'येथे बहुतांचे हित'

Marathwada Mitra Mandal's

COLLEGE OF ENGINEERING

Karvenagar, Pune - 52.

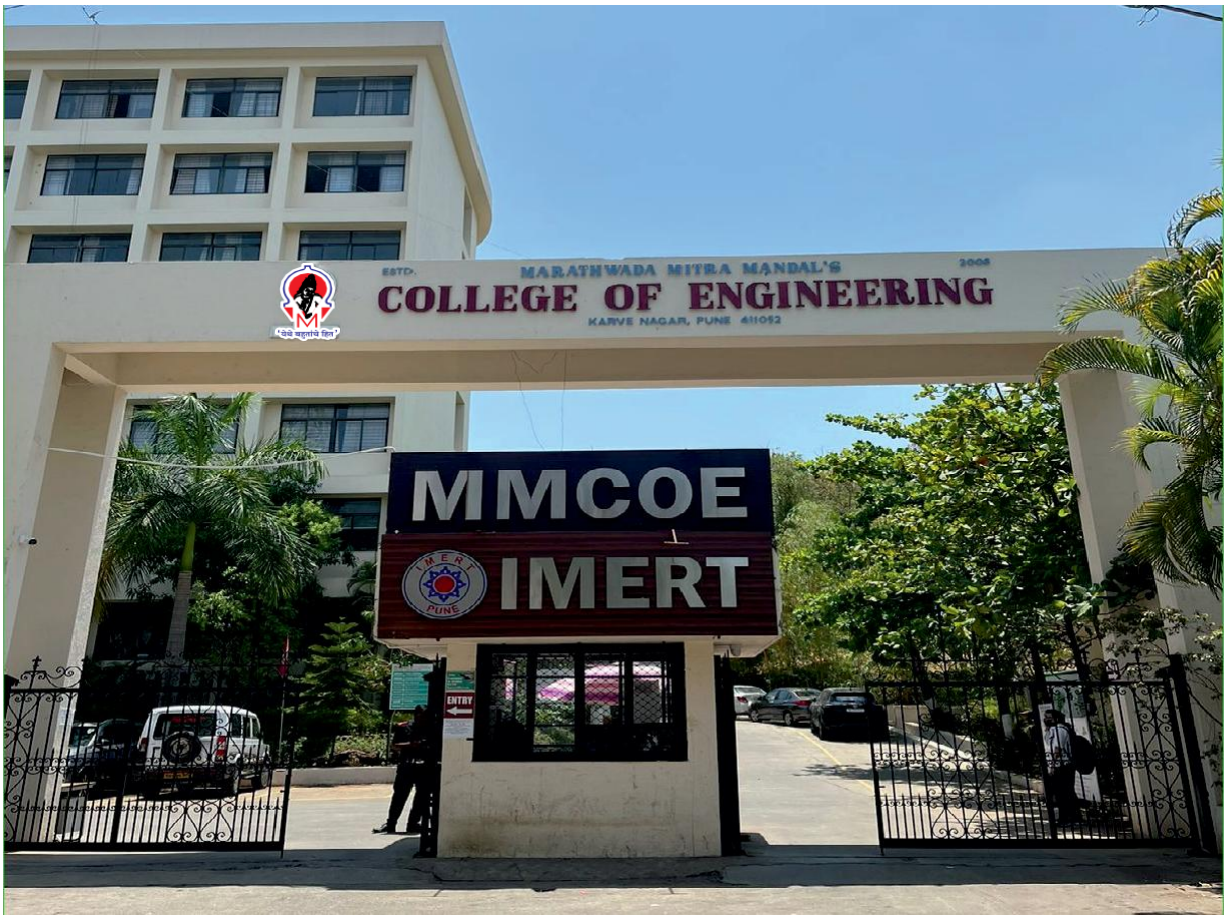
An Autonomous Institute affiliated to SPPU

Accredited with A++ Grade by NAAC
Recipient of Best College award by SPPU | Accredited by NBA
Recognized under 2(f) and 12(B) of UGC Act 1956

www.mmcoe.edu.in

Curriculum Structure and Syllabus

Second Year B.Tech. Mechanical Engineering



Academic Year 2025-26

Marathwada Mitra Mandal's College of Engineering

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A.Y. 2025-26

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Institute Vision

To be a globally renowned institution through excellence in engineering education for sustainable and holistic development

Institute Mission

M1: Empower students with cutting-edge technologies and global competencies

M2: Foster culture of research and entrepreneurial mindset

M3: Imbibe social and professional values

M4: Provide an inclusive environment for lifelong learning

Department Vision

To develop globally competent and socially committed mechanical engineers

Department Mission

Our Mission is to

1. Develop competent professionals through center of excellence
2. Strengthen industry-academia collaboration for ethically responding real-world problems
3. Provide an inclusive environment for entrepreneurship, research and innovation.
4. Empower students for higher education and lifelong learning

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

Program Outcomes (POs)

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

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

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

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including 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: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.(WK1, WK5, and WK7).

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

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

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

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

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

Program Educational Objectives (PEO)

Graduates from our program will:

1. Apply professional skills for solving the problems in mechanical engineering & related fields.
2. Demonstrate ethics and concern for society and the environment.
3. Embrace lifelong learning through higher studies, research and innovation.

Program Specific Outcomes (PSOs)

Graduates from our program will:

PSO-I: Apply advanced technologies of mechanical and allied engineering to address the challenges faced in Industry 4.0.

PSO-II: Contribute to the project in the core and associated domain by using add-on skills like CAD, CAM and CAE.

PSO-III: Develop the ability to innovate socially relevant products and systems by effectively utilizing resources.

Abbreviations	
BSC:	Basic Science Course
UG:	Undergraduate Programme
ESC:	Engineering Science Course
PCC:	Program Core Courses
PEC:	Program Elective Courses
MDM:	Multidisciplinary Minor Courses
OEL:	Open Elective
VSE:	Vocational & Skill Enhancement Course
AEC:	Ability Enhancement Course
EEM:	Entrepreneurship/Economics/Management
IKS:	Indian Knowledge System
VEC:	Value Education Course
RMD:	Research Methodology
CEP/FPR:	Comm. Eng. Project (CEP)/Field Project (FP)
PRJ:	Project
INT/OJT:	Internship/On-Job Training
CCC:	Co-Curricular Courses
IT:	Internal Tool
ET:	External Tool
ETE:	End –Term Examination
CIE:	Continuous Internal Evaluation
TW:	Term work
OR:	Oral Examination
PR:	Practical Examination
L:	Lecture
P:	Practical
T:	Tutorial
OL:	Online Teaching
ODL:	Open Distance Learning

Assessment Tool Guidelines for Continuous Internal Evaluation (CIE)

AY: 2025-26

Distribution of CIE 40 marks for each subject is as below:

Sr. No.	Unit No.	Weightage	Assessment Tools
1	Unit 1	8 Marks	Class Test
2	Unit 2	8 Marks	
3	Unit 3	8 Marks	1. Quizzes 2. Home Assignments 3. Case Study 4. Field work 5. Report writing 6. Presentations/Seminar Topics 7. Mini projects/Course Projects 8. Mind map 9. Poster Presentation 10. Problem Solving and Coding 11. Parametric Study 12. Any other assessment tool with permission of BoS chairperson
4	Unit 4	8 Marks	
5	Unit 5	8 Marks	

1. Above are the suggestive assessment tools for CIE.
2. The class test is a one-time assessment; no retests will be conducted
3. Module coordinators should review and verify the assessment tools implemented for each course.
4. Course coordinators are required to maintain softcopy records of the respective CIE assessment tools used for their classes.

