulus and Rigidity Modulus. Poisson's ratio. Relationship between elastic constants. Deformation in axially loaded bars – uniform cross section, varying cross section, dissimilar materials, principle of superposition. Thermal effects – simple and composite bars.	11	1
2	**Torsion in Shafts:** Torsion theory of elastic circular bars – assumptions and limitations – torsion formula – polar modulus - torsional rigidity. Shaft design for torsional load. **Beams:** Classification – Diagrammatic conventions for supports and loading. Differential equations between load, Shear Force and Bending Moment. Shear Force and Bending Moment Diagrams of cantilever and simply supported beam with point load/UDL. Point of Inflection.	11	2
3	**Stresses in Beams:** Pure Bending – Flexure formula for beams - assumptions and limitations – section modulus – flexural rigidity – derivation and problems for rectangular section only. **Deflection of Beams:** Moment-Curvature relation – assumptions and limitations. Double Integration method, Macaulay's method.	11	3
4	Stress on an inclined plane due to Uniaxial stress – Stress on an inclined plane due to Biaxial stress – Stress on an inclined plane due to two Normal Stresses accompanied by Shear stresses – principal planes and stresses. Mohr's circle of stress. Buckling and stability of long columns – Euler's buckling / crippling load for columns with different end conditions – Euler equation derivation for both ends hinged only – Rankine's formula for columns.	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanics of Solids	R.K. Bansal	Laxmi Publications	2012
2	Mechanics of Solids	S. S. Bhavikatti	New Age International	2013
3	Strength of Materials	Surendra Singh	S. K. Kataria & Sons	2013
4	Strength of Materials	Rattan	McGraw Hills	2011

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanics of materials	R. C. Hibbeler	Pearson Higher Education	2018
2	Engineering Mechanics of Solids	Popov E.	PHI	2002
3	Mechanics of Materials	Beer & Johnston	McGraw Hills	2017
4	Mechanics of Materials	Pytel A. and Kiusalaas J.	Cengage Learning India Private Limited,	2015

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Introduction to Mechanics of solids	https://archive.nptel.ac.in/courses/112/107/112107146/
2	Torsion, Forces & moments transmitted by slender members	https://archive.nptel.ac.in/courses/105/104/105104160/
3	Stresses and deflection due to bending	https://archive.nptel.ac.in/courses/105/105/105105108/
4	Principal stresses, Column buckling	https://archive.nptel.ac.in/courses/105/104/105104160/

FLUID MECHANICS AND MACHINERY

Course Code	24SJPCMET303	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- To establish fundamental knowledge of basic fluid mechanics and its simple applications.
- To familiarize students with the relevance of turbo machines and find solutions to the associated engineering problems.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Identify the fundamental fluid properties, their relationships and apply them to estimate the fluid pressure and hydrostatic forces on bodies.	K3
CO2	Classify the fluid flow and apply the principles of kinematics and dynamics using the conservation of mass and momentum equations.	K3
CO3	Analyse viscous flow through pipes by estimating major and minor losses, understand the basic concepts of boundary layer formation and dimensional analysis.	K3
CO4	Select suitable turbo machine for specific application by identifying the pertinent parameters.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	2	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	-	-	-	-	-	-	-	-	-	3	-

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Properties of fluids**: specific gravity, specific weight, specific volume, dynamic and kinematic viscosity. **Introduction to fluid mechanics** - types of fluids, Newton's law of viscosity. **Pressure measurement:** Fluid pressure, pressure head. Types of pressures measurements, Piezometer, simple and differential manometers. **Fluid statics:** pressure, density, height relationship, centre of pressure, hydrostatic force and pressure on plane and inclined surfaces. Buoyancy and Metacentre. Stability of immersed and floating bodies.	10	1
2	**Fluid kinematics:** Description of fluid motion – Types of flows, Material derivative velocity and acceleration – Streamlines, path lines and streak lines, Stream function and velocity potential function, flow net. **Fluid dynamics**: Continuity equation, Euler's, and Bernoulli's equations. – Flow Measuring instruments – Pitot tube, Orificemeter, Venturimeter, Rectangular and Triangular Notches-(notches Problems not required).	10	2
3	**Pipe flow** – laminar and turbulent flows, significance of Reynolds number, shear stress and velocity distribution in a pipe flow– Hagen-Poiseullie equation, Darcy-Weisbach equation and Chezy's equation, Moody's chart for estimating frictional losses, Major and minor energy losses, hydraulic gradient, and total energy line. Navier-Stokes equation and explanation (without proof). Dimensional analysis using Buckingham's π theorem. Boundary layer theory: Qualitative comparison between laminar and turbulent boundary layer. Boundary layer separation.	12	3
4	**Impact of jets:** Impact of jet on fixed vertical, moving vertical flat plates. Impact of jet on curved vanes – fixed and moving. Velocity triangles. Classification of Turbines and pumps, Comparison and examples. Pelton, Francis and Kaplan Turbines: Principle and working, head, work done, efficiencies (Problems using velocity triangles not required). **Centrifugal Pumps:** Principle and working, head, work required, efficiencies, Priming and cavitation. (Problems using velocity triangles not required). **Reciprocating Pump:** Principle and working – slip, negative slip, work required and efficiency.	12	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fluid Mechanics	Cengel Y. A. and J. M. Cimbala	Tata McGraw Hill	2013
2	Introduction to Fluid Mechanics and Fluid Machines	Som S.K.	McGraw Hill Education India	2011
3	Fluid Mechanics and Hydraulic Machines	Bansal R.K.	Laxmi Publications	2005

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fluid Mechanics	White F.M.	Tata McGraw Hill	2003
2	Engineering applications of Fluid dynamics	Fisher and Henly	Willford Press	2023
3	Fox and McDonald's Introduction to Fluid Mechanics	John W. Mitchell	Wiley	2020

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Fluid Statics	https://youtu.be/rY7bvZn75Do
	Buoyancy, Metacentre and stability	https://youtu.be/gMuucNxc7eI?feature=shared
2	Fluid kinematics	https://youtu.be/rY7bvZn75Do
3	Internal Viscous Flow	https://youtu.be/qLx7ip0eBps
4	Introduction to turbomachines	https://youtu.be/ocVzrn4DLj8

MANUFACTURING PROCESSES

Course Code	24SJPBMET304	CIE Marks	60
Teaching Hours/Week (L:T:P:R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- To gain both theoretical and practical knowledge of traditional manufacturing processes, understand the dependent and independent variables that govern them, and develop practical, cost-effective solutions for real-world problems.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe the fundamental processes and methods involved in casting and powder metallurgy.	K2
CO2	Explain the principles of major welding processes and identify common weld defects and factors affecting weldability.	K2
CO3	Explain the principles of rolling and sheet metal forming processes, including types of rolling and sheet metal techniques and their manufacturing applications.	K2
CO4	Explain the principles of extrusion, drawing, bending, and forging processes, and identify common defects.	K2
CO5	Develop products, processes or technologies for socially relevant applications.	K3, K4, K5

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	-	-	-	-	-	-	-	-	-	2	2

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	General Classification of Manufacturing Processes. **Casting**-Characteristics of sand, design of patterns, cores, chaplets, solidification of metals and Chvorinov's rule, elements of gating system, risers, chills, numerical problems, defects in castings. **Special casting process**- Shell moulding, precision investment, die casting, centrifugal casting, continuous casting and squeeze casting. **Powder Metallurgy**- Powder Production, powder characteristics, mixing, compaction methods, sintering	11	1
2	**Welding**: Classification, Fusion and Solid-state welding processes. **Gas Welding** - Oxyacetylene welding-chemistry, types of flame and its applications **Arc welding-** applications, process parameters, numerical problems, consumable and non-consumable arc welding, SMAW; GTAW; GMAW; SAW; AHW; PAW. Thermit welding, friction welding, electro slag welding, ultrasonic welding, electron beam welding, laser beam welding **Resistance welding**-applications, process parameters, numerical problems Heat Affected Zone, weldability of ferrous and non-ferrous metals, residual stresses and distortion, defects in welding Brazing - soldering - adhesive bonding	11	2
3	**Metal Forming:** Plastic deformation and yield criteria – hot and cold working processes **Rolling-** Flat-rolling process, rolling force and power, numerical problems, types of rolling mills, rolling defects, miscellaneous rolling processes. **Sheet metal operations-** Press tool operations-Shearing, Tension, Compression, Tension and compression operations, applications, numerical problems. Types of die-Progressive dies, Compound dies, and Combination dies	11	3
4	**Forging** -Forging load, numerical problems, Various methods, applications, defects in forging – Wire, Rod, and tube drawing - mechanics of rod and wire drawing, drawing force and power, numerical problems, drawing defects – Deep drawing. **Bending** – Details of bending, Determination of work load, estimation of spring back, numerical problems. **Extrusion-** Metal flow, mechanics of extrusion, numerical problems, miscellaneous processes, defects in extrusion, applications	11	4

Course Assessment Method (CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
➢ 2 Questions from each module. ➢ Total of 8 Questions, each carrying 2 marks. **(8x 2 = 16 marks)**	➢ Two questions will be given from each module, out of which one question should be answered. ➢ Each question carries 6 marks ➢ Each question can have a maximum of 2 sub divisions. **(4x6 = 24 marks)**	**40**

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/ Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone, Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Poster Presentation / Video Presentation: Students present their results in a 2 to 5 minutes video

Assessment and Evaluation for Project Activity

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5

6	Project Quality, Innovation and Creativity	3
Total		**30**

Project Assessment and Evaluation criteria (30 Marks)

1. **Project Planning and Proposal (5 Marks)**
   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology

2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
   - Individual contribution to the presentation
   - Effectiveness in answering questions and handling feedback

3. **Involvement in the Project Work and Team Work (3 Marks)**
   - Active participation and individual contribution
   - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**
   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving
   - Final Result

5. **Final Presentation (5 Marks)**
   - Quality and clarity of the overall presentation
   - Individual contribution to the presentation
   - Effectiveness in answering questions

6. Project Quality, Innovation, and Creativity (3 Marks)
   - Overall quality and technical excellence of the project
   - Innovation and originality in the project
   - Creativity in solutions and approach

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Manufacturing Science	Amitabha Ghosh Asok Kumar Mallik	Affiliated East-West Private Limited	2nd Edition 2010
2	Manufacturing Engineering and Technology	Serope Kalpakjian Steven, R. Schmid	Pearson	8th Edition 2023
3	Manufacturing Technology Volume -1	P N Rao	Tata McGraw Hill	3rd Edition 2001
6	A text book on Manufacturing Technology	R. K Rajput	Laxmi Publications (P) Ltd	2nd Edition 2007

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	American Society for Metals - ASM Metals Handbook, Vol. 14	Joseph R. Davis, S. L. Semiatin,	Forming and Forging ASM International	1989
2	Mechanical Metallurgy	George E Dieter	MGH Education (India)	Eds. 3, 2013.
3	Cold and Hot Forging Fundamentals and Applications	Taylan Altan, Gracious Ngaile, Gangshu Shen	ASM International	2004
4	Foundry Technology	Peter Beeley	Butterworth-Heinemann	
5	Materials and Processes in Manufacturing,	E P DeGARMO, J T Black and R. A Kohser	PHI	8th Eds, 2003.

