AISSMS
COLLEGE OF ENGINEERING
ज्ञानम् सकलजनहिताय
An Autonomous Institute Affiliated with
Savitribai Phule Pune University
Accredited by NAAC with "A+" Grade | NBA - 7 UG Programmes

Savitribai Phule Pune University

All India Shri Shivaji Memorial Society's

COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute Affiliated to Savitribai Phule Pune University, Pune)

Faculty of Science and Technology

National Education Policy (NEP) Compliant Curriculum

S.Y.B. Tech. Mechanical Engineering (Sandwich)

(2025 Pattern)

(With effect from Academic Year 2026-27)

www.aissmscoe.com

Institute Vision & Mission

Vision:

- Service to society through quality education

Mission:

- Generation of national wealth through education and research
- Imparting quality technical education at the cost affordable to all strata of the society
- Enhancing the quality of life through sustainable development
- Carrying out high-quality intellectual work
- Achieving the distinction of the highest preferred engineering college in the eyes of the stakeholders

Department Vision & Mission

Vision:

- To be recognized as a premier centre in the field of Mechanical Engineering Education

Mission:

- To strive continuously for an advancement of academics and lifelong learning through effective teaching learning process.
- To strengthen industry-institute interface, association with professional societies to develop leadership, team work and industry oriented attributes through internship.
- To develop skill based mechanical engineering professionals for sustainable development through project based learning and active research

B. Tech. Mechanical Engineering (Sandwich) (2025 Pattern)

ABBREVIATIONS

Abbreviation	Title	Abbreviation	Title
BSE	Basic Science courses	VSE	Vocational and Skill Enhancement Course
ESC	Engineering Science courses	AEC	Ability Enhancement Course
PCC	Programme Core Courses	HSM	Entrepreneurship/Economics/Management courses
PEC	Programme Elective courses	IKS	Indian Knowledge System
MDM	Multidisciplinary Minor	VEC	Value Education Course
OEC	Open Electives	ELC	Experiential Learning Courses
CC	Co-curricular Courses	L	Lecture
P	Practical	CCA	Comprehensive Continuous Assessment
ISE	IN-semester Examination	ESE	End-semester Examination
TW	Term Work	OR	Oral Examination

Knowledge and Attitude Profile (WK)

Knowledge & Attitude	Description
WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

Program Outcomes (POs)	Description
PO1	**Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	**Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	**Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	**The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	**Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	**Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	**Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10	**Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	**Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

1. Our graduate will have competencies in design and development mechanical elements and systems.
2. Our graduate will have incremental skills to specify and select materials, processes to manufacture and inspect quality of industrial product.
3. Our graduate will have industry oriented attributes through industrial in plant Training.

Program Educational Objectives (PEOs)

Graduates from the mechanical engineering (Sandwich Pattern) program are expected to achieve the following program educational objectives after 3 to 5 Years of graduation.

1. Engage in designing, planning, manufacturing, testing, and developing products and processes in the field of mechanical and allied engineering industries.
2. Work effectively as an individual and as team member in an organization.
3. Meet global expectations of higher studies, research and changing professional
4. Engage in lifelong learning, career enhancement and respond to the demands of Industry and society for sustainable development.

***CONTINUOUS COMPREHENSIVE ASSESSMENT (CCA)**

The continuous and comprehensive assessment (CCA) will be carried out in :

(A) Activities: 20 Marks Any Two (Each carry 10 Marks)

Course Projects	Industrial Visit (Quiz Based)	Guest Lectures (Quiz based)
Quiz related to course	IPR activity	Research Activity related to course
MOOC/ NPTEL Certification		

Guidelines:

I. Course Projects:

Course Projects should be framed based on real-world problems relevant to the subject. Each course project must be communicated through one of the following modes. It is recommended to complete all the communication modes across different course projects:

- Poster Presentation
- PowerPoint Presentation
- Model Making
- Field or Survey Report with Oral Presentation (e.g., case study)
- Submission of Digital Content (e.g. Video Summary)

To evaluate these field activities, assessment rubrics should be designed. The rubrics should include criteria such as clarity, innovation, subject relevance, presentation skills, and technical content. Note: Part of work of any co-curricular activities (relevant to subject contents) like national level project competitions, club activities, paper presentations, startup activities can be accepted as course projects.

II. Industrial Visit:

An industrial visit should be planned in alignment with the subject's scope and should particularly address advancements in the respective field. The purpose is to provide students exposure to actual engineering practices and systems. Assessment of industrial visits should be carried out using any of the following tools:

- Quiz (based on the visit)
- Interactive video or oral discussion
- Submission of a detailed visit report

III. Guest Lectures:

Guest lectures should be relevant to the course and highlight advanced topics or recent trends in the field. Subject experts from academia or industry may be invited. Assessment methods for guest lectures may include:

- Quiz conducted post-lecture
- Attendance monitoring
- Evaluation of attentiveness and participation Rubrics can be developed, if possible, to

objectively assess student involvement in guest lectures.

IV. Quiz related to course:

Unit-wise quizzes should be planned and can be conducted either online (via LMS, Google Forms) or offline. Each quiz should include a pool of 20 questions, The quizzes should be diversified across the following question types:

- Simple Multiple Choice Questions (MCQs)
- Numerical MCQs
- Image-based Questions
- Match the Following
- Fill in the Blanks Drag and Drop (using images or words)

This variety ensures the assessment caters to different cognitive skills and learning styles.

V. IPR activity:

Intellectual Property Rights (IPR) will be conducted as a course-related activity to create awareness among students about the protection of innovative ideas, research work, and technological developments. In this activity, students will be introduced to various forms of IPR such as patents, copyrights, trademarks, and industrial designs. They will be encouraged to identify innovative concepts related to their course, study existing patents, and understand the basic procedure of patent filing. Students will also analyze case studies and discussed the importance of ethical use and protection of intellectual property in engineering and research. This activity enhanced students' understanding of innovation management, research ethics, and the significance of safeguarding intellectual creations in the academic and industrial environment.

VI. Research Activity related to Course :

Publication will be considered as a course-related activity to encourage students to develop research aptitude and technical writing skills. As part of this activity, students will be guided to identify a relevant topic related to their course, conduct a literature review, analyze findings, and prepare a technical paper in a standard research format. They will be introduced to the basics of research publication, including abstract writing, referencing, plagiarism awareness, and selecting suitable journals or conferences. The activity assessed students' ability to present technical information clearly and systematically. This initiative helped students understand the process of academic publication and promoted innovation, critical thinking, and research-oriented learning.

VII. MOOC/ NPTEL certification related to Course:

Students shall select a MOOC course related to current trends in their respective engineering discipline, preferably aligned with their area of specialization. The course must be at the undergraduate

level and should be selected in consultation with the assigned course teacher. It may be taken from recognized MOOC platform such as NPTEL. Students are required to submit hard copies of all course assignments. The student is expected to register for the examination and obtain the certificate from competent authority.

Evaluation Guidelines: Students will be evaluated progressively for a total 10 Marks.

Sr. No.	Parameter	Marks
1	Assignment Scores	05
2	Certification Granted Based on the MOOC Provider's Examination	05
Total Marks		**10**

(B) In-semester Examination (ISE)

In-semester examination will be of 30 marks based on Unit I and II.