Curriculum Structure Sem-III & IV

Second Year B.Tech Mechanical Engineering Semester-III															
Course Code	**Course Name**	**Course Type**	**Teaching Scheme (Hrs/week)**			**Examination Scheme**						**Credits**			
			L	**P**	**T**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**	**L**	**P**	**T**	**Total**
ME24PCC201	Thermofluidic	PCC	3	-	-	40	60	-	-	-	100	3	-	-	3
ME24PCC202	Solid Mechanics	PCC	3	-	-	40	60	-	-	-	100	3	-	-	3
ME24PCC203	Manufacturing Process	PCC	3	-	-	40	60	-	-	-	100	3	-	-	3
*	*MDM	MDM	2	-	-	40	60	-	-	-	100	2	-	-	2
ME24PCC205	Thermofluidic Lab	PCC	-	2	-	-	-	-	50	-	50	-	1	-	1
ME24PCC206	Solid Mechanics Lab	PCC	-	2	-	-	-	-	50	-	50	-	1	-	1
*	*MDM Lab	MDM	-	2	-	-	-	25	-	-	25	-	1	-	1
ME24CEP208	Experiential Learning Laboratory	CEP	-	4	-	-	-	50	-	-	50	-	2	-	2
ME24EEM209	Engineering Economics	EEM	-	-	2	-	-	50	-	-	50	-	-	2	2
SH24VEC201	Environment Sustainability	VEC	-	-	2	-	-	50	-	-	50	-	-	2	2
Total			11	10	4	160	240	175	100	-	675	11	5	4	20

* Refer separate MDM Booklet

Second Year B.Tech Mechanical Engineering Semester-IV															
Course Code	**Course Name**	**Course Type**	**Teaching Scheme (Hrs/week)**			**Examination Scheme**						**Credits**			
			L	**P**	**T**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**	**L**	**P**	**T**	**Total**
ME24PCC251	Applied Thermofluidic	PCC	3	-	-	40	60	-	-	-	100	3	-	-	3
ME24PCC252	Kinematics of Machines	PCC	3	-	-	40	60	-	-	-	100	3	-	-	3
ME24PCC253	Engineering Metallurgy	PCC	3	-	-	40	60	-	-	-	100	3	-	-	3
*	*Open Elective	OEL	3	-	-	40	60	-	-	-	100	3	-	-	3
ME24PCC255	Applied Thermofluidic Lab	PCC	-	2	-	-	-	-	50	-	50	-	1	-	1
ME24PCC256	Kinematics of Machines Lab	PCC		2					50	-	50	-	1	-	1
ME24VSE257	Solid Modeling	VSE	-	4	-	-	-	50	-	-	50	-	2	-	2
ME24VEC258	Industrial Engineering	VEC	-	-	2	-	-	50	-	-	50	-	-	2	2
SH24AEC202	Professional Communication and Personality Development	AEC	-	-	2	-	-	50	-	-	50	-	-	2	2
Total			12	8	4	160	240	150	100	-	650	12	4	4	20

* Refer separate OEL Booklet

L- Lecture P- Practical T- Tutorial CIE-Continuous Internal Evaluation
ETE- End Term Examination TW- Term work PR- Practical OR- Oral
L : 1 Hr.= 1 credit P: 2 Hr. = 1 Credit T: 1 Hr. = 1 Credit

SEMESTER III

Second Year B.Tech Mechanical Engineering

Semester-III

Course Code: ME24PCC201 **Course Name: Thermofluidic**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3		-	-	-	40	60	-	-		100	3		-	3

Prerequisite: Engineering Mathematics - I and II, Engineering Physics, Engineering Chemistry, Engineering Mechanics

Course Objectives:

- To understand the fundamentals of thermodynamics
- To apply the first and second laws of thermodynamics in various engineering systems.
- To understand basic properties of fluids.
- To learn fluid statics and dynamics.
- To understand losses in flow, drag and lift forces.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Explain the basics of thermodynamics with heat and work interactions.
CO2: Apply laws of thermodynamics to steady flow and non-flow processes.
CO3: Determine the properties of steam and their effect on performance of vapour power cycle.
CO4: Apply the laws of fluid statics and fluid dynamics.
CO5: Estimate friction, minor losses in internal flows.

Unit	Contents	Duration (Hrs.)
1	**Fundamentals of Thermodynamics** Ideal Gas, Gas Laws, Equation of State, Ideal gas Processes. Macro and Microscopic Approach, State Postulate.	7
2	**Laws of Thermodynamics** Zeroth law of Thermodynamics, First Law of Thermodynamics, Application to flow and non-flow Processes and Cycles. Second Law of Thermodynamics, Limitations of first law, Kelvin-Planck & Clausius Statement, Equivalence, PMM-I and II, Carnot Cycle, Clausius Inequality, Entropy.	8
3	**Pure Substance** Boiler, Phase changes of water, Properties of steam, Steam Tables, Rankine Cycle analysis, Steam power Plant. Properties of Fluids, Newton's law of viscosity, Rheology.	8
4	**Fluid Dynamics** Pascal's Law, Manometer, Hydrostatic, Buoyancy, Metacenter, Continuity, Bernoulli's equations, Pitot static tube, Venturi meter, and Orifice meter.	8
5	**Fluid Flow** Classification of flow, major & minor losses, hydro dynamically smooth and rough boundaries, compounding of pipes & equivalent pipe, siphons, transmission of power, Boundary layer formation, boundary layer thickness, boundary layer separation, drag and lift concepts.	8
	Total Hours	39

Text Books

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications, 2017.
2. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications, 2017.
3. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill, 2019.
4. R. K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publication, 2015.

Reference Books
1. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill, 2017. 2. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India, 2011. 3. Chaim Gutfinger David Pnueli, "Fluid Mechanics" Cambridge University press. 2003.
Online References
1. NPTEL Course: Prof. Anand T. N. C., IIT Palakkad, "Thermodynamics" (https://onlinecourses.nptel.ac.in/noc23_me76/preview) 2. NPTEL Course: Prof. Suman Chakraborty, IIT Kharagpur, "Introduction to Fluid Mechanics" (https://onlinecourses.nptel.ac.in/noc22_me31/preview) 3. NPTEL Course: Prof. Subashisa Dutta, IIT Guwahati, "Fluid Mechanics" (https://onlinecourses.nptel.ac.in/noc22_ce85/preview)

Second Year B.Tech Mechanical Engineering														
Semester-III														
Course Code: ME24PCC202										**Course Name: Solid Mechanics**				
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
3		**-**	**-**	**-**	**40**	**60**	**-**	**-**		**100**	**3**		**-**	**3**

Prerequisite: Concepts of Statics, Applied Physics

Course Objectives:

- To acquire basic knowledge of stress, strain due to various types of loading.
- To determine Bending, Shear stress, Slope and Deflection on Beam.
- To draw Shear Force and Bending Moment Diagram for transverse loading.
- To solve problems of the slope & deflection of a beam for the beam.
- 5. To apply the concept of Principal Stresses and Theories of Failure.

Course Outcomes:

After completion of this course, students will be able to

CO1. Determine the tensile, compressive and shear stresses developed in machine components

CO2. Compute the principal stresses in 2D loading systems.

CO3. Use the shear force and bending moment diagram for computation of bending and shearing stresses in beams.

CO4. Calculate the slope & deflection of a beam under given loading conditions.

CO5. Determine torsional shear stress in shaft and the critical buckling load on the column.

Unit	Contents	Duration (Hrs.)
1	**Simple Stresses and strains:** Introduction to types of Loads, Definition and concept and of stress and strain, Hooke's law, Stress-Strain diagrams for ductile and brittle materials, Elastic constants and their relationship, Factor of safety, Elongation of prismatic and tapering bars, Compound bars, Thermal stress and strain	7
2	**Compound Stresses:** Introduction, State of stress at a point, General two-dimensional stress system, Principal stresses and strains, Principal planes, Maximum shear stresses, Mohr's circle of stresses. **Thin Cylinders:** Introduction, Thin cylinders subjected to internal pressure; Hoop stresses, Longitudinal stress and change in volume.	8
3	**Shear Force and Bending Moment in Beams:** Types of beams, supports and loadings, Concept of bending moment and shear force Shear force and bending moment diagrams for statically determinate beams. **Bending and Shear Stresses in Beams:** Theory of pure bending, section modulus, flexural rigidity, Transverse shear stress in beams, Bending and shear stress distribution in circular, rectangular, 'I', and 'T' shape cross sections.	9
4	**Deflection of Beams:** Introduction, slope & deflection of a beam with application, Macaulay's Method, Moment area method, Method of Superposition, Castigliano's Theorem.	7

5	**Torsion in Circular Shaft:** Introduction, pure torsion, Torsion equation, Torsional rigidity and polar modulus, Power transmitted by a shaft, Combined bending and torsion. **Columns and Struts:** Introduction, short and long columns. Euler's theory of columns, Euler's Buckling load for different end conditions, Rankine formula for columns.	8
	Total Hours	39

Text Books

1. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication, 11th Edition, 2022
2. Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, "Mechanics of Materials", McGraw Hill Publication , 8e in SI Units Edition, 2020
3. S. S. Rattan, " Strength of Materials", McGraw Hill Publication, 3rd Edition, 2017
4. S.S. Bhavikatti, "Strength of Materials", S. Chand Publishing, 1st Edition, 2021

Reference Books

1. Barry J. Goodno, James M. Gere, "Mechanics of Materials", 9th Edition, 2022 CL
2. D.H. Young, S.P. Timoshenko "Elements of Strength of Materials" East West Press Pvt. Ltd., 5th Edition, 2014.
3. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication, 1968.

