Curriculum
for
Second Year
Bachelor of Technology
in
Mechanical Engineering

(Pattern 2024)

With Effect from A.Y. 2025-26

Matoshri Education Society's

Matoshri College of Engineering and Research Centre, Nashik
(Autonomous)

NBA and NAAC Accredited, Approved by All India Council for Technical Education, New Delhi, Affiliated to Savitribai Phule Pune University, College Code: 5177

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Curriculum Structure and Syllabus for Bachelor of Technology (B.Tech.)
Mechanical Engineering Programme (Pattern 2024)

Matoshri College of Engineering and Research Centre, Nashik has been granted the academic autonomous status from academic year 2024-25 by University Grant Commission. The Academic autonomous status has been considered as an opportunity for imparting comprehensive education. The academic autonomous status can be utilized to implement the National Education Policy (NEP 2020) effectively. The institute has a prudent plan to incorporate necessary dynamism in academic structure to march towards the vision of the institute and develop the research and skill oriented human resources contributing to the development of the nation.

With a focus on staying at the forefront of educational innovation, the institution diligently prepares curricula that are both dynamic and industry-aligned. This process entails meticulous planning and collaboration to ensure the development of comprehensive programs catering to the evolving needs of students and industries alike. The highlights of BTech curriculum structure are:

- Every B.Tech programme is of four years duration with eight semesters.
- The curricula have been designed adhering to the NEP guidelines and norms.
- Meticulous consideration has been observed to support multiple entries and multiple exits.
- The curricula design supports horizontal and vertical mobility of the learners with or without additional credits.
- Efforts have been taken to design the curricula which are unambiguous and self explanatory.
- Students have to earn 176 credits for the award of BTech degree in major discipline with multidisciplinary minor that are uniformly distributed among eight semesters.
- The Student has to earn the additional 18 credits for the award of BTech in major discipline with Honor and multidisciplinary minor. These credits are distributed among semesters-V, VI, VII, VIII.
- The Student has to earn the additional 18 credits for the award of BTech in major discipline Honor with research and multidisciplinary minor. These credits are uniformly distributed among semesters-VI, VII, VIII.
- The Student has to earn the additional 18 credits for the award of BTech in major discipline with double minors. These credits are distributed among semesters-V, VI, VII, VIII.
- The induction program is conducted for two weeks at the start of the first semester and one week at the start of second semester or three weeks in the first semester only. The guidelines and content of the induction program is declared well in advance.

Credit Requirement and Eligibility for the B.Tech programme

Admissions eligibility for first and second year B.Tech will be as per guidelines provided by Admission Regulating Authority of Maharashtra and guidelines of NEP2020.

This Document includes-

Matoshri College of Engineering and Research Centre (Autonomous)
Curriculum for
Second Year Bachelor of Technology- Mechanical Engineering

Table of Contents

home

Table 1: Total Credits and Total Marks for Bachelor of Technology (BTech)		
Semester	**Total Credits**	**Total Marks**
I	22	700
II	22	700
III	22	750
IV	22	750
V	22	700
VI	22	700
VII	22	700
VIII	22	700
Total	**176**	**5700**

Table 2: Nomenclature for Course Codes

YY	U/P/D	NN	MM

Format for Course Codes-

YY - Year of Course launch
U/P/D- U : Undergraduate **P:** Postgraduate **D**- Doctoral
NN- Branch Code
MM- Course Number

NN	Programme (UG)	NN	Programme (PG)
01	First Year B.Tech. (Common for all Disciplines)	**09**	B.Tech. Mechanical Engineering
02	B.Tech. Artificial Intelligence and Data Science	**10**	M.Tech. Geotechnical Engineering
03	B.Tech. Civil Engineering	**11**	M.Tech. Data Science
04	B.Tech. Computer Engineering	**12**	M.Tech. VLSI and Embedded System
05	B.Tech. Electronics and Telecommunication Engineering	**13**	M.Tech. Electrical Power Systems
06	B.Tech. Electronics and Computer Engineering	**14**	M.Tech. Heat Power Engineering
07	B.Tech. Electrical Engineering	**15**	Master of Computer Applications (MCA)
08	B.Tech. Information Technology		

Table 3: Examination Heads and Assessment Schemes

Exam Head	Abbreviation	In Semester Exam (40% of Total Curriculum and Marks)		End Semester Exam (60% of Total Curriculum and Marks)
		In_Sem_Exam_1 (20%)	In_Sem_Exam_2 (20%)	
Theory	**TH**	CAT/CCE based on 20% curriculum	CAT/CCE based on 20% curriculum	Theory examination based on 60% curriculum
Project	**PROJ**	Progress Review I with Demonstration, Presentation, Oral & Report	Progress Review II with Demonstration, Presentation, Oral & Report	Activity, Presentation, Demonstration, Oral & Report as applicable
Internship	**INT**	Progress Review I with Activity, Presentation, Demonstration, Oral & Report as applicable	Progress Review II with Activity, Presentation, Demonstration, Oral & Report as applicable	Activity, Presentation, Demonstration, Oral & Report as applicable
Practical	**PR**	Mid-semester exam based on experiment/ activity performance, demonstration, Presentation, Oral and Journal, Report as applicable		Experiment, activity performance, demonstration, Presentation, Oral & Report, journal as applicable
Term work	**TW**	Mid-semester exam based on experiment/ activity performance, demonstration, Presentation, Oral and Journal, Report as applicable		Activity, Experiment performance, demonstration, Presentation, Oral & Report, journal as applicable
Continuous Assessment Test	**CAT**	Class test examination to assess and evaluate a student's progress with descriptive or objective questions as measure of the student's knowledge and skills in online or offline mode.		
Continuous and Comprehensive Evaluation	**CCE**	Examinations that assess and evaluate learners' abilities based on various dimensions viz- academic performance, work experience, skills, coordination, agility, innovation, teamwork, public speaking, behavior, and similar as a measure of knowledge, skills and attitude.		

home

Table 4: Various Courses' Categories, Description and Abbreviation		
Broad Category	**Description**	**Abbreviations**
Science or Engineering Science	Basic Science Course	BSC
	Engineering Science Course	ESC
Program Courses	Programme Core Course	PCC
	Programme Elective Course	PEC
Multidisciplinary Courses	Multidisciplinary Minor	MDM
	Open Elective	OE
Skill Courses	Vocational and Skill Enhancement Course	VSEC
Humanities Social Science and Management (HSSM)	Ability Enhancement Course	AEC
	Entrepreneurship Development / Engineering Economics / Management	ED / EE / MGT
	Indian Knowledge System	IKS
	Value Education Course	VEC
Experiential Learning Courses	Research Methodology	RM
	Community Engineering Project / Field Project	CEP/ FP
	Project	PROJ
	Internship / On Job Training	INT / OJT
Liberal Learning Courses	Co-curricular Courses	CC
Course Type/ Teaching Learning Schemes	Practical	PR
	Internship	INT
	Theory	TH
	Tutorial	TUT
	Lecture	Lect
	Laboratory Course	Lab
Examination Head	Term work	TW
In Semester Examination	In_Sem_Exam	ISE
Continuous Assessment Test	Continuous Assessment Test	CAT
End Semester Examination	End_Sem_Exam	ESE
Exit Courses for award of Certificate/Diploma/ Degree	Skill Based Bridge Course	SBBC
Continuous & Comprehensive Evaluation	Continuous & Comprehensive Evaluation	CCE
Audit Course	Non-Credit Audit Course	NCAC
Exit Course	Exit Course	EC
Bloom's Taxonomy	Bloom's Taxonomy	BL
Course Outcome	Course Outcome	CO
Program Outcome	Program Outcome	PO
MOOC	Massive Open Online Courses by NPTEL under SWAYAM	MOOC

Table 5: Credit Requirements and Qualification Title with multiple entry and exit option for B Tech Programme					
Levels	**Qualification Title**	**Credit Requirement**			**Exit Course(s) to be completed**
		Minimum Credit	**In Year & Semesters**	**Additional Credit**	
4.5	One Year UG Certificate in Technology	44	1 Year, Semester I and II	8	a) 4-credit job specific internship /apprenticeship of minimum 8 weeks + b) 4-credit Bridge Course
5.0	Two Years UG Diploma in Technology	88	2 Year, Semester I, II, III and IV		
5.5	Three Years Bachelor's Degree in Vocation B. Voc. or B. Sc. Technology	132	3 Year, Semester I, II, III, IV, V, and VI		

Table 6: Credit Distribution Structure for Honour/ Honour with Research Degree								
Levels	**Qualification Title**	**In addition to 176 credit distributed across I to VIII semesters**			**Courses and Credit per Semester**			
		Additional Credit	**In Semesters**	**Additional courses**	**V**	**VI**	**VII**	**VIII**
6.0	B.Tech with Multidisciplinary Minor	-	-	-	-	-	-	-
6.0	B.Tech Honors (in major discipline) with Multidisciplinary Minor	18	V to VIII	Additional courses in major discipline	3 (TH)+ 1 (PR)	4 (TH)+ 1 (PR)	4 (TH)+ 1 (PR)	4 (TH)
6.0	B.Tech Honors and Research (in major discipline) with Multidisciplinary Minor	18	VI and VIII	Research Project in Major discipline	-	6	6	6
6.0	B.Tech in Major Engineering Discipline with Double Minor (Multidisciplinary and Specialization Minor)	18	V to VIII	Additional courses in another discipline/ emerging areas of specialization	3 (TH)+ 1 (PR)	4 (TH)+ 1 (PR)	4 (TH)+ 1 (PR)	4 (TH)

Matoshri College of Engineering and Research Centre (Autonomous)
Curriculum Structure for Bachelor of Technology (BTech) in Mechanical Engineering (Course: 2024)

Table 10: Second Year Bachelor of Technology (SYBTech)
Semester III

Courses				Teaching Scheme Hrs/Week			Examination and Marks (% of Total Curriculum and Marks)				Credit			
							In_Sem Exam (ISE) (40%)		End_Sem Exam (60%)	Marks				
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR	CAT_1	CAT_2	ESE	Total	TH	TUT	PR	Total
24U0921	MDM	Manufacturing Processes	TH	3	-	-	20	20	60	100	3	-	-	3
24U0922	PCC	Theory of Machines	TH	3	-	-	20	20	60	100	3	-	-	3
24U0923	PCC	Engineering Thermodynamics	TH	3	-	-	20	20	60	100	3	-	-	3
24U0924	OE	Logistics & Supply Chain Management	TH	3	-	-	20	20	60	100	3	-	-	3
24U0925	PCCL	Theory of Machines Lab	TW	-	-	2	20		30	50	-	-	1	1
24U0926	PCCL	Engineering Thermodynamics Lab	PR	-	-	2	20		30	50	-	-	1	1
24U0927	PCCL	Manufacturing Processes Lab	PR	-	-	4	40		60	100	-	-	2	2
24U0928	EE	Engineering Economics & Financial Management	TW	1	1		20		30	50	1	1	-	2
24U0929	VEC	Environmental Science	TW	1	1		20		30	50	1	1	-	2
24U0930	CEP/FP	Community Engagement / Field Project@	TW	-	1	2	20		30	50	-	1	1	2
Total				**14**	**03**	**10**	**300**		**450**	**750**	**14**	**3**	**5**	**22**
Total Hours/ Week				**27**			**750**				**22**			

NCAC03: Non-Credit Audit Course_3 *

1. Technical English For Engineers
2. Developing soft skills and personality
3. Foreign Language (preferably German/ Japanese)
4. Entrepreneurship Development
5. Design Thinking
6. Science, Technology and Society

 # Open Elective: Supply Chain Management – 1. Logistics & Supply Chain Management

@ Community Engagement / Field Project: Community Engagement Projects corresponding to the Major (Core) discipline

Matoshri College of Engineering and Research Centre (Autonomous)
Curriculum Structure for Bachelor of Technology (BTech) in Mechanical Engineering (Course: 2024)
Table 11 : Second Year Bachelor of Technology (SYBTech)
Semester IV

Courses				Teaching Scheme Hrs/Week			Examination and Marks (% of Total Curriculum and Marks)				Credit			
							In_Sem Exam (ISE) (40%)		End_Sem Exam (60%)	Marks				
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR	CAT_1	CAT_2	ESE	Total	TH	TUT	PR	Total
24U0931	MDM	Engineering Mathematics- III	TH	3	-	-	20	20	60	100	3	-	-	3
24U0932	PCC	Material Science	TH	2	-	-	20	20	60	100	2	-	-	2
24U0933	PCC	Strength of Materials	TH	3	-	-	20	20	60	100	3	-	-	3
24U0934	PCC	Fluid Mechanics and Hydraulic Machines	TH	3	-	-	20	20	60	100	3	-	-	3
24U0935	OE	Supply Chain Analytics	TH	2		-	20	20	60	100	2	-	-	2
24U0936	PCCL	Material Science Lab	PR	-	-	2	10		15	25	-	-	1	1
24U0937	PCCL	Strength of Materials Lab	TW	-	-	2	10		15	25	-	-	1	1
24U0938	PCCL	Fluid Mechanics and Hydraulic Machines Lab	PR	-	-	2	20		30	50	-	-	1	1
24U0939	ED	Entrepreneurship Development	TW	-	1	2	20		30	50	-	1	1	2
24U0940	VSEC	Computer Aided Machine Drawing	TW	-	1	2	20		30	50	-	1	1	2
24U0941	VEC	Digital Marketing	TW	-	2	-	20		30	50	-	2	-	2
			Total	**13**	**04**	**10**	**300**		**450**	**750**	**13**	**4**	**5**	**22**
Total Hours/ Week				**27**			**750**				**22**			

NCAC04: Non-Credit Audit Course_4 *

1. Language & Mind Emotional Intelligence
2. Human Behaviour
3. Business Ethics
4. Advanced Foreign Language (preferably German/ Japanese)
5. Speaking Effectively
6. Technical writing/ Research writing

 # Open Elective: Supply Chain Management – 2. Supply Chain Analytics

Matoshri College of Engineering and Research Centre (Autonomous)
Curriculum Structure for Bachelor of Technology (BTech) Programme (wef 2024-25)

Table 16: On Exit after One/Two/Three Year completion additional 08-credit to be earned for UG Certificate (level 4.5)/ Diploma (level 5.0)/ BTech (level 5.5) respectively

Courses				Teaching Scheme Hrs/Week **			Award of Credit	Credit			
Course Code	Course Type	Title of Course	Exam Head	Lect	TUT	PR		TH	TUT	PR	Total
EC01	SBBC	Skill Based Bridge Course **(Blended Mode)**	TW	02	01	02	Completion of assignments Based on course certified by the concerned guide	2	1	1	4
EC02	INT	Internship or apprenticeship relevant to chosen course	INT	-	-	08	Completion of internship satisfactorily certified by concerned authority	-	-	4	4
Total				**02**	**01**	**10**		**4**	**-**	**4**	**08**
Total Hours/ Week				**13**				**08**			

** Total span of conduction of courses will be for 2 months

Note: The certificate, diploma, BTech certificate is issued on demand to the candidate after earning additional credits as appropriate within a year after exit.