Course Content	Questions	Marks	Total Marks	Duration
Unit I	Q. 1 or Q.2	15	30	1 Hour
Unit II	Q. 3 or Q.4	15		

(C) END Semester Examination (ESE)

Examination will be carried out on unit III, IV and V carrying following marks weightage:

Unit No.	Marks Weightage
Unit III	16
Unit IV	17
Unit V	17

Note : 7th and 8th semester of SW (The CCA of Machine Design II is based on the Assignment and Design project while for turbo machine the CCA is based on the lab performance activity)

Multiple Entry–Exit Options under NEP 2020 (UG Programmes)

Exit Point	Programme Stage	Minimum Credits Required	Additional Skill / Vocational Requirement	Qualification Awarded
End of Sem II	First Year	40 Credits	• Minimum **8 credits** in work-based vocational courses / Internship / Apprenticeship during summer vacation • **4 credits** from skill-based courses earned in Sem I & II	**UG Certificate** in relevant Discipline / Subject
End of Sem IV	Second Year	80 Credits	• Additional **8 credits** in skill-based vocational courses / Internship / Mini-projects during summer vacation after Second Year	**UG Diploma** in relevant Discipline / Subject
End of Sem VI	Third Year	120 Credits	• Additional **8 credits** in skill-based vocational courses / Internship / Mini-projects during summer vacation after Sixth Semester	**B.Voc.** in relevant Discipline / Subject
End of Sem VIII	Fourth Year	As per Programme Scheme	—	**Bachelor's Degree** in relevant Discipline with **Single Minor**
End of Sem VIII (with extra credits)	Fourth Year	As per Programme Scheme + **18 additional credits**	• Additional credits through approved Minor / Honours / Research courses	**Bachelor's Degree with Double Minor / Honours / Research**

Summary:

- Students may **enter a programme in odd semesters** and **exit after successful completion of even semesters**, as per NEP 2020.
- Exit options are provided at the **end of 2nd, 4th, and 6th semesters** with **Certificate, Diploma, and B.Voc. awards**, respectively.
- Students may **re-enter the programme** and complete the degree **at a stretch or with breaks**, facilitated through **Academic Bank of Credits (ABC)**.
- Skill-based vocational credits may be earned through **SEC / VEC / Internship / Apprenticeship / Mini-projects**, preferably during **summer vacations**.
- **Maximum duration for completion = 2 × normal programme duration**(e.g. For 4-year degree course: 4 × 2 = 8 years. Likewise, for 3-year program, 6 Years and for Certificate / Diploma: Valid standalone award and credits remain in ABC)

Multiple Degree Option

A. B.Tech. Mechanical Sandwich Degree with Multidisciplinary Minor in AIML (160-176 credits).

Note : Compulsory Minors

1. Total 14 Credits
2. Distributed from Sem III to VIII
3. MDM selected from other Discipline (Other than Mechanical)

MDM for Mechanical & Mechanical Sandwich Course

Sem	Subject Code	Course	Credits	Teaching Scheme (L—T-P)
III	25AIMDM201D	Fundamentals of Artificial Intelligence and Machine Learning	02	2-0-0
IV	25AIMDM202D	Artificial Intelligence in quality Control	02	2-0-0
V	25AIMDM301D	Intelligent System and Artificial Intelligence	04	3-0-1
VI	25AIMDM302D	Numerical & Statistical Methods for Artificial Intelligence	02	2-0-0
VII	25AIMDM401D	Fundamentals of Deep Learning	02	2-0-0
VIII	25AIMDM402D	Artificial Intelligence in Hybrid Electric Vehicles	02	2-0-0

B. B.Tech. Mechanical Sandwich Honours Degree in Design and Simulation chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits):

- Enables students to take up **five-six additional courses in the same Engg./Tech.** Discipline of 18 to 20 credits distributed over **semesters III to VIII.**
- The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are **over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

Note : Choice Based Minors (Over and Above Class A)

1. Total 18-20 Credits
2. Distributed from Sem III to VIII
3. MDM selected from Mechanical Discipline

C. B.Tech. Mechanical Sandwich Honours with Research Degree in chosen Major Engg./Tech.Discipline with Multidisciplinary Minor (180-194 credits):

- The students will work on **a research project or dissertation for 18 credits** in the fourth year in the respective Major Engg. / Tech. Discipline.
- The decision regarding the distribution of 18 credits for Research Project in **Semesters VII and VIII** of the Fourth Year will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.
- **These 18 Credits will be over and above the min.160-max. 176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech. Program.

Note : Choice Based Minors (Over and Above Class A)

1. Total 18-20 Credits
2. Distributed from Sem VII & VIII
3. MDM selected from Mechanical Discipline

Research Degree Mechancal & Mechanical Sw Course

Course Objectives:

1. To inculcate research culture at UG level.
2. To develop analytical and problem-solving skills.
3. To encourage publication and innovation.
4. To integrate theory with real-time engineering problems.

Course Outcomes (COs): After completion, student will be able to:

CO1: Identify and formulate engineering research problems.

CO2: Conduct literature review and gap analysis.

CO3: Apply experimental/simulation tools for solution development.

CO4: Analyze and interpret research data scientifically.

CO5: Prepare technical paper/patent and defend the project.

Sem	Course	Credits	Teaching Scheme (L-T-P)
	Sem VII		
01	Research Ethics & Academic Integrity	03	3-0-0
02	Statistical Tools in Research	03	3-0-0
03	Research Communication and Presentation Skill	02	2-0-0

Sem	Course	Credits	Teaching Scheme (L-T-P)
Sem VIII			
01	Research Project (other than Regular Project)	06	0-0-12
02	Article Publication based on allocated project (Conference /Journal & Patent / Copyright based on Project Work	04	0-0-4

D. B.Tech. Mechanical Sandwich Degree in chosen Major Engg./ Tech. Discipline with Double Minor (Multidisciplinary and Specialisation Minor, 180-194 credits):

Students would take **up five-six additional courses of 18 to 20 credits in another Engg./ Tech. discipline/ Emerging Areas** Specialization.Distributed over **semesters III to VIII**.

The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are **over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

- **Multidisciplinary Minor in Mechanical and Mechanical Sandwich Engineering**
- **Offered by: Department of Mechanical and Mechanical Sandwich Engineering**
- **Applicable to: Civil, Chemical, Electrical, Robotics and Automation Engineering branches.**

Sem	Course	Contents	Credits	Teaching Scheme (L—T-P)
III	Manufacturing Engineering	**Unit I:** Overview of manufacturing processes, classification, and industrial applications. **Unit II:** Casting and metal forming processes (rolling, forging, extrusion). **Unit III:** Machining processes: turning, milling, drilling, tool wear, cutting fluids. **Unit IV:** Joining processes: welding, brazing, soldering, adhesive bonding. **Unit V:** Surface finishing, process selection, and introduction to advanced manufacturing.	03	3-0-0
IV	Basic Material Science	**Unit I:** Structure of materials, crystal systems, defects in solids. **Unit II:** Mechanical properties of materials and testing methods. **Unit III:** Phase diagrams and heat treatment processes.	03	3-0-0