Online References

1. NPTEL Course: Prof. S.K. Bhattacharyya, Strength of Materials (https://nptel.ac.in/courses/105105108)
2. NPTEL Course: Prof. K. Ramesh, IIT Madras, Strength of Materials (https://onlinecourses.nptel.ac.in/noc23_me140/preview)

Second Year B.Tech Mechanical Engineering														
Semester III														
Course Code: ME24PCC203										**Course Name: Manufacturing Processes**				
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
3	**-**	**-**	**-**	**-**	**40**	**60**	**-**	**-**	**-**	**100**	**3**	**-**	**-**	**3**

Prerequisite: Engineering Exploration Lab - 2

Course Objectives:

- Identify and explain the major elements and components of each machine tool and their respective functions in the machining process.
- Understand the basic principles and significance of casting as a primary manufacturing process.
- Classify, describe and configure the principles of various welding techniques.
- Understand the fundamental concept of plastic deformation and identify the factors affecting metal plasticity during forming operations.
- Understand the fundamentals of sheet metal forming processes and their significance in manufacturing industries

Course Outcomes:

After learning the course, the students will be able to:
CO1: Apply suitable machine tool in various applications.
CO2: Understand basics of manufacturing, elements of casting, construction of pattern, gating system, different types of casting method and their application.
CO3: Explain different welding processes and evaluate welding characteristics.
CO4: Understand mechanism of metal forming techniques.
CO5: Apply the basic principles to design dies and tools for forming and shearing operations.

Unit	Contents	Duration (Hrs.)
1	**Machine Tools and Their Elements** Lathe Machine, Drilling Machine, Grinding Machine and Milling Machine: Overview and working principle, Indexing mechanism of Milling machine, Material Removal Rate and numerical.	8
2	**Casting Processes** Introduction to casting processes, Patterns: Pattern materials, types of patterns, Allowances pattern design, Moulding sand, Properties of moulding sands, Core making, melting practices and furnaces, Pouring and solidification phenomena, Gating system design, Casting defects and inspection.	7
3	**Joining Processes** Introduction, Classification of joining processes, types of joints, Arc welding, Resistance welding Gas welding: Principles, Equipment's, types and applications, Soldering, Brazing, Welding defects and inspection.	8

4	**Metal Forming Processes** Plastic deformation, Factors affecting plastic deformation, Hot and Cold working, Friction and lubrication in metal forming, Rolling Process, Forging Process, Drawing Process, Extrusion Process, forming defects, Causes and remedies for all forming processes.	8
5	**Sheet Metal Forming** Introduction to sheet metal working, Types of sheet metal operations, Press-types and main parts of power press, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design. Recent trend in sheet metal and their formability in manufacturing automotive panel.	8
	Total Hours	**39**

Text Books

1. P. N. Rao, "Manufacturing Technology Vol. I & II", Tata McGraw Hill, New Delhi, 2009.
2. P. C. Sharma, "Production Engineering", S Chand and Company Pvt. Ltd, New Delhi, 2008.
3. S. K. Hajra Choudhury and A.K. Hajra Choudhury, "Elements of Workshop Technology", Vol.: I Manufacturing Processes, Media Promoters and Publisher Pvt. Ltd, New Delhi, 2012.
4. O. P. Khanna, "Welding Technology", Dhanpat Rai Publications, 2006.
5. P. L. Jain, "Principles of Foundry Technology", Tata McGraw Hill, New Delhi, 2001.
6. M. P. Groover, "Fundamentals of modern manufacturing", Fifth Edition, Wiley Publication, 2015.

Reference Books

1. R. K. Jain, "Production Technology", Khanna Publishers, 2009.
2. Hein and Rosenthal, "Principles of Metal Casting", Tata McGraw-Hill, 1967.

Online References

1. NPTEL Course: Prof. D K Dwivedi , IIT Roorkee , "Fundamentals of Manufacturing Processes" (https://onlinecourses.nptel.ac.in/noc24_me123/preview)
2. NPTEL Course: Prof. Sounak Kumar Choudhury, IIT Kanpur, "Manufacturing Processes – Casting and Joining" (https://onlinecourses.nptel.ac.in/noc21_me40/preview)

Second Year B.Tech Mechanical Engineering														
Semester-III														
Course Code: ME24PCC205										**Course Name: Thermofluidic Lab**				
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
-	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**50**	**50**	**-**	**1**	**-**	**1**

Prerequisite: Engineering Mathematics - I and II, Engineering Physics, Engineering Chemistry, Engineering Mechanics

Course Objectives:

- To understand the basic properties of fluids.
- To learn fluid statics and dynamics.
- To understand losses in flow.
- To understand computational tools.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Analyze and evaluate the thermal properties of fluids and steam

CO2: Apply experimental techniques to determine discharge coefficients of flow measuring devices

CO3: Apply experimental techniques to determine major and minor hydraulic losses in pipe systems

CO4: Apply the knowledge of computational tools and industry for fluid flow simulation.

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	Determination of HCV of gaseous fuel using Junker's calorimeter respectively.	02
2	Determination of dryness fraction of steam using combined separating and throttling calorimeter.	02
3	Determination of equivalent evaporation and heat balance.	04
4	Determination of a. Fluid viscosity and its variation with temperature. b. Metacentric height of floating object.	02
5	Determine the Reynold's Number and the Type of Flow using Reynolds apparatus.	02
6	Determination of coefficient of discharge of Orifice meter and Venturimeter.	02
7	Determination of coefficient of discharge of V Notch	02
8	Determination of minor and major losses through pipes	02
9	Simulation of fluid flow by using suitable software	04
10	Industrial visit	04
	Total Hours	26

Text Books
1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications, 2017. 2. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications, 2017. 3. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill, 2019. 4. R. K. Bansal, "Fluid Mechanics & Hydraulic Machines", Laxmi Publication, 2015.
Reference Books
1. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill, 2017. 2. Kundu, Cohen, Dowling, "Fluid Mechanics", Elsevier India, 2011. 3. Chaim Gutfinger David Pnueli, "Fluid Mechanics" Cambridge University press. 2003.
Online References
1. NPTEL Course: Prof. Anand T. N. C., IIT Palakkad, "Thermodynamics" (https://onlinecourses.nptel.ac.in/noc23_me76/preview) 2. NPTEL Course: Prof. Suman Chakraborty, IIT Kharagpur, "Introduction To Fluid Mechanics" (https://onlinecourses.nptel.ac.in/noc22_me31/preview) 3. NPTEL Course: Prof. Subashisa Dutta, IIT Guwahati, "Fluid Mechanics" (https://onlinecourses.nptel.ac.in/noc22_ce85/preview)

Second Year B.Tech Mechanical Engineering														
Semester-III														
Course Code: ME24PCC206										**Course Name: Solid Mechanics Lab**				
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
-	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**50**	**50**	**-**	**1**	**-**	**1**

Prerequisite: Concepts of Statics, Applied Physics

Course Objectives:

- Determine how materials deform (strain) and how internal forces (stress) develop when external loads are applied.
- Understand how different materials respond to loads, including elastic (temporary) and plastic (permanent) deformations.
- Assess the maximum loads that structures or components can safely withstand without failure.
- Study causes of failure such as fracture, fatigue, buckling, and creep to prevent catastrophic breakdowns.

Course Outcomes:

After learning the course, the students will be able to:

CO1. Determine the tensile, compressive and shear stresses developed in machine components

CO2. Compute the principal stresses in 2D loading systems.

CO3. Use the shear force and bending moment diagram for computation of bending and shearing stresses in beams.

CO4. Calculate the slope & deflection of a beam under given loading conditions.

CO5. Determine torsional shear stress in shaft and the critical buckling load on the column.