Table 17: Various Courses' Categories and Credit Distribution						
Broad Category	**Description**	**Abbreviations**	**NEP Credit**	**MCERC Credit**	**MCERC Total**	**%**
Basic Science and Engineering Science **NEP= 30** **MCERC= 29** **16.48%**	Basic Science Course	BSC	14-18	14	16	9.09 %
	Basic Science Course Lab	BSCL		02		
	Engineering Science Course	ESC	16-12	11	13	7.39 %
	Engineering Science Course Lab	ESCL		02		
Program Core Courses **NEP= 64 to74** **MCERC= 76** **43.18%**	Programme Core Course	PCC	44-54	38	54	30.68 %
	Programme Core Course Lab	PCCL		16		
	Programme Elective Course	PEC	20	17	22	12.5 %
	Programme Elective Course Lab	PECL		05		
Multidisciplinary Courses **NEP= 22** **MCERC= 26** **14.77%**	Multidisciplinary Minor	MDM	14	16	16	9.09 %
	Open Elective	OE	08	08	10	5.68 %
	Open Elective Lab	OEL		02		
Skill Courses **NEP= 08, MCERC= 07** **3.98%**	Vocational and Skill Enhancement Course	VSEC	07	07	07	3.98 %
Humanities Social Science and Management **NEP= 14, MCERC=12** **6.82%**	Ability Enhancement Course	AEC	04	02	02	1.14 %
	Entrepreneurship Development / Engineering Economics / Management	ED / EE / MGT	04	04	04	2.27 %
	Indian Knowledge System	IKS	02	02	02	1.14 %
	Value Education Course	VEC	04	04	04	2.27 %
Experiential Learning Courses **NEP= 22, MCERC=22** **12.5%**	Research Methodology	RM	04	04	04	2.27 %
	Community Project / Field Project	CEP/ FP	02	02	02	1.14 %
	Project	PROJ	04	04	04	2.27 %
	Internship / On Job Training	INT / OJT	12	12	12	6.82 %
Liberal Learning Courses **NEP= 04, MCERC=04** **2.27%**	Co-curricular Courses	CC	04	04	04	2.27 %
Total			**164-174**	**176**	**176**	**100%**

home

Program Outcomes (POs)		
Learners are expected to know and be able to–		
PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, Engineering fundamentals, and an Engineering specialization to the solution of complex Engineering problems.
PO2	**Problem analysis**	Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and Engineering sciences.
PO3	**Design / Development of Solutions**	Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations.
PO4	**Conduct Investigations of Complex Problems**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern Tool Usage**	Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The Engineer and Society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practices.
PO7	**Environment and Sustainability**	Understand the impact of the professional Engineering solutions in societal and Environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of Engineering practice.
PO9	**Individual and Team Work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication Skills**	Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance**	Demonstrate knowledge and understanding of Engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary Environments.
PO12	**Lifelong learning**	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0921: Manufacturing Processes		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 03 Hours/Week	**02**	**CAT_1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

Prerequisite: Engineering Physics, Mechanical Engineering Workshop

Companion Course, if any: 24U0927: Manufacturing Processes Lab

Course Objectives:

- To introduce the concept of manufacturing technology with the help of various casting processes widely employed in industries, procedure of casting and aspects of Mould Design in Casting.
- To understand the characteristics, process details and applications of metal forming processes with the related details of its equipment and tooling.
- To understand plastic and polymer processing techniques along with their applications.
- To apply fundamentals of sheet metal working in the field of manufacturing.
- To learn fundamentals of Jigs and Fixtures.
- To understand the different modern machining processes.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1. SELECT appropriate moulding, core making and melting practices, pouring time, solidification rate, riser size and location for sand casting process.	5
CO2. UNDERSTAND mechanism of metal forming processes.	2
CO3. DIFFERENTIATE thermoplastics and thermosetting and **EXPLAIN** polymer processing techniques.	2
CO4. DEMONSTRATE press working operations and **EXPLAIN** dies and tools for forming and shearing operations	2
CO5. APPLY the knowledge of Jigs and Fixtures for variety of operations	3
CO6. APPLY the advanced knowledge and technical skills in modern tools of manufacturing engineering for the design of products and processes.	3

Course Contents

Unit I	**Casting Processes**	**(08 Hr.)**

Sand Casting, Pattern types, materials, pattern making allowances, moulding sand types, properties and testing. Hand and machine moulding processes and equipments.
Core - types and manufacturing, Gating Systems, Cleaning and finishing.
Defects in casting, Shell moulding, Investment casting, Die casting, Centrifugal casting, and Continuous casting.

Exemplars/ Case Studies: Turbine blades and engine components, Brake drums and discs

Unit II	**Metal Forming Processes**	**(08 Hr.)**

Hot and Cold working, Factors affecting plastic deformation, Yield criteria
Rolling Process: Terminology, Classification of rolling processes, Rolling mills, Cold rolling, Hot rolling, Rolling of bars, Billets and Shapes, Defects in rolled products
Forging: Principle, Classification, Equipments, Open and Closed Die Forging.
Extrusion: Classification of extrusion processes, Equipment and Principle of Extrusion Processes.

Wire and Tube Drawing: Wire and tube drawing process, Swaging Process and Shot peening process.		
Exemplars/ Case Studies: Sheets, plates, and strips for automotive, hand tools like hammers and wrenches		
Unit III	**Processing of polymers**	**(08 Hr.)**
Thermoplastics and Thermosetting, Processing of polymers, Thermoforming, Extrusion Molding – Compression molding, Transfer molding, Blow molding, Injection molding – Process and equipment. Extrusion of Plastic – Type of extruder, extrusion of film, pipe, cable and sheet Thermoforming – Principle, Pressure forming and Vacuum forming		
Exemplars/ Case Studies: Automotive parts (bumpers, dashboards), Medical devices (syringes, IV components), Consumer goods (toys, electronic casings)		
Unit IV	**Sheet Metal Working**	**(08 Hr.)**
Types of sheet metal operations, Types of dies and punches, Material for dies and punches, Design for Progressive Die, Clearance analysis, Center of pressure, Blank size determination, strip layout, Sheet utilization ratio, Method of reducing forces.		
Exemplars/ Case Studies: Manufacturing car bodies, chassis, and panels. Producing fuel tanks, Exhaust systems, and brackets		
Unit V	**Jigs and Fixtures**	**(08 Hr.)**
Concept of degree of freedom, 3-2-1 principle of location, General guidelines to design Jigs and fixtures, Advantages of Jig and Fixtures **Jigs:** Definition, Elements of jig, Location guidelines, Principles of clamping, Principles of guiding element, Types of jig - Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, and Latch jig. **Fixtures:** Definition, Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Assembly and Inspection fixtures, Indexing fixtures.		
Exemplars/ Case Studies: Tool Design for Automobile Components.		
Books & Other Resources		
Text Books: 1. P. N. Rao, "Manufacturing Technology Vol. I & II", Tata McGraw Hill Publishers 2. P. C. Sharma, "Production Engineering", Khanna Publishers		
Reference Books: 1. R. K. Jain, "Production Technology", Khanna Publishers 2. Hajara Choudhary, Bose S K, Elements of Workshop Technology Vol I and II, Asia Publishing House		
e-Books: ● Manufacturing Processes; H. N. Gupta, R. C. Gupta, Arun Mittal; https://engg.matoshri.edu.in/ebooks/mechanical/Manufacuring%20process%20by%20gupta%20&%20arun.pdf ● Introduction to Manufacturing processes and Workshop Technology; Rajendar Singh; https://engg.matoshri.edu.in/ebooks/mechanical/Manufacturing%20Engg%20&%20%20Technology.pdf ● Manufacturing Processes and Materials: Exercises; Miltiadis A. Boboulos; https://engg.matoshri.edu.in/ebooks/mechanical/manufacturing-processes-and-materials-exercises.pdf ● Manufacturing Technology, Volume I, Foundry, Forming and Welding; P. N. Rao; https://engg.matoshri.edu.in/ebooks/mechanical/2__Rao_-_Manufacturing_Technology_Vol-1_(2018,_Mc_Graw_Hill_India)_-_libgen_lc.pdf		
Mooc course: ● https://archive.nptel.ac.in/courses/112/107/112107219/		

- https://onlinecourses.nptel.ac.in/noc24_me48/preview
- https://archive.nptel.ac.in/courses/112/105/112105127/

The CO-PO Mapping Matrix														
CO\PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	1	1	0	0	0	2	1	1	2	2	1
CO2	2	-	1	1	1	0	0	0	2	1	1	3	2	1
CO3	2	-	1	1	1	2	0	0	2	1	1	2	2	1
CO4	3	1	1	1	1	0	0	0	2	1	1	3	2	1
CO5	3	-	1	1	1	0	0	0	2	1	1	2	2	1
CO6	2	1	1	1	1	0	0	0	2	1	1	3	2	1

Matoshri College of Engineering & Research Centre, Nashik
Second Year Bachelor of Technology
24U0922: Theory of Machines

Teaching Scheme	Credit	Examination Head: TH Examination Scheme & Marks
TH: 03 Hours/Week	03	CAT_1: 20 Marks CAT_2: 20 Marks ESE: 60 Marks

Prerequisite:
Engineering Mathematics, Engineering Physics, Engineering Mechanics, Engineering Drawing, Geometric Modeling& Drafting

Companion Course, if any: 24U0925: Theory of Machines Lab

Course Objectives:

- **Analyze** the fundamental principles of **mechanisms** and **machines** by identifying kinematic links, pairs, and chains, and applying **Grashof's rule** and **Kutzbach's criterion** for mechanism design
- **Develop** the skills needed to analyze velocity and acceleration in mechanisms using both analytical and graphical methods.
- .**Synthesize** and **design** mechanisms using **Frudenstein's equation** and **Chebychev spacing** for **function generation** in both 2-position and 3-position synthesis for complex motion generation.
- **Apply** the theory of **cams and followers** to **construct cam profiles** and analyze various **motion types** to design mechanisms with specific follower motions
- **Examine** and **classify** different types of **gears and gear trains**, applying the principles of **gearing law** and **conjugate action** to determine their functionality in industrial and automotive applications.

Course Outcomes:		BL
On completion of the course, learner will be able to–		
CO.1	**Understand** the principles of kinematics and **apply** them to real-world mechanisms	**2,3**
CO.2	**Explain** the concepts of velocity and acceleration in mechanisms and **illustrate** their analysis using analytical and graphical methods	**2,3**
CO.3	**Synthesize** mechanisms using Frudenstein's equation, Chebychev spacing, and graphical methods for function generation.	**6**
CO.4	**Apply** the principles of cam design to **construct** cam profiles for various types of follower motions	**3,6**
CO.5	**Analyze and apply** gear principles to various types of gears and gear trains	**3,4**
CO.6	**Integrate** the knowledge of kinematics, cam design, and gear theory to solve complex mechanical problems and develop innovative solutions for real-life industrial applications for the benefit of society	**5.6**

Course Contents		
Unit I	**Introduction to Mechanisms**	**(9)Hr.)**
Introduction to Kinematics and Kinetics, Planar and Spatial Mechanisms, Kinematic Link, Constrained Motion, Kinematic Pairs, Joints Kinematic Chains, Mechanisms and Machines, Degrees of Freedom, Kutzbach and Grubler's criterion, Grashof's rule and rotatability limits, Kinematic Inversion, Four bar chain, Slider Crank Mechanism and Double Slider Mechanism and their Inversions. Equivalent Linkages. Introduction to Robotic Mechanisms, humanoid robots and drone motion mechanisms.		
Exemplars/ Case Studies: Robotic Arm, Suspension System, Steering Mechanism, Internal Combustion Engine.		
Unit II	**Kinematic Analysis of Simple Mechanisms**	**(09 Hr.)**
Kinematic Requirements in Design of machines, Analytical methods for displacement, velocity and acceleration analysis of slider crank mechanism. Velocity and acceleration analysis mechanisms by relative velocity method, instantaneous centers method (Graphical method) Coincident points; Coriolis component of acceleration, Loop closure equation, Complex number method for kinematic analysis		
Exemplars/ Case Studies: Excavators, Cranes and Lifts		
Unit III	**Kinematic Synthesis of Mechanism**	**(08 Hr.)**
Analysis and Synthesis, Synthesis: Type, number and dimensional. Function generation, path generation and motion generation. Accuracy (precision) points, Frudenstein's equation and Chebychev spacing for function generation. Dimensional synthesis (Graphical): Two position synthesis, Three Position synthesis, Coupler curves. Computer-Aided Synthesis.		
Exemplars/ Case Studies: Windshield Wiper Mechanism		
Unit IV	**Cams and Followers**	**(08 Hr.)**
Classification of Followers and Cams, Terminology of Cams. Displacement diagrams for follower motion: uniform velocity motion, simple harmonic motion, uniform acceleration and retardation motion, Cycloidal motion. Cam Profile Construction: Construction techniques for knife-edge, roller followers. Pressure angle and undercutting, Techniques to prevent undercutting. Cam Jump Phenomenon. Introduction to advanced polynomial cam.		
Exemplars/ Case Studies: IC Engines		
Unit V	**Gears and Gear Train**	**(08Hr.)**
Types of Gears, Gear Terminology, Gear tooth profiles, Law of Gearing and conjugate action. Spur gear contact ratio, interference, Force analysis. Terminology: Helical, Bevel, Worm, Spiral and Rack & Pinion Gears. Gear Trains: Types of Gear Trains, Velocity Analysis. Applications of gear trains in automotive and industrial systems.		
Exemplars/ Case Studies: Transmission System		
Books & Other Resources		

Text Books:

1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Theory of Machines by RS Khurmi and JK Gupta; S.Chand and Company Ltd., New Delhi.

Reference Books:

1. Sadhu Singh, Theory of Machines, Pearson
2. D.K. Pal, S.K. Basu, Design of Machine Tools, Oxford &Ibh Publishing Co. Pvt. Ltd.
3. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
4. A. Ghosh and A.K. Mallick, "Theory of Mechanisms and Machines," Affiliated East-West Pvt. Ltd, New Delhi, 1988.
5. Shigley, J. E., and Uicker, J. J., Theory of Machines and Mechanisms, Oxford University Press

e-Books:

Theory of Machines; Khurmi, R. et al.;
https://engg.matoshri.edu.in/ebooks/mechanical/Theory-of-Machines.pdf
Theory of Machines and Mechanisms; Joseph Edward Shigley, John Joseph Uicker;
https://engg.matoshri.edu.in/ebooks/mechanical/4__joseph-e-shigley-theory-of-machines-and-mechanism.pdf

Mooc course:

- https://archive.nptel.ac.in/courses/112/106/112106270/
- http://archive.nptel.ac.in/courses/112/104/112104121/
- https://archive.nptel.ac.in/courses/112/105/112105268/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	1	-	1	3	1	1
CO2	3	2	2	2	1	-	-	-	1	2	-	1	3	2	1
CO3	3	2	2	2	-	1	1	-	1	2	-	1	3	2	1
CO4	3	1	2	2	1	1	-	-	1	2	-	1	3	1	1
CO5	3	1	-	-	-	1	-	-	1	2	-	2	3	1	2
CO6	3	2	3	2	1	1	1	1	1	1	1	3	3	2	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0923: Engineering Thermodynamics		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme and Marks**
TH: 03 Hours/Week	**03**	**CAT_1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

Prerequisite: Higher Secondary Science courses, Engineering Physics, Engineering Chemistry

Course Objectives:

- To understand the concepts and laws of thermodynamics
- To understand the concept of Entropy and Availability
- To understand the use of Steam Tables, Mollier Chart and analyze vapour power cycles
- To understand the performance analysis of a steam generator
- To understand and analyze gas power cycle and refrigeration cycle

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1. UNDERSTAND the concept of thermodynamics and APPLY the first law of thermodynamics to flow and non-flow processes.	2,3
CO2. APPLY the second law of thermodynamics to system and understand the concept of entropy, available and non-available energy.	2,3
CO3. DETERMINE the properties of steam and their effect on the performance of vapour power cycle.	3
CO4. UNDERSTAND the construction and working of different types of boilers and ANALYZE the performance of steam generator.	2,4
CO5. ANALYZE the performance of gas power and refrigeration cycle.	4
CO6. APPLY concepts of engineering thermodynamics to solve engineering problems utilizing advanced technology.	3

Course Contents

Unit I	**Fundamentals of Thermodynamics**	**(08Hr.)**

Basic Concepts and definitions of thermodynamics, Applications of thermodynamics, Point function and Path function, Quasi-static process, Thermodynamic Equilibrium, Zeroth law of thermodynamics, Temperature and Temperature scale.

First law of thermodynamics, Concept of heat and work, Joules experiments, Application of first law to flow and non-flow processes and cycle. Steady flow energy equation (SFEE), Applications of SFEE to various devices such as Nozzle, Turbine, Boiler, Compressor, Perpetual Motion Machine of first kind (PMM-I).

Exemplars/ Case Studies: Refrigerators, air conditioners, and heat pumps

Unit II	**Second Law of Thermodynamics and Ideal Gas**	**(08 Hr.)**

Limitations of the first law, Kelvin-Planck and Clausius statements of the second law, Carnot cycle and Carnot Theorem, Thermal reservoir- Heat Engine, Refrigerator and Heat pump. Perpetual Motion Machine of second kind (PMM-II), Equivalence of the two statements. Entropy as a property, Clausius Inequality, Principle of increase of Entropy, Available and Unavailable Energy, Concept of Reversibility and Irreversibility, Availability.

Ideal Gas laws, Ideal Gas equation, Ideal Gas constant, Specific heats of gas. Ideal Gas Processes- on

P-v and T-s diagrams.