		Unit IV: Ferrous and non-ferrous materials and alloys. **Unit V:** Advanced materials: composites, polymers, ceramics, and smart materials.		
V	Fundamentals of Engineering Thermodynamics	**Unit I:** Basic concepts, systems, properties, and thermodynamic equilibrium. **Unit II:** First law of thermodynamics for closed and open systems. **Unit III:** Second law of thermodynamics and entropy. **Unit IV:** Thermodynamic cycles (Carnot, Rankine, Otto, Diesel). **Unit V:** Applications in engineering systems and energy analysis.	03	3-0-0
VI	Fundamentals of Machine Design	**Unit I:** Design philosophy, material selection, and factor of safety. **Unit II:** Stress analysis: static and dynamic loading, failure theories. **Unit III:** Design of machine elements: shafts, keys, couplings. **Unit IV:** Design of fasteners, springs, and welded joints. **Unit V:** Introduction to fatigue, reliability, and design optimization.	03	3-0-0
VII	Automation in Manufacturing	**Unit I:** Introduction to automation, types, and strategies. **Unit II:** Industrial automation components: sensors, actuators, controllers. **Unit III:** PLC programming and industrial control systems. **Unit IV:** Robotics in manufacturing and applications. **Unit V:** Flexible Manufacturing Systems (FMS) and Industry 4.0 concepts.	03	3-0-0
VIII	Fundamentals of heat transfer.	**Unit I:** Modes of heat transfer: conduction, convection, radiation. **Unit II:** Steady-state and transient heat conduction. **Unit III:** Convective heat transfer and boundary layer concepts. **Unit IV:** Radiation heat transfer and heat exchange between surfaces. **Unit V:** Heat exchangers and industrial applications.	03	3-0-0

Open Elective Baskets			
BASKET	**SEM-III**	**SEM-IV**	**SEM-V**
Leadership, Management & Innovation	Principles of Management and Organizational Behaviour	Leadership and Team Dynamics	Supply Chain Management
Sustainability and Green Technologies	Circular Economy for Sustainable Development	Green Practices and ESG Frameworks	Sustainable Technologies and Carbon Management
Entrepreneurship & Business	Start-up Management and Venture Creation	Innovation and Business Strategy	Digital Marketing
Holistic Development & Well-Being	Health and Nutrition for Professionals	Stress Management and Mental Well-Being	Lifestyle Management and Preventive Healthcare
Global Languages	French Language Module – I	French Language Module – II	French Language Module – III
	German Language Module – I	German Language Module – II	German Language Module – III
	Japanese Language Module -I	Japanese Language Module -II	Japanese Language Module -III

Honor Offered by Mechanical and Mechanical Engineering (Sandwich)

Simulation and Testing

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks						Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	L	P	T	Total
SEM-3	25MEHNR201	CAD Modelling Tools in Industry	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-3	25MEHNR201L	CAD modelling Laboratory	-	2	-	-	-	-	25	-		-	1	-	01
SEM-4	25MEHNR202	Simulation and Analysis Tools in Industry	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-4	25MEHNR202L	Simulation and Analysis Lab		2	-	-	-	-	25	-	-	-	1	-	01
SEM-5	25MEHNR301	Prototyping & Manufacturing Tools	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-5	25MEHNR301L	Automation and Robotics Lab	-	2	-	-	-	-	25	-	-	-	1	-	01
SEM-6	25MEHNR302	Testing & Validation Tools	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-6	25MEHNR302L	Testing & Validation Lab	-	2	-	-	-	-	-	25	-	-	1	-	01
SEM-7	25MEHNR401	Industry based Tools for Customer Satisfaction	2	-	-	20	30	50	-	-	-	2	-	-	02
	Total		**14**	**8**		**100**	**150**	**250**	**75**	**25**	**-**	**14**	**4**	**-**	**18**

Double Minors offered by each department						
Offering Department	**Double Minor Offered**	**Sem-3**	**Sem-4**	**Sem-5**	**Sem-6**	**Sem-7**
AI &ML Engineering	**Blockchain Technology**	Fundamentals of Blockchain Technology	Smart Contracts and Decentralized Applications	Blockchain Security and Cryptography	Decentralized AI and Web3 Technologies	Blockchain Applications and Emerging Trends
Chemical Engineering	**Environmental Engineering**	Air Pollution Control	Wastewater Treatment	Solid Waste Management	Climate Change and Sustainability	Mini Project
	Energy Engineering	Introduction of Energy	Bio-energy	Electrochemical Energy	Hydrogen Fuel	Mini Project
Civil Engineering	**Infrastructure Engineering**	Introduction to Infrastructure Engineering	Fundamentals of Infrastructure Engineering	Smart Transportation & Urban Infrastructure	Sustainable & Resilient Infrastructure Systems	Emerging Technologies in Infrastructure Engineering
Computer Engineering	**Cybersecurity Engineering**	Introduction to Cybersecurity	Cryptography and Network Security	Ethical Hacking	Digital Forensics	Cryptography and Data Protection
Electrical Engineering	**Renewable Energy systems**	Renewable Energy Sources for Sustainable Development	Solar Photovoltaic Systems	Wind Energy Conversion Systems	Power Electronics and Control for RES	Renewable Energy: Policies, Planning & Audit
E&TC Engineering	**Communication Engineering**	Analog Communication	Digital Communication	Cellular Networks	Mobile Computing	Optical & Microwave Communication
VLSI D&T Engineering	**Semiconductor IC Design**	Digital Electronics	System Design using Verilog	Digital CMOS Design	Analog CMOS Design	AI for VLSI
Mechanical Engineering	**Mechanical Systems Engineering**	Fundamentals of Manufacturing	Fundamentals of Engineering metallurgy	Fundamentals of Thermal Engineering	Fundamentals of Machine Design	Sustainable and Solar Engineering
Mechanical Sandwich Engineering	**Mechanical Systems Engineering**	Fundamentals of Manufacturing	Fundamentals of Engineering metallurgy	Fundamentals of Thermal Engineering	Fundamentals of Machine Design	Sustainable and Solar Engineering

R&A Engineering	Robotics and Automation	Fundamentals of Robotics and Automation	Programming for Robotics	Sensors and Actuators in Robotic Systems	Introduction to Robot Kinematics	Robot Simulation and Application

Double Minor offered by Mechanical Engineering

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks						Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	L	P	T	Total
SEM-3	25MEMNR201	Fundamentals of Manufacturing	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-3	25MEMNR201L	Material testing Lab	-	2	-	-	-	-	25	-		-	1	-	01
SEM-4	25MEMNR202	Fundamentals of Engineering metallurgy	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-4	25MEMNR202L	Engineering Metallurgy Lab		2	-	-	-	-	25	-	-	-	1	-	01
SEM-5	25MEMNR301	Fundamentals of Thermal Engineering	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-5	25MEMNR301L	Thermodynamics Lab	-	2	-	-	-	-	25	-	-	-	1	-	01
SEM-6	25MEMNR302	Fundamentals of Machine Design	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-6	25MEMNR302L	Machine Design Lab	-	2	-	-	-	-	-	25	-	-	1	-	01
SEM-7	25MEMNR401	Sustainable and Solar Engineering	2	-	-	20	30	50	-	-	-	2	-	-	02
	Total		**14**	**8**		**100**	**150**	**250**	**75**	**25**	**-**	**14**	**4**	**-**	**18**

Double Minor offered by Robotics & Automation Engineering

Robotics and Automation

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks						Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	L	P	T	Total
SEM-3	25RAMNR201	Fundamentals of Robotics and Automation	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-3	25RAMNR201L	Fundamentals of Robotics and Automation Lab	-	-	1	-	-	-	25	-		-	-	1	01
SEM-4	25RAMNR202	Programming for Robotics	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-4	25RAMNR202L	Programming for Robotics Lab		2	-	-	-	-	25	-	-	-	1	-	01
SEM-5	25RAMNR301	Sensors and Actuators in Robotic Systems	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-5	25RAMNR301L	Sensors and Actuators in Robotic Systems Lab	-	2	-	-	-	-	-	25	-	-	1	-	01
SEM-6	25RAMNR302	Introduction to Robot Kinematics	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-6	25RAMNR302L	Introduction to Robot Kinematics Lab	-	2	-	-	-	-	-	-	25	-	1	-	01
SEM-7	25RAMNR401	Robot Simulation and Application	2	-	-	20	30	50	-	-	-	2	-	-	02
	Total		**14**	**06**	**01**	**100**	**150**	**250**	**50**	**25**	**25**	**14**	**3**	**1**	**18**