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Casting	• https://archive.nptel.ac.in/courses/112/107/112107219/ • https://archive.nptel.ac.in/courses/112/107/112107144/
2	Welding	• https://archive.nptel.ac.in/courses/112/107/112107144/ • https://www.youtube.com/watch?v=uRVaLUQUmA8&list=PLACB124F79F677B6A
3	Rolling & Sheet metal operations	• https://www.youtube.com/watch?v=HSn3G3r69QE&list=PLLy_2iUCG87AMeXL_nGl5_6-L-hD8IK6i
4	Forging, Wire drawing, Bending, Extrusion	• https://www.youtube.com/watch?v=HSn3G3r69QE&list=PLLy_2iUCG87AMeXL_nGl5_6-L-hD8IK6i

INTRODUCTION TO ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Course Code	24SJGNEST305	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- Demonstrate a solid understanding of advanced linear algebra concepts, machine learning algorithms and statistical analysis techniques relevant to engineering applications, principles and algorithms.
- Apply theoretical concepts to solve practical engineering problems, analyze data to extract meaningful insights, and implement appropriate mathematical and computational techniques for AI and data science applications.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concept of machine learning algorithms including neural networks and supervised/unsupervised learning techniques for engineering applications.	K3
CO2	Apply advanced mathematical concepts such as matrix operations, singular values, and principal component analysis to analyze and solve engineering problems.	K3
CO3	Analyze and interpret data using statistical methods including descriptive statistics, correlation, and regression analysis to derive meaningful insights and make informed decisions.	K3
CO4	Integrate statistical approaches and machine learning techniques to ensure practically feasible solutions in engineering contexts.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	3	3	-	-	-	-	-	-	-	2	1
CO2	3	3	3	3	-	-	-	-	-	-	-	3	1
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Introduction to AI and Machine Learning:** Basics of Machine Learning - Supervised Learning, Unsupervised Learning, Reinforcement Learning (Basics only) -types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression-unsupervised model example- K-means clustering. Artificial Neural Network- Perceptron- Universal Approximation Theorem (statement only)- Multi-Layer Perceptron- Deep Neural Network (definition only)- demonstration of regression and classification problems using MLP. (Text-2)	11	1
2	**Mathematical Foundations of AI and Data science:** Role of linear algebra in Data representation and analysis - Vectors, Matrices, Matrix Multiplication and Transformation – Matrix decomposition- Singular Value Decomposition (SVD)- Spectral decomposition- Dimensionality reduction technique-Principal Component Analysis (PCA). (Text-1)	11	2
3	**Applied Probability and Statistics for AI and Data Science:** Basics of probability- Sample Space, Event, Probability of an Event - random variables and statistical measures - rules in probability- Addition rule, Multiplication rule, Complementary rule - Bayes theorem and its applications- statistical estimation-Maximum Likelihood Estimator (MLE) - statistical summaries- Correlation analysis- linear correlation (direct problems only)- regression analysis- linear regression (using least square method) (Text book 4)solutions.	11	3
4	**Basics of Data Science:** Benefits of data science-use of statistics and Machine Learning in Data Science- data science process - applications of Machine Learning in Data Science- modelling process- demonstration of ML applications in data science- Big Data and Data Science. (For visualization the software tools like Tableau, PowerBI, R or Python can be used. For Machine Learning implementation, Python, MATLAB or R can be used.) (Text book-5)	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Miniproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can

choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Linear Algebra	Gilbert Strang	Wellesley-Cambridge Press	6th edition, 2023
2	Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow	Aurélien Géron	O'Reilly Media, Inc.	2nd edition,2022
3	Mathematics for machine learning	Deisenroth, Marc Peter, A. Aldo Faisal, and Cheng Soon Ong	Cambridge University Press	1st edition. 2020
4	Fundamentals of mathematical statistics	Gupta, S. C., and V. K. Kapoor	Sultan Chand & Sons	9th edition, 2020
5	Introducing data science: big data, machine learning, and more, using Python tools	Cielen, Davy, and Arno Meysman	Simon and Schuster	1st edition, 2016

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Data science: concepts and practice	Kotu, Vijay, and Bala Deshpande	Morgan Kaufmann	2nd edition, 2018
2	Probability and Statistics for Data Science	Carlos Fernandez-Granda	Center for Data Science in NYU	1st edition, 2017
3	Foundations of Data Science	Avrim Blum, John Hopcroft, and Ravi Kannan	Cambridge University Press	1st edition, 2020
4	Statistics For Data Science	James D. Miller	Packt Publishing	1st edition, 2019
5	Probability and Statistics -The Science of Uncertainty	Michael J. Evans and Jeffrey S. Rosenthal	University of Toronto	1st edition, 2009
	An Introduction to the Science of	Joseph C. Watkins	chrome-extension://efaidnbmn	Preliminary Edition.

6	Statistics: From Theory to Implementation		nnibpcajpcg lclefindmkaj/https://www.math.ari zo	

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/106/106/106106198/
2	https://archive.nptel.ac.in/courses/106/106/106106198/ https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/resources/lecture-29-singular- value-decomposition/
3	https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/resources/lecture-19- video/
4	https://archive.nptel.ac.in/courses/106/106/106106198/

ECONOMICS FOR ENGINEERS

(**Course Code**	24SJICHUT346	**CIE Marks**	50
Teaching Hours/Week (L:T:P:R)	2:0:0:0	**ESE Marks**	50
Credits	2	**Exam Hours**	2 Hrs. 30 Min.
Pre-requisites (if any)	None	**Course Type**	Theory

Course Objectives:

- Understanding of finance and costing for engineering operation, budgetary planning and control
- Provide fundamental concept of micro and macroeconomics related to engineering industry
- Deliver the basic concepts of Value Engineering.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		**Bloom's Knowledge Level (KL)**
CO1	Understand the fundamentals of various economic issues using laws and learn the concepts of demand, supply, elasticity and production function.	K2
CO2	Develop decision making capability by applying concepts relating to costs and revenue, and acquire knowledge regarding the functioning of firms in different market situations.	K3
CO3	Outline the macroeconomic principles of monetary and fiscal systems, national income and stock market.	K2
CO4	Make use of the possibilities of value analysis and engineering, and solve simple business problems using break even analysis, cost benefit analysis and capital budgeting techniques.	K3

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

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO 1**	**PSO 2**
CO1	-	-	-	-	-	1	-	-	-	-	1	1	-
CO2	-	-	-	-	-	1	1	-	-	-	1	1	-
CO3	-	-	-	-	1	-	-	-	-	-	2	2	-
CO4	-	-	-	-	1	1	-	-	-	-	2	2	-

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Basic Economics Concepts - Basic economic problems – Production Possibility Curve – Utility – Law of diminishing marginal utility – Law of Demand - Law of supply – Elasticity - measurement of elasticity and its applications – Equilibrium- Changes in demand and supply and its effects Production function - Law of variable proportion – Economies of Scale – Internal and External Economies – Cobb-Douglas Production Function	6	1
2	Cost concepts – Social cost, private cost – Explicit and implicit cost – Sunk cost - Opportunity cost - short run cost curves - Revenue concepts Firms and their objectives – Types of firms – Markets - Perfect Competition – Monopoly - Monopolistic Competition - Oligopoly (features and equilibrium of a firm)	6	2
3	Monetary System – Money – Functions - Central Banking –Inflation - Causes and Effects – Measures to Control Inflation - Monetary and Fiscal policies – Deflation Taxation – Direct and Indirect taxes (merits and demerits) - GST National income – Concepts - Circular Flow – Methods of Estimation and Difficulties - Stock Market – Functions- Problems faced by the Indian stock market-Demat Account and Trading Account – Stock market Indicators- SENSEX and NIFTY solutions.	6	3
4	Value Analysis and value Engineering - Cost Value, Exchange Value, Use Value, Esteem Value - Aims, Advantages and Application areas of Value Engineering - Value Engineering Procedure - Break-even Analysis - Cost-Benefit Analysis - Capital Budgeting - Process planning	6	4

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Case study/ Micro project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
10	15	12.5	12.5	50

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
Minimum 1 and Maximum 2 Questions from each module. Total of 6 Questions, each carrying 3 marks **(6x3 =18marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. **(4x8 = 32 marks)**	**50**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Managerial Economics	Geetika, Piyali Ghosh and Chodhury	Tata McGraw Hill,	2015
2	Engineering Economy	H. G. Thuesen, W. J. Fabrycky	PHI	1966
3	Engineering Economics	R. Paneerselvam	PHI	2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Engineering Economy	Leland Blank P.E, Anthony Tarquin P. E.	Mc Graw Hill	7th Edition
2	Indian Financial System	Khan M. Y.	Tata McGraw Hill	2011
3	Engineering Economics and analysis	Donald G. Newman, Jerome P. Lavelle	Engg. Press, Texas	2002
4	Contemporary Engineering Economics	Chan S. Park	Prentice Hall of India Ltd	2001

ENGINEERING ETHICS AND SUSTAINABLE DEVELOPMENT

Course Code	24SJICHUT347	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	2:0:0:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Nil	Course Type	Theory

Course Objectives:

- Equip with the knowledge and skills to make ethical decisions and implement gender-sensitive practices in their professional lives.
- Develop a holistic and comprehensive interdisciplinary approach to understanding engineering ethics principles from a perspective of environment protection and sustainable development.
- Develop the ability to find strategies for implementing sustainable engineering solutions.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop the ability to apply the principles of engineering ethics in their professional life.	K3
CO2	Develop the ability to exercise gender-sensitive practices in their professional lives	K4
CO3	Develop the ability to explore contemporary environmental issues and sustainable practices.	K5
CO4	Develop the ability to analyse the role of engineers in promoting sustainability and climate resilience.	K4
CO5	Develop interest and skills in addressing pertinent environmental and climate-related challenges through a sustainable engineering approach.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	-	-	-	-	-	3	3	2	2	-	2	-	-
CO2	-	2	-	-	-	3	3	2	2	-	2	-	-
CO3	-	-	-	-	-	3	3	3	3	-	2	-	2
CO4	-	3	-	-	-	3	3	3	3	-	2	1	2
CO5	-	-	-	-	-	3	3	3	3	-	2	-	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Fundamentals of ethics - Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Ingenuity, diligence and responsibility, Integrity in design, development, and research domains, Plagiarism, a balanced outlook on law - challenges - case studies, Technology and digital revolution-Data, information, and knowledge, Cybertrust and cybersecurity, Data collection & management, High technologies: connecting people and places-accessibility and social impacts, Managing conflict, Collective bargaining, Confidentiality, Role of confidentiality in moral integrity, Codes of Ethics. Basic concepts in Gender Studies - sex, gender, sexuality, gender spectrum: beyond the binary, gender identity, gender expression, gender stereotypes, Gender disparity and discrimination in education, employment and everyday life, History of women in Science & Technology, Gendered technologies & innovations, Ethical values and practices in connection with gender - equity, diversity & gender justice, Gender policy and women/transgender empowerment initiatives.	6	1
2	Introduction to Environmental Ethics: Definition, importance and historical development of environmental ethics, key philosophical theories (anthropocentrism, biocentrism, ecocentrism). Sustainable Engineering Principles: Definition and scope, triple bottom line (economic, social and environmental sustainability), life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: Basics of ecosystems and their functions, Importance of biodiversity and its conservation, Human impact on ecosystems and biodiversity loss, An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Sustainable urban planning and green infrastructure.	6	2,5
3	Hydrology and Water Management: Basics of hydrology and water cycle, Water scarcity and pollution issues, Sustainable water management practices, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, reuse, reduce and recycling, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Introduction to the circular economy model, Differences between linear and circular economies, degrowth principles, Strategies for implementing circular economy practices and degrowth principles in engineering. Mobility and Sustainable Transportation: Impacts of transportation on the environment and climate, Basic tenets of a Sustainable Transportation design, Sustainable urban mobility solutions, Integrated mobility systems, E- Mobility, Existing and upcoming models of sustainable mobility solutions.	6	3,5

4	Renewable Energy and Sustainable Technologies: Overview of renewable energy sources (solar, wind, hydro, biomass), Sustainable technologies in energy production and consumption, Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Basics of climate change science, Impact of climate change on natural and human systems, Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Overview of key environmental policies and regulations (national and international), Role of engineers in policy implementation and compliance, Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real- world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future.	**6**	**4,5**

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Continuous internal evaluation will be based on individual and group activities undertaken throughout the course and the portfolio created documenting their work and learning. The portfolio will include reflections, project reports, case studies, and all other relevant materials.

- The students should be grouped into groups of size 4 to 6 at the beginning of the semester. These groups can be the same ones they have formed in the previous semester.
- Activities are to be distributed between 2 class hours and 3 Self-study hours.
- The portfolio and reflective journal should be carried forward and displayed during the 7th Semester Seminar course as a part of the experience sharing regarding the skills developed through various courses.