Exemplars/ Case Studies: Steam turbines, gas turbines

Unit III	**Properties of Pure Substances and Vapour Power Cycle**	**(08Hr.)**

Properties of Pure Substances: Formation of steam, Phase changes, Steam Properties, Dryness fraction, Use of Steam Tables and Mollier diagram, Steam Calorimeters.

Vapour Power Cycle: Carnot Cycle, Rankine Cycle, Comparison of Carnot cycle and Rankine cycle, Introduction to Steam power Plant, Efficiency of Rankine Cycle, Modified Rankine Cycle.

Exemplars/ Case Studies: Refrigeration and Air Conditioning, Boiler and Heat Exchanger, Thermal Power Plants

Unit IV	**Steam Generators**	**(07Hr.)**

Boiler- Terms, Classification, Construction and working principle, Modern Boilers, Boiler Mountings and Accessories, Classification of Draught, Chimney Height and Diameter.
Performance of steam Generator, Equivalent Evaporation, Boiler Efficiency, Heat Balance Sheet.

Exemplars/ Case Studies: Thermal power plants (coal, nuclear, gas)

Unit V	**Gas Power Cycles and Refrigeration Cycles**	**(07Hr.)**

An Overview of Reciprocating Engine- Terminology, Air-Standard Assumptions, Otto Cycle, Diesel Cycle, Dual combustion Cycle, Comparision of Otto, Diesel and Dual cycles, Brayton Cycle. Reversed Carnot cycle, Reversed Brayton cycle, Vapor Compression Cycle and representation of cycle on P-h and T-s diagram.

Exemplars/ Case Studies: Automobiles, motorcycles, and trucks

Books and Other Resources

Text Books:

1. Nag, P.K, "Basic and Applied Thermodynamics", Tata McGraw-Hill Publishing Co. Ltd.
2. R. K. Rajput, "Engineering Thermodynamics", Laxmi Publications (P) Ltd.

Reference Books:

1. Cengel and Boles, "Thermodynamics An Engineering Approach", McGraw Hill
2. R. K. Rajput, "Thermal Engineering", Laxmi Publications (P) Ltd
3. Domkundwar, Kothandaraman and Domkundwar,"Thermal Engineering",Dhanpat Rai Publishers

Other Suggested Reading

1.NPTEL Courses: https://onlinecourses.nptel.ac.in

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	1	-	-	2	1	-	2	3	2	2
CO2	3	2	-	-	-	1	-	-	2	1	-	2	3	3	2
CO3	3	2	-	-	-	1	1	-	2	1	-	2	3	2	2
CO4	3	2	-	-	1	2	1	-	2	1	-	2	3	2	2
CO5	3	2	-	-	1	2	1	-	2	1	-	2	3	2	2
CO6	3	2	2	1	1	2	2	-	2	1	-	2	3	2	2

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0924: Logistics & Supply Chain Management		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 03 Hours/Week	**03**	**CAT_1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

Prerequisite: Financial Management, Digital Marketing

Course Objectives:

- To acquaint with the concept of key drivers of supply chain performance and their inter-relationships with strategy.
- To impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management.
- To acquaint with the design problems and develop an understanding of information technology in supply chain optimization.
- To acquaint with the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1. Understand the basic concepts and process of supply chain management with a focused approach towards manufacturing and retailing	2
CO2. Understand the demand requirement and forecasting and also to integrate technology through customer service in SCM.	2
CO3. Plan, organize and manage inventory in material management department.	4
CO4. Understand different purchasing and sourcing decisions in SCM.	2
CO5. Organize supply chain network and have a basic insight into various contemporary practices.	4
CO6. Design and Implement concepts of SCM for various fields.	4

Course Contents

Unit I	**Introduction to Supply Chain Management**	**(08 Hr.)**
Supply Chain-Concept- Need and Evolution: Approaches, Phases and processes of supply chain drivers and obstacles. Supply Chain strategies- Strategic fit and scope		
Unit II	**Demand and Supply in Supply Chain Management**	**(08 Hr.)**
Planning Demand and Supply in SCM – Demand forecasting, aggregate planning, managing Predictable variability. Customer service and Integration of technology in SCM (IT & E- business) - New product development process managing in supply chain.		
Unit III	**Inventory Planning and Managing Inventory**	**(08 Hr.)**
Inventory Planning and Managing Inventory in SCM- Benefits of Inventory Planning- Factors affecting inventory approaches and Methods to manage Inventory. Inventory Control: Inventory Audits and Cycle counts; Challenges in Inventory Management		
Unit IV	**Sourcing and Logistics Management**	**(08 Hr.)**
Purchasing and sourcing decisions in SCM- Transportation, Logistics, Warehousing, Container isation		

and Packaging and Outsourcing.
Logistics Management: Types of Logistic Activities; Importance of Logistics Management, Integrated Logistics and its Support.

Unit V	Designing Supply Chain Network	(08 Hr.)

Distribution Network- Performance Management and Control; Benchmarking, Gap Analysis; Balance Score card for SCM.
Recent trends; Improvement in supply chain visibility, Risk factors and costs- Resilience for global value chain under threat- Outsourcing Supply Chain Operations, Co-Maker ship, The Role of E-Commerce in Supply Chain Management, Green Supply Chain Management.

Books & Other Resources

Text Books:

1. Sunil Chopra and Peter Meindi, SCM-Strategy, Planning & Operation, 6th Edition, Pearson Publishers, Reprint 2019
2. Rahul V Attekar, SCM-Concepts & Cases, 2ndEditon, PHI, 2017
3. Mohanty RP, & Deshmukh SG, Essentials of SCM, 1st Edition, Jaico Publishers, Reprint 2018.

Reference Books:

1. Agarwal DK, Logistics & Supply Chain Management, 1st Edition, MacMillan India, Reprint 2018
2. Mentzer, John T., Fundamentals of SCM-Twelve Drivers of Competitive Advantage, 3rd Edition , Sage Publications, 2018
3. Logistics and S Supply Chain Management, 5th Edition; FT Publishers International; Reprint 2019
4. Michael H Hugos: Essentials of Supply Chain Management, 4th Edition, Wiley Publishers, Reprint 2018
5. Judy Dickens: Principles and Practices in Supply Chain Management, 1st Edition, Reprint 2017

Mooc Course:

- https://onlinecourses.nptel.ac.in/noc24_hs128/preview
- https://archive.nptel.ac.in/courses/110/106/110106045/
- https://onlinecourses.nptel.ac.in/noc23_mg71/preview

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	-	2	1	1	1	1	1	2	2	2	2
CO2	3	3	2	1	1	-	-	-	1	1	-	2	2	3	2
CO3	3	3	3	-	-	1	1	1	1	1	-	2	2	2	2
CO4	3	2	2	-	1	1	-	-	1	1	1	2	2	2	2
CO5	3	2	2	-	1	1	-	1	1	1	1	3	3	2	2
CO6	3	3	2	2	3	-	1	-	1	-	1	2	3	3	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0925 : Theory of Machines Lab		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme & Marks**
PR: 02 Hours/Week	**01**	**CCE-TW : 20 Marks** **ESE-TW : 30 Marks**

Companion Course, if any: 24U0922: Theory of Machine

Course Objectives:

- **To develop** an understanding of the principles of kinematics and dynamics in mechanisms and their real-world applications.
- **To enhance** problem-solving skills in analyzing the velocity, acceleration, and force characteristics of mechanisms using both analytical and graphical methods.
- **To equip** students with the knowledge and skills required for the design and analysis of cam profiles and gear systems in mechanical systems.
- **To provide** hands-on experience in constructing and **analyzing** mechanisms using software tools for simulation and modeling
- To **integrate** kinematic, cam, gear theory, and force analysis to solve practical engineering problems in real-world industrial applications**..**

Course Outcomes	**BL**
On completion of the course, learner will be able to–	
CO1. Understand the principles of kinematics and apply them to analyze real-world mechanisms in mechanical systems**.**	**2**
CO2. Analyze and solve problems related to velocity and acceleration in mechanisms using both graphical and analytical methods.	**3,4**
CO3. Design cam profiles and gear systems using appropriate principles to meet specific follower motion requirements in mechanical design.	**5,6**
CO4. Develop hands-on experience in constructing and analyzing mechanisms through simulation and modeling software, demonstrating proficiency in both the design and analysis processes**.**	**5,6**
CO5. Integrate knowledge of kinematics, cam design, gear theory, and force analysis to develop innovative solutions to complex engineering problems in industrial applications.	**3,6**
CO6. Understand and **apply** principles of mechanisms to analyze real-world systems, evaluate their impact, and create innovative solutions for engineering challenges and societal needs.	**4, 5,6**

Suggested List of Laboratory Experiments/Assignments

Guidelines for instructor's Manual

The student shall complete experiments/assignments as part of the Term Work. The Term Work will be evaluated based on the completion of practical experiments, assignments using drawing aids, assignments using software and programming languages, assignments using the virtual laboratory, and a detailed industrial visit report.

Sr. No.	List of Practical	Mapping CO(s)
1	**Practical: 03 Experiment (Experiment No 1 is compulsory)**	
	1. To construct a physical working model of a mechanism using waste materials, applying theoretical knowledge to real-life applications.	1,3
	2. Study the manufacturing process of gears using a rack cutter and generate an involute profile	1,5,6
	3. Study and analyze the speed and torque characteristics of an epicyclic (planetary) gear train	1,2,4
	4. Study and verify the cam jump phenomenon	1,2,4,
2	**Assignments Using Drawing Aids (04):** The assignments should be completed on Half Imperial drawing sheets. Assignment 1 is compulsory. Any 3 from assignment 2 to 5	
	1. Identify mechanisms in real life and analyze for types and number of links, pairs, and obtain degrees of freedom. Submit the sheet and working video of the mechanism.	1.2,
	2. Solve two problems on velocity and acceleration analysis using relative velocity and acceleration methods.	3.4,
	3. Solve two problems on velocity analysis using the instantaneous center of rotation (icr) method.	3.4
	4. Draw cam profile for any two problems with a combination of various follower motions (radial and off-set cam).	3,4,
	5. Draw the internal gear mechanism of the selected gearbox ensuring that all components are clearly labeled.	3,4
3	**Assignment using software (any 2)**	
	1. To design a simple planar mechanism using any software (Geo Gebra, SAM, Working Model, any 3D modeling software, etc.).	2,3,5
	2. To write computer programs (using software/programming languages like C, Python, Scilab, MATLAB, etc.) for kinematic analysis of a slider-crank mechanism using the analytical method.	3,4,5
	3. To generate a cam profile using any modeling software (Mech Analyser, any 3D modeling software).	4,5
	4. To synthesize the four-bar and slider-crank mechanisms using GeoGebra, SAM, or any 2D/3D modeling software.	4,6
4	**Industrial Visit**	
	A compulsory industrial visit must be arranged to industries/establishments incorporating automation and mechanization during the semester to provide students with awareness and understanding of the course. Automobile, Manufacturing Industry Sugar Factory: Bottle Filling Plants, Food Processing Industry, Cement Industry, Pharmaceutical, Printing press.	4
5	**Assignments using Virtual Laboratory (Any 2)**	1,2,3,4
	1. Mechanics of Machines Lab (All Experiments) Link**:** **http://mm-nitk.vlabs.ac.in/index.html**	
	2. Mechanisms and Robotics - Oldham Coupling Mechanism Link**:** **http://vlabs.iitkgp.ernet.in/mr/index.html**	

	3. Mechanisms and Robotics - Quick Return Mechanism Link**:** **http://vlabs.iitkgp.ernet.in/mr/index.html**	
	4. Mechanisms and Robotics - CAM Follower Mechanism Link**:** **http://vlabs.iitkgp.ernet.in/mr/index.html**	
6	**Assignments on Content Beyond Syllabus (any 1)**	2.,3,4
	1. Kinematic Analysis of Robotics Mechanisms 2. Kinematics of Steering Mechanisms 3. Introduction to Additive Manufacturing (AM) Mechanisms 4. Design simple motion paths for additive manufacturing. **5.** Introduction to Micro-Mechanisms	

Books & Other Resources

Text Books:

1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Theory of Machines by RS Khurmi and JK Gupta; S.Chand and Company Ltd., New Delhi.

Reference Books:

1. Sadhu Singh, Theory of Machines, Pearson
2. Dr. V. P. Singh, Theory of Machine, Dhanpatrai and sons.
3. A. Ghosh and A.K. Mallick, "Theory of Mechanisms and Machines," Affiliated East-West Pvt. Ltd, New Delhi, 1988.

Internet Sources

- https://www.geogebra.org/
- https://openmodelica.org/
- https://www.blender.org/
- https://solvespace.com/tutorial.pl
- https://www.edrawsoft.com/
- https://animagraffs.com/
- http://kmoddl.library.cornell.edu/
- https://507movements.com/mm_101.html

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	-	-	-	-	-	-	1	-	1	3	1	1
CO2	3	2	2	2	1	-	-	-	1	2	-	1	3	2	1
CO3	3	2	2	2	2	2	1	-	1	2	-	1	3	2	1
CO4	3	1	2	2	2	2	-	-	1	2	-	1	3	1	1
CO5	3	1	-	-	-	2	-	-	1	2	-	2	3	1	2
CO6	3	2	3	2	2	2	1	1	1	1	1	3	3	2	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0926: Engineering Thermodynamics Lab		
Teaching Scheme	**Credit**	**Examination Head: PR** **Examination Scheme and Marks**
PR: 02 Hours/Week	**01**	**CCE-PR: 20 Marks** **ESE-PR: 30 Marks**

Companion Course: Higher Secondary Science courses, Engineering Physics, Engineering Chemistry

Course Objectives:

- To understand the concepts and laws of thermodynamics
- To understand the concept of Entropy and Availability
- To understand the use of Steam Tables, Mollier Chart and analyze vapour power cycles
- To understand the performance analysis of a steam generator
- To understand and analyze gas power cycle and refrigeration cycle

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1. UNDERSTAND the concept of thermodynamics and APPLY the first law of thermodynamics to flow and non-flow processes.	2,3
CO2. APPLY the second law of thermodynamics to system and understand the concept of entropy, available and non available energy.	2,3
CO3. DETERMINE the properties of steam and their effect on the performance of vapour power cycle.	3
CO4. UNDERSTAND the construction and working of different types of boilers and ANALYZE the performance of steam generator.	2,4
CO5. ANALYZE the performance of gas power and refrigeration cycle.	4
CO6. APPLY concepts of engineering thermodynamics to solve engineering problems utilizing advanced technology.	3

List of Laboratory Experiments/Assignments

Sr. No.	Complete any six experiments from 1 to 8, Experiment no 9 and 10 are compulsory.	**Mapping CO(s)**
1	Survey of temperature sensors used in various thermal systems.	1
2	Determination of calorific value of solid/liquid fuel using Bomb Calorimeter.	1
3	Determination of calorific value or gaseous fuel using Boys Gas Calorimeter.	1
4	Measurement of fuel properties such as Flash Point/ Fire Point.	1
5	Demonstration of different types of boiler Mountings and Accessories.	3
6	Trail on boiler to calculate boiler efficiency and equivalent evaporation.	3

7	Determination of dryness fraction of steam using Steam Calorimeter.	3
8	Thermodynamic Analysis of any System /Model by using any Computer Software.	6
9	Exergy and energy analysis of steam generator.	2
10	**Activity:-** Presentation based Compulsory study of following topics must be done by students during semester to gain awareness and further understanding of the course and a presentation of the same should be included in the TW: Boilers/Vapour Compression cycle/Boiler mountings/ Boiler accessories(any one)	6
11	**Industrial Visit:-**Visit to any Process Industry/Plant having Boiler. Students must submit properly documented Detailed Industrial Visit Report in his/her own words.	4

Books & Other Resources

Text Books:

1. Nag, P.K, "Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
2. R. K. Rajput, "Engineering Thermodynamics", Laxmi Publications (P) Ltd.
3. S.K.Gupta, "Engineering Thermodynamics, S. Chand and Company Pvt. Ltd.