B. Tech. Mechanical Engineering (Sandwich)(2025 Pattern)

Distribution of Credits

S. N.	Course Type	Course Title	No. of Credits (Semester wise)								Credits	
			I	II	III	IV	V	VI	VII	VIII	Total	%
1	BSC	Basic Science courses	8	8	-	-	-	-	-	-	16	9.52
2	ESC	Engineering Science courses	9	6	-	-	-	-	-	-	15	8.93
3	PCC	Programme Core Courses	-	3	12	12	8	8	6	-	49	29.17
4	PCE	Programme Elective courses	-	-	-	-	4	8	6	4	22	13.10
5	MDM	Multidisciplinary Minor	-	-	2	2	4	2	2	2	14	8.33
6	OEC	Open Elective	-	-	2	2	2	-	-	-	6	3.57
7	VSE	Vocational and Skill Enhancement Course	1	1	1	1	2	2	-	-	8	4.76
8	AEC	Ability Enhancement Course	2	-	-	2	-	-	-	-	4	2.38
9	HSM	Entrepreneurship/Economics/Management courses	-	-	2	2	-	-	-	-	4	2.38
10	IKS	Indian Knowledge System	-	2	-	-	-	-	-	-	2	1.19
11	VSE	Value Education Course	-	-	2	1	-	-	-	-	3	1.79
12	ELC	Experiential Learning Courses	-	-	1	-	-	2	6	12	21	12.5
13	CCE	Co-curricular & Extracurricular Activities	2	2	-	-	-	-	-	-	4	2.38
			22	**22**	**22**	**22**	**20**	**22**	**20**	**18**	**168**	**100**

B. Tech. Mechanical Sandwich Engineering (2025 Pattern)

Curriculum Structure: Semester III

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits
				L	P	T	CCA	ISE	ESE	TW	OR	PR	Total	
1.	PCC	25MSPCC201	Solid Mechanics	3	-	-	20	30	50	-	--	-	100	3
2.	PCC	25MEPCC202	Thermal & Fluid Engineering*	3	-	-	20	30	50	-	--	-	100	3
3.	PCC	25MSPCC203	Manufacturing Engineering	3	-	-	20	30	50	-	--	-	100	3
4.	MDM	25AIMDM201D	Multidisciplinary Minor-I	2	-	-	20	30	50	-	--	-	100	2
5.	OEC	25OEC201	Open Elective I *	2	-	-	20	30	50	-	--	-	100	2
6.	PCC	25MSPCC201L	Solid Mechanics Laboratory	-	2	-	-	-	-	-	25	-	25	1
7.	PCC	25MEPCC202L	Thermal & Fluid Engineering Laboratory	-	2	-	-	-	-	-	25	-	25	1
8.	PCC	25MEPCC203L	Intelligent Mechanical Systems Laboratory	-	2	-	-	-	-	-	-	25	25	1
9.	VSE	25MEVSE201	Workshop practices	-	2	-	-	-	-	-	-	25	25	1
10.	HSM	25HSM201	Entrepreneurship/Economics/ Management Course-I	-	-	2	-	-	-	50	-	-	50	2
11.	VEC	25VEC 201	Universal Human Values	-	-	2	-	-	-	50	-	-	50	2
12.	ELC	25ELC201	Community Engagement Project*	-	2	-	-	-	-	25	-	-	25	1
		Total		**13**	**10**	**4**	**100**	**150**	**250**	**125**	**50**	**50**	**725**	**22**

L: Lecture, P: Practical, T: Tutorial, CCA: Continuous Comprehensive Assessment; ISE: In-semester Examination; ESE: End Semester Examination; PR: Practical Examination, OR: Oral Examination, TW: Term Work.

Multidisciplinary Minor-I:

Sr. No.	Course Code	Course Name
1.	25AIMDM201D	Fundamentals of Artificial Intelligence and Machine Learning

Open Elective-I

Sr. No.	Course Code	Course Name
1.	25OEC201A	Principles of Management and Organizational Behaviour
2.	25OEC201B	Circular Economy Sustainable Development
3.	25OEC201C	Start-up Management and Venture Creation
4.	25OEC201D	Health and Nutrition for Professionals
5.	25OEC201E	French Language Module-I
6.	25OEC201F	German Language Module-I
7.	25OEC201G	Japanese Language Module-I

Vocational and Skill Enhancement Course-I:

Sr. No.	Course Code	Course Name

1.	25MEVSE201	Workshop practices

Entrepreneurship/Economics/Management Courses (HSSM)-I:		
Sr. No.	**Course Code**	**Course Name**
1.	25HSM201A	Engineering Economic Analysis.
2.	25HSM201B	Entrepreneurship
3.	25HSM201C	Project Management
4.	25HSM201D	Financial Accounting

B. Tech. Mechanical Sandwich Engineering (2025 Pattern)

Curriculum Structure: Semester IV

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Examination Scheme and Marks							Credits
				L	P	T	CCA	ISE	ESE	TW	OR	PR	Total	
1.	PCC	25MSPCC204	Mathematical Foundation for Mechanical Engineering *	3	-	-	20	30	50	-	--	-	100	3
2.	PCC	25MEPCC205	IC Engines & Electric Vehicles*	3	-	-	20	30	50	-	--	-	100	3
3.	PCC	25MSPCC206	Engineering Materials and Metallurgy	3	-	-	20	30	50	-	--	-	100	3
4.	MDM	25AIMDM202D	Multidisciplinary Minor-II	2	-	-	20	30	50	-	--	-	100	2
5.	OEC	25OEC202	Open Elective Course II *	2	-	-	20	30	50	-	--	-	100	2
6.	PCC	25MEPCC204L	Metrology & Quality Control Laboratory	-	2	-	-	-	-	-	25	-	25	1
7.	PCC	25MEPCC205L	IC Engines Laboratory	-	2	-	-	-	-	-	25	-	25	1
8	PCC	25MEPCC206L	Materials & Metallurgical Testing Laboratory	-	2	-	-	-	-	-	25	-	25	1
9	VSE	25MEVSE202	Solid Modeling & Drafting Laboratory	-	2	-	-	-	-	-	-	25	25	1
10	AEC	25AEC201	Modern Indian Language	2	-	-	-	-	-	25	25	-	50	2
11	HSM	25HSM202	Entrepreneurship/Economics/ Management Course-II	-	-	2	-	-	-	50	-	-	50	2
12	VEC	25VEC202	Indian Constitution and Governance	-	-	1	-	-	-	25	-	--	25	1
			Total	**15**	**8**	**3**	**100**	**150**	**250**	**100**	**100**	**25**	**725**	**22**

L: Lecture, P: Practical, T: Tutorial, CCA: Continuous Comprehensive Assessment; ISE: In-semester Examination; ESE: End Semester Examination; PR: Practical Examination, OR: Oral Examination, TW: Term Work.