Sl. No.	Item	Particulars	Group/ Individual (G/I)	Marks
1	Reflective Journal	Weekly entries reflecting on what was learned, personal insights, and how it can be applied to local contexts.	I	5
2	Micro project (Detailed documentation of the project, including methodologies, findings, and	1 a) Perform an Engineering Ethics Case Study analysis and prepare a report 1 b) Conduct a literature survey on 'Code of Ethics for Engineers' and prepare a sample code of ethics	G	8
		2. Listen to a TED talk on a Gender-related topic, do a literature survey on that topic and make a report citing the relevant papers with a specific analysis of the Kerala context	G	5

	reflections)	3. Undertake a project study based on the concepts of sustainable development* - Module II, Module III & Module IV	G	12
3	Activities	2. One activity* each from Module II, Module III & Module IV	G	15
4	Final Presentation	A comprehensive presentation summarizing the key takeaways from the course, personal reflections, and proposed future actions based on the learnings.	G	5
		Total Marks		**50**

*Can be taken from the given sample activities/projects

Evaluation Criteria:

- **Depth of Analysis:** Quality and depth of reflections and analysis in project reports and case studies.
- **Application of Concepts:** Ability to apply course concepts to real-world problems and local contexts.
- **Creativity:** Innovative approaches and creative solutions proposed in projects and reflections.
- **Presentation Skills:** Clarity, coherence, and professionalism in the final presentation.

Suggested Activities/Projects:

Module-II

● Write a reflection on a local environmental issue (e.g., plastic waste in Kerala backwaters or oceans) from different ethical perspectives (anthropocentric, biocentric, ecocentric).
● Write a life cycle analysis report of a common product used in Kerala (e.g., a coconut, bamboo or rubber-based product) and present findings on its sustainability.
● Create a sustainability report for a local business, assessing its environmental, social, and economic impacts
● Presentation on biodiversity in a nearby area (e.g., a local park, a wetland, mangroves, college campus etc) and propose conservation strategies to protect it.
● Develop a conservation plan for an endangered species found in Kerala.
● Analyze the green spaces in a local urban area and propose a plan to enhance urban ecology using native plants and sustainable design.
● Create a model of a sustainable urban landscape for a chosen locality in Kerala.

Module-III

● Study a local water body (e.g., a river or lake) for signs of pollution or natural flow disruption and suggest sustainable management and restoration practices.
● Analyse the effectiveness of water management in the college campus and propose improvements - calculate the water footprint, how to reduce the footprint, how to increase supply through rainwater harvesting, and how to decrease the supply-demand ratio
● Implement a zero-waste initiative on the college campus for one week and document the challenges and outcomes.

● Develop a waste audit report for the campus. Suggest a plan for a zero-waste approach.
● Create a circular economy model for a common product used in Kerala (e.g., coconut oil, cloth etc).
● Design a product or service based on circular economy and degrowth principles and present a business plan.
● Develop a plan to improve pedestrian and cycling infrastructure in a chosen locality in Kerala

Module-IV

● Evaluate the potential for installing solar panels on the college campus including cost- benefit analysis and feasibility study.
● Analyse the energy consumption patterns of the college campus and propose sustainable alternatives to reduce consumption - What gadgets are being used? How can we reduce demand using energy- saving gadgets?
● Analyse a local infrastructure project for its climate resilience and suggest improvements.
● Analyse a specific environmental regulation in India (e.g., Coastal Regulation Zone) and its impact on local communities and ecosystems.
● Research and present a case study of a successful sustainable engineering project in Kerala/India (e.g., sustainable building design, water management project, infrastructure project).
● Research and present a case study of an unsustainable engineering project in Kerala/India highlighting design and implementation faults and possible corrections/alternatives (e.g., a housing complex with water logging, a water management project causing frequent floods, infrastructure project that affects surrounding landscapes or ecosystems).

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Ethics in Engineering Practice and Research	Caroline Whitbeck	Cambridge University Press & Assessment	2nd edition & August 2011
2	Virtue Ethics and Professional Roles	Justin Oakley	Cambridge University Press & Assessment	November 2006
3	Sustainability Science	Bert J. M. de Vries	Cambridge University Press & Assessment	2nd edition & December 2023
4	Sustainable Engineering Principles and Practice	Bhavik R. Bakshi,	Cambridge University Press & Assessmen	2019
5	Engineering Ethics	M Govindarajan, S Natarajan and V S Senthil Kumar	PHI Learning Private Ltd, New Delhi	2012
6	Professional ethics and human values	RS Naagarazan	New age international (P) limited New Delhi	2006.
7	Ethics in Engineering	Mike W Martin and Roland Schinzinger,	Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi	4" edition, 2014

COMPUTER AIDED MACHINE DRAWING & MODELLING

Course Code	24SJPCMEL307	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Nil	Course Type	Lab

Course Objectives:

- To introduce modern CAD packages for drafting and modelling of engineering components.
- To create a digital mock-up of engineering components

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Interpret engineering drawings and create 2D part and assembly drawings using CAD software, adhering to BIS standards and incorporating GD&T principles.	K3
CO2	Develop detailed 2D assembly drawings with sectional views and bills of materials for mechanical components such as couplings and joints.	K3
CO3	Create accurate 3D models and assemblies of mechanical components using parametric and feature-based modeling techniques.	K3
CO4	Apply surface modeling techniques to design and represent complex external geometries of consumer and mechanical objects.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	3	-	-	-	-	3	-	-	3	2
CO2	3	-	2	-	3	-	-	-	-	3	-	-	3	2
CO3	3	-	2	-	3	-	-	-	-	3	-	-	3	2
CO4	3	-	2	-	3	-	-	-	-	3	-	-	3	2

SYLLABUS

Part	Syllabus Description	CO
Part A	Understand the basics of machine drawing, including BIS code of practice, types of lines, dimensioning, scales of drawing, sectional views, geometric tolerances, and the importance of GD&T. Manual Drawing of simple 2D sketches to familiarize and practice these concepts. Learn and practice drawing different types of rigid shaft couplings used for connecting shafts with collinear axes using 2D drafting software (Flange Coupling, Protected Flange Coupling etc). Understanding Basics of Assembly Drawings using 2D drafting software and creating a 2D Assembled Drawing with required Sectional Views (Universal coupling or knuckle joint). Understanding Basics of Assembly Drawings using 2D drafting software and creating a 2D Assembled Drawing with required Sectional Views and prepare BOM (Stuffing Box). Use of geometrical dimensioning and tolerancing (GD&T) in drawing. (Minimum 5 Nos.)	**1, 2**
Part B	Creating 3D machine components (Minimum 4 Nos). Creating 3D assembly models of Socket and spigot joint, Knuckle Joint, Rigid flange couplings, Bushed Pin flexible coupling, Plummer block, Screw jack etc. Modelling of surfaces of the given geometry like helmet, mouse, fender of automobiles etc. Parametric modelling of standard parts such as nuts, bolts, rivets, washers etc (Minimum 3 Nos).	**3, 4**
Out of 12 exercises, 5 should be from Part A and 7 should be from Part B		

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.

- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record.*

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - **Pre-Lab Assignments:** Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - **Understanding of Theory:** Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.
2. **Conduct of Experiments (7 Marks)**
   - **Procedure and Execution**: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - **Skill Proficiency:** Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - **Teamwork:** Collaboration and participation in group experiments.
3. **Lab Reports and Record Keeping (6 Marks)**
   - **Quality of Reports:** Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - **Timely Submission:** Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.
4. **Viva Voce (5 Marks)**
   Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

   Final Marks Averaging: *The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.*

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - **Procedure Understanding and Description:** Clarity in explaining the procedure and understanding each step involved.
   - **Preliminary Work and Planning:** Thoroughness in planning and organizing materials/equipment.
   - **Algorithm Development:** Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
   Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**
   - **Accuracy of Results:** Precision and correctness of the obtained results.
   - **Analysis and Interpretation:** Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**
   - Ability to explain the experiment, procedure results and answer related questions

- Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

Completeness, clarity, and accuracy of the lab record submitted

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Geometric Dimensioning and Tolerancing	James D. Medows	James D. Meadows & Associates, Inc.	2009
2	Fundamentals of Geometric Dimensioning and Tolerancing	Alex Krulikowski	Delmar Cengage Learning	2012 3rd Edition
3	CAD, 3D Modeling, Engineering Analysis, and Prototype Experimentation	Jeremy Zhang Li	Springer	2010 5th Edition

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	Engineering Graphics and Design - Course (nptel.ac.in)

MATERIALS TESTING LAB

Course Code	24SJ PCMEL308	CIE Marks	50
Teaching Hours/Week (L: T:P: R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Lab

Course Objectives:

- Characterize the mechanical behaviour of materials under various loading conditions.
- Relate material properties and microstructure to engineering applications

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Evaluate the mechanical properties of different materials under various loading conditions.	K3
CO2	Relate material microstructure to its mechanical behaviour.	K3
CO3	Analyse the effect of design features on the performance of mechanical components.	K3
CO4	Utilize experimental techniques to determine material properties.	K3
CO5	Apply fundamental engineering principles to analyse the behaviour of structures under load.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	2	-	-	-	-	-	-	3	-
CO2	2	3	-	-	-	-	-	-	-	-	-	2	2
CO3	2	3	3	-	-	-	-	-	-	-	-	3	2
CO4	2	-	-	3	3	-	-	-	-	-	-	3	-
CO5	2	3	3	3	2	1	-	-	-	-	-	3	2

Course Assessment Method (CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- *Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- *Endorsement by Chief Examiner: The chief examiner shall endorse the record*

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - **Pre-Lab Assignments:** Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - **Understanding of Theory:** Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**
   - **Procedure and Execution:** Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - **Skill Proficiency:** Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - **Teamwork:** Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**
   - **Quality of Reports:** Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - **Timely Submission:** Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**
   Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

   Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - **Procedure Understanding and Description**: Clarity in explaining the procedure and understanding each step involved.
   - **Preliminary Work and Planning:** Thoroughness in planning and organizing materials/equipment.
   - **Algorithm Development:** Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
   Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**
   - Accuracy of Results: Precision and correctness of the obtained results.
   - Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**
   - Ability to explain the experiment, procedure results and answer related questions
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**
   Completeness, clarity, and accuracy of the lab record submitted

EXPERIMENTS

Expt. No.	Details of Experiments
1	Evaluate the tensile properties of a ductile material (mild steel, high-strength steel, or tor-steel) using a Universal Testing Machine (UTM) equipped with an extensometer.
2	Conduct compressions test on a ductile material (mild steel, tor-steel, or high-strength steel) using a Universal Testing Machine (UTM) equipped with an extensometer.
3	Determine the tensile properties of cast iron (a brittle material) using a Universal Testing Machine (UTM) equipped with an extensometer.
4	Determine the shear strength of a mild steel rod using a shear test.
5	Perform Brinell/Vickers/Rockwell hardness tests on a given material
6	Determine the torsional rigidity of mild steel/copper/brass rods.
7	Evaluate the flexural stiffness (flexural rigidity) of mild steel/copper/brass specimens using a three-point bend test on a Universal Testing Machine (UTM)

8	Determine the notch toughness of the material at room temperature using Izod and Charpy impact testing.
9	Investigate the effect of coil type (close-coiled vs. open-coiled) and arrangement (series vs. parallel) on spring stiffness.
10	Microstructure of mild steel/copper/ brass/aluminium using optical microscope, double disc polishing machine, emery papers and etchant.
11	Analyse the fracture surface morphology of a ductile or brittle material using an optical microscope for fractographic characterisation.
12	Evaluate the fracture toughness of a material with a Universal Testing Machine (UTM)
13	To study the procedure for plotting S-N curve using Fatigue testing machine
14	Perform stress analysis using photo elasticity.
15	Measure the deformation (strain) of an object using strain gauges.
16	Perform a bending test on a wooden beam to assess its load-carrying capacity.