Reference Books:

1. R.K.Rajput, "Thermal Engineering", Laxmi Publications (P) Ltd
2. Domkundwar, Kothandaraman and Domkundwar,"Thermal Engineering",Dhanpat Rai Publishers
3. P. L Ballaney, "Thermal Engineering", Khanna Publishers

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	1	-	-	2	1	-	2	3	2	2
CO2	3	2	-	-	-	1	-	-	2	1	-	2	3	3	2
CO3	3	2	-	-	-	1	1	-	2	1	-	2	3	2	2
CO4	3	2	-	-	1	2	1	-	2	1	-	2	3	2	2
CO5	3	2	-	-	-	-	-	-	2	1	-	2	3	2	2
CO6	3	2	2	1	1	2	2	-	2	1	-	2	3	2	2

Matoshri College of Engineering & Research Centre, Nashik Third Year Bachelor of Technology 24U0927: Manufacturing Processes Lab		
Teaching Scheme	**Credit**	**Examination Head: PR** **Examination Scheme & Marks**
PR: 04 Hours/Week	**02**	**CCE: 40 Marks** **ESE: 60 Marks**

Companion Course: 24U0921 Manufacturing Processes

Course Objectives:

- To acquire skills to produce a composite job by manual process.
- To acquire skills to handle grinding and milling machine and to produce gear by milling.
- To classify, describe and configure the principles of various welding techniques.
- To understand plastic processing techniques.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 UNDERSTAND the constructional details, working of Centre Lathe and **PERFORM** lathe operations.	2,3
CO.2 UNDERSTAND the constructional details and working of a horizontal milling machine and **PERFORM** milling operations.	2,3
CO.3 PERFORM welding using Resistance/ Arc welding technique	3
CO.4 UNDERSTAND procedure of plastic processing	2
CO.5 PERFORM surface grinding operation	3
CO.6 SELECT and APPLY manufacturing processes for engineering components/applications	2,6

Suggested List of Laboratory Experiments/Assignments

Guidelines for Instructor's Manual

The student shall complete the following activity as a Term Work Journal Practical.

Sr. No	**List of Practical**	**Mapping CO(s)**
	Part-A	
1	Manufacture of Job using Lathe Machine operations	1,6
2	a. Manufacture of spur gear on milling machine using indexing head b. Manufacture of Nut on milling machine	2,6
3	a. Job using Electric Arc welding, b. Job using Resistance (Spot) Welding.	3,6
4	Job of plastic component like bottle, bottle caps, Machine handles etc. by injection moulding process.	4,6
5	Grinding of component using table grinding machine.	5,6
6	Manufacturing any one sheet metal component involving minimum three different operation	6

	(use dies and press)	
7	a. Process planning sheets for job 1. b. Process planning sheets for job 2.	1,2,6
8	Prpepare CNC program and Simulate using suitable software for component (CNC Turning)	1, 2,6
9	Report based on industrial visit to study manufacturing processes.	1-6
	Part-B	
1	Learn following through Power point presentation (to be teach and present by faculty) 1.Joining Processes: Arc Welding- Theory, SMAW, GTAW, FSAW, Submerged arc welding, Stud Welding. Resistance welding- Theory, Spot, Seam and Projection weld process. Gas Welding. Soldering, brazing and braze welding. 2. Machining Processes: Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, multi-point tool. Construction and working of lathe, attachments and accessories, lathe mechanisms. Thread cutting and taper turning methods 3. Milling machine: Types of milling, Construction, Working and Mechanism of milling machine. Cutter- types and geometry and their application, Speed, feed and depth of cut. Universal Dividing head, methods of indexing- Simple, Compound, Differential. 4. Drilling Machine: Twist drill geometry, tool holder, Types of drilling machine, Types of drills and operations, speed, feed of drill, Simple numerical to calculate machining time. 5. Grinding Machines: Abrasive machining process machines - Types, construction and operation. Grinding wheel 6.Super finishing processes: a. Honing, b. Buffing, c. Lapping, d. Burnishing 7. CNC machining: CNC Turning, CNC Milling	1,2

Books & Other Resources

Text Books:

1. P. N. Rao, "Manufacturing Technology Vol. I & II", Tata McGraw Hill Publishers
2. P. C. Sharma, "Production Engineering", Khanna Publishers

Reference Books:

1. R. K. Jain, "Production Technology", Khanna Publishers
2. Hajara Choudhary, Bose S K, Elements of Workshop Technology Vol I and II, Asia Publishing House

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	0	3	1	3	3	2	3	3	3	1
CO2	3	2	1	1	3	0	3	1	3	3	2	3	3	3	1
CO3	2	2	1	1	3	0	3	1	3	3	2	3	3	2	1
CO4	2	2	1	1	3	2	3	1	3	3	2	3	3	2	1
CO5	2	2	1	1	3	0	3	1	3	3	2	3	3	2	1
CO6	3	2	1	2	3	0	3	1	3	3	2	3	3	3	1

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0928: Engineering Economics and Financial Management		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme and Marks**
TH: 01 Hours/Week **TUT: 01 Hours/Week**	**02**	**CCE :20 Marks** **ESE : 30 Marks**

Prerequisite: Engineering Mathematics, Fundamentals of Economics, Basic Accounting

Companion Course, if any: ---

Course Objectives:

Course Objectives:

The course is aimed to:

- Introduce fundamental concepts of engineering economics and financial management
- Provide knowledge of cost estimation and break-even analysis
- Develop decision-making skills using investment feasibility techniques.
- Familiarize students with financial management, budgeting, and stock market.
- Introduce financial accounting and taxation principles.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 **Understand** the role of economics in engineering decisions by analyzing financial terms, market structures, and economic systems..	**2**
CO.2 **Analyze and estimate** engineering project costs using different cost estimation methods and break-even analysis.	**4**
CO.3 **Evaluate** investment feasibility and risk in engineering projects using financial decision-making techniques.	**5**
CO.4 **Apply** financial management principles to budgeting, capital management, and investment planning in engineering firms**.**	**3**
CO.5 **Gain knowledge** of stock markets, investment instruments, and financial statements.	**2**
CO.6 **Integrate** economic, financial, and managerial concepts to make informed engineering decisions, optimize project costs, and enhance financial sustainability.	**6**

Course Contents

Unit-I:	**Basics of Economic and Financial Management**	**6 hrs**

Engineering Economics: Definition, Scope, and Importance in Engineering.
Economic and Financial Terms: Gross Domestic Product (GDP), Inflation, Deflation, Exchange Rate, Purchasing Power Parity (PPP), National Income, Per Capita Income, Interest Rate, Prime Rate, Repo Rate, Capital Expenditure, Operating Expenditure, Return on Investment (ROI).
Law of Demand and Supply, Demand and Supply Curves, Market Equilibrium, Elasticity of Demand.
Market Structures: Perfect Competition, Monopoly, Oligopoly.
Economic Systems: Capitalist, Socialist, and Mixed Economies.
Time Value of Money (TVM): Concept and Importance in Engineering Decisions, Present Value (PV) and Future Value (FV).

Exemplars/ Case Studies	Fieldwork – Local Economic Survey of an an engineering firm

Unit-II:	**Cost Analysis, and Break-Even Analysis**	**8 hrs**
Types of Costs: Fixed, Variable, and Semi-Variable Costs Sunk Cost, Opportunity Cost, Incremental Cost and Marginal Cost, Overhead and Indirect Costs. Cost Indexes and Cost Estimation Methods, Life Cycle Costing in Engineering Projects. Break-even Analysis: Break-even Point Calculation and Graphical Representation, Profit-Volume Relationship, Application of Break-even Analysis in Engineering Decision-Making.		
Exemplars/ Case Studies	Cost Estimation and Break-even Analysis of an engineering firm	
Unit-III:	**Investment Feasibility and Risk Analysis**	**8 hrs**
Importance of Cash Flow in Engineering Projects, Cash Flow Diagrams and their Components. Investment Decision-Making Techniques: Present Worth (PW) Method, Future Worth (FW) Method and Annual Worth (AW) Method. Investment Feasibility and Project Selection: Internal Rate of Return (IRR), External Rate of Return (ERR), Payback Period, Benefit-Cost Ratio (BCR), Sensitivity and Risk Analysis in Project Selection.		
Exemplars/ Case Studies	**Investment Analysis**: Choose an engineering investment opportunity (real or hypothetical), prepare a report evaluating the investment's feasibility.	
Unit-IV:	**Financial Management, Budgeting, and Share Market**	**7 hrs**
Financial Management - Definition, Scope of Financial Management in Engineering, Financial Planning for Engineering Firms, Sources of Finance for Engineering Projects. Budgeting: Purpose and Importance of Budgeting, General Budget vs. Industry Budget, Types of Budgets, Concept and Importance of Working Capital. Share Market, Types of Share Markets, Stock Exchanges (NSE, BSE), Market Indices (Sensex, Nifty), SEBI and its Functions, Types of Shares, Demat and Trading Accounts, Dividends, Shares, Bonds, Mutual Funds, and Initial Public Offering (IPO).		
Exemplars/ Case Studies	Budgeting for Engineering Projects: Prepare a detailed budget for a engineering project	
Unit-V:	**Financial Accounting and Taxation for Engineers**	**6 hrs**
Introduction to financial accounting, double entry book keeping, journal, ledger. Financial Statements- Balance Sheet, Income Statement, and Cash Flow Statement. Financial Ratios: Liquidity, Profitability, and Solvency Ratios. Depreciation, Methods of Depreciation, Effect of Depreciation on Costs. Taxation**:** Direct Taxes vs. Indirect Taxes, Goods and Services Tax (GST), Corporate Tax and Income Tax, Tax Benefits and Deductions.		
Exemplars/ Case Studies	Case Study Financial Statement Analysis: Analyze the financial statements of a listed engineering company	
Text Books:		
1. Engineering Economics -Chan S. Park, Pearson Prentice Hall, fourth Edition 2. Prasanna Chandra – Financial Management: Theory and Practice, McGraw Hill Education.		
Reference Books:		
1. Khan and Jain – Financial Management: Text, Problems, and Cases, McGraw Hill. 2. I Panneerselvam R. – Engineering Economics, PHI Learning Pvt. Ltd.		
MOOC Courses:		

https://nptel.ac.in/courses/110107144
https://nptel.ac.in/courses/110101005
https://nptel.ac.in/courses/110101149

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	2		-	-	-	2	1	3	-	1
CO2	3	2	3	-	-	-	-	-	-	-	2	1	3	2	1
CO3	3	3	3	2	-	-	-	-	-	2	3	2	3	3	2
CO4	-	-	-	-	3	2	-	-	-	2	3	2	-	-	2
CO5	3	3	3	2	-	-	2	-	-	-	3	2	3	3	2
CO6	3	3	3	2	-	2	2	-	2	-	3	2	3	3	2

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0929: Environmental Science		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme & Marks**
TH : 01 Hour/Week **TUT: 01 Hour/Week**	**02**	**CCE : 20 Marks** **ESE : 30 Marks**

Course Objectives:

- To introduce students to ecology, ecosystem functions, and conservation programs.
- To introduce students to pollution types and key environmental issues.
- To introduce students to India's biodiversity and conservation efforts.
- To introduce students to climate change, its impacts, and mitigation policies.
- To introduce students to environmental acts, policies, and institutional measures for protection.
- To introduce students to key environmental concepts, including ecology, pollution, biodiversity, climate change, and conservation.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1: Students will understand ecology, ecosystem functions, and conservation.	2
CO2: Students will understand pollution types and major environmental issues.	2
CO3: Students will understand India's biodiversity and conservation efforts.	2
CO4: Students will understand climate change and its mitigation.	2
CO5: Student will learn key Environmental laws, policies and Frameworks	2
CO6: Students will gain a comprehensive understanding of environmental concepts, including ecology, pollution, biodiversity, climate change, and related laws.	2

Preamble:

An environmental study is a multidisciplinary academic field which systematically studies human interaction with the environment. Environmental science connects principles from the physical sciences, commerce/economics, the humanities, and social sciences to address complex contemporary environmental issues. Imparting basic knowledge about the environment and its allied problems. Developing an attitude of concern for the environment.

Course Contents

Unit Number	Unit Title	Hours
I	**Ecology and Ecosystem**	**3**

Ecology : History of Ecology, Environment and its component
Ecosystem : Function of Ecosystem , Energy flow, Food Chain, Bio-Geotechnical Cycle, Ecological Succession, Terrestrial Ecosystem, Aquatic Ecosystem, National Wetland conservation program, Namami Ganga Program, Recent Issue

II	Environmental pollution & Environmental Issue	5
Environmental pollution : Pollutants, Air pollution, water pollution, Soil pollution, Radioactive Pollution, E-waste, Solid Waste, Thermal Pollution, Plastic Pollution, Acid Rain, Environmental pollution & Health **Environmental Issue:** Sand Mining in India, Impact of radiation, Cost of Environmental degradation in India		
III	**Biodiversity**	**5**
Biodiversity: Indian Biodiversity, Animal Diversity of India, Plant Diversity of India, Marine Organism, Protected Area Network **Conservation Efforts :** Project Tiger, Project Elephant, Secure Himalaya, Crocodile conservation Project, Government Measures and Recent Iniative		
IV	**Climate Change**	**6**
Climate Change, Ocean Acidification, Ozone Depletion, Impact of Climate change – India, Mitigation policies: carbon sink, Carbon credit, Carbon Tax, India and Climate Change		
V	**Acts, Policies & Institutional Measures**	**6**
Acts, Policies : Wild life Protection Act 1972,Enviornmental Protection Act 1986, National Forest policies 1988, Biological Diversity Act 2002, Coastal Regulation Zone, Biomedical Waste Management Rule 2016, E- waste Management Rule 2016 **Institutional Measures:** Institutional Measures, Environmental organization, Climate Change Organization, International Environment Conventions		

Term Work Assessment Guidelines

Students must submit the report of all conducted activities conducted during Tutorial from group (of 02-03) students.

The brief guidelines for report preparations are as follows:

1. One activity report must be of maximum 3 pages;
2. Combined Report of all activities with cover pages, table of contents and certificate (signed by instructor) is to be submitted in soft copy (.pdf) format only.
3. The report must contain:
   - General information about the activity;
   - Define the purpose of the activity;
   - Detail out the activities carried out during the visit in chronological order;
   - Summarize the operations/process(methods) during the activities;
   - Describe what you learned (outcomes) during the activities as a student;
   - Add photos of the activity; (optional)
   - Add a title page to the beginning of your report;
   - Write in clear and objective language; and
   - Get well presented, timely and complete report submitted

Recommended Assessment and Weightage Parameters:

tendance 30%, Assignments/Activities-Active participation and proactive learning 50% and report 20%)

Tutorial Conduction and Term work Guidelines (Set of Suggested Activities)

Sr. No.	Problem Statements	Mapping CO(s)
1.	Report/Presentation on simple ecosystems-pond, river, hill slopes etc	CO1

2.	Report/Presentation on the effect of Environmental Pollution on any world famous Structure/ monument.	CO2
3.	Report/Presentation on importance of different sources of water available nearby them.	CO3
4.	Report/Presentation on the effect of air pollution and noise pollution on human beings.	CO4
5.	Report/Presentation on the current scenario of E-Waste management.	CO5

Books

Text Books:

1. Environment by Shankar IAS Academy Publication
2. The text book of Environmental studies, Dr. P. D. Raut, Shivaji University, 2013
3. "A Text Book of Environmental Studies", Dr. D. K. Asthana, S. Chand

Reference Books:

1. "Air Pollution", M. N. Rao, McGrawHill, Publication.
2. "E-waste Management and Procurement of Environment", Dr. Suresh Kumar, Authorspress, 2021.
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
6. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA,
7. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media ®
8. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai,

e-Books:

1. Bharucha, Erach (2005): "Text Book of Environmental Studies for Undergraduate Courses", University Press (India) pvt ltd, Hyderabad, India
2. Kothari Dr Milind- 2005- Environmental Education- Universal Publication Agra.
3. IGNOU 1995- FST- 1/4 Foundation course in Science and Technology "Environment and Resource" – Indira Gandhi Open University, New Delhi.