Multidisciplinary Minor-II		
Sr. No.	**Course Code**	**Course Name**
1.	25AIMDM202D	Artificial Intellgence in Quality Control

Open Elective-II:		
Sr. No.	**Course Code**	**Course Name**
1.	25OEC202A	Leadership and Team Dynamics
2.	25OEC202B	Green Practices and ESG Frameworks
3.	25OEC202C	Innovation and Business Strategy
4.	25OEC202D	Stress Management and Mental Well-Being
5.	25OEC202E	French Language Module-II
6.	25OEC202F	German Language Module-II
7.	25OEC202G	Japanese Language Module-II

Vocational and Skill Enhancement Course-II:		
Sr. No.	**Course Code**	**Course Name**
1.	25MEVSE202	Solid Modeling & Drafting

Entrepreneurship/Economics/Management Courses (HSSM)-II:		
Sr. No.	**Course Code**	**Course Name**
1.	25HSM202A	Business Fundamentals for Entrepreneurs
2.	25HSM202B	Entrepreneurship Essentials
3.	25HSM202C	Fundamentals Management for Managers
4.	25HSM202D	Business Intelligence and Analytics

Modern Indian Language (MIL):		
Sr. No.	**Course Code**	**Course Name**
1.	25AEC201A	Marathi
2.	25AEC201B	Sanskrit

Double Minors offered by each department						
Offering Department	**Double Minor Offered**	**Sem-3**	**Sem-4**	**Sem-5**	**Sem-6**	**Sem-7**
AI &ML Engineering	**Blockchain Technology**	Fundamentals of Blockchain Technology	Smart Contracts and Decentralized Applications	Blockchain Security and Cryptography	Decentralized AI and Web3 Technologies	Blockchain Applications and Emerging Trends
Chemical Engineering	**Environmental Engineering**	Air Pollution Control	Wastewater Treatment	Solid Waste Management	Climate Change and Sustainability	Mini Project
	Energy Engineering	Introduction of Energy	Bio-energy	Electrochemical Energy	Hydrogen Fuel	Mini Project
Civil Engineering	**Infrastructure Engineering**	Introduction to Infrastructure Engineering	Fundamentals of Infrastructure Engineering	Smart Transportation & Urban Infrastructure	Sustainable & Resilient Infrastructure Systems	Emerging Technologies in Infrastructure Engineering
Computer Engineering	**Cybersecurity Engineering**	Introduction to Cybersecurity	Cryptography and Network Security	Ethical Hacking	Digital Forensics	Cryptography and Data Protection
Electrical Engineering	**Renewable Energy systems**	Renewable Energy Sources for Sustainable Development	Solar Photovoltaic Systems	Wind Energy Conversion Systems	Power Electronics and Control for RES	Renewable Energy: Policies, Planning & Audit
E&TC Engineering	**Communication Engineering**	Analog Communication	Digital Communication	Cellular Networks	Mobile Computing	Optical & Microwave Communication
VLSI D&T Engineering	**Semiconductor IC Design**	Digital Electronics	System Design using Verilog	Digital CMOS Design	Analog CMOS Design	AI for VLSI
Mechanical Engineering	**Mechanical Systems Engineering**	Fundamentals of Manufacturing	Fundamentals of Engineering metallurgy	Fundamentals of Thermal Engineering	Fundamentals of Machine Design	Sustainable and Solar Engineering
Mechanical Sandwich Engineering	**Mechanical Systems Engineering**	Fundamentals of Manufacturing	Fundamentals of Engineering metallurgy	Fundamentals of Thermal Engineering	Fundamentals of Machine Design	Sustainable and Solar Engineering
R&A Engineering	**Robotics and Automation**	Fundamentals of Robotics and Automation	Programming for Robotics	Sensors and Actuators in Robotic Systems	Introduction to Robot Kinematics	Robot Simulation and Application

Double Minor offered by Robotics & Automation Engineering

Robotics and Automation

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks						Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	L	P	T	Total
SEM-3	25RAMNR201	Fundamentals of Robotics and Automation	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-3	25RAMNR201L	Fundamentals of Robotics and Automation Lab	-	-	1	-	-	-	25	-		-	-	1	01
SEM-4	25RAMNR202	Programming for Robotics	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-4	25RAMNR202L	Programming for Robotics Lab		2	-	-	-	-	25	-	-	-	1	-	01
SEM-5	25RAMNR301	Sensors and Actuators in Robotic Systems	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-5	25RAMNR301L	Sensors and Actuators in Robotic Systems Lab	-	2	-	-	-	-	-	25	-	-	1	-	01
SEM-6	25RAMNR302	Introduction to Robot Kinematics	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-6	25RAMNR302L	Introduction to Robot Kinematics Lab	-	2	-	-	-	-	-	-	25	-	1	-	01
SEM-7	25RAMNR401	Robot Simulation and Application	2	-	-	20	30	50	-	-	-	2	-	-	02
	Total		**14**	**06**	**01**	**100**	**150**	**250**	**50**	**25**	**25**	**14**	**3**	**1**	**18**

Open Elective Baskets			
BASKET	**SEM-III**	**SEM-IV**	**SEM-V**
Leadership, Management & Innovation	Principles of Management and Organizational Behaviour	Leadership and Team Dynamics	Supply Chain Management
Sustainability and Green Technologies	Circular Economy for Sustainable Development	Green Practices and ESG Frameworks	Sustainable Technologies and Carbon Management
Entrepreneurship & Business	Start-up Management and Venture Creation	Innovation and Business Strategy	Digital Marketing
Holistic Development & Well-Being	Health and Nutrition for Professionals	Stress Management and Mental Well-Being	Lifestyle Management and Preventive Healthcare
Global Languages	French Language Module – I	French Language Module – II	French Language Module – III
	German Language Module – I	German Language Module – II	German Language Module – III
	Japanese Language Module -I	Japanese Language Module –II	Japanese Language Module -III

Honor offered by Mechanical and Mechanical SW Engineering

Simulation and Testing

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks						Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	L	P	T	Total
SEM-3	25MEHNR201	CAD Modelling Tools in Industry	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-3	25MEHNR201L	CAD modelling Laboratory	-	2	-	-	-	-	25	-		-	1	-	01
SEM-4	25MEHNR202	Simulation and Analysis Tools in Industry	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-4	25MEHNR202L	Simulation and Analysis Lab		2	-	-	-	-	25	-	-	-	1	-	01
SEM-5	25MEHNR301	Prototyping & Manufacturing Tools	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-5	25MEHNR301L	Automation and Robotics Lab	-	2	-	-	-	-	25	-	-	-	1	-	01
SEM-6	25MEHNR302	Testing & Validation Tools	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-6	25MEHNR302L	Testing & Validation Lab	-	2	-	-	-	-	-	25	-	-	1	-	01
SEM-7	25MEHNR401	Industry based Tools for Customer Satisfaction	2	-	-	20	30	50	-	-	-	2	-	-	02
	Total		**14**	**8**		**100**	**150**	**250**	**75**	**25**	**-**	**14**	**4**	**-**	**18**

Double Minor offered by Mechanical: Mechanical Engineering

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks						Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	L	P	T	Total
SEM-3	25MEMNR201	Fundamentals of Manufacturing	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-3	25MEMNR201L	Material testing Lab	-	2	-	-	-	-	25	-		-	1	-	01
SEM-4	25MEMNR202	Fundamentals of Engineering metallurgy	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-4	25MEMNR202L	Engineering Metallurgy Lab		2	-	-	-	-	25	-	-	-	1	-	01
SEM-5	25MEMNR301	Fundamentals of Thermal Engineering	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-5	25MEMNR301L	Thermodynamics Lab	-	2	-	-	-	-	25	-	-	-	1	-	01
SEM-6	25MEMNR302	Fundamentals of Machine Design	3	-	-	20	30	50	-	-	-	3	-	-	03
SEM-6	25MEMNR302L	Machine Design Lab	-	2	-	-	-	-	-	25	-	-	1	-	01
SEM-7	25MEMNR401	Sustainable and Solar Engineering	2	-	-	20	30	50	-	-	-	2	-	-	02
	Total		**14**	**8**		**100**	**150**	**250**	**75**	**25**	**-**	**14**	**4**	**-**	**18**