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	Tension test for ductile material on universal testing machine.	4
2	Compression test for brittle material on universal testing machine.	4
3	Shear test of ductile material on universal testing machine.	4
4	Experimental verification of flexural formula in bending for simply supported beam.	4
5	Torsion test on solid circular bar of ductile material.	4
6	Impact test on mild steel specimen using Izod and Charpy impact test.	2
7	Deflection of simply supported beam under point load at center of beam.	2
8	Deflection of cantilever beam under point load at the free end.	2
	Total Hours	26

Text Books
1. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication, 11th Edition, 2022 2. Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, "Mechanics of Materials", McGraw Hill Publication, 8e in SI Units Edition, 2020 3. S. S. Rattan, "Strength of Materials", McGraw Hill Publication, 3rd Edition, 2017 4. S.S. Bhavikatti, "Strength of Materials", S. Chand Publishing, 1st Edition, 2021
Reference Books
1. Barry J. Goodno, James M. Gere, "Mechanics of Materials", 9th Edition, 2022 CL 2. D.H. Young, S.P. Timoshenko "Elements of Strength of Materials" East West Press Pvt. Ltd., 5th Edition, 2014. 3. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication, 1968.
Online References
1. NPTEL Course: Prof. S.K. Bhattacharyya, "Strength of Materials", (https://nptel.ac.in/courses/105105108) 2. SWAYAM Prabha: Prof. K. Ramesh, IIT Madras, "Strength of Materials" (https://onlinecourses.nptel.ac.in/noc23_me140/preview)

Second Year B.Tech Mechanical Engineering														
Semester-III														
Course Code: ME24CEP208					**Course Name: Experiential Learning Laboratory**									
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
-	**4**	**-**	**-**	**-**	**-**	**-**	**50**	**-**	**-**	**50**	**-**	**2**	**-**	**2**

Prerequisite: Basic Knowledge of Engineering Materials

Course Objectives:

The objectives of this course are to:

- Equip students with a comprehensive understanding of manufacturing principles and the effective use of machine tools for precision engineering.
- Introduce the concepts of sustainable product design and development to foster environmentally responsible engineering practices.
- Develop students' problem-solving skills to implement technical knowledge in designing feasible and practical engineering solutions.
- Build foundational knowledge in thermal sciences and their application to creating energy-efficient and sustainable solutions.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply manufacturing principles to produce components with high precision and quality using machine tools

CO2: Explain sustainability aspect of product design and development

CO3: Implement the technical knowledge to design feasible solutions

CO4: Apply concepts of thermal science for sustainable solutions

List of Lab Activities

Sr. No.	Name of the Activities	Duration (Hrs.)
1	Detailed process planning and machining of parts using lathe machines	4
2	Demonstration on indexing mechanism. Calculation of index crank and index plate movement by simple indexing and manufacture of spur gear on a milling machine using indexing head	4
3	Machining on surface grinding operations and measurement of surface roughness produced and estimation of machining time	4
4	Fabrication of mechanical components using resistance welding technique.	4
5	Manufacturing of plastic components using injection moulding technique	4
6	CNC part program using G Codes and M Codes	4
7	Machining of a mechanical component using CNC machine	4
8	Machining of a mechanical component using VMC machine	4
9	Precision cutting and engraving using a laser cutting machine	4

	Total Hours	36

Capstone Project		
1.	Design and develop a sustainable system using renewable energy sources	24
2.	Develop a system for ergonomic assessment and improvement	
3.	Design and develop the system using robotics and automation.	
4.	Develop the system using thermal and heat transfer techniques	
5.	Design and manufacture a functional prototype using additive manufacturing	
6.	Design a device or system incorporating smart materials	
	Total Hours	24

Text Books

1. S. K. Hajra Choudhary and N. Roy, "Element of Workshop Technology: Vol.1 and 2", Media Promoters and Publishers Pvt. Ltd., 2012.
2. H.S. Bawa, "Workshop Practice", Tata McGraw Hill Education (Publisher), 2017.
3. A. K. Chitale and R. C. Gupta, "Product Design and Manufacturing", PHI Learning Pvt. Ltd., 2020.

Reference Books

1. C. C. Kai and L. K. Fai, "3D Printing and Additive Manufacturing: Principles & Applications", 4th Edition, World Scientific, 2015
2. J. Larmer and S. Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences, 2017
3. M. P. Groover, "Production system & Computer Integrated manufacturing", Person India, 2007.
4. K. C. John, "Mechanical Workshop Practice", Prentice Hall Publication, New Delhi, 2010
5. R. K. Jain, "Production Technology Manufacturing Systems", Vol-I & II, Khanna Publishers, 2014
6. P. K. Nag, "Engineering Thermodynamics", TMH, 2017.

Online References

1. NPTEL Course: Prof. Inderdeep Singh, IIT, Roorkee, "Product Design and Development", [https://nptel.ac.in/courses/112107217]
2. NPTEL Course: Prof. A. Mahalingam and Prof. B. Ramadurai, IIT, Madras "Design Thinking - A Primer", [https://onlinecourses.nptel.ac.in/noc22_mg32/preview]
3. NPTEL Course: Prof. S. N. Joshi, IIT, Guwahati, "Laser-based manufacturing", [https://onlinecourses.nptel.ac.in/noc22_me92/preview]

Guidelines for Term Work

1	Capstone Project Student Groups shall be engaged in three batches per division.
2	Term work shall be based on continuous assessment of week wise activities and performance in project. The student shall complete the following activity as a Term Work Journal.

Second Year B.Tech Mechanical Engineering														
Semester-III														
Course Code: ME24EEM209									**Course Name: Engineering Economics**					
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
-	**-**	**2**	**-**	**-**	**-**	**-**	**50**	**-**	**-**	**50**	**-**	**-**	**2**	**2**

Prerequisites: Basic of Mathematics

Course Objectives:

- To introduce the fundamental concepts and terminology of engineering economics
- To develop an understanding of production theory
- To explore the structure and characteristics of different market forms
- To apply core principles of engineering economic analysis and management

Course Outcomes:

After learning the course, the students will be able to:

CO1: Apply fundamental concepts and use of terminology of engineering economics under different market conditions

CO2: Understand the basic theory of production in economics using different inputs and outputs factors

CO3: Understand the various markets and their characteristics in engineering economics

CO4: Apply the management principles of engineering economics

Unit	Contents
1	**Introduction to Engineering Economics** Definition of Engineering Economics, Fundamentals of Economics, Difference between Microeconomics & Macroeconomics, Theory of demand and supply, determinants, law of demand, law of supply, equilibrium between demand and supply Elasticity, time value of money
2	**Theory of Production in Economics** Production function, meaning, factors of production Law of variable proportions and law of returns to scale cost, meaning, short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost, Break even analysis
3	**Economic Markets** Basics of economic market, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly) National Income, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP, NDP, Personal income, disposal income, Indian Economy
4	**Engineering Economics Management** Definitions, Nature, scope Management and administration, skill, types and roles of managers Management Principles, Scientific principles, administrative principles, Maslow's Hierarchy of needs theory, Functions of Management and organization

List of Tutorial (Any 8)

Sr. No.	Name of the Tutorial	Duration (Hrs.)
1	Demand and Supply Interaction to Determine Market Equilibrium	2
2	Calculate and Interpret the Time Value of Money Or	4
3	Evaluation of Price Elasticity of Demand.	4
4	Classify and Compare Different Types of Production Costs	2

5	Determine the Break-Even Point from Cost and Revenue Data	4
6	Comparison of Characteristics of Economic Market Structures	2
7	Estimation of National Income Indicators Using Economic Parameters	4
8	Application of Maslow's Hierarchy of Needs to Identify Employee Motivation Factors	4
9 Or 10	Interpret and Illustrate the Principles of Management Or Identification of Managerial Roles and Skills	4 4
	Total Hours	26

Text Books

1. A.R. Arya Sri, "Managerial Economics and Financial Analysis", TMH Publications
2. S.C. Sharma and Banga T. R., "Industrial Organization & Engineering Economics", Khanna Publications
3. S.N. Maheswari and S.K Maheswari, "Financial Accounting", Fifth Edition, Vikas Publishing House

Reference Books

1. R.Paneerselvam, "Engineering Economics", PHI publication, 2013.
2. S.P.Robbins and A.D. Decenzo, "Fundamentals of Management: Essential Concepts and Applications", Pearson Education.
3. Dr. K. K. Dewett and M. H. Navalur, "Modern Economic Theory", By Chand Publications.

Online References

1. NPTEL Course: Prof. S. K. Mandal, Principles of Economics: https://onlinecourses.nptel.ac.in/noc23_ec06/preview
2. NPTEL Course: Prof. P.K. Jha, Engineering Economic Analysis: https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-me35/).

Second Year B.Tech Mechanical Engineering

Semester - III

Course Code:SH24VEC201 **Course Name: Environment Sustainability (VEC)**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	-	2	-	-	-	-	50	-	-	50	-	-	2	2

Prerequisites: A basic understanding of environmental science, geography, or social studies

Course Objectives:

- Understand the foundational concepts of sustainability, including its social, environmental, and economic dimensions, and the global need for sustainable development.
- Gain insights into the 17 United Nations Sustainable Development Goals (SDGs) and the role of technology, international cooperation, and policy in achieving them.
- Identify and explain different types of pollution (air, water, solid waste), their sources and impacts, and sustainable approaches to waste management including the 3Rs (Reduce, Reuse, Recycle) and zero-waste concepts.
- Evaluate global and local environmental challenges, including climate change, global warming, ozone depletion, and resource degradation.