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Callister's Materials Science and Engineering	D. Wayne Callister and David G. Rethwisch	Wiley	10th Editon 2018
2	Mechanical Testing and Evaluation	Howard Kuhn; Dana Medlin	ASM International	Volume 8 2000

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanics of Materials	James M. Gere and Barry J. Goodno	Cengage Learning	9th Edition 2022
2	Introduction to Materials Science for Engineers	James F. Shackelford	Pearson	8th Edition 2022

Video Links (NPTEL, SWAYAM…)
https://onlinecourses.nptel.ac.in/noc23_mm38/preview
https://archive.nptel.ac.in/courses/112/107/112107146/
https://archive.nptel.ac.in/courses/112/106/112106293/

Semester IV

FOURTH SEMESTER (January-June)														
Sl. No:	Slot	Course Code	Course Type	Course Category	Course Title (Course Name)	Credit Structure				SS	Total Marks		Credits	Hrs./ Week
						L	T	P	R		CIE	ESE		
1	A	24SJGCMAT401	BSC	GC	Mathematics for Physical Science - 4	3	0	0	0	4.5	40	60	3	3
2	B	24SJPCMET402	PC	PC	Machine Tools and Metrology	3	1	0	0	5	40	60	4	4
3	C	24SJPCMET403	PC	PC	Engineering Thermodynamics	3	1	0	0	5	40	60	4	4
4	D	24SJPBMET404	PC-PBL	PB	Mechanics of Machinery	3	0	0	1	5.5	60	40	4	4
5	E	24SJPEMET41N	PE	PE	***Program Elective - 1***	3	0	0	0	4.5	40	60	3	3
6	G S3/S4	24SJICHUT346 / 24SJICHUT347	HMC	IC	Economics for Engineers / Engineering Ethics and Sustainable Development	2	0	0	0	3	50	50	2	2
7	L	24SJPCMEL407	PCL	PC	Fluid Mechanics and Hydraulics Machine Lab	0	0	3	0	1.5	50	50	2	3
8	Q	24SJPCMEL408	PCL	PC	Manufacturing Technology Lab	0	0	3	0	1.5	50	50	2	3
9	R/M/H		VAC		REMEDIAL / MINOR / HONOURS COURSE	3	1	0	0	5			4*	4*
Total										**31/36**			**24/28***	**26/30***

Note: *Engineering Economics and Engineering Ethics and Sustainable Development shall be offered either in S3 or S4.*

PROGRAM ELECTIVE I: 24SJPEMET41N					
SLOT	COURSE CODE	COURSES	L-T-P-R	HOURS	CREDIT
E	24SJPEMET411	Turbo Machinery	3-0-0-0	3	3
	24SJPEMET412	Nuclear Energy	3-0-0-0		3
	24SJPEMET413	Composite Materials	3-0-0-0		3
	24SJPEMET414	Components of Intelligent Systems	3-0-0-0		3
	24SJPEMET416	Advanced Metal Joining Techniques	3-0-0-0		3
	24SJPEMET417	Technology Management	3-0-0-0		3
	24SJPEMET418	Supply Chain and Logistics Management	3-0-0-0		3
	24SJPEMET415*	**Advanced Mechanics of Solids**	**3-0-0-0**		**5 or 3**

***Note:** Level 5 courses in the B. Tech curriculum carry a total of 5 credits, consisting of 3 credits for the Programme Elective and 2 additional credits. The additional 2 credits shall be awarded only if the student meets the eligibility conditions specified in the SJCET B. Tech. Academic Regulation 2024. If those conditions are not fulfilled, the student will receive only 3 credits for the course.*

MATHEMATICS FOR PHYSICAL SCIENCE - 4

Course Code	24SJGCMAT401	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Basic calculus.	Course Type	Theory

Course Objectives:

- To familiarize students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science.
- 2. To provide the students with the basics of various numerical methods to develop problem solving skills used in various engineering disciplines.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand the concept, properties and important models of discrete random variables and to apply in suitable random phenomena.	K3
CO2	Understand the concept, properties and important models of continuous random variables and to apply in suitable random phenomena.	K3
CO3	Estimate population parameters, assess their certainty with confidence intervals, and test hypotheses about population means and proportions using z-tests and the one-sample t-test.	K3
CO4	Apply numerical methods to find solutions of linear system of equations, ordinary differential equations and Laplace equations.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2	2	-	-	-	-	-	-	2	1	-
CO2	3	3	2	2	-	-	-	-	-	-	2	1	-
CO3	3	3	2	2	-	-	-	-	-	-	2	1	-
CO4	3	3	2	2	-	-	-	-	-	-	2	1	-

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Random variables, Discrete random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Binomial distribution, Poisson distribution, Poisson distribution as a limit of the binomial distribution, Joint pmf of two discrete random variables, Marginal pmf, Independent random variables, Expected value of a function of two discrete variables. *[Text 1: Relevant topics from sections 3.1 to 3.4, 3.6, 5.1, 5.2]*	9	1
2	Continuous random variables and their probability distributions, Cumulative distribution function, Expectation, Mean and variance, Uniform, Normal and Exponential distributions, Joint pdf of two Continuous random variables, Marginal pdf, Independent random variables, Expectation value of a function of two continuous variables. *[Text 1: Relevant topics from sections 3.1, 4.1, 4.2, 4.3, 4.4, 5.1,5.2]*	9	2
3	Confidence Intervals, Confidence Level, Confidence Intervals and One-side confidence intervals for a Population Mean for large and small samples (normal distribution and t-distribution), Hypotheses and Test Procedures, Type I and Type II error, z Tests for Hypotheses about a Population Mean (for large sample), t Test for Hypotheses about a Population Mean (for small sample), Tests concerning a population proportion for large and small samples. *[Text 1: Relevant topics from 7.1, 7.2, 7.3, 8.1, 8.2, 8.3, 8.4]*	9	3
4	Newton-Raphson Method, Gauss Elimination Method, Gauss - Jordan Method, Numerical solution of ordinary differential equations-Euler's method, Modified Euler's method, Runge - Kutta method of 2nd Order, Numerical solution of Laplace equation –Jacobi's Method, Curve Fitting by Method of Least Squares - Straight lines, Parabola. *[Text 2: Relevant topics from sections 2.5, 4.2, 7.5, 8.4, 8.5, 9.4]*	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Probability and Statistics for Engineering and the Sciences	Devore J. L.	Cengage Learning	9th edition, 2016
2	Introductory Methods of Numerical Analysis	S. S. Sastry	PHI Learning Pvt Limited	5th edition, 2012

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition andYear
1	Probability, Random Variables and Stochastic Processes,	Papoulis, A. & Pillai, S.U.	McGraw Hill.	4th edition, 2002
2	Introduction to Probability and Statistics for Engineers and Scientists	Ross, S. M.	Academic Press	6th edition, 2020
3	Numerical methods for Engineers	Steven C. Chapra, Raymond P. Canale	McGraw Hill Education	8th edition, 2021

Video Links (NPTEL, SWAYAM…)

Module No.	Topic	Link ID
1	Discrete probability Distributions	https://archive.nptel.ac.in/courses/117/105/117105085/
2	Continuos Probability Distributibutions	https://archive.nptel.ac.in/courses/117/105/117105085/
3	Statistical inference	https://archive.nptel.ac.in/courses/117/105/117105085/
4	Numerical methods	https://archive.nptel.ac.in/courses/111/107/111107105/

MACHINE TOOLS AND METROLOGY

Course Code	24SJPCMET402	CIE Marks	40
Teaching Hours/Week (3:1:0:0)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- To develop knowledge of appropriate process parameters to be used for various machining operations.
- Understand the principles and operation of precision measurement tools and equipment used in modern manufacturing.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Describe various machine tool operations	K2
CO2	Determine machining time and power consumption in various machining processes	K3
CO3	Explain limits, fits and tolerances	K2
CO4	Identify the uses of various advanced measuring instruments	K1

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Machining:** basic machine tools; single and multi-point cutting tools, tool geometry and materials, mechanics of chip formation: orthogonal and oblique cutting, shear angle, velocity relationship; merchant's analysis of cutting forces; cutting power estimation, tool life, and wear; economics of machining, numerical problems **Lathe**- Types, parts, specifications of lathe, lathe operations, accessories, process parameters, machining time calculations. Shaping, Planning, and Slotting machines – Classification, types of operations.	11	1
2	**Drilling Machines** –Operations, drill bit nomenclature, process parameters, machining time calculations and cutting forces. **Milling machines** – types, milling operations, types of milling cutters, milling cutter nomenclature, process parameters, machining time calculations and cutting forces. Indexing head and different indexing methods. **Grinding**- types of grinding machines, operations, cutting forces in grinding, grinding mechanisms, grinding wheels, honing, and lapping **Broaching** – different machines, cutter for broaching, internal and external broaching – applications. **Gear generation** -Gear hobbing. Work holding - jigs, and fixtures- functions and comparison	11	2
3	**Metrology** –Need for inspection, accuracy and precision, calibration, errors in measurement, standards of measurement. **Limits, fits and tolerances** - Principle of interchangeability, selective assembly approach, Tolerances-Classification of Tolerance, Types of fit, Allowances-Hole basis and Shaft basis systems, System of limits and fits, numerical problems. Limit gauging-classification of gauges, Taylor's Principle, gauge tolerance – wear allowance	11	3
4	Angular measurements-Autocollimator, Angle Dekkor. Comparators-Classification, Dial indicators, Electrical and electronic comparators, pneumatic comparators Interferometry- Principle of Interference, Optical Flats, NPL Flatness Interferometer, Pitter–NPL Gauge Interferometer and Laser Interferometers Gear measurement- Gear tooth terminology, errors in spur gears, measurement of gear elements. Screw Thread Measurement- Terminology, Measurement of major, minor, and effective diameters (2-wire and 3-wiremethods). Surface Roughness Measurement- Components of surface texture, Analysis of surface traces, Specification of surface texture, Measurement of surface roughness-Stylus probe instruments Geometric Form Measurement: Straightness, Flatness, Roundness, Concepts of coordinate-measuring machine (CMM)	11	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Elements of Workshop Technology Vol-II Machine Tools	S K Hajra Choudhury Nirjhar Roy	Media Promoters and Publishers Pvt Limited	15th Edition 2016
2	Manufacturing Science	Amitabha Ghosh Asok Kumar Mallik	Affiliated East-West Private Limited	2nd Edition 2010
3	Engineering Metrology and Measurements	N.V. Raghavendra, l. Krishnamurthy	Oxford University Press	1st Edition 2013
4	Manufacturing Engineering and Technology	Serope Kalpakjian Steven R Schmid	Pearson	8th Edition 2013

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Workshop Technology,	Chapman W. A. J.,	Viva books (P) Ltd	5th Edition 2013
2	Metrology for Engineers,	Galyer J.F.W., Schotbolt C.R.,	ELBS.	5th Edition 1990
3	Machine Tools	Chernov	MIR Publication	2nd Edition 1975
4	HMT, Production Technology	--	Tata McGraw-Hill	2017

5	Practical Engineering Metrology	Sharp K.W. B.	Sir Isaac Pitman & Sons Ltd.	1966
6	Machine Tool Design Vol. 1 to 4	Acharkan. N.	MIR Publication	2000
7	ASME, Handbook of Industrial Metrology.	--	--	2000
8	Engineering Metrology	Hume K. J.	Macdonald &Co. Ltd.	3rd edition 1970

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Cutting Tool Geometry	https://archive.nptel.ac.in/courses/112/105/112105233/
2	Introduction to Metrology	https://nptel.ac.in/courses/112106179

ENGINEERING THERMODYNAMICS

Course Code	24SJPCMET403	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PC

Course Objectives:

1. Introduce the principles and laws of thermodynamics
2. Apply laws of thermodynamics to engineering systems
3. Identify systems where laws of thermodynamics are applicable