***CONTINUOUS COMPREHENSIVE ASSESSMENT (CCA)**

The continuous and comprehensive assessment (CCA) will be carried out in :

(A) Activities: 20 Marks (Any Two Each carry 10 Marks)

Course Projects	Industrial Visit (Quiz Based)	Guest Lectures (Quiz based)
Quiz related to course	IPR activity	Research Activity related to course
MOOC/ NPTEL Certification		

Guidelines:

VIII. Course Projects:

Course Projects should be framed based on real-world problems relevant to the subject. Each course project must be communicated through one of the following modes. It is recommended to complete all the communication modes across different course projects:

- Poster Presentation
- PowerPoint Presentation
- Model Making
- Field or Survey Report with Oral Presentation (e.g., case study)
- Submission of Digital Content (e.g. Video Summary)

To evaluate these field activities, assessment rubrics should be designed. The rubrics should include criteria such as clarity, innovation, subject relevance, presentation skills, and technical content. Note: Part of work of any co-curricular activities (relevant to subject contents) like national level project competitions, club activities, paper presentations, startup activities can be accepted as a course projects.

IX. Industrial Visit:

An industrial visit should be planned in alignment with the subject's scope and should particularly address advancements in the respective field. The purpose is to provide students exposure to actual engineering practices and systems. Assessment of industrial visits should be carried out using any of the following tools:

- Quiz (based on the visit)
- Interactive video or oral discussion
- Submission of a detailed visit report

X. Guest Lecturers:

Guest lectures should be relevant to the course and highlight advanced topics or recent trends in the field. Subject experts from academia or industry may be invited. Assessment methods for guest lectures may include:

- Quiz conducted post-lecture
- Attendance monitoring
- Evaluation of attentiveness and participation Rubrics can be developed, if possible, to

objectively assess student involvement in guest lectures.

XI. Quiz related to course:

Unit-wise quizzes should be planned and can be conducted either online (via LMS, Google Forms) or offline. Each quiz should include a pool of 20 questions, The quizzes should be diversified across the following question types:

- Simple Multiple Choice Questions (MCQs)
- Numerical MCQs
- Image-based Questions
- Match the Following
- Fill in the Blanks Drag and Drop (using images or words)

This variety ensures the assessment caters to different cognitive skills and learning styles.

XII. IPR activity:

Intellectual Property Rights (IPR) will be conducted as a course-related activity to create awareness among students about the protection of innovative ideas, research work, and technological developments. In this activity, students will introduce to various forms of IPR such as patents, copyrights, trademarks, and industrial designs. They will be encouraged to identify innovative concepts related to their course, study existing patents, and understand the basic procedure of patent filing. Students also analyzed case studies and discussed the importance of ethical use and protection of intellectual property in engineering and research. This activity enhanced students' understanding of innovation management, research ethics, and the significance of safeguarding intellectual creations in the academic and industrial environment.

XIII. Research Activity related to Course :

Publication will be considered as a course-related activity to encourage students to develop research aptitude and technical writing skills. As part of this activity, students will be guided to identify a relevant topic related to their course, conduct a literature review, analyze findings, and prepare a technical paper in a standard research format. They will be introduced to the basics of research publication, including abstract writing, referencing, plagiarism awareness, and selecting suitable journals or conferences. The activity assessed students' ability to present technical information clearly and systematically. This initiative helped students understand the process of academic publication and promoted innovation, critical thinking, and research-oriented learning.

XIV. MOOC/ NPTEL certification related to Course:

Students shall select a MOOC course related to current trends in their respective engineering discipline, preferably aligned with their area of specialization. The course must be at the undergraduate

level and should be selected in consultation with the assigned course teacher. It may be taken from recognized MOOC platform such as NPTEL. Students are required to submit hard copies of all course assignments. The student is expected to register for the examination and obtain the certificate from competent authority.

Evaluation Guidelines: Students will be evaluated progressively for a total 100 Marks.

Sr. No.	Parameter	Marks
1	Assignment Scores	05
2	Certification Granted Based on the MOOC Provider's Examination	05
Total Marks		**10**

(B) In-semester Examination (ISE)

In-semester examination will be of 30 marks based on Unit I and II.

Course Content	Questions	Marks	Total Marks	Duration
Unit I	Q. 1 or Q.2	15	30	1 Hours
Unit II	Q. 3 or Q.4	15		

(C) END Semester Examination (ESE)

Examination will be carried out on unit 3,4 and 5 carrying following marks weightage:

Unit No.	Marks Weightage
Unit III	16
Unit IV	17
Unit V	17

Note : 7th and 8th semester of SW (The CCA of Machine Design II is based on the Assignment and Design project while for turbo machine the CCA is based on the lab performance activity)

Multiple Entry–Exit Options under NEP 2020 (UG Programmes)

Exit Point	Programme Stage	Minimum Credits Required	Additional Skill / Vocational Requirement	Qualification Awarded
End of Sem II	First Year	40 Credits	• Minimum **8 credits** in work-based vocational courses / Internship / Apprenticeship during summer vacation • **4 credits** from skill-based courses earned in Sem I & II	**UG Certificate** in relevant Discipline / Subject
End of Sem IV	Second Year	80 Credits	• Additional **8 credits** in skill-based vocational courses / Internship / Mini-projects during summer vacation after Second Year	**UG Diploma** in relevant Discipline / Subject
End of Sem VI	Third Year	120 Credits	• Additional **8 credits** in skill-based vocational courses / Internship / Mini-projects during summer vacation after Sixth Semester	**B.Voc.** in relevant Discipline / Subject
End of Sem VIII	Fourth Year	As per Programme Scheme	—	**Bachelor's Degree** in relevant Discipline with **Single Minor**
End of Sem VIII (with extra credits)	Fourth Year	As per Programme Scheme + **18 additional credits**	• Additional credits through approved Minor / Honours / Research courses	**Bachelor's Degree with Double Minor / Honours / Research**

Summary:

- Students may **enter a programme in odd semesters** and **exit after successful completion of even semesters**, as per NEP 2020.
- Exit options are provided at the **end of 2nd, 4th, and 6th semesters** with **Certificate, Diploma, and B.Voc. awards**, respectively.
- Students may **re-enter the programme** and complete the degree **at a stretch or with breaks**, facilitated through **Academic Bank of Credits (ABC)**.
- Skill-based vocational credits may be earned through **SEC / VEC / Internship / Apprenticeship / Mini-projects**, preferably during **summer vacations**.
- **Maximum duration for completion = 2 × normal programme duration**(e.g. For 4-year degree course: 4 × 2 = 8 years. Likewise, for 3-year program, 6 Years and for Certificate / Diploma: Valid standalone award and credits remain in ABC)