Course Outcomes:

After the completion of course, the students can:

CO1: Describe the fundamental ideas of environmental sustainability.

CO2: Examine sustainability's social, economic, and environmental facets.

CO3: Analyse how human actions affect Environmental systems.

CO4: Propose strategies for sustainable development in various sectors.

Unit	Content
1	Introduction to Environmental Sustainability: Global environmental issues, Foundations of Environmental Sustainability. Sustainability: Challenges, potential; role of technology, policies.
2	Environmental Pollution and Waste Management: Air Pollution: Sources and Effects of Air Pollution. Water Pollution: Sources of Water Pollution, Sustainable Wastewater Treatment. Solid Waste zero Waste Concepts (3R Concept).
3	Climate Change and Energy: Understanding Climate Change, Science and impacts of climate change Climate modeling and adaptation, Sustainable Energy Solutions, Renewable energy technology, Efficient energy system and conservation

4	Sustainable Development Practices: Sustainability in Cities, infrastructure and cities that are sustainable, green buildings and smart cities.	
Sr. No	**List of Tutorial (Select any 08 activities out of 10 contributing to 26 hours)**	**Hours**
1	Examine the river pollution in Pune.	4
2	Prepare a climate change strategy for your town, city, or building.	4
3	Initiate a campaign to bring emphasis to a sustainability concern.	4
4	Examine The Current Environmental Issue	2
5	Examine a successful sustainability attempt from the real world	2
6	Home energy audit: Have students make a list of all the appliances and light bulbs in their house. How much energy does their house use if all the lights are on for 4 hours per day? If their appliances are on for 2 hours per day? How much energy could they save if they switched to energy-efficient appliances or lightbulbs?	2
7	Use recycled material in art projects: recycled materials can make beautiful art projects such as jewelry, planters, and birdhouses. Incorporating materials that would otherwise be thrown away into art projects can show your students how to find new uses for these items.	2
8	Life cycle: One way to show students what happens when you put something in the trash versus recycling or reusing the object is to do a life cycle analysis. This is a flowchart that shows the environmental impacts of an object, from extracting the raw materials to decomposition and everything in between. When something is put in the trash instead of being reused or recycled, the life cycle assessment will show a bigger environmental impact. When something is reused or recycled, the environmental impact is less because raw materials don't need to be extracted to create something new.	4
9	Go on a field trip: Visit your local landfill, recycling center, or a nearby composting facility where the students can see firsthand what is happening to waste and learn about the lifecycle of waste and its effect on the environment.	2
10	Compare carbon footprints of different materials used in construction or manufacturing in India.	2
	Total Hours for 08 Activities	**26**

Text Books
1. Sharma, "P.D. Ecology and Environment", Rastogi Publications,2020. 2. Kaushik, C.P., Kaushik, Anubha, "Perspectives in Environmental Studies New Age",International Publishers, 2021. 3. Agarwal, S.K. "Environmental Management", APH Publishing Corporation, 2005.
Journals and Articles
1. Kalam, A.P.J. Abdul, Srijan Pal Singh, "Target 3 Billion Innovative Solutions Towards Sustainable Development", Penguin Books,2011. 2. Kolbert, Elizabeth, "The Sixth Extinction: An Unnatural History", Henry Holt and Co.,2014.
Online References
1. NPTEL Course: Prof. Trupti Mishra, IIT Bombay, "Business and Sustainable Development" [https://nptel.ac.in/courses/110101153] 2. NPTEL Course: By Prof. Brajesh Kumar Dubey, IIT Kharagpur, "Sustainable Engineering Concepts And Life Cycle Analysis" [https://onlinecourses.nptel.ac.in/noc23_ce90/preview]

SEMESTER IV

Second Year B.Tech Mechanical Engineering

Semester-IV

Course Code: ME24PCC251 **Course Name: Applied Thermofluidic**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3		-	-	-	40	60	-	-	-	100	3	-	-	3

Prerequisite: Thermofluidic, Engineering Mathematics - I, Engineering Mathematics - II

Course Objectives:

- To analyze the construction of IC engines and characteristics of various engine cycles.
- To explain fuel systems, stages of combustion, abnormal combustion in SI and CI engines.
- To apply different testing methods for evaluating performance parameters of IC engines.
- To describe classification, operating principles and selection criteria of hydraulic turbines.
- To analyze performance characteristics of centrifugal pumps.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Discuss the basics of engine terminology, air standard and actual cycles.
CO2: Explain factors affecting the combustion performance of SI and CI engines.
CO3: Evaluate the performance parameters of engines.
CO4: Analyze the performance of hydraulic machines.
CO5: Estimate performance parameters of a centrifugal pump.

Unit	Contents	Duration (Hrs.)
1	**Introduction to Internal Combustion (IC) Engine** **IC engine:** Construction of engines, Terminology, Classification, Applications, Intake and exhaust system, Valve actuating mechanisms, Valve timing diagram. **Fuel, air and actual cycle:** Air-standard cycles, fuel-air cycles and actual cycles, Losses in engines, and comparison of air standard and actual cycle.	7
2	**SI and CI Engines** **SI engines:** Carburetion, Electronic fuel injection system, Stages of combustion in SI engines, Abnormal combustion, Detonation, Rating of fuels in SI engines. **CI engines:** Fuel injection system, Fuel injectors, nozzles, Stages of combustion in CI engines, Knocking and parameters affecting knocking, Rating of fuels in CI engines.	8
3	**Testing of IC Engines** Objective of testing, Various performance parameters for I.C. Engine - Indicated power, brake power, friction power, SFC, AF ratio. Methods to determine various performance parameters, characteristic curves, heat balance sheet.	7
4	**Hydraulic Turbines** Classification of turbo machines, Fundamental equations & losses. Impulse momentum principle and its applications. Introduction to the hydroelectric power plant, Classification of hydraulic turbines, Pelton turbine, Francis turbine, Kaplan turbine, Velocity diagrams, Performance characteristics, Specific speed, Selection of turbines, Cavitation and governing of turbines.	9
5	**Centrifugal Pump** Classification of pumps, Types of heads, Velocity triangles, Effect of outlet blade angle, Cavitation, NPSH, Thoma's cavitation factor, Priming of pumps, Specific speed, Performance characteristics, Pumps in series and parallel, Selection of pumps.	8
	Total Hours	39

Text Books
1. Ganesan V., "Internal Combustion Engines", McGraw-Hill Publications, 2012 2. Mathur M. L. and Sharma R. P., "A course in Internal combustion engines", Dhanpat Rai & Co., 2015 3. Modi P N and Seth S N., "Hydraulics & Fluid Mechanics and Machinery", Standard Book House, 2022 4. Bansal R. K., "Fluid mechanics and hydraulic machines", Laxmi Publications, 2019
Reference Books
1. Domkundwar V. M., "Internal Combustion Engine", Dhanpat Rai & Co., 2018 2. Heywood J. B., "Internal Combustion Engine Fundamentals", McGraw-Hill Publications, 2018 3. Pai B. U., "Turbomachines", Wiley India, 2015
Online References
1. NPTEL Course: Dr. Vinayak Kulkarni, Prof. Pranab K. Mondal, IIT Guwahati, "IC Engines and Gas Turbines", (https://onlinecourses.nptel.ac.in/noc22_me65/preview) 2. NPTEL Course: Prof. Suman Chakraborty, IIT Kharagpur, "Introduction To Fluid Mechanics" (https://nptel.ac.in/courses/112105269) 3. NPTEL Course: Prof. Subashisa Dutta, IIT Guwahati, "Fluid Mechanics" (https://nptel.ac.in/courses/105103192)

Second Year B.Tech Mechanical Engineering

Semester- IV

Course Code: ME24PCC252 **Course Name: Kinematics of Machines**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
3	-	-	-	-	40	60	-	-	-	100	3	-	-	3

Prerequisite: Engineering Mathematics - I and II, Engineering Physics, Solid Mechanics.

Course Objectives:

- To understand the concepts of mechanisms, kinematic chains, and degrees of freedom.
- To develop analytical and graphical methods for velocity and acceleration analysis of mechanisms.
- To impart knowledge of mechanism synthesis for specific motion requirements.
- To enable students to draw cam profiles for various types of follower motions.