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Understand basic concepts of thermodynamics and apply zeroth law for temperature measurement.	K3
CO2	Apply first law of thermodynamics for open and closed systems.	K3
CO3	Apply second law of thermodynamics in various cyclic devices and determine entropy changes associated with various processes.	K3
CO4	Determine the changes in properties of pure substances during phase change processes and understand equation of state for ideal and real gases.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2
CO4	2	3	2	2	-	-	-	-	-	-	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction and basic concepts, application areas of thermodynamics, macroscopic and microscopic viewpoints, continuum, systems and control volumes, types of systems, properties of a system, state and equilibrium, the state postulate, processes and cycles. Temperature and the Zeroth law of thermodynamics, temperature scales, forms of energy, physical insight to internal energy, energy transfer by heat and work, path function.	**10**	**1**
2	First law of thermodynamics, energy balance, (energy and exercise, dieting, mass gain and mass loss, etc. Can be discussed as examples), mechanisms of energy transfer, moving boundary work, boundary work for polytropic process, energy balance for closed systems, enthalpy and specific heats, flow work and the energy of a flowing fluid, mass and energy analysis of control volumes, SFEE, steady-flow devices: nozzles and diffusers, throttling valves, mixing chambers	**11**	**2**
3	Thermal energy reservoirs, heat engines and thermal efficiency, refrigerators and heat pumps, COP, heat pumps, Second law: Kelvin–Planck statement, Second law: Clausius statement, equivalence of the two statements, perpetual-motion machines, reversible and irreversible processes, internally reversible processes. Carnot and Reversed Carnot cycle, Carnot principles, thermodynamic temperature scale, Clausius inequality, entropy, the increase of entropy principle, the Tds relations. Entropy generation, S_{gen} associated with a heat transfer process, entropy generation in daily life, isentropic process, Third law of thermodynamics, exergy, reversible work and irreversibility, second-law efficiency	**12**	**3**
4	Phase transformations of pure substance, saturated liquid, saturated vapor and superheated vapor, triple point, properties during change of phase, T-v, p-v and p-T diagram of pure substance, Mollier charts, dryness fraction, property calculations using steam tables, isentropic efficiency of steam turbines and nozzles. Ideal gas equation, gas constants, deviations from ideal gas model, compressibility factor, compressibility chart, Van-der-Waals equation of state.	**11**	**4**

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Thermodynamics: an engineering approach.	Cengel, Yunus A., Michael A. Boles, and Mehme Kanoğlu.	McGraw-hill	2011
2	Engineering Thermodynamics	P.K. Nag	McGraw-Hill Education	6th Edition, 2017

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fundamentals of Engineering Thermodynamics,	Moran J. Shapiro N. M.	Wiley	2006
2	Fundamentals of Thermodynamics	Richard E. Sonntag, Claus Borgnakke, Gordon J. VanWylen	Wiley	8th Edition, 2014
3	Thermodynamics: Principles and Applications	Jean-Philippe Ansermet, Sylvain D. Brechet	Cambridge University Press	1st Edition, 2019
4	Engineering Thermodynamics	James Beverly Johns, Regina E. Dugan	Prentice Hall	1996

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Introduction and Basic concepts, zeroth law	1. Engineering Thermodynamics - Prof. Suman Chakraborty, IIT Kharagpur https://nptel.ac.in/courses/112/105/112105123/ 2. Chemical Engineering Thermodynamics - Prof. Dr. Sandip Roy IIT Bombay https://nptel.ac.in/courses/103/101/103101004/
2	First law of thermodynamics for closed and open systems	1. Engineering Thermodynamics - Prof. Suman Chakraborty, IIT Kharagpur https://nptel.ac.in/courses/112/105/112105123/ 2. Chemical Engineering Thermodynamics - Prof. Dr. Sandip Roy IIT Bombay https://nptel.ac.in/courses/103/101/103101004/
3	Second law of thermodynamics, Entropy	1. Engineering Thermodynamics - Prof. Suman Chakraborty, IIT Kharagpur https://nptel.ac.in/courses/112/105/112105123/ 2. Chemical Engineering Thermodynamics Prof. Dr. Sandip Roy IIT Bombay https://nptel.ac.in/courses/103/101/103101004/
4	Pure substances, Equation of state for Ideal and real gases	Engineering Thermodynamics - Prof. Suman Chakraborty, IIT Kharagpur https://nptel.ac.in/courses/112/105/112105123/

MECHANICS OF MACHINERY

Course Code	24SJPBMET404	CIE Marks	60
Teaching Hours/Week (L:T:P:R)	3:0:0:1	ESE Marks	40
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Nil	Course Type	Theory

Course Objectives:

- To understand the kinematics of different mechanism
- To understand the motion resulting from a specified set of linkages and to synthesis the mechanism.
- To understand and to design of cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's KnowledgeLevel (KL)
CO1	Calculate degrees of freedom of mechanisms and interpret their inversions.	K3
CO2	Perform velocity and acceleration analysis of various planar mechanisms	K4
CO3	Construct a mechanism for a specified output motion and solve the problems n cams	K4
CO4	Solve the problems on gears and gear drives, including selection depending on requirement.	K3
CO5	Create prototype of various mechanisms.	K6

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2	2
CO4	3	2	-	-	-	-	-	-	-	-	-	2	2
CO5	3	3	3	2	-	-	2	-	2	2	-	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Degrees of Freedom, Mobility analysis - Kutzbach and Grubler's criterion, Grashof's criterion. Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, four bar chain, Slider Crank Mechanisms, Double slider crank Mechanisms and their Inversions. Exact Straight-Line Motion Mechanisms- Peaucellier mechanism, Hart's Mechanism. Approximate Straight-Line Motion Mechanisms- Watt's mechanism. Steering gear mechanism- Davis steering gear, Ackermann's steering gear	11	1
2	**Velocity analysis of mechanisms** (Up to six links)– relative motion - relative velocity. Instantaneous centre -Kennedy's theorem-velocity analysis using instantaneous centre. (Up to six links) **Acceleration analysis**- Relative acceleration - Coriolis acceleration (Crank and slotted lever and Whitworth quick return mechanism)	11	2
3	**Kinematic synthesis** (planar mechanisms) - type, number and dimensional synthesis –Definitions of Motion, Path and Function generation, precision points, Chebychev spacing, Freudenstein's equation. **Cams** - Types of cam and followers - displacement diagrams, velocity and acceleration analysis of SHM, uniform velocity, uniform acceleration, cycloidal motion- Graphical cam profile synthesis- knife edge and roller follower with and without offset	11	3
4	**Gears** – Classification- Terminology of spur, helical, bevel, and worm gear – Law of gearing -tooth profiles-path of contact- arc of contact- contact ratio - interference- minimum number of teeth to avoid interference -undercut-backlash **Gear trains** - simple and compound gear trains - planetary gear trains. Tabulation method	11	4

Course Assessment Method (CIE: 60 marks, ESE: 40 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Project	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	30	12.5	12.5	60

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 2 marks **(8x2 = 16 marks)**	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 6 marks. **(4x6 = 24 marks)**	**40**

PBL Course Elements

L: Lecture (3 Hrs.)	R: Project (1 Hr.), 2 Faculty Members		
	Tutorial	**Practical**	**Presentation**
Lecture delivery	Project identification	Simulation/ Laboratory Work/ Workshops	Presentation (Progress and Final Presentations)
Group discussion	Project Analysis	Data Collection	Evaluation
Question answer Sessions/Brainstorming Sessions	Analytical thinking and self-learning	Testing	Project Milestone Reviews, Feedback, Project reformation (If required)
Guest Speakers (Industry Experts)	Case Study/ Field Survey Report	Prototyping	Presentation of prototype: PPT Presentation (8 t0 10 slides)

Assessment and Evaluation for Project Activity (CO 5)

Sl. No	Evaluation for	Allotted Marks
1	Project Planning and Proposal	5
2	Contribution in Progress Presentations and Question Answer Sessions	4
3	Involvement in the project work and Team Work	3
4	Execution and Implementation	10
5	Final Presentations	5
6	Project Quality, Innovation and Creativity	3
Total		**30**

1. **Project Planning and Proposal (5 Marks)**
   - Clarity and feasibility of the project plan
   - Research and background understanding
   - Defined objectives and methodology
2. **Contribution in Progress Presentation and Question Answer Sessions (4 Marks)**
   - Individual contribution to the presentation
   - Effectiveness in answering questions and handling feedback
3. **Involvement in the Project Work and Team Work (3 Marks)**
   - Active participation and individual contribution
   - Teamwork and collaboration

4. **Execution and Implementation (10 Marks)**
   - Adherence to the project timeline and milestones
   - Application of theoretical knowledge and problem-solving
   - Final Result
5. **Final Presentation (5 Marks)**
   - Quality and clarity of the overall presentation
   - Individual contribution to the presentation
   - Effectiveness in answering questions
6. **Project Quality, Innovation, and Creativity (3 Marks)**
   - Overall quality and technical excellence of the project
   - Innovation and originality in the project
   - Creativity in solutions and approaches

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Theory of Machines and Mechanisms	Ballaney P. L.	Khanna Publishers	2005
2	Theory of Machines	S. S. Rattan	Tata McGraw Hill	2009
3	Theory of Mechanisms and Machines	A Ghosh	East West	2008

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Kinematics and Dynamics of Machinery	C. E. Wilson, P. Sadler	Pearson Education	2005
2	Theory of Machines and Mechanisms	J. E. Shigley, J. J. Uicker	McGraw Hill	2010
3	Machines and Mechanisms Applied Kinematic Analysis	D. H. Myskza	Pearson Education	2013
4	Kinematics and Dynamics of Machinery	Norton	Tata McGraw Hill	2009

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Various mechanisms animations	www.youtube.com for mechanism animations
2	Velocity analysis and Acceleration analysis	https://archive.nptel.ac.in/courses/112/105/112105268/
3	Kinematic synthesis and Cams	https://archive.nptel.ac.in/courses/112/105/112105268/
4	Gears and Gear trains	https://archive.nptel.ac.in/courses/112/105/112105268/

FLUID MECHANICS AND HYDRAULICS MACHINES LAB

Course Code	24SJ PCMEL407	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Fluid Mechanics and Machinery (24SJPCMET303)	Course Type	Lab

Course Objectives:

- To familiarize the applications of fluid mechanics and dynamics.
- To get acquainted with the practical implication of viscous flow and discharge measuring equipment in both closed & open channel flow.
- To gain practical experience in handling various hydraulic machines.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the fundamental principles of fluid mechanics to understand the flow of fluid through pipes, notches, and associated losses.	K3
CO2	Select a pump/turbine based on the given operating conditions and determine the performance of a given Fluid/Turbo machine under various operating conditions.	K4
CO3	Demonstrate the ability to work in groups and present results. Also, understand the ethical issues with decision making and professional conduct.	K5

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	-	-	2	2	-	-	-	-	-	-	3	2
CO3	-	-	2	2	-	-	-	3	2	1	2	-	-

Expt. No.	Experiments
1	Determination of coefficient of discharge and calibration of Notches.
2	Determination of coefficient of discharge and calibration of Orifice meter.
3	Determination of coefficient of discharge and calibration of Venturi meter.
4	Determination of hydraulic coefficients of orifices and mouthpieces with constant and varying head.
5	Determination of Chezy's constant and Darcy's coefficient on pipe friction apparatus.
6	Determination of the minor losses in pipe.
7	Experiments on hydraulic ram.
8	Reynolds experiment.
9	Bernoulli's experiment.
10	Determination of metacentric height and radius of gyration of floating bodies.
11	Performance test on Positive displacement pumps.
12	Performance test on Centrifugal pumps and determination of operating characteristics.
13	Performance test on Gear pump.
14	Performance test on Pelton turbine and determination of operating characteristics.
15	Performance test on reaction turbines (Francis and Kaplan Turbines) and determination of operating characteristics.
16	Speed variation test on Pelton turbine.
Minimum 10 experiments should be completed	

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record:*** *Students shall be allowed for the end semester examination only upon submitting the duly certified record.*
- ***Endorsement by External Examiner:*** *The external examiner shall endorse the record*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics	Cengel Y. A. and J.M. Cimbala	Tata McGraw Hill	2013
2	Introduction to fluid mechanics and fluid machines	Som S.K	McGraw Hill Education	2011
3	Fluid mechanics and hydraulic machines	Bansal R. K	Laxmi Publications	2005

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Fluid Mechanics	White F.M.	Tata McGraw Hill	2003
2	Engineering applications of fluid dynamics	Fisher & Henley	Willford Press	2023

Video Links (NPTEL, SWAYAM…)	
Topic	**Link ID**
Fluid Statics	https://www.youtube.com/watch?v=rY7bvZn75Do&list=PLwdnzlV3ogoWrAmpEcsPXayfsXnFf YY1O&index=4 Bouyancy, Metacentre and stability https://www.youtube.com/watch?v=gMuucNxc7eI&list=PLwdnzlV3ogoV-ATGY2ptuLS9mwLFOJoDw&index=7&pp=iAQB
Fluid kinematics	https://www.youtube.com/watch?v=rY7bvZn75Do&list=PLwdnzlV3ogoWrAmpEcsPXayfsXnFf YY1O&index=4
Internal Viscous Flow	https://www.youtube.com/watch?v=qLx7ip0eBps&list=PLCoE5wxWtHFYiVGswvsWRaHjv18vx ZzE2&index=17
Introduction to turbomachines	https://www.youtube.com/watch?v=ocVzrn4DLj8&list=PLbMVogVj5nJQQp3QLuzbcHrt0XncZZ TiE&index=2

MANUFACTURING TECHNOLOGY LAB

Course Code	24SJPCMEL408	CIE Marks	50
Teaching Hours/Week (L:T:P:R)	0:0:3:0	ESE Marks	50
Credits	2	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PCL

Course Objectives:

- To understand the parts of various machine tools and impart hands-on experience on lathe, drilling, shaping, milling, grinding, tool and cutter grinding machines.
- To study process parameters and practice arc and gas welding technologies.