Web Links:

1. Prof. Mukesh Sharma, IIT Kanpur https://archive.nptel.ac.in/courses/105/102/105102089
2. Prof. J. Bhattacharyya, IIT Kharagpur, https://archive.nptel.ac.in/courses/123/105/123105001
3. Prof. Bhola Ram Gurjar, IIT Roorkee, https://archive.nptel.ac.in/courses/105/107/105107213

MOOC Courses:

https://onlinecourses.swayam2.ac.in/cec21_ge21/preview

The CO-PO Mapping Matrix

CO\ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	3	2	-	-	-	2	1	-	2
CO3	-	-	-	-	-	-	3	2	-	-	-	2	1	-	2
CO4	-	-	-	-	-	-	3	2	-	-	-	2	1	-	2
CO5	-	-	-	-	-	2	2	3	-	-	-	3	1	-	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0930: Community Engagement / Field Projects		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme & Marks**
TUT: 01 Hours/Week **PR: 02 Hours/Week**	**02**	**CCE-TW : 20 Marks** **ESE-TW: 30 Marks**

Learning Objectives:

- To provide the students an exposure to contemporary social reality.
- To cultivate in the students the spirit of active involvement in the service to the community.
- Community awareness, suggesting practical, impactful devices or systems to address local needs in a community, while actively involving community members in the process through needs assessments, workshops, and feedback loops, potentially focusing on areas like energy efficiency, water conservation, waste management, or accessible technology development.
- To inculcate a sense of social responsibility in students

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 Improve access to essential services or technologies tailored to local needs	**6**
CO.2 Enhance efficiency and sustainability of existing systems	**6**
CO.3 Mitigation of environmental concerns related to mechanical processes	**6**
CO.4 Increase community resilience through innovative solutions	**6**
CO.5 Apply theoretical knowledge to real-world problems	**3**
CO.6 Understand diverse perspectives and challenges faced by local populations	**2**

Guidelines for Field Project :-

- **Identify the problem of community**
- **Awareness of readymade solution for identified problems to community**

Sr. No.	Suggested Community problems (farmers)	Mapping CO(s)
1.	**Water purification systems for rural communities**	1
2.	**Energy-efficient cooking stoves to reduce fuel consumption**	2
3.	**Assistive devices for individuals with disabilities**	1
4.	**Irrigation systems for sustainable agriculture**	2
5.	**Waste sorting and recycling system -** user-friendly waste sorting mechanism for community centers or schools, educating residents on proper waste disposal.	3
6.	Composting system for households or community gardens, promoting sustainable waste management.	2,3
7.	Plastic waste into usable materials, potentially collaborating with local recycling facilities.	4
8.	**Demonstration projects-** demonstration units for residents to experience the potential benefits of the proposed technology.	4
9.	**Agriculture water management**	4,5
10.	**Modern vegetable farming**	4,5
11.	**Seedbed preparation and Seed treatment**	5
12.	**Insect and Pest management**	5

13.	Engagement among farmers in developing farming knowledge	4
14.	Greenhouse with climate control, irrigation, and nutrient delivery systems for optimal crop growth	4
15.	**Solar-powered irrigation system-** a solar-powered pump system for small-scale farmers to improve water access.	4
16.	Biogas plant that utilizes agricultural waste for renewable energy production, promoting sustainability in farming practices	2, 4
17.	Automates drip irrigation, optimizing water usage and reducing water wastage in agricultural fields	4,5
18.	Solar-powered tools and equipment for use in agriculture, reducing dependence on traditional energy sources	4,5
19.	Connecting local farmers directly with consumers, fostering community-supported agriculture	5,6
20.	Packaging solutions that monitor and extend the shelf life of perishable agricultural products during transportation and storage.	5,6
21.	Combine aquaculture with traditional agriculture for improved resource utilization and sustainability	6
22.	Cold storage facilities that optimize temperature and humidity control for preserving the quality of agricultural produce.	6

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	-	-	3	3	2	1	2	2	2	3	1	1	3
CO2	2	2	2	2	3	3	3	-	2	2	2	3	2	2	3
CO3	2	2	-	-	2	1	2	1	2	2	2	3	2	2	3
CO4	1	1	-	-	2	2	2	-	2	3	2	3	1	1	3
CO5	3	2	-	-	1	2	2	1	2	2	2	3	3	2	3
CO6	2	1	-	-	-	2	2	2	2	2	2	2	2	1	2

Guidelines for Term Work - The student shall complete the following activity as a Term Work.

Part A :- CCE-TW (20 Marks)

Assessment Rubric: **Problem Analysis Report (20Marks)**

Parameter →	Community issue identification	Analysis of Issue	Report
Max. Marks	5 Marks	10 Marks	5 Marks

Part B: - ESE-TW (30 Marks)

Study and Analysis of community case and Present it.

(Group of 05 Students for one case)

A case study includes the following sections:

- **Executive summary**: Introduces the topic
- **Introduction**: Summarizes the task
- **Findings**: Identifies the key problems
- **Discussion**: Summarizes the major problems
- **Conclusion**: Includes words of advice and a call to action
- **Recommendations**: States your recommendations
- **References**: Includes references and acknowledgments

Assessment Rubric: **Presentation based evaluation (30Marks)**

Parameter →	larity and Structure	ontent & Solution suggested	resentation skills &	nnovative Insights
Max. Marks	5 Marks	10 Marks	10 Marks	5 Marks

Matoshri College of Engineering & Research Centre, Nashik
Second Year Bachelor of Technology
NCAC04: Non-Credit Audit Course_3

Teaching Scheme	Credits	Examination Scheme
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course III

- Technical English For Engineers
- Entrepreneurship Development
- Developing soft skills and personality
- Design Thinking
- Foreign Language (preferably German/ Japanese)
- Science, Technology and Society

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course
• The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary. • During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course. • On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the marksheet.

The CO-PO Mapping Matrix

Name of Audit Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Audit Course - III Technical English For Engineers	-	-	-	-	1	2	-	1	1	2	-	1	3	-	2
Audit course III- Entrepreneurship Development	-	-	-	-	-	3	3	3	3	2	2	3	1	2	2
Audit course III- Developing soft skills and personality	-	-	-	-	-	3	-	1	2	3	-	1	1	3	2
Audit course III- Design Thinking	2	-	2	1	-	2	2	2	1	1	2	2	2	-	2
Audit course III- Foreign Language (preferably German/ Japanese)	-	-	-	-	-	1	-	-	1	2	-	1	-	1	1
Audit course III- Science, Technology and Society	2	-	-	-	-	2	3	3	-	2	2	2	2	2	2
Avg.	2	-	2	1	1	2	3	2	2	2	2	2	2	2	2

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0931: Engineering Mathematics – III		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 03 Hours/Week	**03**	**CAT_1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

Prerequisite: Derivative, integration, differential & integral calculus, Fourier series, vector algebra.

Course Objectives:

- To make the students familiarize with concepts and techniques in ordinary & partial differential equations, Laplace transform & Fourier transform, vector calculus, multiple integrals and their applications.
- The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 SOLVE higher order linear differential equations and its applications to model and analyze mass spring systems.	2,3
CO.2 APPLY Integral transform techniques such as Laplace transform and Fourier transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.	2,3
CO.3 PERFORM Vector differentiation, analyze the vector fields and APPLY to fluid flow problems.	2,3
CO.4 SOLVE multiple integrals and its application to find area bounded by curves, volume bounded by surfaces.	2,3
CO.5 SOLVE Partial differential equations such as wave equation, one and two dimensional heat flow equations	2,3
CO.6 Apply theoretical knowledge to real-world scenarios for problem solving and analysis.	3

Course Contents

Unit I	**Linear Differential Equations (LDE) and Applications**	**(08 Hr.)**

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE,. Modelling of Mass-spring systems, Free & Forced damped and undamped systems.

Exemplars/ Case Studies:

Mechanical Systems (Oscillations and Vibrations) -In mechanical systems, LDEs can model the behavior of objects in motion, like the vibration of a spring or a pendulum,

Equation for damped harmonic motion,

Heat Conduction- The heat equation, which describes the distribution of temperature in a given region over time, is a second-order linear partial differential equation.

Unit II	**Transforms**	**(08 Hrs)**

Fourier Transform (FT): Fourier integral theorem, Fourier transform, Fourier sine & cosine transforms, Inverse Fourier Transforms. Laplace Transform (LT): LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Exemplars/ Case Studies:
Control Systems and Engineering- In control theory, the Laplace transform is used to model and analyze the behavior of dynamic systems. It is used in the transfer function approach to analyze the stability, performance, and response of mechanical systems.
Mechanical Systems-In mechanical engineering, the Laplace transform is used to analyze systems involving springs, dampers, and masses.
It can help find the displacement or velocity of a system under a specific force or initial condition.
Heat Transfer and Diffusion-In heat transfer and diffusion problems, the Laplace transform is used to solve partial differential equations (PDEs) like the heat equation. The Laplace transform simplifies the analysis of heat conduction in solids over time.
The Fourier Transform- to solve linear differential equations, particularly in problems related to heat conduction, wave propagation, and vibrations.
Heat Equation: The Fourier Transform is used to solve the heat equation, which describes how heat distributes over time in a material. By transforming the problem into the frequency domain, the solution becomes easier to handle.
Wave Equation: The Fourier Transform is also used in solving the wave equation, which models phenomena such as sound waves or vibrations in a string.
Vibration Analysis- the Fourier Transform is used to study the frequency response of systems subjected to vibrations. It helps in identifying resonant frequencies, which can be critical for the design of structures and machines to avoid destructive vibrations.

Unit III	**Vector Differentiation**	**(08 Hr.)**

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Exemplars/ Case Studies: Fluid dynamics, stress analysis. Machine Learning- Optimization techniques

Unit IV	**Multiple Integrals and their Applications**	**(10 Hr.)**

Double and Triple integrations, Applications to find Area and Volume,
Line integral by Green's Lemma, Surface integral by Stokes theorem and Volume integrals by Gauss's Divergence theorem.

Exemplars/ Case Studies: Heat distribution, stress analysis.

Unit V	**Applications of Partial Differential Equations (PDE)**	**(08 Hr.)**

Basic concepts, modelling of Vibrating String, Solution of Wave equation, One- and two-dimensional Heat flow equations, Method of separation of variables, use of Fourier series. Solution of Heat equation by Fourier transforms.

Exemplars/ Case Studies:
Heat Equation -Heat Conduction and Diffusion
Models temperature distribution in solids.
Used in heat conduction, thermal engineering, and diffusion processes.
Wave Equation– Vibrations and Waves
Models vibrating strings, membranes, and sound waves.
Laplace's and Poisson's Equations – Electrostatics and Fluid Flow
Models steady-state heat conduction, electrostatics, and gravitational fields, used in fluid flow problems.
Navier-Stokes Equations – Fluid Mechanics, Describes fluid flow, aerodynamics, used in aircraft design and modeling.

Books & Other Resources

Text Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, Delhi

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics', 10e, by Wiley India.
2. M. D. Greenberg, "Advanced Engineering Mathematics", 2e, by Pearson Education.
3. Peter V. O'Neil , "Advanced Engineering Mathematics", 7e, by Cengage Learning
4. S. L. Ross, "Differential Equations", 3e by Wiley India.
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, by Elsevier Academic Press.

e-Books:

- Dean G.Duffy," Advanced Engineering Mathematics",CRC press https://engg.matoshri.edu.in/ebooks/mechanical/Applied_Mathematics_Dean_G__Duffy_-_Advanced_engineering_mathematics_(1997,_CRC_Press)_-_libgen_lc.pdf
- Christopher C.Tisdell,"Engineering Mathematics" https://engg.matoshri.edu.in/ebooks/engg_sciences/engineering-mathematics-youtube-workbook.pdf
- "Engineering Mathematics" https://ebooksecure.com/download/engineering-mathematics

MOOC Courses:

- https://www.my-mooc.com/en/mooc/differential-equations-in-action--cs222
- http://digimat.in/nptel/courses/video/122107037/L01.html
- https://onlinecourses.nptel.ac.in/noc23_ma33/preview

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	-	-	-	-	-	-	1	-	2	3	2	1
CO2	3	2	2	-	-	-	-	-	-	1	-	2	3	2	1
CO3	3	3	2	-	2	-	-	-	-	1	2	2	3	2	1
CO4	3	3	2	-	2	-	-	-	-	1	-	2	3	2	1
CO5	3	2	2	-	2	-	-	-	-	2	-	2	3	2	1
CO6	3	3	2	-	2	-	-	-	-	2	-	2	3	2	1

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0932: Material Science		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 02 Hours/Week	**02**	**CAT: 20 Marks** **CCE: 20 Marks** **ESE: 60 Marks**

Prerequisite: Higher Secondary Science courses, Engineering Physics, Engineering Chemistry

Course Objectives:

- To understand different types of engineering materials and their applications.
- To understand correlation between the internal structure of materials and their mechanical properties.
- To discuss various methods to quantify the mechanical integrity of materials and their failure criteria.
- To interpret equilibrium phase diagrams of alloys.
- To understand different heat treatment methods to tailor the properties of Fe-C alloys.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 COMPARE crystal structures and ASSESS different lattice parameters.	4
CO.2 DESCRIBE various methods to measure and test the mechanical properties of materials.	2
CO.3 ANALYSE effect of heat treatment on properties of Steel.	4
CO.4 UNDERSTAND the properties of ferrous and non-ferrous alloys through various heat treatments.	2
CO.5 UNDERSTAND the concept of polymer, ceramic, composite and other advanced materials.	2
CO.6 SELECT suitable materials for mechanical engineering systems.	3

Course Contents

Unit I	**Crystal Structures and Deformation of Materials**	**(08 Hr.)**

Crystal Structures: Study of crystal structures-BCC, FCC and HCP, Lattice parameters & properties, Miller indices, Crystal imperfections, and Diffusion mechanisms.
Material Properties: Mechanical, Electrical, Optical and Magnetic properties.
Deformation of Materials: Elastic deformation, Plastic deformation: slip, twinning, work hardening, Baushinger effect, Recovery, Re-crystallization and Grain growth.
Fracture: Types of fractures, Creep & Fatigue failures.

Unit II	**Material Testing and Characterization Techniques**	**(08 Hr.)**

Destructive Testing: Impact test, and Hardness test.
Non-Destructive Testing (NDT): Eddy current test, Sonic & Ultrasonic testing, X-ray Radiography testing - Principle and Applications.
Microscopic Techniques: Sample preparation and etching procedure, Optical microscopy and Electronic microscopy - Scanning Electron Microscope, Transmission Electron Microscope, X-ray diffraction Principle and Applications.
Macroscopy: Sulphur printing, Flow line observation, Spark test.

Unit III	**Heat Treatment**	**(08 Hr.)**

Phase diagrams and microstructure, Cooling Curves, Iron - carbon phase diagram.
Austenite Transformation in Steel: Time temperature transformation diagrams, Continuous cooling transformation diagrams. Retained austenite and its effect.

Heat Treatment of Steel: Annealing, Tempering, Normalizing, Spheroidising, Austempering, Martempering, Case hardening, Carburizing, Nitriding, Cyaniding, Carbo-nitriding, Flame and Induction hardening, Vacuum and Plasma hardening, Sub-zero treatment, Hardenability.

Unit IV	Ferrous and Non-Ferrous Materials	(08 Hr.)

Ferrous Materials and Alloys: Iron and steel, Stainless steel and tool steels.
Indian Standards (IS), American Iron and Steel Institute (AISI) Standards for specifications of carbon steels and alloy steels.
Non-Ferrous Materials and Alloys: Copper and its Alloys - Gilding Metal, Cartridge Brass, Muntz Metal, Tin Bronze, Beryllium Bronze and applications.
Aluminum and its Alloy - LM5, Duralumin, Y-Alloy, Hinduminum and applications.
Nickel and its Alloys - Invar, Inconel and applications.
Titanium and its Alloys - α Alloys, α-β Alloys and applications.
Cobalt and its Alloys - Stellite Alloys, Alnico and applications.

Unit V	Polymers, Ceramics, Composites and Advanced Materials	(08 Hr.)

Polymers: Classification and applications, Polymerization techniques.
Ceramics: Oxide ceramics, Ceramic insulators, Bio-ceramics and Glasses and applications.
Composites: Reinforcement, Matrix, Metal matrix composites, Ceramic matrix composites and Polymer matrix composites and applications.
Advanced materials: Biomaterials, Optical materials, High temperature materials, Energy materials, Smart materials, Nanomaterials and applications.

Books & Other Resources

Text Books:

1. Dr. V. D. Kodgire & S. V. Kodgire, "Material Science & Metallurgy For Engineers", Everest Publication.
2. A. K. Bhargava, C.P. Sharma, "Mechanical Behaviour & Testing of Materials", P H I Learning Private Ltd.