Course Outcomes:

After learning the course, the students will be able to:
CO1: Calculate the degree of freedom of provided mechanisms
CO2: Determine the velocity and acceleration in mechanisms using analytical and graphical approach
CO3: Synthesize the mechanisms using graphical and analytical technique.
CO4: Draw a cam profile for follower motions.

Unit	Contents	Duration (Hrs.)
1	**Mechanisms** Kinematic link, pair, chain, mechanisms, Grashoff 's law, degree of freedom, kinematic inversions of four bar chain, slider and double slider crank chain, introduction to spatial mechanisms	7
2	**Kinematic Analysis of Mechanisms: Analytical Method and Graphical Method** Analytical methods for analysis of slider crank mechanism, velocity and acceleration analysis using vector and complex algebra methods. Graphical method: displacement, velocity and acceleration analysis of mechanisms by relative velocity method and instantaneous center of velocity, Klein's construction	9
3	**Dimensional Synthesis of Mechanism-Analytical and Graphical Method** Introduction to synthesis of mechanism, path function and motion generation, precision positions, Chebychev spacing, mechanical and structural errors. Graphical Method: two and three position synthesis Analytical Method: Freudenstein's equation.	8
4	**Cam and Followers** Classification of cams and followers- terminology, types of follower motion, cam profile for given follower motion, cam jump phenomenon.	7
5	**Gear and Gear Trains** Classification of gears and their terminologies, law of gearing, gear tooth profiles, path of contact, arc of contact, sliding velocity, interference and undercutting, force analysis and geometrical relations. Types of gear train, problems on tabular method.	8
	Total Hours	**39 Hrs.**

Text Books

1. S. S. Rattan, "Theory of Machines", Fifth Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi,2019
2. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi,2017

Reference Books

1. Shiley J. E. and Uicker J.J. "Theory of Machines and Mechanism", McGraw Hill Inc. 2013
2. Sadhu Singh, "Theory of Machines", Pearson,2011
3. Wilson C.E., Sandler J.P. "Kinematics and Dynamics of Machinery", Pearson Education
4. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI

Online References

1. NPTEL Course: Prof. Anirvan DasGupta, IIT Kharagpur, "Kinematics of Mechanisms and Machines". (https://nptel.ac.in/courses/112105268)
2. NPTEL Course: Prof. Ashok K Mallik, IIT Kanpur, "Kinematics of Machines" (https://nptel.ac.in/courses/112104121)
3. NPTEL Course: Prof. Sujatha Srinivasan, IIT Madras, "Theory of Mechanisms". (https://nptel.ac.in/courses/112106270)

Second Year B. Tech Mechanical Engineering														
Semester IV														
Course Code: ME24PCC253							**Course Name: Engineering Metallurgy**							
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
3	**-**	**-**	**-**	**-**	**40**	**60**	**-**	**-**	**-**	**100**	**3**	**-**	**-**	**3**

Prerequisites:

Engineering Physics, Engineering Chemistry, Manufacturing Processes

- **Course Objectives:**
- Understand the fundamental crystal structures such as BCC, FCC, and HCP, and analyze their lattice parameters and atomic arrangements.
- To study and apply destructive and non-destructive testing methods along with microscopic techniques for material characterization.
- To understand solidification behavior, interpret phase diagrams, and analyze the iron-carbon equilibrium diagram with emphasis on invariant reactions.
- To highlight the significance of heat treatment in altering the structure and enhancing the properties of materials.
- To study the composition, properties, and applications of ferrous and non-ferrous materials

Course Outcomes:

After learning the course, the students will be able to:

CO1: Compare crystal structures and lattice parameters, linking them to material imperfections and mechanical behavior for practical applications.

CO2: Utilize destructive and non-destructive testing to determine mechanical properties for informed material selection.

CO3: Identify system parameters viz., phases, variables, component, grains, grain boundary, and degree of freedom

CO4: Analyze the influence of alloying elements and heat treatment on material properties for informed material processing

CO5: Select materials for specific applications by integrating theoretical knowledge with practical

Unit	Contents	Duration (Hrs.)
1	**Crystal Structure and Mechanical Behavior of Materials** Crystal Structures: Study of Crystal structures BCC, FCC, HCP and its lattice parameters, Miller indices, crystal imperfections. Properties of Materials: Mechanical, chemical, electrical and magnetic. Deformation of Materials: Elastic deformation, plastic deformation: slip, twinning, work hardening, recovery, re-crystallization and grain growth. Types of fractures.	8
2	**Material Testing and Characterization Techniques** Destructive testing and non-destructive testing. Microscopic Techniques: Sample preparation and etching procedure, optical microscopy, electronic microscopy - only SEM, TEM and X-ray diffraction.	6
3	**Phase Diagrams and Iron-Carbon Diagram** Solid solutions: Introduction, Types, Hume Rothery rule for substitutional solid solutions Solidification: Nucleation & crystal growth, solidification of pure metals, solidification of alloys. Phase Diagrams: Cooling curves, types of phase diagrams, Gibbs phase rules. Iron-Carbon Diagram: Iron-carbon equilibrium diagrams in detail with emphasis in the invariant reactions.	8

4	**Heat Treatments** Austenite transformation in steel: Time temperature transformation diagrams, continuous cooling transformation diagrams, Retained austenite and its effect. Heat Treatment Processes: Introduction, Annealing, Normalising, Hardening, Tempering, Austempering, Martempering, Sub-Zero Treatment, Hardenability. Surface Hardening: Classification, Flame hardening, Induction hardening, Carburising, Nitriding, Carbonitriding.	7
5	**Ferrous and Non-Ferrous Materials** Ferrous Materials**:** Carbon Steel, Alloy Steel (effect of alloying elements and sensitization), Cast Iron: Classification, types & their composition, properties, designation and Industrial application. Non-Ferrous Materials: Copper Alloys, Aluminium Alloy, Nickel Alloys, Titanium, Cobalt Alloys, Bearing Alloys: Classification, types & their composition, properties, designation and Industrial application. Selection of Material: selection of materials for various applications with example case studies such as materials for large astronomical telescopes, springs, flywheels, safe pressure vessels and reactors.	10
	Total Hours	**39**

Text Books

1. Dr. V. D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication, 46th Edition, 2022.
2. William D. Callister, "Materials Science and Engineering an Introduction", Jr, John Wiley & Sons, Inc., 10th Edition, 2018.

Reference Books

1. A. K. Bhargava, C.P. Sharma, "Mechanical Behaviour & Testing of Materials", P H I Learning Private Ltd, 1st Edition, 2011.
2. V. Raghvan, "Material Science & Engineering",Prentice Hall of India, New Delhi, 6th Edition, 2015.
3. S. H. Avner, "Introduction to Physical Metallurgy", Tata McGraw-Hill, 2nd Edition, 2017.
4. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd., 6th Edition, 2014.
5. George Ellwood Dieter, "Mechanical Metallurgy", McGraw-Hill, 3rd Edition 2013.

Online References

1. NPTEL Course: Prof. R.N. Ghosh, IIT, Kharagpur, "Principles of Physical Metallurgy" (https://nptel.ac.in/courses/113105023)
2. NPTEL Course: Prof. Rajesh Prasad, IIT, Delhi, "Introduction to Materials Science and Engineering" (https://nptel.ac.in/courses/113102080)
3. NPTEL Course: Prof. S. Sankaran, IIT, Madras, "Materials Characterization" (https://nptel.ac.in/courses/113106034)

Second Year B.Tech Mechanical Engineering

Semester-IV

Course Code: ME24PCC255 **Course Name: Applied Thermofluidic Lab**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1

Prerequisite: Thermofluidic, Engineering Mathematics - I, Engineering Mathematics - II

Course Objectives:

- Analyze the performance parameters of petrol and diesel engines.
- Demonstrate the impulse-momentum principle using an impact of jet test rig.
- Evaluate the performance of impulse and reaction water turbines.
- Plot operating characteristics of a centrifugal pump by conducting experimental trials.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Evaluate the performance characteristics of petrol and diesel engines.
CO2: Verify the impulse-momentum principle by using the impact of jet test rig.
CO3: Analyze the performance and operating characteristics of impulse and reaction turbines.
CO4: Interpret the operating characteristics of a centrifugal pump.