Course Outcomes (COs)

At the end of the course students should be able to:

	Course Outcome	Bloom's Knowledge Level (KL)
CO1	The students can operate different machine tools with understanding of work holders and operating principles to produce different part features to the desired quality.	K3
CO2	Apply cutting mechanics to metal machining based on cutting force and power consumption.	K3
CO3	Programming and manufacturing of complex profiles in CNC machines with high precision.	K3
CO4	Fabricate and assemble various metal components by welding and students will be able to visually examine their work and that of others for discontinuities and defects.	K3
CO5	Gain knowledge on the structure, properties, testing and applications of ferrous and non-ferrous metals.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	-	-	1	-	-	-	-	-	-	-	2	1
CO2	3	-	-	3	-	-	-	-	-	-	-	2	-
CO3	3	-	-	2	3	-	-	-	-	-	-	-	2
CO4	3	-	-	1	-	-	-	-	-	-	-	1	-
CO5	3	-	-	1	-	-	-	-	-	-	-	2	2

SYLLABUS

Expt. No.	Experiments
1	Exercises on lathe: - Plain and step turning.
2	Exercises on lathe: - Ball & curve, and Taper turning.
3	Exercises on lathe: - Thread cutting.
4	Exercises on lathe: - Measurement of cutting forces in turning Process.
5	Exercises on shaping machine: - flat surfaces.
6	Exercises on shaping machine: - Grooves and key ways.
7	Exercises on drilling machine: - drilling, boring, reaming, taping and counter sinking etc.
8	Exercises on drilling machine: - Measurement of cutting forces in drilling process.
9	Exercises on cylindrical grinding machine: - Grinding of a plain cylindrical surface.
10	Exercises on surface grinding machine: - Grinding of a flat surface.
11	Exercises on tool and cutter grinding machine: - Grinding of a single-point cutting tool.
12	Exercises on milling machine: - Plane and pocket milling operations.
13	Exercises on milling machine: - Spur gear cutting operation.
14	Exercises on milling machine: - Measurement of cutting forces in milling process.
15	Exercises on arc welding: - butt welding and lap welding of M.S. sheets.
16	Exercises on gas welding: - butt welding and lap welding of M.S. sheets.
17	Study and preparation of program, simulation and exercise on CNC lathe: - turning, step turning, taper turning, thread cutting, ball and cup turning etc.
18	Study and preparation of program, simulation and exercise on CNC milling machine: - surface milling, pocket milling, contour milling etc.
19	Metallurgy: - Specimen preparation, etching & microscopic study of Steel, Cast iron and Brass and grain size measurement.
20	Exercises on part quality inspection using machine vision systems.
21	Exercises on industrial robots- manual and programmed path planning

A minimum of 12 sets of experiments are mandatory but both experiments mentioned for programming and experiments on CNC machines are mandatory.

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

- ***Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.***
- ***Endorsement by External Examiner: The external examiner shall endorse the record***

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of thePublisher**	**Edition and Year**
1	Production Technology	HMT	Tata McGraw Hill	2017
2	Workshop Technology Part I	W. A. J. Chapman	ELBS & Edward Arnold Publishers	1972
3	Numerical Control of Machine Tools	Yoram Koren	McGraw-Hill	2014
4	Production Technology	HMT	Tata McGraw Hill	2017

Continuous Assessment (25 Marks)

1. **Preparation and Pre-Lab Work (7 Marks)**
   - **Pre-Lab Assignments:** Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.
   - **Understanding of Theory:** Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. **Conduct of Experiments (7 Marks)**
   - **Procedure and Execution:** Adherence to correct procedures, accurate execution of experiments, and following safety protocols.
   - **Skill Proficiency:** Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.
   - **Teamwork:** Collaboration and participation in group experiments.

3. **Lab Reports and Record Keeping (6 Marks)**
   - **Quality of Reports:** Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.
   - **Timely Submission:** Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. **Viva Voce (5 Marks)**
   Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. **Procedure/Preliminary Work/Design/Algorithm (10 Marks)**
   - **Procedure, Understanding and Description:** Clarity in explaining the procedure and understanding each step involved.
   - **Preliminary Work and Planning:** Thoroughness in planning and organizing materials/equipment.
   - **Algorithm Development:** Correctness and efficiency of the algorithm related to the experiment.
   - Creativity and logic in algorithm or experimental design.

2. **Conduct of Experiment/Execution of Work/Programming (15 Marks)**
   Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. **Result with Valid Inference/Quality of Output (10 Marks)**
   - **Accuracy of Results:** Precision and correctness of the obtained results.
   - **Analysis and Interpretation:** Validity of inferences drawn from the experiment or quality of program output.

4. **Viva Voce (10 Marks)**
   - Ability to explain the experiment, procedure results and answer related questions
   - Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. **Record (5 Marks)**
   Completeness, clarity, and accuracy of the lab record submitted

PROGRAM ELECTIVES 1

TURBO MACHINERY

Course Code	24SJPEMET41N	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Fluid Mechanics and Machinery 24SJPCMET303	Course Type	Theory

Course Objectives:

- To understand how to apply the fundamental principles of fluid mechanics and thermodynamics in the operation of different turbomachines
- To give an insight into the general analysis of radial flow and axial flow turbomachines.
- To familiarise and understand the working and the performance of different power-generating turbomachines
- To familiarise and understand the working and the performance of different power-consuming turbomachines

Course Outcomes (COs)

At the end of the course, students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use the fundamental principles of fluid mechanics and thermodynamics and find the efficiencies of power-generating and power-consuming turbomachines.	K3
CO2	Analyse the velocity triangles for radial flow and axial flow turbomachines and find the performance for parametrical changes.	K3
CO3	Select an appropriate power-generating turbomachine for a particular application	K3
CO4	Select an appropriate power-consuming turbomachine for a particular application	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2
CO3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	2	2	-	-	-	-	-	-	-	-	2	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Introduction:** Definition of turbo machine, Classification: Axial flow, radial flow and mixed flow machines, parts of turbo machines, Comparison with positive displacement machines. **Thermodynamics of fluid flow:** Application of first and second law of thermodynamics to turbo machines. Preheat factor in compressors, work and efficiency for compressors and turbines. **Energy exchange in Turbo machines:** Euler's equation, Alternate form of Euler's equation, components of energy transfer.	9	1
2	**General Analysis of Turbo machines:** **Radial flow compressors**– general analysis, degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance. **Axial flow compressors**-degree of reaction, velocity triangles.	9	2
3	**Hydraulic Turbines:** Classification **Pelton Wheel** – Principle of working, velocity triangles, efficiencies and losses. **Reaction turbines** – Francis turbine: Principle of working, velocity triangles, efficiencies and losses, draft tube, governing, cavitation. **Kaplan and Propeller turbines** - Principle of working, velocity triangles, efficiencies and losses. Selection of turbines for power plants	9	3
4	**Centrifugal Pumps:** Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Theoretical head – capacity relationship, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. **Fans, Blowers and Compressors:** Classification and working principles of fans, blowers and compressors. **Centrifugal Compressors:** Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of thePublisher	Edition and Year
1	Fluid Mechanics and Thermodynamics of Turbomachinery	Dixon, S.I,	Pergamom Press	1999
2	Fundamentals of Turbo Machinery	B.K Venkanna	PHI Learning Pvt. Ltd	1st Edition 2009
3	Turbines, Compressor and Fans	Yahya, S.H,	Tata Mc Graw Hill,	1996
4	A Text Book of Turbomachines	Dr. M S Govinde Gowda	I I P Iterative International Publishers	2024

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition andYear
1	Turbomachinery – Fundamentals, Selection and Preliminary Design	Marco Gambini, Michela Vellini	Springer	1st Edition, 2021
2	Fundamentals of Turbomachines	Erik Dick	Springer	2nd Edition 2022

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Introduction to Turbomachines	https://www.youtube.com/watch?v=TiJZp-KB6h8
	Euler's equation and fundamentals	https://www.youtube.com/watch?v=ocVzrn4DLj8 (types and classification) https://youtu.be/DlkmkeENGwg
2	Radial and Axial Flow, Velocity triangles	https://youtu.be/DlkmkeENGwg
3	Pelton Wheel	https://www.youtube.com/results?search_query=pelton+wheel+turbine+nptel
	Francis Turbine	https://www.youtube.com/watch?v=S153vKWEIzw&t=1002s
	Kaplan Turbine	https://youtu.be/b7kTKdEISHc
4	Centrifugal Pumps	https://youtu.be/_-yk5GwFnKM, Lecture 32: Centrifugal Pump: Basics - YouTube https://www.youtube.com/watch?v=3nDAQ0D3e34&t=1201s Pumps - YouTube

NUCLEAR ENERGY

Course Code	24SJPEMET41N2	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Nil	Course Type	Theory

Course Objectives:

- To explore the motivations and basic physics for nuclear reactors
- To understand the power plant and reactor fuel cycle
- To understand the components of nuclear reactor.
- To acquire nuclear waste management and Indian nuclear power program

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Analyse the role of fuel cycle and explain the basic physics of nuclear reactors.	K2
CO2	Evaluate different options for fuel handling and spent fuel management	K2
CO3	Describe the key components of a nuclear reactor system and their Functions	K2
CO4	Understand the regulatory framework for nuclear reactor safety	K2