Reference Books:

1. W. D. Callister, "Materials Science & Engineering," Wiley India, 2014.
2. K. G. Budinski and M.K. Budinski, "Engineering Materials", PHI India, 2002.
3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd.

e-Books:

- Materials Science and Engineering An Introduction; William D. Callister; https://engg.matoshri.edu.in/ebooks/mechanical/Materials_Science_and_Engineering_-_An_Introduction7th.pdf
- Physics of Strength and Fracture Control; Anatoly A. Komarovsky; https://engg.matoshri.edu.in/ebooks/mechanical/17.pdf
- Mechanical Behaviour of Engineering Materials: Metals, Ceramics, Polymers, and Composites; J. Rösler, H. Harders, M. Bäker; https://engg.matoshri.edu.in/ebooks/mechanical/628.pdf

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	2	-	-	1	-	2	3	1	2
CO2	2	3	-	-	2	2	2	-	-	2	-	2	2	3	2
CO3	3	2	1	-	-	1	2	-	1	1	-	2	3	2	2
CO4	3	2	-	-	-	-	2	-	-	2	-	2	3	2	2
CO5	3	2	1	1	-	2	1	-	-	1	1	2	3	2	2
CO6	3	2	2	1	-	3	-	1	1	2	-	2	3	2	2

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0933: Strength of Materials		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 03 Hours/Week	**03**	**CAT_1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

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

Companion Course, if any: 24U0936: Mechanical Engineering Lab -2 (B. Strength of Material)

Course Objectives:

- To acquire basic knowledge of stress, strain due to various types of loading.
- To draw Shear Force and Bending Moment Diagram for transverse loading.
- To determine Bending, Shear stress, Slope and Deflection on Beam.
- To solve problems of Torsional shear stress for shaft and Buckling for the column.
- To apply the concept of Principal Stresses and Theories of Failure.
- To utilize the concepts of Solid Mechanics on industrial application.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1. DEFINE various types of stresses and strain developed on determinate and indeterminate members.	1
CO2. DRAW Shear force and bending moment diagram for various types of transverse loading and support	3
CO3. COMPUTE the slope & deflection, bending stresses and shear stresses on a beam.	3
CO4. CALCULATE torsional shear stress in shaft and buckling on the column.	3
CO5. APPLY the concept of principal stresses and theories of failure to determine stresses on a 2-D element	3
CO6. UTILIZE the concepts of Solid Mechanics to solve real world application based problems.	3

Course Contents

Unit I	**Simple stresses & strains**	**08 Hr.**

Types of loads and stresses with applications, Hooke's law, Poisson's ratio, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Inter relation between elastic constants, Stress-strain diagram for ductile and brittle materials, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads and self-weight, Thermal stresses in plain and composite members.

Exemplars/ Case Studies: Bridges, Cables, Beams, Suspensions

Unit II	**Shear Force & Bending Moment Diagrams**	**07 Hr.**

Introduction to Shear force and bending moment diagram with application, Shear force and bending moment diagram for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load, couple and combined loading, Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure.

Exemplars/ Case Studies: Beam, Chassis, Suspension, and Axles

Unit III	**Stresses, Slope & Deflection on Beams**	**10 Hr.**

Bending Stress on a Beam: Theory of Simple bending, assumptions in pure bending, flexural formula,

Bending stress distribution along the different cross-sections

Shear Stress on a Beam: Transverse shear stress on a beam with application, shearstress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section

Slope & Deflection on a Beam: Slope & deflection on a beam with application,Macaulay's Method, Slope and Deflection for all standard beams.

Exemplars/ Case Studies: Beam, Shafts, Levers, and Frames

Unit IV	Torsion & Buckling	07 Hr.

Torsion of circular shafts: Assumption & derivation in torsion formula, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis

Buckling of columns: Introduction & applications, Different column conditions, critical, safe load, determination by Euler's theory, Limitations of Euler's Theory

Exemplars/ Case Studies: Automobile propellers, Torsion springs are used in door hinges, garage doors, Axles.

Unit V	Principal Stresses & Theories of Failure	07 Hr.

Principal Stresses: Transformation of PlaneStress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses

Theories of Elastic failure: Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory

Exemplars/ Case Studies: Designing robust and lightweight vehicles, design of tools and machines, design of car frames

Books & Other Resources

Text Books:

1. S. Ramamurtham, "Strength of material", Dhanpat Rai Publication
2. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.

Reference Books:

1. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi
2. Singer and Pytel, "Strength of materials", Harper and row Publication
3. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication
4. Sadhoo Singh, "Strength of Material", Khanna Book Publishing

e-Books:

- Mechanics of Solids; S. S. Bhavikatti; https://engg.matoshri.edu.in/ebooks/mechanical/Mechanics%20of%20Solids%20by%20S.S.Bhavikatti.pdf
- An Introduction to the Mechanics of Solids; Stephen H. Candall, Norman C. Dahi, Thomas J. Lardner; https://engg.matoshri.edu.in/ebooks/mechanical/63__introduction_to_the_mechanics_of_solids.pdf
- Solid Mechanics; James R. Rice; https://engg.matoshri.edu.in/ebooks/mechanical/EBK_073_Solid_Mechanics.pdf
- Mechanics of Solids and Fracture; Ho Sung Kim; https://engg.matoshri.edu.in/ebooks/mechanical/mechanics-of-solids-and-fracture.pdf

Mooc course:

- https://nptel.ac.in/courses/112107146
- https://onlinecourses.nptel.ac.in/noc23_me140/preview
- https://archive.nptel.ac.in/courses/112/106/112106141/

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	1	1	-	1	2	-	2	3	-	2
CO2	3	3	2	-	-	2	-	-	2	1	-	2	3	3	2
CO3	2	2	2	1	-	2	2	-	1	1	-	2	2	2	2
CO4	3	2	2	1	-	2	2	-	2	2	-	2	3	2	2
CO5	3	2	2	-	-	2	2	-	1	2	-	2	3	2	2
CO6	3	2	2	1	2	2	-	1	2	1	-	2	3	2	2

Matoshri College of Engineering and Research Centre, Nashik Second Year Bachelor of Technology 24U0934: Fluid Mechanics and Hydraulic Machines		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme and Marks**
TH: 03 Hours/Week	**03**	**CAT_1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

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

Course Objectives:

- To understand basic properties of fluids.
- To learn fluid statics and dynamics
- To study basics of flow visualization
- To understand Bernoulli's theorem and its applications.
- To understand losses in flow, drag and lift forces
- To analyse the flow in water pumps and turbines.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1. DETERMINE various properties of fluid.	5
CO2. APPLY the laws of fluid statics and concepts of buoyancy and **IDENTIFY** types of fluid flow and terms associated in fluid kinematics	3
CO3. APPLY principles of fluid dynamics to laminar flow	3
CO4. ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface	5
CO5. DETERMINE performance parameters of rotodynamic machines and hydraulic turbines.	5
CO6. APPLY concepts of Fluid sciences to solve engineering problems utilizing advanced technology.	3

Course Contents

Unit I	**Properties of Fluid**	**(08 Hr.)**

Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, types of fluid and rheology, numerical on viscosity-flow through pipe, lubrication, bearing, brake fluids, parallel plates, rotating shafts, vapor pressure, surface tension, capillarity, compressibility

Exemplars/ Case Studies: Hot Air Balloon, Hydraulic Brakes, Ship Floating, Carburetors.

Unit II	**Fluid Statics and Kinematics**	**(08 Hr.)**

Fluid statics: Forces acting on fluid element, Pascal's law, hydrostatics law, hydraulic ram.
Buoyancy: Flotation, stability of bodies.
Fluid Kinematics: Types of flows, flow description methods, velocity and acceleration fields, continuity equation in 1D and 3D flow, flow visualization : path line, stream line and streak line, stream tube, angularity, vorticity, stream function and velocity potential function, flow net.

Exemplars/ Case Studies: Aerodynamics in Aviation and Automobiles

Unit III	**Fluid Dynamics**	**(08 Hr.)**

Euler's equation of motion- differential form and Navier Stokes equation, Euler's equation of motion along streamline, Bernoulli's theorem and modified Bernoulli's theorem, stagnation pressure,

Hydraulic Gradient Line, Total Energy Line.
Flow measurement: Venturimeter, orifice meter, pitot tubes, flow meter, introduction to orifices, notches and weirs.
Laminar flow: Entrance region theory, velocity and shear Stress distribution for laminar flow through pipe, fixed parallel plates and Couette flow, velocity profile of turbulent flow.

Exemplars/ Case Studies: Carburetor in Engines, Air and Refrigerant flow.

Unit IV	Internal and External Flow	(08 Hr.)

Internal Flow: Losses - major and minor losses, hydro dynamically smooth and rough boundaries, Moody's chart, compounding of pipes and equivalent pipe, Siphons.
External Flow: Boundary layer formation over a flat plate, boundary layer thickness, displacement thickness, momentum thickness and energy thickness, boundary layer separation and methods to control separation.

Exemplars/ Case Studies: HVAC Systems, Blood Flow in Arteries and Veins, Cooling of Electronics devices, Wind Turbines.

Unit V	Hydraulic Machines	(10 Hr.)

Rotodynamic Machines: Theory of Rotodynamic machines; Various efficiencies;Centrifugal pumps, Cavitation in pumps, Reciprocating pumps, Surging, Choking. -No Numerical treatment
Hydraulic Turbines: Classification of water turbines; Velocity triangles; Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines – working principles, Cavitation.-No Numerical-

Exemplars/ Case Studies: Steam Turbine, Marine Propulsion.

Books and Other Resources

Text Books:

1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2005.
2. S.S. Rattan, Fluid Mechanics and Hydraulic Machines, Khanna Book Publishing, 2019.

Reference Books:

1. F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011
2. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.
3. Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988
4. P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India,2012.

e-Books:

- Fluid Mechanics and the Theory of Flight; R. S. Johnson; https://engg.matoshri.edu.in/ebooks/engg_sciences/fluid-mechanics-and-the-theory-of-flight.pdf
- Introduction to Fluid Mechanics; Edward J. Shaughnessy, Ira M. Katz, James P. Schaffer; https://engg.matoshri.edu.in/ebooks/mechanical/Introduction%20to%20Fluid%20Mechanics.pdf
- Basics of Fluid Mechanics; Genick Bar–Meir; https://engg.matoshri.edu.in/ebooks/mechanical/Fluid%20Mechanics%20(1).pdf
- Fluid Mechanics, Thermodynamics of Turbomachinery; S.L. Dixon; https://engg.matoshri.edu.in/ebooks/mechanical/Fluid%20Mechanics%20and%20Thermodynamics%20of%20Turbomachinery%20(4th%20Edition).pdf

- An Introduction to Fluid Mechanics; Chung Fang; https://engg.matoshri.edu.in/ebooks/mechanical/6_Springer_Textbooks_in_Earth_Sciences_Geography_and_Environment_Fang,_Chung_-_An_introduction_to_fluid_mechanics_(2019,_Springer)_-_libgen_lc.pdf

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	1	-	-	-	1	-	2	3	2	2
CO2	3	2	-	-	-	-	-	-	-	1	-	2	3	2	2
CO3	3	2	1	1	-	-	-	-	-	1	-	2	3	2	2
CO4	3	2	1	1	-	-	-	-	-	1	-	2	3	2	1
CO5	3	3	3	1	2	1	1	-	1	1	-	3	3	3	3
CO6	3	2	3	1	3	1	1	-	1	1	-	3	3	2	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0935: Supply Chain Analytics		
Teaching Scheme	**Credit**	**Examination Head: TH** **Examination Scheme & Marks**
TH: 02 Hours/Week	**02**	**CAT _1: 20 Marks** **CAT_2: 20 Marks** **ESE: 60 Marks**

Prerequisite: Logistics & Supply Chain Management

Course Objectives:

- To take crucial decisions for companies to gain competitive edges in their respective businesses are supported by scientific decision making methodologies using analytics based on data-driven supply chain management.
- To apply Business Analytics techniques to formulate supply chain models for evaluating and optimizing supply chain performances. Emphasis will be placed on drawing practical perspectives and managerial insights from analytical solutions. It will equip students with versatile analytical skills in modelling, analysing and solving supply chain management problems from various industries, and provide practical hands-on experience in planning for customer demands, inventory consumption, production capacities, material requirements, etc.
- To make the right decisions and creating business values across supply chains. Students will learn how to use the available data to understand what has happened in the past and what is currently happening, as well as to predict what will happen in the future and to make optimal decisions. These analytical skills are crucial for helping companies to gain competitive edges in their respective businesses.

Course Outcomes:		**BL**
On completion of the course, learner will be able to–		
CO.1	Understand the role and importance of supply chain analytics	2
CO.2	Discuss the key challenges and drivers in managing supply chains	2
CO.3	Apply the analytical tools to optimize the supply chain drivers	3
CO.4	Evaluate the performance of different supply chain by Predictive Analytics	5
CO.5	Use of Prescriptive Analytics and Technology for Supply Chain Analytics	3
CO.6	Apply the concept of SCA to real world engineering applications	3

Course Contents

Unit I	**Introduction to Supply Chain Analytics**	**(08 Hr.)**

Introduction to Supply Chain Strategy and Processes, The Triple A framework of Supply Chain, The link between Business Strategy and Supply Chain Strategy: Efficient Vs Responsive Supply Chains, Supply Chain Processes – Plan, Source, Make, Deliver and Sell, New Business Models emerging from Value created by the Supply Chain,

Unit II	**Novel Data Sources' for Supply Chain Analytics**	**(08 Hr.)**

Organization data from internal systems, Data Available Outside Organization boundaries, Unstructured Data from Reviews, Social media, blogs etc. Data Sources from new technologies – Block chain, Internet of Things

Unit III	**Descriptive Analytics**	**(08 Hr.)**

Process of Problem Discovery through Analytics, Pre-processing of raw data from core Supply Chain Systems. Data Validation of Data from multiple core systems. Handling missing data, Collating data

from different systems to make it meaningful for analysis.
Descriptive Analytics, Supply Chain Metrics - Spends/Sourcing Analytics, Inventory Analytics: ABC XYZ Analysis, Logistics Analytics: Delivery Cost and Service Level Metrics, Production Analytics: Process, Capacity, Quality and Service Analytics metrics, Customer Analytics: Customer Acquisition and Retention Metrics.

Unit IV	**Predictive Analytics**	**(08 Hr.)**

What is Predictive Analytics?
Various Use Cases for Prescriptive Analytics
Demand Forecasting: Time Series Techniques, Causal techniques
Process of Predictive Modelling: From Building models to evaluating model fit.
Supervised Models: Predicting Customer Churn, Based on Structured Data, Based on Unstructured Data – Text Mining Topic Modelling, Predicting Equipment Failure.
Unsupervised Models: Dimensionality Reduction: Reducing number of variables to simplify model Building, Clustering: Use cases in Recommender Systems and Segmentation.

Unit V	**Prescriptive Analytics and Technology for Supply Chain Analytics**	**(08 Hr.)**

Prescriptive Analytics: What is Prescriptive Analytics?
Examples of new age use cases of Real time Prescriptive Analytics in Supply Chain fuelled by Digitization. (Driving real time decisions in Manufacturing / Inventory, Management / Logistics or Sales Campaigns or Algorithmic Marketing), Analytical framework for specifying a trade-off problems and optimization problems, Formulation a model for Prescriptive Analytics with hands on exercise e.g. Network Design
Technology for Supply Chain Analytics:
Data warehousing and Data Center/AWS (including Extraction, Transformation, Loading) Modelling Tools: Implementation of Real Time System with Model Building – Case Studies of AWS.
End to End Supply Chain Solutions. Internet of Things and Block Chain.

Books & Other Resources

Text Books:

1. Chopra, S. and P. Meindl, Supply Chain Management: Strategy, Planning, and Operation, 6th Edition, Pearson Education, 2016
2. Simchi-Levi, D., P. Kaminsky and E. Simchi-Levi, Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies, McGraw-Hill/Irwin, 2009

Reference Books:

1. Bertsimas, D. and R. M. Freund, Data, Models, and Decisions: The Fundamentals of Management Science, 2nd Edition, Dynamic Ideas Publisher, 2004
2. Hillier, F. S. and M. S. Hillier, Introduction to Management Science: A Modelling and Case Studies Approach with Spreadsheets, 5th Edition, McGraw Hill Publisher, 2014

MOOC Courses:

- https://onlinecourses.nptel.ac.in/noc23_mg16/preview
- https://archive.nptel.ac.in/courses/110/107/110107074/
- https://archive.nptel.ac.in/courses/110/105/110105141/

The CO-PO Mapping Matrix															
CO\PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	-	-	-	-	2	1	1	2	-	1	2	2	2	2
CO2	2	2	1	2	2	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	2	3	-	-	-	1	1	-	3	3	2	2
CO4	2	2	3	3	3	-	-	-	1	1	-	3	3	2	2
CO5	2	2	3	3	3	-	-	-	1	1	-	3	3	2	2
CO6	2	2	-	-	2	-	1	-	1	1	-	3	2	3	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0936: Material Science Lab		
Teaching Scheme	**Credit**	**Examination Head: PR** **Examination Scheme & Marks**
PR: 02 Hours/Week	**01**	**CCE-PR: 10 Marks** **ESE-PR: 15 Marks**

Part A : Material Science

Prerequisite: Higher Secondary Science courses, Engineering Physics, Engineering Chemistry

Companion Course, if any: 24U0932: Material Science.