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	Trial on petrol engine test rig to determine friction power and mechanical efficiency of engine	02
2	Trial on petrol engine test rig to determine thermal efficiency of engine	04
3	Trial on diesel engine test rig to prepare heat balance sheet	04
4	Trial on Impact of jet test rig to verify of impulse momentum principle	04
5	Trial on impulse water turbine (Pelton wheel) and plotting of main and operating characteristics	02
6	Trial on reaction water turbine (Francis turbine) and plotting of main and operating characteristics	04
7	Trial on centrifugal pump and plotting operating characteristics	02
8	Industrial visit to automobile manufacturing plant or service station or hydroelectric power plant	04
	Total Hours	**26 Hrs**

Text Books

1. Ganesan V., "Internal Combustion Engines", McGraw-Hill Publications, 2012
2. Mathur M. L. and Sharma R. P., "A course in Internal combustion engines", Dhanpat Rai & Co., 2015
3. Modi P N and Seth S N., "Hydraulics & Fluid Mechanics and Machinery", Standard Book House, 2022
4. Bansal R. K., "Fluid mechanics and hydraulic machines", Laxmi Publications, 2019

Reference Books
1. Domkundwar V. M., "Internal Combustion Engine", Dhanpat Rai & Co., 2018 2. Heywood J. B., "Internal Combustion Engine Fundamentals", McGraw-Hill Publications, 2018 3. Pai B. U., "Turbomachines", Wiley India, 2015
Online References
1. NPTEL Course: Dr. Vinayak Kulkarni, Prof. Pranab K. Mondal, IIT Guwahati, "IC Engines and Gas Turbines", (https://onlinecourses.nptel.ac.in/noc22_me65/preview) 2. NPTEL Course: Prof. Suman Chakraborty, IIT Kharagpur, "Introduction To Fluid Mechanics" (https://nptel.ac.in/courses/112105269) 3. NPTEL Course: Prof. Subashisa Dutta, IIT Guwahati, "Fluid Mechanics" (https://nptel.ac.in/courses/105103192)

Second Year B.Tech Mechanical Engineering

Semester- IV

Course Code: ME24PCC256 **Course Name: Kinematics of Machines Lab**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	2	-	-	-	-	-	-	-	50	50	-	1	-	1

Prerequisite: Engineering Mathematics - I and II, Engineering Physics, Solid Mechanics.

Course Objectives:

- To analyze the motion characteristics of various mechanisms such as epicyclic gear trains and cams, including speed, torque, and follower behavior.
- To construct and study gear and cam profiles using graphical and experimental methods.
- To analysis velocity and acceleration of mechanisms using analytical, graphical, and ICR methods.
- To develop computational skills through programming for kinematic analysis and to relate theoretical knowledge with industrial applications via visits.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Analyze motion characteristics such as speed and torque in epicyclic gear trains and dynamic behavior in cam-follower systems.

CO2: Construct cam and gear profiles using graphical and experimental methods based on given motion specifications.

CO3: Perform velocity and acceleration analysis of mechanisms using analytical methods and the Instantaneous Centre of Rotation (ICR) technique. .

CO4: Develop and implement computer-based solutions for kinematic analysis and relate theoretical knowledge with practical applications via industry exposure.

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	To determine speed and holding torque of an epicyclic gear train.	02
2	To verify the load and cam jump speed relationship using radial cam.	02
3	To draw involute gear tooth profile using rack and pinion cutter mechanism.	02
4	To solve problems on velocity and acceleration analysis using relative velocity and acceleration method.	04
5	To solve problems on velocity analysis using the ICR method.	04
6	To draw the cam profile for various follower motion with radial and off-set cam.	04
7	To write a computer program for kinematic analysis of slider crank mechanism using analytical method. (Open-source Software)	04
8	Industrial visit to manufacturing industries with assembly-line automation	04
	Total Hours	26

Text Books

1. S. S. Rattan, "Theory of Machines", Fifth Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi,2019
2. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi,2017

Reference Books

1. Shiley J. E. and Uicker J.J. "Theory of Machines and Mechanism", McGraw Hill Inc. 2013
2. Sadhu Singh, "Theory of Machines", Pearson,2011
3. Wilson C.E., Sandler J.P. "Kinematics and Dynamics of Machinery", Pearson Education

Online References

1. NPTEL Course: Prof. Anirvan DasGupta, IIT Kharagpur, Kinematics of Mechanisms and Machines. (https://nptel.ac.in/courses/112105268)
2. NPTEL Course: Prof. Ashok K Mallik, IIT Kanpur, Kinematics of Machines (https://nptel.ac.in/courses/112104121)

Second Year B.Tech Mechanical Engineering

Semester-IV

Course Code: ME24VSE257 **Course Name: Solid Modeling**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	4	-	-	-	-	-	50	-	-	50	-	2	-	2

Prerequisite: Engineering Mathematics - I and II, Engineering Graphics.

Course Objectives:

- To develop students' proficiency in 3D modeling techniques for designing individual parts and mechanical assemblies using CAD software
- To equip students with the skills required to create detailed manufacturing drawings, including dimensions, tolerances, and material specifications in accordance with industrial standards
- To familiarize students with additive manufacturing processes, enabling them to fabricate physical components using 3D printing technologies.

Course Outcomes:

After learning the course, the students will be able to:

CO1: Prepare 3-D part and assembly model of mechanical system.
CO2: Prepare manufacturing drawing with all the details.
CO3: Prepare components using 3-D printing machine

List of Experiments

Sr. No.	Name of the Experiment	Duration (Hrs.)
1	Assignment on solid modeling of a machine component.	8
2	Assignment on parametric solid modeling of a machine component using various commands and features of the software.	8
3	Assignment on assembly modeling using proper mating conditions and generation of exploded view	12
4	Assignment on creating production drawing with the limit, fits and tolerance representation	8
5	Introduction to Surface Design, Creating Wireframe Geometry, Shape Design Common Tools, Creating Surfaces, Understanding operations toolbar.	8
6	Design and Manufacturing of an assembly using 3-D printing	8
	Total Hours	*52*

Text Books

1. Ibrahim Zeid, "Mastering CAD/CAM", McGraw-Hill, 1st Edition, 2004.
2. Chris McMahon and Jimmie Browne, "CADCAM: Principles, Practice and Manufacturing Management", Pearson Education, 2nd Edition, 1999.
3. M. Groover and E.W. Zimmers, "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson Education, 1st Edition, 1983.

Reference Books
1. David A. Madsen, David P. Madsen, "Engineering Drawing and Design", Cengage Learning, 6th Edition, 2016. 2. William M. Neff, "Fundamentals of Computer Aided Geometric Design", Springer, 1st Edition, 1995. 3. Jaecheol Koh, Gyeongho Son, "Solid Modeling and Applications: Rapid Prototyping, CAD and CAE Theory", Springer, 1st Edition, 2005. 4. James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics: Principles and Practice", Addison-Wesley, 3rd Edition, 2013.
Online References
1. NPTEL Course: Prof. Surya Dutta, IIT Roorkee, "Computer Aided Design and Manufacturing" (https://nptel.ac.in/courses/112/107/112107288/) 2. NPTEL Course: Prof. Santhakumar Mohan, IIT Palakkad, "Mechanics and Control of Robotic Manipulators" (https://onlinecourses.nptel.ac.in/noc25_me105/preview) 3. Coursera: "3D CAD Fundamental" by National Taiwan University (https://www.coursera.org/learn/3d-cad-fundamentals)

Second Year B.Tech Mechanical Engineering														
Semester-IV														
Course Code: ME24VEC258										**Course Name: Industrial Engineering**				
Teaching Scheme (Hours/Week)					**Examination Scheme**						**Credits**			
L	**P**	**T**	**OL**	**ODL**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**TOTAL**	**L**	**P**	**T**	**TOTAL**
-	**-**	**2**	**-**	**-**	**-**	**-**	**50**	**-**	**-**	**50**	**-**	**-**	**2**	**2**

Prerequisites: Engineering Mathematics, Communication skills, Manufacturing Processes, Engineering Economics.

Course Objectives:

- To understand and apply various productivity enhancement techniques.
- To introduce the fundamental concepts and purpose of work measurement.
- To acquaint the students with different aspects of facility design
- To introduce the students with different aspects of production planning, and control.

Course Outcomes:

After completing the course, the students will be able to:
CO1: Apply different methods for enhancing productivity.
CO2: Apply various concepts used in method study.
CO3: Select a plant location and create plant layout.
CO4: Simulate the production planning activities using a software.

Contents

1	**Productivity and Method Study** Introduction to Industrial Engineering, Work system design, productivity improvement techniques, productivity improvement models, method Study.
2	**Work Measurement Techniques** Introduction and types of WMT, recording techniques/charts, types of allowances, determination of time standards.
3	**Production Facility Design** Selection of Plant location, Plant Design, Types of layout and types of production, material handling equipments.
4	**Production Planning and Control** Forecasting Techniques, CPM and PERT techniques and numerical, Industrial Safety.