Multiple Degree Option

E. B.Tech. Mechanical Sandwich Degree with Multidisciplinary Minor in AIML (160-176 credits).

Note : Compulsary Minors

4. Total 14 Credits
5. Distributed from Sem III to VIII
6. MDM selected from other Discipline (Other than Mechanical)

MDM for Mechancal & Mechanical Sw Course

Sem	Subject Code	Course	Credits	Teaching Scheme (L—T-P)
III	25AIMDM201D	Fundamentals of Artificial Intelligence and Machine Learning	02	2-0-0
IV	25AIMDM202D	Artificial Intelligence in quality Control	02	2-0-0
V	25AIMDM301D	Intelligent System and Artificial Intelligence	04	3-0-1
VI	25AIMDM302D	Numerical & Statistical Methods for Artificial Intelligence	02	2-0-0
VII	25AIMDM401D	Fundamentals of Deep Learning	02	2-0-0
VIII	25AIMDM402D	Artificial Intelligence in Hybrid Electric Vehicles	02	2-0-0

F. B.Tech. Mechanical Sandwich Honours Degree in Design and Simulation chosen Major Engg./ Tech. Discipline with Multidisciplinary Minor (180-194 credits):

- Enables students to take up **five-six additional courses in the same Engg./Tech.** Discipline of 18 to 20 credits distributed over **semesters III to VIII.**
- The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are **over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

Note : Choice Based Minors (Over and Above Class A)

4. Total 18-20 Credits
5. Distributed from Sem III to VIII
6. MDM selected from Mechanical Discipline

G. B.Tech. Mechanical Sandwich Honours with Research Degree in chosen Major Engg./Tech.Discipline with Multidisciplinary Minor (180-194 credits):

- The students will work on **a research project or dissertation for 18 credits** in the fourth year in the respective Major Engg. / Tech. Discipline.
- The decision regarding the distribution of 18 credits for Research Project in **Semesters VII and VIII** of the Fourth Year will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.
- **These 18 Credits will be over and above the min.160-max. 176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./ Tech. Program.

Note : Choice Based Minors (Over and Above Class A)

4. Total 18-20 Credits
5. Distributed from Sem VII & VIII
6. MDM selected from Mechanical Discipline

Research Degree Mechancal & Mechanical Sw Course

Course Objectives:

5. To inculcate research culture at UG level.
6. To develop analytical and problem-solving skills.
7. To encourage publication and innovation.
8. To integrate theory with real-time engineering problems.

Course Outcomes (COs): After completion, student will be able to:

CO1: Identify and formulate engineering research problems.

CO2: Conduct literature review and gap analysis.

CO3: Apply experimental/simulation tools for solution development.

CO4: Analyze and interpret research data scientifically.

CO5: Prepare technical paper/patent and defend the project.

Sem	Course	Credits	Teaching Scheme (L-T-P)
Sem VII			
01	Research Ethics & Academic Integrity	03	3-0-0
02	Statistical Tools in Research	03	3-0-0
03	Research Communication and Presentation	02	2-0-0

	Skill		

Sem	Course	Credits	Teaching Scheme (L-T-P)
	Sem VIII		
01	Research Project (other than Regular Project)	06	0-0-12
02	Article Publication based on allocated project (Conference /Journal & Patent / Copyright based on Project Work	04	0-0-4

H. B.Tech. Mechanical Sandwich Degree in chosen Major Engg./ Tech. Discipline with Double Minor (Multidisciplinary and Specialisation Minor, 180-194 credits):

Students would take **up five-six additional courses of 18 to 20 credits in another Engg./ Tech. discipline/ Emerging Areas** Specialization.Distributed over **semesters III to VIII**.

The decision regarding the mechanism of distribution of these 18-20 credits over semesters III to VIII, which are **over and above the min.160-max.176 Credits** prescribed for Four Year Multidisciplinary Bachelor's Degree in Engg./Tech., will be taken by Academic Authorities of University/ Autonomous Engineering Colleges.

- **Multidisciplinary Minor in Mechanical Engineering**
- **Offered by: Department of Mechanical Engineering**
- **Applicable to: Civil, Chemical, Electrical, Robotics and Automation Engineering branches.**

Sem	Course	Contents	Credits	Teaching Scheme (L—T-P)
III	Manufactuirng Engineering	**Unit I:** Overview of manufacturing processes, classification, and industrial applications. **Unit II:** Casting and metal forming processes (rolling, forging, extrusion). **Unit III:** Machining processes: turning, milling, drilling, tool wear, cutting fluids. **Unit IV:** Joining processes: welding, brazing, soldering, adhesive bonding. **Unit V:** Surface finishing, process selection, and introduction to advanced manufacturing.	03	3-0-0

IV	Basic Material Science	**Unit I:** Structure of materials, crystal systems, defects in solids. **Unit II:** Mechanical properties of materials and testing methods. **Unit III:** Phase diagrams and heat treatment processes. **Unit IV:** Ferrous and non-ferrous materials and alloys. **Unit V:** Advanced materials: composites, polymers, ceramics, and smart materials.	03	3-0-0
V	Fundamental of Engineering Thermodynamics	**Unit I:** Basic concepts, systems, properties, and thermodynamic equilibrium. **Unit II:** First law of thermodynamics for closed and open systems. **Unit III:** Second law of thermodynamics and entropy. **Unit IV:** Thermodynamic cycles (Carnot, Rankine, Otto, Diesel). **Unit V:** Applications in engineering systems and energy analysis.	03	3-0-0
VI	Fundamental of Machine Design	**Unit I:** Design philosophy, material selection, and factor of safety. **Unit II:** Stress analysis: static and dynamic loading, failure theories. **Unit III:** Design of machine elements: shafts, keys, couplings. **Unit IV:** Design of fasteners, springs, and welded joints. **Unit V:** Introduction to fatigue, reliability, and design optimization.	03	3-0-0
VII	Automation in Manufacturing	**Unit I:** Introduction to automation, types, and strategies. **Unit II:** Industrial automation components: sensors, actuators, controllers. **Unit III:** PLC programming and industrial control systems. **Unit IV:** Robotics in manufacturing and applications. **Unit V:** Flexible Manufacturing Systems (FMS) and Industry 4.0 concepts.	03	3-0-0
VIII	Fundamentals of heat transfer.	**Unit I:** Modes of heat transfer: conduction, convection, radiation. **Unit II:** Steady-state and transient heat conduction. **Unit III:** Convective heat transfer and boundary layer concepts. **Unit IV:** Radiation heat transfer and heat exchange between surfaces. **Unit V:** Heat exchangers and industrial applications.	03	3-0-0

SEMESTER III

Course: Solid Mechanics			**Code: 25MSPCC201**
Teaching Scheme (Hrs /Week)		**Credit**	**Evaluation Scheme**
Lecture	3	3	CCA 20
			ISE 30
			ESE 50

Prerequisites: Engineering Physics, Engineering Mathematics, Engineering Mechanics / Engineering Graphics

- **Course Objectives: The objectives of the course are**

1 To provide fundamental knowledge of stress, strain, mechanical properties of materials, and relationships between elastic constants.

2 To introduce concepts of strain energy and analyze stresses due to impact loading and thin cylindrical pressure vessels.

3 To develop analytical skills to determine shear forces and bending moments in beams and construct SFD and BMD under various loading conditions.

4 To enable students to evaluate bending and shear stress distribution in beams and determine section modulus for different cross sections.

5 To impart knowledge of torsional behaviour of shafts and buckling of long columns under various end conditions.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1	Explain the fundamental concepts of stress, strain, and mechanical properties of materials
CO2	Determine strain energy, impact stresses, and stresses in thin cylinders.
CO3	Calculate and analyse internal forces and moments in structural members using free-body diagrams
CO4	Compute the bending stresses and shear stresses on a beam.
CO5	Analyze torsional stresses in shafts and determine critical buckling load of columns for different end conditions.