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	-	-	-	-	-	-	-	-	2	1	2
CO2	2	1	-	-	-	-	-	-	-	-	2	1	2
CO3	2	2	1	-	-	-	-	-	-	-	1	1	2
CO4	1	1	2	-	-	-	-	-	-	-	1	1	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**MOTIVATION FOR NUCLEAR ENERGY SOURCE**: Role of electricity; energy disparities among countries; energy sources; present source of energy; global resource estimates; issues associated with fossil fuels, potential role of nuclear energy; current status of nuclear energy & Indian energy resources. **BASIC PHYSICS OF NUCLEAR REACTORS**: Isotopes; binding energy; nuclear stability; α, β, γ and neutron interactions; concept of neutron cross section, radioactive decay law; units of radioactivity; Fission – fission energy, critical mass, Gabon natural reactor, liquid drop model of fission cross section, prompt & delayed neutrons, neutron life cycle, infinite multiplication factor and 4 factor formula and 6 factor formula; effective multiplication factor; neutron moderation, moderator, slowing down; criticality, reactive power; reactor kinetics & control. (Analytical treatment excluded)	9	1
2	**REACTOR FUEL CYCLE**; fuel cycle material balance, uranium mining & milling; uranium conversion to uranium hexafluoride; enrichment – gaseous: diffusion & centrifuge; fuel fabrication; commuting radioactive materials; storage of spent fuel; reprocessing – solvent extraction: Purex, Urex, Truex, and Pyro processing: electrolysis. (Analytical treatment excluded)	6	2
3	**COMPONENTS OF NUCLEAR REACTOR**: Fermi pile – control, safety, radiation monitoring; reactor core; fuel, control rods; moderator; essential core components; containment; core catcher; steam generator; turbine generator; steam water system; turbine generator; steam water system; fuel handling; cooling spent fuel; Nuclear reactor types pressurized water reactor, boiling water reactor, Canada-deuterium reactor, solid cooled fast reactor, advanced gas cooled reactor. **NEXT GENERATION REACTORS**: basic knowledge and conceptual difference of next generation reactors only – Generation I, II, III, IV; Fusion reaction- Lawson criterion, inertial and magnetic confinements (Analytical treatment excluded)	12	3
4	**RADIATION SAFETY AND NUCLEAR WASTE MANAGEMENT**: Biological effects of radiation and shielding Radioactive waste type – exempted and low-level waste; classified low, intermediate and high-level waste; treatment and conditioning of nuclear waste – incineration, compaction, cementation, vitrification; Waste disposal methods – near surface disposal, deep geological disposal, disposal at outer space, deep boreholes and disposal at sea. **INDIAN POWER PROGRAM**: installing a nuclear establishment; research reactor apsara, Canada-India research reactor, Indian 3 stage nuclear program – advanced heavy water reactor, accelerator driven subcritical systems, compact temperature reactor. (Analytical treatment excluded)	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering Physics	R K Guptha & S L Gaur	Dhanpat Rai	45th Edition (2012)
2	Nuclear reactor engineering	Dr G Vaidyanathan	S Chand & Co Pvt Ltd	1st Edition (2013)

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Nuclear Reactor Engineering	S. Glasstone and A. Sesonske,	CBS	2004
2	Source book on atomic energy	S Glasstone	Krieger Publishing Company	2012

Video Links (NPTEL, SWAYAM…)

Module No.	Topic	Link ID
1	Basic physics of nuclear reactors	https://archive.nptel.ac.in/courses/112/101/112101007
2	Working of a nuclear reactor	https://www.youtube.com/watch?v=1U6Nzcv9Vws
3	Working of a nuclear power plant	https://www.youtube.com/watch?v=jpDRfaWYk3I
4	Nuclear safety	https://archive.nptel.ac.in/courses/112/101/112101007

COMPOSITE MATERIALS

Course Code	24SJPEMET413	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- To provide and impart knowledge to the students about the definition, benefits, and classification of composite materials.
- The students will be able to understand the concept of various matrices and reinforcements used in composites.
- To provide the students about types of fibers, polymer matrix composites, metal matrix composites, ceramic matrix composites and its manufacturing and applications.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Understand about composites, various matrices and reinforcements used in composites, types of fibres	K2
CO2	To know about polymer matrix composites, classification, properties, characteristics and applications, manufacturing methods.	K2
CO3	To know about metal matrix composites, classification, properties, characteristics and applications, manufacturing methods.	K2
CO4	To know about ceramic matrix composites, classification, properties, characteristics and applications, manufacturing methods.	K2

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO17	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	-	1	-	-	3	1	-	-	-	1	2	1
CO2	3	-	1	-	-	3	1	-	-	-	2	2	1
CO3	3	-	1	-	-	3	1	-	-	-	1	2	1
CO4	3	-	1	-	-	3	1	-	-	-	2	2	1

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Composite**: Introduction, definition, characteristics, functions, classification of composites based on structure and matrix, smart composites, industrial applications. **Interfaces**: wettability and bonding interface in composites. Types of bonding at interface. **Fibers:** Introduction, types of fibers, natural fibers, glass fiber fabrication, structure, properties and applications, Boron fiber fabrication, structure, properties and application. Carbon fiber, Ex-Pan carbon fiber, Ex cellulose carbon fiber, Ex-Pitch carbon fiber structure, properties and applications, Aramid fiber fabrication, structure, properties and applications, Whiskers: characteristics, properties and applications.	11	1
2	**Polymer matrix composites (PMC):** Thermoset, thermoplastic and elastomeric polymers, properties, characteristics and applications as matrix materials. **Processing of polymer matrix composites**: Hand layup methods and spray layup method. Moulding methods: pressure bagging and bag Moulding methods, Autoclave-based processing with prepregs, pultrusion and filament winding process.	9	2
3	**Metal matrix composites (MMC)**: Classification of metals, intermetallic, alloys and their potential role as matrices in composites, properties, characteristics and applications of metals as matrix materials **Production techniques**: Powder metallurgy, diffusion bonding, melt stirring, squeeze casting, liquid infiltration under pressure, insitu process.	8	3
4	**Ceramic matrix composites (CMC):** Classification of ceramics and their potential role as matrices, properties, characteristics and applications of CMC **Conventional production techniques**: Cold pressing and sintering, hot pressing, reaction bonding, liquid infiltration, pultrusion. Lanxide process, insitu chemical technique, sol-gel technique.	8	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Composite Materials: Science and Engineering	K. K. Chawla	Springer	3rd Edition 2013
2	Fiber-reinforced composites	P.K.Mallicak	M. Dekker, New York	1988

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Composite Materials, Engineering and Sciences	F.L.Matthews & R.D.Rawlings,	Chapman & hall, London	1994
2	Hand Book of Composites	George Lubin. Van Nostrand, Reinhold Co.	Springer	1982

Video Links (NPTEL, SWAYAM…)

Module No.	Topic	Link ID
1	Composite Materials - Introduction	https://www.youtube.com/watch?v=JBMVZpRD-Zk
2	Processing of Polymer Matrix Composites	https://www.youtube.com/watch?v=tP8JCX87DzI
3	Metal Matrix Composites	https://www.youtube.com/watch?v=RihoVfzEfWI
4	Ceramic Matrix Composites	https://www.youtube.com/watch?v=LGERbwD5S2g

COMPONENTS OF INTELLIGENT SYSTEMS

Course Code	24SJPEMET414	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	Theory

Course Objectives:

- To provide students the ability to understand the working of various sensors and transducers.
- To provide students the ability to develop systems for actuation of mechanical systems

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain the working of sensors and transducers	K2
CO2	Describe the operation of actuators for intelligent systems	K2
CO3	Develop the hardware and software for microcontroller based systems for actuation	K3
CO4	Outline the basic concepts of Embedded Systems and IoT	K2

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	3	3	-	-	-	-	-	-	-	-	1	-
CO2	3	3	3	-	-	-	-	-	-	-	-	1	-
CO3	3	3	3	-	3	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-	-

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Sensors and Transducers:** **Internal Sensors**: Position - Optical Encoders, Potentiometers, LVDT, Velocity - Encoders, Tachogenerators, Acceleration – Different types of accelerometers, Gyroscopes, IMU, Force transducers **External Sensors:** Contact Sensors, Inductive and Capacitive Proximity sensors, GPS, Ultrasonic transducers and SONAR, RADAR and Doppler effect, LIDAR **Sensor Characteristics:** Sensitivity, Linearity, Measurement /Dynamic range, Response Time, Accuracy, Repeatability and Precision, Resolution & Threshold, Bandwidth	9	1
2	**Actuators:** **Hydraulic and Pneumatic Actuators:** Working of Hydraulic and Pneumatic Actuators at block diagram level, advantages and disadvantages of each **Electric Actuators:** Electric motors - DC motors, Stepper motors, Servo motors, BLDC motors, Transmission Elements, advantages and disadvantages of Electric Actuators	9	2
3	**Microcontrollers:** Definitions of microprocessors and microcontrollers with basic block diagrams and differences between them **Arduino Uno microcontroller**: Board Study (Board level Block schematic) - Chip (Features only – Architecture not needed), GPIO, Memory, Programming Interface **Programming:** Arduino IDE, Sample Code for interfacing LED and Switch, DC motor and Stepper motor control, LCD Interfacing	9	3
4	**Introduction to Embedded Systems and IoT:** **Embedded Systems:** Applications of embedded systems-Consumer electronics, Robotics, Automobiles **Embedded System Architecture:** Hardware - Processor, Controller, Memory, Peripherals; Software - Application, Middleware, OS, Device Drivers, Tool chain- Assembler, Interpreter, Compiler, Linker, Loader, Debugger **IoT:** Definition, Impact of IoT in Manufacturing, Smart homes, Transportation and Cities **Wired Communication:** Basics of Serial communication (UART, SPI, I2C) **Wireless Communication:** Basics of Wi-Fi, Bluetooth, Zigbee, LoRa, and NFC ***Case Study:*** Design and implementation of a simple Embedded/IoT Project	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Introduction to Robotics	S K Saha	McGraw-Hill Education (India)	2008
2	Sensors, Actuators, and their Interfaces: A multidisciplinary introduction	SciTech Publishing Inc	SciTech Publishing Inc	2011
3	Beginning Arduino	Michael McRoberts	Apress	1st Edition, 2011
4	Embedded Systems: An Integrated Approach	Lyla B Das	Pearson Education India	1st Edition, 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Sensors and Transducers	D. Patranabis	PHI Learning	2nd edition, 2003
2	Embedded Systems Architecture, programming and Design	Raj Kamal	Tata McGraw-Hil	3rd edition, 2013

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Arduino	https://onlinecourses.swayam2.ac.in/aic20_sp04/unit?unit=4&lesson=7

ADVANCED METAL JOINING TECHNIQUES

Course Code	24SJPEMET416	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	None	Course Type	PE

Course Objectives:

- To establish fundamental knowledge Advanced welding technologies
- To enable the learner to select appropriate metal joining technique based on the application.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Summarise the Solid-state welding techniques and outline the physics of adhesive bonding.	K2
CO2	Compare and select between explosive welding, friction welding and ultrasonic welding based on the applications.	K3
CO3	Understand radiant energy welding technologies and explain the principle and working of EBW, LBW and PAW.	K2
CO4	Outline the modern joining technologies and select appropriate brazing technique to resolve modern metal joining problem.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	-	-	-	2	-	-	-	-	2	2	2
CO2	2	2	2	-	-	2	-	-	-	-	2	2	2
CO3	2	2	-	-	-	-	-	-	-	-	2	2	2
CO4	2	3	2	-	-	-	-	-	-	-	2	2	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Solid State Welding**: Principle and mechanism of solid-state welding, techniques, process parameters and applications of diffusion welding, cold pressure welding. **Adhesive Bonding**: Principle – types of adhesives, bonding methods – applications.	9	1
2	**Explosive welding:** principle and theory, equipment used, Process parameters and characteristics, weld joint design, Applications, advantages, and limitations. **Friction and Friction stir welding:** principle and theory – Process parameters and applications, Tools, and Metal flow. **Ultrasonic Welding:** principle, theory, and types –Welding environment, equipment used- Process parameters and characteristics, weld joint design and applications.	9	2
3	**Electron Beam Welding (EBW)** - principle and theory, Welding environment, equipment used- Process parameters and characteristics, weld joint design, Applications, advantages, and limitations. **Laser Beam Welding (LBW)** – Principle and theory, types of lasers, Process parameters and characteristics, Applications, advantages, and limitations. **Plasma Arc Welding (PAW) –**Theory – transferred arc and non-transferred arc techniques, equipment – applications.	9	3
4	**Magnetically Impelled Arc Butt (MIAB)**– principle and applications. Under water welding – wet and dry under water welding-set-up for underwater welding systems. **Brazing** – Principle – processes involved – torch brazing, furnace brazing, vacuum brazing, induction brazing – advantages and applications. **Micro-joining and nano-joining:** Introduction, theory, and applications.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	*Part B*	*Total*
2 Questions from each module. Total of 8 Questions, each carrying 3 marks ***(8x3 = 24marks)***	*Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions.* ***(4x9 = 36 marks)***	***60***

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Advanced welding Processes	J. Norrish	Woodhead publishing	2006
2	Welding Processes and Technology	Parmar R. S	Khanna Publishers	1998

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Principles of Welding	R. W. Messler	John Wiley and Sons	1999
2	Metal Joining Manual	Schwartz M. M	McGraw-Hill Inc.	1979
3	Micro-joining and Nano-joining	Y. N. Zhou	Woodhead publishing	2008

Video Links (NPTEL, SWAYAM…)

Module No.	Topic	Link ID
1	Solid state welding and Adhesive bonding	https://nptel.ac.in/courses/112103244
2	Explosive welding, Ultra-sonic welding	https://nptel.ac.in/courses/112103244
3	EBW, LBW, PAW	https://nptel.ac.in/courses/112103244
4	Micro and Nano joining	https://nptel.ac.in/courses/112103244

TECHNOLOGY MANAGEMENT

Course Code	24SJPEMET416	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Nil	Course Type	Theory

Course Objectives:

- To impart an in-depth understanding of management functions, in various domains such as technology, operations, human resources, marketing, corporate social responsibilities, finance, entrepreneurship, and intellectual property rights.
- To explore the impact of technology on human needs, business plans, competition, innovation, and research, with focus on Indian context.