Course Objectives:

- To understand different types of engineering materials and their applications.
- To understand correlation between the internal structure of materials and their mechanical properties.
- To discuss various methods to quantify the mechanical integrity of materials and their failure criteria.
- To develop skills in specimen preparation for microscopic examination and perform detailed micro-structural analysis of different materials using optical metallurgical microscope.
- To understand the effect of heat treatment on mechanical properties of steel.

Course Outcomes:	**BL**
On completion of the course, learner will be able to –	
CO7. USE of Destructive and Non-destructive tests for different materials and applications.	3
CO8. CONDUCT and ANALYZE various methods to measure and test the mechanical properties of materials.	3,4
CO9. UNDERSTAND the properties of ferrous and non-ferrous alloys.	2
CO10. ANALYZE the microstructures of steels, cast irons, and non-ferrous metals.	4
CO11. APPLY the specimen preparation process for microscopic examination and interpret the micro-structural features of metal specimens.	3
CO12. SELECT appropriate materials for various engineering systems in real-world engineering applications.	4

Suggested List of Laboratory Experiments/Assignments

Guidelines for Instructor's Manual

The student shall complete experiments/assignments as a part of the Term Work.

Sr. No.	**List of Practical/Assignments**	**Mapping CO(s)**
A.	**Practical:**	
1.	Destructive Testing – Rockwell Hardness Test	1,2,6
2.	Impact Test for Steel, Aluminum, and Copper (Charpy/Izod)	1,2,6
3.	Non Destructive Testing - Dye Penetrant Test/ Magnetic Particle Test.	1,2,6
4.	Specimen Preparation for Microscopic Examination using Optical Metallurgical Microscope	2,4,5,6
5.	Observation and Drawing of Microstructure of Steels, Cast Iron of Various Compositions	2,3,4,6
6.	Observation and Drawing of Microstructure of Non Ferrous Metals of Various	2,3,4,6

	Compositions	
7.	Jominy End Quench Test for Hardenability	1,2,3,6
B.	**Assignment:**	
1.	Exploration of Engineering Alloy (Name, Composition, Properties, Microstructure, Heat Treatment, Designation & Specific applications)	1 to 6
2.	Assignment on Geometry of Crystals: Symmetry, Lattices. Link: https://youtu.be/HIoLYeH3Ml0?si=2k53WckN1BEqRxws	2,3
3.	Assignment on Defects in Crystals. Link: https://youtu.be/ecn8bPDV6Sc?si=T05OZL61erOhSuvT	2,3
C.	**Assignments using Virtual Laboratory:**	
1.	Creep Test **Link:** https://eerc01-iiith.vlabs.ac.in/exp/creep-test-experiment/index.html	1,2,3,6
2.	Fatigue Test **Link:** https://eerc01-iiith.vlabs.ac.in/exp/fatigue-test-experiment/index.html	1,2,3,6
3.	Fluorescence Microscope Link:https://mrmsmtbs-iitk.vlabs.ac.in/exp/nucleus-cells-proliferation/index.html	2,6

Books & Other Resources

Online Testing/ Simulation Videos Links:

1. Materials Testing: Rockwell Hardness Test
   Link: https://www.youtube.com/watch?v=i1x-vJ85sBA
2. Materials Testing: Impact test
   Link: https://www.youtube.com/watch?v=tpGhqQvftAo
3. Materials Testing: Non-destructive Testing
   Link 1: https://www.youtube.com/watch?v=SIu-66GaEf4
   Link 2: https://www.youtube.com/watch?v=0VwKaHNvxLk
   Link 3: https://www.youtube.com/watch?v=AF_hyT_DwKA
4. Specimen Preparation
   Link: https://www.youtube.com/watch?v=lL4gQfkjta4
5. Observation of Microstructures
   Link 1: https://www.youtube.com/watch?v=r8obw3TamBk6
   Link 2: https://www.youtube.com/watch?v=0SIr2sBHxA4
6. Jominy End-Quench Test
   Link: https://www.youtube.com/watch?v=qW0aUbTWtVM

Text Books:

3. Dr. V. D. Kodgire & S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest Publication.
4. A. K. Bhargava, C.P. Sharma, “Mechanical Behaviour & Testing of Materials”, P H I Learning Private Ltd.

Reference Books:

1. W. D. Callister, “Materials Science & Engineering,” Wiley India, 2014.
2. K. G. Budinski and M.K. Budinski, “Engineering Materials”, PHI India, 2002.
3. Higgins R. A., “Engineering Metallurgy”, Viva books Pvt. Ltd.

e-Books:

- Materials Science and Engineering An Introduction; William D. Callister; https://engg.matoshri.edu.in/ebooks/mechanical/Materials_Science_and_Engineering_-_An_Introduction7th.pdf
- Physics of Strength and Fracture Control; Anatoly A. Komarovsky; https://engg.matoshri.edu.in/ebooks/mechanical/17.pdf
- Engineering Materials 1 An lntroduction to their Properties and Applications; Michael F. Ashby, David R. H. Jones; https://engg.matoshri.edu.in/ebooks/mechanical/78__Engineering_Materials_2E_VOLUME1.pdf
- Mechanical Behaviour of Engineering Materials: Metals, Ceramics, Polymers, and Composites; J. Rösler, H. Harders, M. Bäker; https://engg.matoshri.edu.in/ebooks/mechanical/628.pdf

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	-	2	2	-	-	1	-	2	3	1	2
CO2	2	3	-	-	2	2	2	-	-	2	-	2	2	3	2
CO3	3	2	1	-	-	1	2	-	1	1	-	2	3	2	2
CO4	3	2	-	-	-	-	2	-	-	2	-	2	3	2	2
CO5	3	2	1	1	-	2	1	-	-	1	1	2	3	2	2
CO6	3	2	2	1	-	3	-	1	1	2	-	2	3	2	2

Matoshri College of Engineering & Research Centre, Nashik
Second Year Bachelor of Technology
24U0937: Strength of Materials Lab

Teaching Scheme	Credit	Examination Head: TW Examination Scheme & Marks
PR: 02 Hours/Week	01	ISE-PR: 10 Marks ESE-PR: 15 Marks

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

Companion Course, if any: 24U0933: Strength of Materials

Course Objectives:

- To acquire basic knowledge of stress, strain due to various types of loading.
- To draw Shear Force and Bending Moment Diagram for transverse loading.
- To determine Bending, Shear stress, Slope and Deflection on Beam.
- To solve problems of Torsional shear stress for shaft and Buckling for the column.
- To apply the concept of Principal Stresses and Theories of Failure.
- To utilize the concepts of Strength of Materials on industrial application.

Course Outcomes:	BL
On completion of the course, learner will be able to–	
CO.1 **DEFINE** various types of stresses and strain developed on determinate and indeterminate members.	1
CO.2 **DRAW** Shear force and bending moment diagram for various types of transverse loading and support	3
CO.3 **COMPUTE** the slope & deflection, bending stresses and shear stresses on a beam.	3
CO.4 **CALCULATE** torsional shear stress in shaft and buckling on the column.	3
CO.5 **APPLY** the concept of principal stresses and theories of failure to determine stresses on a 2-Delement	3
CO.6 **UTILIZE** the concepts of Strength of Materials to solve real world application based problems.	3

Sr. No.	List of Practical	Mapping CO(s)
1.	Tension test.	1,6
2.	Compression test.	1,2,6
3.	Shear test.	1,2,5,6
4.	Bending test.	1,3,6
5.	Torsion test.	1,4,6

Books & Other Resources

Text Books:

1. S. Ramamurtham, “Strength of material”, Dhanpat Rai Publication
2. S.S. Rattan, “Strength of Material”, Tata McGraw Hill Publication Co. Ltd.

Reference Books:

1. R. K. Bansal, “Strength of Materials”, Laxmi Publication
2. B.K. Sarkar, “Strength of Material”, McGraw Hill New Delhi

e-Books:

- Mechanics of Solids; S. S. Bhavikatti; https://engg.matoshri.edu.in/ebooks/mechanical/Mechanics%20of%20Solids%20by%20S.S.Bhavikatti.pdf
- An Introduction to the Mechanics of Solids; Stephen H. Candall, Norman C. Dahi, Thomas J. Lardner; https://engg.matoshri.edu.in/ebooks/mechanical/63__introduction_to_the_mechanics_of_solids.pdf
- Solid Mechanics; James R. Rice; https://engg.matoshri.edu.in/ebooks/mechanical/EBK_073_Solid_Mechanics.pdf
- Mechanics of Solids and Fracture; Ho Sung Kim; https://engg.matoshri.edu.in/ebooks/mechanical/mechanics-of-solids-and-fracture.pdf

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	1	1	-	1	2	-	2	3	-	2
CO2	3	3	2	-	-	2	-	-	2	1	-	2	3	3	2
CO3	2	2	2	1	-	2	2	-	1	1	-	2	2	2	2
CO4	3	2	2	1	-	2	2	-	2	2	-	2	3	2	2
CO5	3	2	2	-	-	2	2	-	1	2	-	2	3	2	2
CO6	3	2	2	1	2	2	-	1	2	1	-	2	3	2	2

Matoshri College of Engineering and Research Centre, Nashik Second Year Bachelor of Technology 24U0938: Fluid Mechanics and Hydraulic Machines Lab		
Teaching Scheme	**Credit**	**Examination Head: PR** **Examination Scheme and Marks**
PR: 02 Hours/Week	**01**	**CCE-PR : 20 Marks** **ESE-PR : 30 Marks**

Companion Course: Engineering Mathematics - I, Engineering Mathematics - II, Engineering Mechanics, Engineering Physics.

Learning Objectives:

Objectives include-

- To understand basic properties of fluids.
- To learn fluid statics and dynamics
- To study basics of flow visualization
- To understand Bernoulli's theorem and its applications.
- To understand losses in flow, drag and lift forces
- To learn to establish relation between flow parameters.

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 DETERMINE various properties of fluid.	5
CO.2 APPLY the laws of fluid statics and concepts of buoyancy and **IDENTIFY** types of fluid flow and terms associated in fluid kinematics	3
CO.3 APPLY principles of fluid dynamics to laminar flow	3
CO.4 ESTIMATE friction and minor losses in internal flows and DETERMINE boundary layer formation over an external surface	5
CO.5 DETERMINE performance parameters of rotodynamic machines and hydraulic turbines.	5
CO.6 APPLY concepts of Fluid sciences to solve engineering problems utilizing advanced technology.	3

Suggested List of Laboratory Experiments/Assignments

Guidelines for Instructor's Manual

The student shall complete the following activity as a Practical.

Total 9 experiments from the following list must be performed. During practical, the Student is evaluated based on the completion of Practical, Assignments using Virtual Lab and Detailed Mini project / Industrial Visit Report.

Sr. No.	List of Practical (Experiment # 3 and 9 are compulsory; Perform any Eight experiments)	Mapping CO(s)
1.	Determination of pressure using manometers (minimum two)	1
2.	Determination of fluid viscosity and its variation with temperature.	1
3.	Determination of Metacentric height of floating object.	2
4.	Verification of modified Bernoulli's equation.	3
5.	Calibration of Orifice meter/ Venturimeter /Notch	4

6.	Determination of minor/major losses through metal/non-metal pipes.	4
7.	Study of Impulse momentum principle and its application to fixed flat, moving, inclined, and curved plates/vanes.	5
8.	Study and Trial on Impulse water Turbine/Centrifugal Pump and plotting the main and operating characteristics	5
9.	Visit to any hydroelectric power plant and report to be submitted.	5,6
	Assignments using Virtual Laboratory *(Any Two Virtual Lab experiments from experiment #1,2,5,7,8 mentioned above)* Experiment 1. https://labs.vlabsdev.in/exp/d1-l19-e6/index.html Experiment 2. https://labs.vlabsdev.in/exp/d1-l19-e2/index.html Experiment 5. https://uorepc-nitk.vlabs.ac.in/exp/flow-through-orifice-meter/ Experiment 5. https://fm-nitk.vlabs.ac.in/exp/venturimeter/ Experiment 7. https://fm-nitk.vlabs.ac.in/exp/impact-of-jet/index.html Experiment 8. https://fmc-nitk.vlabs.ac.in/exp/pelton-turbine/theory.html	

Beyond Scope of Syllabus

Case study based on real industrial project related to course. (Students with Course teacher should visit industries to solve their unsolved cases and present a report).

Books and Other Resources

Text Books:

1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2005.
2. S.S. Rattan, Fluid Mechanics and Hydraulic Machines, Khanna Book Publishing, 2019.

Reference Books:

1. F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011
2. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.
3. Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988
4. P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India, 2012.

@The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	-	-	-	-	1	1	-	2	2	2	2
CO2	3	1	-	-	-	-	-	-	2	1	-	2	3	1	2
CO3	3	2	1	-	-	-	-	-	1	1	-	2	3	2	2
CO4	3	2	1	1	-	-	-	-	2	1	-	2	3	2	2
CO5	3	3	2	1	1	-	-	-	2	1	-	2	3	3	2
CO6	3	2	2	2	2	1	1	-	2	1	-	2	3	2	2

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0939: Entrepreneurship Development		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme & Marks**
TU: 01 Hours/Week **PR: 02 Hours/Week**	**02**	**CCE-TW: 20 Marks** **ESE-TW: 30 Marks**

Prerequisite: Finance Management

Course Objectives:

- The objective of this course is to develop and strengthen entrepreneurial quality and motivationamongst the students.
- To motivate the entrepreneurial instinct and to develop necessary knowledge and skills amongthe students.
- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO.1 Describe Entrepreneurship	2
CO.2 Understand influencing an Entrepreneur motivation	2
CO.3 Examine role of entrepreneur in economic development and business	3
CO.4 Describe the steps to establish an enterprise in financing and accounting	2
CO.5 Discus of entrepreneurs about project finance	2
CO.6 Analyze International Entrepreneurship Opportunities	4

Sr. No.	**Course Contents**	**Mapping CO(s)**
1	Entrepreneurship: As a career choice - Why only Entrepreneurship? - Market Scope for Entrepreneurship - Various schemes for setting up SME's	1,2
2	Successful Entrepreneur & Experiences in Small Scale Industry.	1,2
3	Opportunities Search & Idea Generation, Planning a small business and sources of information.	2,3,6
4	Recent Trends in Business & Experiences in Small Scale Industry.	2,3
5	Goal Setting	2,3
6	Role of Support agencies in entrepreneurship Development- DIC	3,4
7	Role of Support agencies in entrepreneurship Development-Banks	3,4
8	How to prepare business plan	4
9	Business plan: Cost of project and Means of finance	5
10	Sources of Funds: Venture Capital	4,5
11	Project Making & Implementation	5

12	Soft Skills Development : Communication, Interpersonal Relationship, Team Building, Creativity & Problem Solving	1 to 6
13	Industrial Visit to Start-Ups.	1 to 6

Books & Other Resources

Text Books:

1. Vasant Desai, Dynamics of Entrepreneurship Development, Himalaya Publication house.
2. David Holt Entrepreneurship, New Venture Creation, Prentice Hall India.
3. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning, 2021.
4. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2020.