List of Tutorial

Sr. No.	Name of the Tutorial	Duration (Hrs.)
1	Numerical based assignment on Productivity.	4
2	To generate suitable process chart for any production/assembly process.	4
3	Hands on assignment on application of work measurement technique(s) using suitable software.	6
4	Optimizing service operation capacity planning using suitable software.	6
5	Industrial safety audit of any selected Industry.	4
6	Presentation on "Recent trends in Industrial Engineering"	2
	Total Hours	26

Text Books
1. O. P. Khanna, 'Industrial Engineering and Management', Dhanpat Rai Publication. 2. M Mahajan, 'Industrial Engineering and Production Management', Dhanpat Rai and Co. 3. Martand Telsang, 'Industrial Engineering', S. Chand Publication.
Reference Books
1. H. B. Maynard, K Jell, Maynard's, 'Industrial Engineering Hand Book', McGraw Hill Education. 2. Barnes, 'Motion and Time Study Design and Measurement of Work', Wiley, India. 3. Sumanth, D.J, 'Productivity Engineering and Management', TMH, New Delhi. 4. Prem Vrat, Sardana, G.D. and Sahay, B.S, 'Productivity Management - A Systems Approach', Narosa 5. Publications, New Delhi. 6. Jocobs, C.A., 'Production and Operations Management', Tata McGraw Hill. 7. G. K. Agarawal, 'Plant Layout and Material Handling', Jain Brothers.
Online References
1. NPTEL Course: Dr. Indradeep Singh, IIT Roorkee, "Work System Design" (https://onlinecourses.nptel.ac.in/noc25_me122/preview) 2. NPTEL Course: Prof. Uday Shanker Dixit, IIT Guwahati, "Industrial Engineering and operation research" (https://onlinecourses.nptel.ac.in/noc25_me181/preview) 3. NPTEL Course: Prof. D K Dwivedi, IIT Roorkee, "Principles of Industrial Engineering" (https://onlinecourses.nptel.ac.in/noc21_me15/preview)

Second Year B.Tech Mechanical Engineering

Semester-IV

Course Code: SH24AEC202 **Course Name: Professional Communication & Personality Development**

Teaching Scheme (Hours/Week)					Examination Scheme						Credits			
L	P	T	OL	ODL	CIE	ETE	TW	OR	PR	TOTAL	L	P	T	TOTAL
-	-	2	-	-	-	-	50	-	-	50	-	-	2	2

Prerequisite: Basic understanding of LSRW skills, grammar, and vocabulary of the English Language.

Course Objectives:

- To develop students' rhetorical and persuasive abilities for effective oral communication and audience engagement.
- To familiarize students with key business and managerial terminologies essential for effective communication and decision-making.
- To strengthen analytical and critical thinking skills for constructing logical arguments and making informed decisions.
- To cultivate professional and technical writing competence, ensuring clarity, accuracy, and etiquette in communication.

Course Outcomes:

After learning the course, the students will be able to:

CO1 Demonstrate effective rhetoric, persuasive skills, audience engagement, and adaptability in communication.

CO2: Apply visual aids, body language, voice modulation, and confidently manage audience questions and maintain engagement throughout.

CO3: Analyze information and construct logical arguments to solve problems and make informed Decisions.

CO4: Exhibit professional and technical writing skills and avoid common pitfalls, ensuring clear, polite, and informative communication.

Contents	
1	**Public Speaking** Using Persuasive language and understanding the context in public speaking Controlling nervousness, building confidence, stage presence, poise, and impact Employing voice modulation, pace, volume & pitch.
2	**Presentation Skills** Structuring a presentation & using visual aids Understanding audience connection strategies & feedback Handling Q&A sessions with confidence.
3	**Critical Thinking** Working on Case Studies and Situational Analysis Structuring the argument and handling rebuttal Analyzing logical fallacies and cognitive biases.
4	**Technical Writing** Structuring emails for different purposes (requests, complaints, updates, and follow-ups) Avoiding common mistakes and making the right use of CC, BCC, and reply-all options Blog/article/ newsletter/survey report format and examples.
5	**Group Discussion** Implementing coherence and cohesion in structuring the argument

	Integrating non-verbal communication in the conversation Managing disagreement and aggression in the discussion.

List of Tutorials

Sr. No.	Name of the Tutorial	Duration (Hrs.)
1	Ice-breaking Session	2
2	Storytelling	4
3	Idea Presentation	4
4	Advertisement Creation	4
5	Case Study Analysis	2
6	Debate	2
7	Email Writing (Professional & Personal)	2
8	Blog Writing	2
9	Survey Reports	2
10	Group Discussion	2
	Total Hours	26

Text Books

1. Stephen E. Lucas, *The Art of Public Speaking*, McGraw Hill Publication, ISBN-10: 1260914275 | ISBN-13: 9781260914276.
2. Jaishri Jethwaney and Sanjay Bhargava, *Corporate Communication: Principles and Practices*.
3. Dr. Ranjit Singh, *Critical Thinking and Problem Solving*.
4. Rajendra Pal and J. S. Korlahalli, *Essentials of Business Communication*, Sultan Chand & Sons, 2011. ISBN: 8180547299, 9788180547294.

Reference Books

1. Shiv Khera, *You Can Win*, Bloomsbury India, ISBN-10: 9382951717 · ISBN-13: 9789832951711.
2. Carmine Gallo, *Talk Like TED*, Macmillan Business.
3. Garr Reynolds, *Presentation Zen: Simple Ideas on Presentation Design and Delivery*, New Riders.
4. Peter Facione and Carol Ann Gittens, *Think Critically*.
5. Lewis Vaughn, *The Power of Critical Thinking*, Oxford University Press.
6. Emily Post and Peter Post, *The Etiquette Advantage in Business: Personal Skills for Professional Success*.

Online References

1. NPTEL Course: *Technical English for Engineers* – https://onlinecourses.nptel.ac.in/noc20_hs56/preview
2. SWAYAM Course: *English for Research Paper Writing* – https://onlinecourses.swayam2.ac.in/ntr24_ed15/previe
3. SWAYAM Course: *Personality Development and Communication Skills* – https://onlinecourses.swayam2.ac.in/cec22_cm03/preview

AICTE Approved Programmes

Branch	Intake			Career Options
	B.Tech.	M.Tech.	Working Professional Direct Second Year	
Computer Engineering	180	Computer Engineering:18	---	Data Science, Artificial Intelligence (AI), Big Data Analytics, High Performance Computing (HPC), Machine Learning, Database Engineering, Computer Networks, Cyber Security, IOT
Electrical Engineering	60	Power Electronics & Drives: 06	30	Public Sector, Power Sector, Software Development, Maintenance Engineering, Contractor & Supervisor, Energy Auditor, Internet of Things (IoT), Robotics and Automation, Industry 4.0, Chartered Engineer, Electric Vehicles,
Electronics & Telecommunications Engineering	180	VLSI and Embedded System: 06	---	Internet of Things (IoT), Robotics and Automation, Industry 4.0, Wireless Communication 4G, 5G, 6G, Artificial Intelligence, VLSI, Embedded Systems, Satellite Communication, Data Science, Power Electronics, Computer Networking, Blockchain Technology, Signal Processing, Electronic Design
Information Technology	180	Data Science: 06	---	Software Development &Testing, Cyber Security, Cloud Computing, Big Data Analytics, IoT, Machine Learning, Artificial Intelligence, Blockchain, Database Management, Data Engineer, Data Science
Mechanical Engineering	120	Design Engineering: 06	30	Machine Design, System Modeling, Simulation, Robotics, Mechatronics, Rapid Prototyping, 3D Printing, Composite Materials, Automotive & Electrical Vehicles, Manufacturing Sector, HVAC Systems, Energy Engineering and Process Industry, Robotics, Data Science, Public Sector, Power Sector, Software Development, Mechanical Design Engineer, Design Quality Assurance Manager, Engineering, Service, Teaching, Designing Machines & Tools
Artificial Intelligence and Data Science	180	---	---	Cyber Security Analyst, Software Development Expert, Artificial Intelligence Engineer, Data Scientist, Data Analysis, Machine Learning Engineer, Machine Learning Architect, Product Analyst, Software Architect, Data Warehouse Engineer, Product Manager, Front-end Developer, Full Stack Developer
Ph.D Research Center in Computer Engineering.				

Industry Connect through Professional Bodies / Students' Chapters

- CII
- ISHRAE
- ACM
- ISRD
- GDSC
- IE(I)
- TATA
- ASHRAE
- IETE
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- ISACA
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- STP

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