Course Outcomes (COs)

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

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Develop an understanding of management functions and managerial tasks in various domains, including operations, human resources, marketing, corporate social responsibilities, finance, entrepreneurship, and intellectual property rights.	K2
CO2	Understand the evolution of technology and technology management, with its impact on human needs, in the Indian context.	K2
CO3	Examine the implications of technological changes in industrial and service sectors.	K3
CO4	Analyse the multifaceted impacts of technological changes with a special focus on the Indian context and government initiatives for managing technological advancements.	K4

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	-	-	-	-	1	1	2	1	2	3	1	1	-
CO2	-	-	-	-	-	-	-	-	1	1	1	-	-
CO3	-	-	-	-	-	-	-	-	2	1	1	1	1
CO4	-	-	-	-	-	-	-	-	1	1	1	1	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	**Management theory:** Management definition & functions; System approaches to management; Task & responsibilities of manager. **Management process:** Planning; Organizing; Decision making. **Management operations:** Human resource; marketing; corporate & social responsibilities; financial; entrepreneurship Patent & Intellectual property rights.	9	1
2	**Technology concept:** Significant technology changes during last 2 centuries; Direct and indirect effect of technology on human need factors. **Dimensions of technology management:** Role & importance of technology management; business plan; technology & competition; new ventures; innovation; research; research infra structure; examples of speed of introducing technology development into social use. **Technology management in Indian context:** Aspects and issues of technology management: technology change, life cycle, diffusion & growth, transformation, alternatives, appropriateness, policy instruments, planning, development options & strategies	9	2
3	**Implication in technology changes:** Production function and technology change. **Nature of technology change:** Incremental, radical; New technology system. **Technology revolution**: Information technology revolution, Changes in service; Personal service, Process changes. **Macro- effects of technological change:** Knowledge intensity & skill mismatch; Erosion of competitive mismatch in developing countries. **Technology absorption:** Technology package & dependence; Terminology and concepts in absorption. **Technology import in India:** Indian experience; Managing technology absorption, Government initiatives.	9	3
4	**Technology environment:** Science & Technology in India; Policies, Linkages at enterprise levels. **Technology support systems:** financing; information systems; organizing technology at enterprise level. **Technology forecasting:** Innovation chain; Necessity; Role; Classification. Forecasting approaches: Methods; Methodology comparison; Pitfalls & mistakes. **Digital Transformation and Industry 4.0:** Concepts and significance of digital transformation. **Industry 4.0 technologies:** IoT, AI, ML, Big Data, Robotics, and Cyber-Physical Systems. Impact of digital transformation on business models and processes.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Management of Technology and Innovation	P N Rastogi	SAGE Publications	2009
2	Managing Strategic Innovation & Change	Tushman, M.L. and Anderson	Oxford University Press, New York,	2004
3	Management of Technology and Innovation	Khurana, V. K.	Ane Books New Delhi,2012	2012
4	Managing Technology and Innovation for Competitive Advantage	Narayanan	Pearson Education,	2002

Reference Books

Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition andYear
1	Strategic Management of Technology and Innovation	RobertA, Burgelman, Clayton.M.Christensen, Steven.C.Wheelright,	McGraw-Hill Education	5th, 2009
2	Innovation Management and New Product Development	Paul Trott,	Pearson Education	2009
3	Innovation Management, Strategies, Implementation and Profits	Afuah, A	Oxford University Press	2009

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	System approaches to management	https://archive.nptel.ac.in/courses/110/106/110106157/
2	Technology management in Indian Context	https://archive.nptel.ac.in/courses/110/106/110106157/
3	Technology absorption	https://archive.nptel.ac.in/courses/110/106/110106157/
4	Technology forecasting	https://archive.nptel.ac.in/courses/110/106/110106157/

SUPPLY CHAIN AND LOGISTICS MANAGEMENT

Course Code	24SJPEMET415	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

- Understand the complexity and key issues in supply chain management.
- Describe logistics networks, distribution planning, routing design and scheduling models.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain basic supply chain concepts, strategic fit, drivers, and effects of globalization.	K2
CO2	Use forecasting and planning methods to manage demand and improve supply chain coordination.	K3
CO3	Analyze inventory types and determine optimal product availability under uncertainty.	K3
CO4	Apply logistics and transport methods, considering performance and sustainability.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	2	2	-	-	-	2	-	-	2	-	-	2	2
CO2	2	3	2	-	2	-	-	-	2	2	-	3	2
CO3	3	3	2	-	3	-	-	-	-	1	-	3	2
CO4	2	2	2	-	3	3	-	-	2	1	2	2	3

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Understanding the Supply chain, Achieving strategic fit in a supply chain. Supply chain drivers and metrics. Analysing and designing the supply chain network, factors affecting distribution network design, role of network design, models for designing regional network configuration. Impact of globalisation on supply chain networks.	9	1
2	Demand forecasting in supply chain, role of forecasting, components of forecasting, forecasting methods. Aggregate planning in supply chain, basic trade-offs in aggregate planning, linear programming in aggregate planning. Coordination in supply chain, impact of lack of coordination in the chain, obstacles to coordination, managerial levers to improve coordination.	9	2
3	Managing economies of scale in a supply chain: Cycle inventory, Aggregating Multiple Products in a Single Order & Quantity Discounts. Managing uncertainty in a Supply chain – Safety inventory: Factors affecting the optimal level of product availability. Impact of supply uncertainty on safety inventory. Impact of aggregation on safety inventory. Factors affecting the optimal level of Product availability.	9	3
4	Logistics management and its components. Modes of transportation and their performance Characteristics & Transportation infrastructure policies. Routing and scheduling in transportation. Design options for a transportation and logistics network. Trade-offs in transportation design, Tailored transportation. Role of sustainability in a supply chain. Sustainability connected supply chain drivers.	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Supply Chain Management: Strategy, planning & Operation	Sunil Chopra and Dharam Vir Kalra	Pearson	7th edition, 2019

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Designing and managing the supply chain concepts, strategies, and cases studies	David Simchi- Levi, Edith Simchi-Levi	McGraw Hill	4th edition, 2022
2	Production and operations management	R. Panneerselvam	PHI	3rd edition, 2013

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Understanding the Supply Chain, Strategic Fit, Supply Chain Drivers, Network Design, Globalization Impact	• https://www.youtube.com/watch?v=P-Q-pzSCfkQ • https://jkccollege.digimat.in/nptel/courses/video/110107074/L09.html • https://archive.nptel.ac.in/courses/110/105/110105141/
2	Demand Forecasting, Aggregate Planning, Coordination in Supply Chain	• https://archive.nptel.ac.in/courses/110/107/110107074/ • https://avcce.digimat.in/nptel/courses/video/110106045/L05.html
3	Cycle Inventory, Safety Inventory, Product Availability	• https://archive.nptel.ac.in/courses/110/107/110107074/ • https://www.youtube.com/watch?v=qvjdlo9UHvI
4	Logistics Management, Transportation Modes, Sustainability in Supply Chain	• https://www.youtube.com/watch?v=FtTax3UKoJk • https://www.youtube.com/watch?v=aoOL88Ih_Jo&list=PL7625ds25GTvjBDY9nxgfOtjcVLxfxTmB

ADVANCED MECHANICS OF SOLIDS

Course Code	24SJPEMET415	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	2:1:0:0	ESE Marks	60
Credits	5/3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	24SJPCMET302 Mechanics of Solids	Course Type	Theory

Course Objectives:

- To study the methodologies in theory of elasticity at a basic level.
- To acquaint with the solution of advanced bending problems.
- To study the methods for torsion in components with non-circular cross section and thin- walled structures.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply the concepts of stress and strain analysis in solids.	K3
CO2	Apply stress function method for solving two-dimensional problems.	K3
CO3	Solve axi-symmetric problems and general bending problems for skewed loading and for beams which are curved.	K3
CO4	Apply solution methods for torsion in components with non-circular cross-sections and thin-walled structures.	K3

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

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO 1	PSO 2
CO1	3	2	1	-	-	-	-	-	-	-	-	3	2
CO2	3	2	1	-	-	-	-	-	-	-	-	3	1
CO3	3	2	1	-	-	-	-	-	-	-	-	3	2
CO4	3	2	1	-	-	-	-	-	-	-	-	3	2

SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to theory of elasticity – 3D stress components in rectangular and cylindrical coordinate systems. Equations of equilibrium in rectangular coordinate system. Cauchy's equations. Stress transformation. Hydrostatic and deviatoric stress components. Octahedral stresses. Displacement field – Strain tensor – Strain-displacement relations (no derivation required) – constitutive equations (no derivation required). Boundary value problems – Different boundary conditions.	9	1
2	Equations in polar coordinates (2D) – equilibrium equations and strain-displacement relations. Airy's stress function and equation – polynomial method of solution – solution for bending of a cantilever beam with end load. Application of stress function to Lame's problem – Stress concentration problem of a small hole in a large plate (only Stress distribution)	9	2
3	**Axisymmetric problems:** thin cylinders pressurized from inside, thick cylinders pressurized from inside and outside, Rotating disks. Unsymmetrical bending of straight beams possessing two axes of symmetry – shear centre – Winkler Bach theory for Bending of curved beams (with rectangular cross-section).	9	3
4	**Torsion of non-circular bars:** St.Venant's and Prandtl's methods – solutions for elliptical cross-section. Membrane analogy. Torsion of thin-walled tubes, thin rectangular sections, rolled sections and multiply connected sections	9	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks **(8x3 = 24marks)**	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Theory of Elasticity	T.G. Sitharam and L. Govinda Raju	Springer	First Edition, 2021
2	Advanced Mechanics of Solids	L.S. Srinath	McGraw Hill Education	Third Edition, 2017
3	Solid Mechanics	S.M.A. Kazimi	McGraw Hill Education	Second Edition, 2017
4	Advanced Mechanics of Materials	S. Jose	Pentagon Educational Services	First Edition, 2013
5	Advanced Mechanics of Solids	S. Anil Lal	Siva Publications	First Edition, 2017

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Theory of Elasticity	S.P. Timoshenko and J.N. Goodier	McGraw Hill Education	Third Edition, 2009
2	Mechanics of Solids and Structures	David W.A. Rees	Imperial College Press	Second Edition, 2016
3	Engineering Solid Mechanics: Fundamentals and Applications	Ragab A.R.and Bayoumi S. E.	CRC Press	First Edition, 2018
4	Elasticity: Theory, Applications and Numericals	Martin H. Sadd	Academic Press	Second Edition, 2012

Video Links (NPTEL, SWAYAM…)		
Module No.	**Topic**	**Link ID**
1	Stress and strain tensor	https://archive.nptel.ac.in/courses/112/101/112101095/
2	2D problems in polar coordinate system, Stress function method	https://archive.nptel.ac.in/courses/105/108/105108070/
3	Axisymmetric problems, Unsymmetrical bending	https://archive.nptel.ac.in/courses/105/108/105108070/
4	Torsion of non-circular bars and thin-walled tubes	https://archive.nptel.ac.in/courses/112/101/112101095/