Reference Books:

1. Peter F. Drucker , Innovation and Entrepreneurship
2. S.S. Khanka, Entrepreneurial Development S. Chand & Company Ltd. New Delhi
3. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad.
4. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2020.
5. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2020.
6. Rajeev Roy, "Entrepreneurship" 2 Edition, Oxford University Press, 2020.

e-Books:

1. "So You Want to Be an Entrepreneur: How to Get Started" Havard Business School Online https://info.email.online.hbs.edu/entrepreneurship-ebook
2. "Introduction to Entrepreneurship" -Katherine Carpenter https://kpu.pressbooks.pub/introtoentrepreneurship/
3. "Digital Entrepreneurship"- Mariusz Soltanifar**,** Mathew Hughes**,** Lutz Göcke https://library.oapen.org/handle/20.500.12657/47272
4. "Entrepreneurship and Innovations in E-business" - Fang Zhao https://dl.ojocv.gov.et/admin_/book/Entrepreneurship%20and%20innovation%20in%20e-commerce%20(%20PDFDrive%20).pdf

Mooc Course:

- https://onlinecourses.nptel.ac.in/noc21_mg70/preview
- https://onlinecourses.nptel.ac.in/noc25_de07/preview
- https://elearn.nptel.ac.in/shop/nptel/entrepreneurship/?v=c86ee0d9d7ed

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	3	3	3	2	3	2	3	-	-	3
CO2	-	-	-	-	-	3	3	3	2	3	2	3	-	-	3
CO3	-	-	-	-	-	3	2	3	2	3	2	3	-	-	3
CO4	-	-	-	-	-	3	-	2	2	3	3	3	-	-	3
CO5	-	-	-	-	-	3	-	3	2	3	3	3	-	-	3
CO6	2	1	-	-	-	3	-	3	2	3	3	3	2	1	3

Guidelines for Term Work - The student shall complete the following activity as a Term Work.

Part A :- CCE-TW (20 Marks)

Assessment Rubric: 1. **Industries Survey for Start-up. & Report (10Marks)**

Parameter →	**Industry identification**	**Comparative analysis report of similar Start-Up**
Max. Marks	**5 Marks**	**5 Marks**

2. **Entrepreneurship Awareness Camp/Workshop (10Marks)**

Part B: - ESE-TW (30 Marks)

Study and Analysis of Business case for Start-up. Present and submit Report.

(Group of 05 Students for one case)

A case study includes the following sections:

- **Executive summary**: Introduces the topic
- **Introduction**: Summarizes the task
- **Findings**: Identifies the key problems
- **Discussion**: Summarizes the major problems
- **Conclusion**: Includes words of advice and a call to action
- **Recommendations**: States your recommendations
- **References**: Includes references and acknowledgments

Prepare and Present Case study from the following Start-up/ any other identified by student or given by Course Coordinator (Any one):-

Note:- Visit to industry of interest chosen for case study

	List of Industries		**Mapping CO(s)**
	1. News Paper Publication	23. Maritime Transport	1-6
	2. Book Publishing	24. Defense Manufacturer	
	3. Mumbai Dabbawala	25. Beverage Manufacturer	
	4. Disaster management	26. Rail Transportation	
	5. Organic Farming	27. Warehousing Solutions Provider	
	6. Mid-Size Furniture Manufacturer	28. Luxury Watch Manufacturer in Competitive Market	
	7. Chemical Manufacturing in Asia	29. Specialty Crop Market	
	8. Apparel Manufacturer	30. Telecom	
	9. Furniture Retailer	31. Power & Utilities Supply Chain	
	10. Pharmaceutical Distributor	32. Industrial Metals Distributor	
	11. Organic Food	33. Cold storage chain	
	12. Cosmetics Manufacturer	34. Specialty Foods	
	13. Fast Food	35. Agricultural Supply Chain Firm	
	14. Apparel Brand	36. Pharma Manufacturing	

	15. Agricultural Chemicals (pesticides) Distributor 16. Hospitals 17. E-commerce Retailer in Fashion 18. Ecommerce in High-Tech Gadgets 19. Online Grocery Retailer 20. Wholesale Trade in Technology Products 21. Semiconductor Manufacturer in High-Tech Sector 22. Food Manufacturing	37. Oil & Gas Supply Chain Optimization 38. Healthcare 39. Eco-Friendly Packaging Manufacturer 40. Building Material Manufacturer 41. Automotive Equipment Manufacturer 42. Wholesale Agriculture Distributors 43. Military Supply Chain. 44. Electronics and Appliance Store	

Part B: - ESE-TW (30 Marks)

Study and Analysis of Business case for Startup from following list. Present and submit Report.

Assessment Rubric: **Presentation based evaluation on Startup studied (15 Marks)**

Parameter →	Topic Selection	Presentation Skill	Understanding
Max. Marks	**05 Marks**	**05 Marks**	**05 Marks**
Rubric	1. Relevance to courses/ branch/ multidiscipline, 2. Type of technology used – latest, innovative, any other, 3. Implementation of concept/ Design,	1. Preparation of Slides, Explanation of Slides, 2. Communication Techniques, 3. Presentation on due date,	1. Selection of topic, 2. Relevance to technical knowledge & technology, 3. Sequence of process followed, 4. Question – Answer Session 5. Outcomes / Usability)

Assessment Rubric: **Startup Report (15 Marks)**

Parameter →	Report writing	Understanding	Punctuality & Timely Completion
Max. Marks	**05 Marks**	**05 Marks**	**05 Marks**
Rubric	Structured draft with clear objectives, methodology, and citations. Minimal or no revisions needed.	1. Technical knowledge, 2. Sequence of process followed,	bmission of Startup Report on due date

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology 24U0940: Computer Aided Machine Drawing		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme & Marks**
TU: 01 Hours/Week **PR: 02 Hours/Week**	**02**	**CCE: 20 Marks** **ESE: 30 Marks**

Prerequisite: Fundamentals of Engineering Drawing, Projection of Solids and Basic knowledge of 2-D drafting using graphics software

Course Objectives:

- Learn the fundamentals of machine drawing and uses of solid modeling software's.
- Understand the various tools of Computer-Aided Design (CAD) software's to create Parametric 2-D Sketches.
- Equip students with CAD software skills for creating 3D solid models and assembly of the components.
- Study the Limits, Fits and Tolerances used in Engineering Drawings.
- Demonstrate the ability to visualize, model, and modify machine parts and assemblies using CAD tools.

Course Outcomes:	**BL**
On completion of the course, learner will be able to –	
CO.1 Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA, CFD, PLM.	2
CO.2 Use any CAD software to generate 2D parametric sketching.	3,6
CO.3 Create 3D model of any machine components using CAD tools.	6
CO.4 Generate 3D assembly with detailed views, including sectional and exploded views, using CAD tools.	6
CO.5 Incorporate appropriate fits, tolerances, and surface finish symbols in the drawings to meet design requirements.	3
CO.6 Develop skills to visualize, model and effectively communicate design ideas through technical drawings.	4

Course Contents

Unit I	**Introduction to Machine Drawing and CAD Tools**	**02 Hr.**
Fundamentals of Machine Drawing, Evolution of CAD, importance of CAD in the light of allied technologies, solid modeling, and introduction to Graphical User Interface (GUI) of any commercially used solid modeling software.		
Unit II	**Parametric Sketching**	**02 Hr.**
Parametric sketching - draw and modify 2D entities, apply/modify constraints and dimensions.		
Unit III	**Parametric Solid Modelling**	**02 Hr.**
Parametric solid modeling - fundamentals, transform the parametric 2-D sketch into a 3D solid, feature operations, feature based modeling, design by features, feature recognition.		
Unit IV	**Assembly Modelling**	**02 Hr.**
Assembly modeling - defining relationship between various parts of machine, creation of constraints,		

generation of exploded view

Unit V	Geometric Dimensioning, Tolerancing and Production Drawing	04 Hr.

Geometric dimensioning and tolerancing - Limits, Fits, Dimensional Tolerances, Geometric Tolerances, Introduction to ASME Y14.5 – 2009.
Production drawing – generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning and tolerancing.

Books & Other Resources

Text Books:

1. Bhat N. D., "Machine Drawing", Charotar Publications, New Delhi 2014
2. Ajeet Siingh, " Machine Drawing", Mc Graw Hill Publications, New Delhi 2012
3. ASME Y14.5 -2009, ASME, 2009

Reference Books:

1. Bhattacharyya, "Machine Drawing", Oxford
2. P.S.Gill , "Machine Drawing", S. K. Kataria & Sons publication,
3. M. P. Groover and E. W. Zimmers Jr., "Computer-Aided Design and Manufacturing", Pearson Education.

Lab Work

1. Assignment on 2-D sketching with geometrical and dimensional constraints (2 hrs.)
2. Assignment on parametric solid modeling of a machine component (4 hrs.)
3. Assignment on solid modeling of the parts of a machine components. (Parts of Cotter joint, Knuckle joint, Oldham coupling, Foot step bearing, Universal Coupling etc. can be considered in batches). (10 hrs.)
4. Assignment on assembly modeling of the parts modeled in assignment 3 using proper mating conditions and generation of exploded view. (4 hrs.)
5. Generation of production drawings of the parts and assembly with appropriate tolerancing. (4 hrs.)

The CO-PO Mapping Matrix

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	-	-	3	-	-	-	2	-	-	2	1	1	-
CO2	3	-	-	-	3	-	-	-	2	2	-	2	1	1	-
CO3	3	-	-	-	3	-	-	-	2	2	-	2	2	2	-
CO4	3	2	3	2	3	-	-	-	2	2	-	2	2	2	2
CO5	2	2	-	-	3	-	-	-	2	3	-	2	2	2	2
CO6	2	1	-	-	3	-	-	-	2	3	-	2	2	2	2

Matoshri College of Engineering & Research Centre, Nashik Second Year B. Tech		
24U0941: Digital Marketing		
Teaching Scheme	**Credit**	**Examination Head: TW** **Examination Scheme & Marks**
TUT: 02 Hour/Week	**02**	**CCE: 20 Marks** **ESE: 30 Marks**
Prerequisite Courses: Basic Computer & Internet Knowledge		
Companion Course, if any: ----		

Course Objectives:

- Understand the fundamentals of digital marketing, including its evolution, business models, and ethical considerations.
- Learn the core principles of Search Engine Optimization (SEO) and implement SEO strategies including keyword research, on-page and off-page SEO
- Develop knowledge of **E-Mail Marketing**, including various campaign types, tools, and best practices.
- Explore **Social Media Marketing (SMM)** strategies and platforms to engage with target audiences effectively
- Analyze the impact of **digital transformation technologies** such as AI, cloud computing, big data, and IoT on modern businesses
- Apply digital marketing strategies through **practical assignments**, including SEO keyword research, email campaigns, social media marketing, and YouTube video creation

Course Outcomes:	**BL**
On completion of the course, learner will be able to–	
CO1-Compare traditional and digital marketing approaches, analyze different business models and evaluate marketing tactics of online marketplaces and a traditional store	4-Analyze
CO2- Perform keyword research using Google Keyword Planner and implement SEO techniques for website optimization .	3-Apply
CO3-Analyze and compare different e-mail marketing tools and **design an effective e-mail marketing campaign**	4-Analyze
CO4-Evaluate and compare various social media platforms, develop case studies, and create social media marketing strategies	5-Evaluate
CO5-Research and analyze how companies leverage AI, cloud computing, IoT, and big data in digital marketing and **present findings in a structured report or presentation**	4-Analyze
CO6-Create a YouTube video as part of a digital marketing campaign and optimize it using SEO and social media marketing strategies	6-Create

Following are the contents to be discussed in tutorial session

Course Contents		
Unit Number	**Unit Title**	**Hours**
Unit- I	**Introduction to Digital marketing**	**3**
History of marketing, Traditional Vs Digital Marketing , Digital Marketing Channels, Understanding Online Marketplaces, Consumer Journey, Business Models in Digital Marketing (Business to Business, Business to Consumer, Consumer to Consumer, Direct to Consumer), Ethical & Legal Considerations in Digital Marketing		
Unit- II	**Search Engine Optimization (SEO)**	**3**
How Search Engines Work ,Fundamentals of SEO and its significance, Keyword selection and mapping, Content optimization, On-Page SEO & HTML Tag Optimization, Off-Page SEO & Link Building, Technical SEO, Search Engine Marketing		
Unit- III	**E-MAIL MARKETING**	**3**
Fundamentals of E-Mail Marketing & Its Importance, Types of E-Mail Marketing: Promotional E-Mails, Transactional E-Mails , Newsletter E-Mails, Drip Campaigns (Automated Series E-Mails) , E-Mail Marketing Best Practices, E-Mail Marketing Tools		
Unit-IV	**SOCIAL MEDIA MARKETING (SMM)**	3
Introduction to Social Media Marketing and its significance, Popular Social Media Platforms & Their Uses, Key Strategies for Effective Social Media Marketing, Social Media Marketing Tools		
Unit-V	**DIGITAL TRANSFORMATION & FUTURE TRENDS**	**3**
Digital Transformation and its significance, **Key Technologies Driving Digital Transformation**: Cloud Computing, Big Data & Analytics, Artificial Intelligence (AI) & Machine Learning, Internet of Things (IoT), Block chain & Cybersecurity, **Future Trends in Digital Transformation**: 5G Connectivity, Metaverse & Virtual Reality (VR/AR), Hyper-Personalization, No-Code & Low-Code Platforms Sustainable & Green Tech		

Following are the contents to be covered in Practical session

Sr. No	List of Laboratory Assignments	
1.	Compare the business model, pricing strategy, customer engagement, and marketing tactics of online marketplaces and a local traditional store and create a report on findings.	4-Analyze
2.	Perform keyword search for a Dentist Hospital Website based on search volume and competition using Google keyword planner tool.	3- Apply
3.	Explore and compare various E-Mail Marketing Tools, understand their features, and create an email marketing campaign for a brand.	4-Analyze
4.	Analyze and compare different social media platforms based on their features, target audience, and best use cases. Compile your findings and prepare a report which should include tables, case study, and sample post	4-Analyze
5.	Choose a company and research its AI, cloud computing, IoT, or big data strategies and present findings in a PowerPoint presentation.	4-Analyze
6.	Create a YouTube Video for Digital Marketing	6-Create

CO-PO Correlation Matrix

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	--	--	--	1	--	--	--	2	2	2
CO2	2	2	2	1	3	1	--	1	1	1	2	2
CO3	1	2	2	1	3	1	--	1	2	3	1	2
CO4	2	2	2	2	3	2	--	1	3	3	2	2
CO5	3	3	1	2	3	2	--	1	3	3	2	3
CO6	2	3	3	2	3	2	--	1	3	3	2	3

Matoshri College of Engineering & Research Centre, Nashik Second Year Bachelor of Technology NCAC04: Non-Credit Audit Course_4		
Teaching Scheme	**Credits**	**Examination Scheme**
-	-	-

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

Faculty mentor shall be allotted for individual courses and he/she shall monitor the progress for successful accomplishment of the course. Such monitoring is necessary for ensuring that the concept of self-learning is being pursued by the students 'in true letter and spirit'.

- If any course through Swayam/ NPTEL/ virtual platform is selected the minimum duration shall be of 8 weeks.
- However if any of the course duration is less than the desired (8 weeks) the mentor shall ensure that other activities in form of assignments, quizzes, group discussion etc. (allied with the course) for the balance duration should be undertaken.

In addition to credits courses, it is mandatory that there should be an audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of the audit course. The student may opt for any one of the audit courses in each semester. Such audit courses can help the student to get awareness of different issues which make an impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Students can choose one of the audit courses from the list of courses mentioned. Evaluation of the audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not considered in the calculation of the performance indices SGPA and CGPA. Evaluation of the audit course will be done at institute level itself.

Selecting an Audit Course

List of Courses to be opted (Any one) under Audit Course IV

- Language & Mind Emotional Intelligence
- Advanced Foreign Language (preferably German/ Japanese)
- Human Behaviour
- Speaking Effectively
- Business Ethics
- Technical writing/ Research writing

Using NPTEL Platform: (preferable)

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Students can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with a certificate.

Assessment of an Audit Course

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of the same can be submitted as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as "Present" and the student will be awarded the grade AP on the mark sheet.

The CO-PO Mapping Matrix

Name of Audit Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Audit Course - IV Language & Mind Emotional Intelligence	-	-	-	-	-	2	2	2	2	2	2	2	3	-	2
Audit Course - IV Advanced Foreign Language (preferably German/ Japanese)	-	-	-	-	-	1	-	-	1	3	-	3	1	2	2
Audit Course - IV Human Behaviour	-	-	-	-	-	2	2	2	2	2	2	2	1	3	2
Audit Course - IV Speaking Effectively	-	-	-	-	1	1	-	2	1	3	2	2	2	-	2
Audit Course - IV Business Ethics	-	-	-	-	-	1	-	3	2	2	2	2	-	1	1
Audit Course - IV Technical writing/ Research writing	2	-	-	-	1	2	2	3	1	3	-	2	2	2	2
Avg.	2	-	-	-	1	2	2	2	2	3	2	2	2	2	2