- **Course Contents:**

Unit I	**Simple Stress Strain**	**8 Hours**

Types of Loads Types of Stresses with applications, Hooke's Law, Poisson's Ratio and Relationship between Elastic Constants. Stress Strain Curve for ductile and brittle materials, Factor of safety, Stresses and Strains in beams, homogeneous and composite bars under concentrated loads, self-weight. Thermal stresses.

Unit II	Principal Stresses, Impact Loading and Thin Cylinders	8 Hours

Principal Stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Mohr's Circle), Theories of Elastic Failure: Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Stresses induced due to gradually applied, suddenly applied and impact loading

Thin Cylinders - Circumferential and Longitudinal Stresses

Unit III	Shear Force & Bending Moment Diagrams	8 Hours

Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed 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. SFD and BMD for Standard Beam Cases (Simply Supported Beams, Cantilever Beams, etc)

Unit IV	Bending Stress & Shear Stress	8 Hours

Bending Stress on a Beam: Introduction to bending stress on a beam with application, Theory of Simple bending, assumptions in pure bending, derivation of flexural formula, Moment of inertia of common cross section (Circular, Hollow Circular, Rectangular, I & T), Bending stress distribution along the same cross section.

Shear Stress on a Beam: Introduction to transverse shear stress on a beam with application,

Self study: Shear stress distribution diagram along the Circular, Hollow Circular, Rectangular, I & T cross-section

Unit V	Torsion & Columns	8 Hours

Torsion of Circular Shafts: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Buckling of columns: Introduction to buckling of column with its application, Different End Conditions for Columns.

Self study: Critical and safe load determination by Euler's theory. Limitations of Euler's Theory.

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1.Quiz (Google Form based Quiz)
2. Short PPT or Report Submission on advanced topics (sample list given below)
3. Real life cases with photos / images (sample list given below)
4. Assignment containing problems with solutions (especially from GATE, IES or other Competitive Exams,

Old SPPU Question Papers)

2 - Contact Stresses, Thick Vs Thin Cylinders, Negative Poisson Ratio Materials, List of Formulae with Images, Poisson Ratio and/or Modulus of Elasticity Values for Standard Engineering Materials, Stress - Strain Curves for various materials, Photoelasticity

3 - Types of Beams, Loads, Stresses, Slope-Deflection for Beams, Pressure Vessels, Springs, Sections of Beams, etc

- **Textbooks:**
  1. R. K. Bansal, "Strength of Materials", Laxmi Publication
  2. S. Ramamurtham, "Strength of material", Dhanpat Rai Publication

- **Reference Books:**
  1. Beer and Johnston, "Strength of materials", CBS Publication
  2. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore
  3. R. S. Khurmi, "Strength of Materials", S. Chand Publication

- **MOOC / NPTEL Courses:**

1. nptel.ac.in/courses/105105108
   (NPTEL1, Strength of Materials, Prof. S. K. Bhattacharyya, IIT Kharagpur)
2. nptel.ac.in/courses/112106141
   (NPTEL2, Mechanics of Materials – Prof. M.S. Sivakumar, IIT Madras)
3. nptel.ac.in/courses/112107146
   (NPTEL3, Mechanics of Materials, Dr. Satish C Sharma, IIT Roorkee)

Course: Thermal & Fluid Engineering			**Code: 25MEPCC202**
Teaching Scheme (Hrs. /Week)		**Credit**	**Evaluation Scheme**
Lecture	3	3	CCA 20
			ISE 30
			ESE 50

Prerequisites: Engineering physics, Engineering mathematics and Engineering mechanics.

- **Course Objectives: The objectives of the course are**

1 To introduce the fundamental concepts and laws of thermodynamics and enable students to understand energy interactions, thermodynamic systems, and application of the first and second laws to basic processes and cycles.

2 To develop understanding of entropy and availability concepts and their significance in analyzing the direction, feasibility, and efficiency of thermodynamic processes.

3 To study the properties of pure substances and steam, understand steam generation and boiler components, and perform boiler performance calculations using steam tables and charts

4 To introduce the fundamental properties of fluids, laws of fluid statics, and principles of fluid flow, along with practical methods of pressure and discharge measurement.

5 To develop understanding of internal and external fluid flow characteristics, including laminar flow behavior in pipes and boundary layer concepts over flat plates, with emphasis on drag and lift phenomena.

- **Course Outcomes:** After successful completion of course, students will be able to:

CO No.	Course Outcome
CO1	Explain thermodynamic concepts, laws, and processes, and apply the first and second laws of thermodynamics to analyze simple closed and open systems, heat engines, refrigerators, and irreversibilities.
CO2	Explain entropy and availability concepts and evaluate entropy changes of closed and open systems, including ideal gas processes.
CO3	Analyze steam properties, use steam tables and Mollier charts, determine dryness fraction, and evaluate boiler performance through efficiency, equivalent evaporation, and heat balance calculations.
CO4	Explain fluid properties and static laws and apply Bernoulli's equation to solve numerical problems involving manometers, viscosity, and Venturimeter.
CO5	Analyze laminar internal flow and external boundary layer flow, and solve numerical problems related to boundary layer thickness, displacement thickness, momentum thickness, and energy thickness

- **Course Contents:**

Unit I	Basics of thermodynamics First and Second law of thermodynamics	8 Hours

Thermodynamic system, system boundary and surrounding, Types of systems, Macroscopic and Microscopic approach, Thermodynamic Equilibrium, Property, State, Path, process, cycle, Quasi -static Process, Reversible and Irreversible Process, Thermodynamic work, path and Point function, Zeroth law, Ideal gas laws and General gas equation. First law of thermodynamics, Flow process and non-flow process, SFEE, Second law of thermodynamics and their equivalence, Heat Engine, Heat pump. Refrigerator, PMM-I, PMM-II, Carnot cycle, Concept of Reversibility and Irreversibility.

Unit II	Entropy	8 Hours

Entropy: Clausius Inequality, Entropy as a property, Principle of increase of Entropy, Entropy changes for an Open and Closed System, Change of Entropy for an ideal gas, Third law of thermodynamics.

Availability: Available and Unavailable Energy, Concept of Availability, Availability of heat source at constant temperature and variable temperature, Availability of non-flow and steady-flow Systems, Concept of exergy.

Unit III	Properties of Pure substances	8 Hours

Formation of steam, Phase changes, Properties of steam, Steam Table, Study of p-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its determination using calorimeter.

Steam Generators: Classification, Introduction to IBR Act, Non-IBR boilers, Fire tube and water tube boilers, Low pressure boilers - Cornish & Locomotive, Boiler mountings and accessories. Boiler Performance Calculations: Equivalent Evaporation, Boiler efficiency, Heat balance Sheet.

Unit IV	Introduction to Fluid Mechanics	8 Hours

Definition of fluid, concept of continuum, density, specific weight, specific gravity, viscosity, viscosity laws, types of fluid and rheology, vapour pressure surface tension, capillarity, compressibility. Laws of fluid statics: forces acting on fluid element, Pascal's law, hydro statics law. Pressure measurement: pressure scale, piezometer, barometer, manometer - simple, inclined, differential, micro manometer, inverted.

Self study: Bernoulli's Equation Venturimeter.

Unit V	Internal and External Flow	8 Hours

Laminar flow: Entrance region theory, velocity and shear Stress distribution for laminar flow through pipe, fixed parallel plates Siphon and Power Transmission.

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.

Self study: Drag and lift concepts, types of drag, drag & lift coefficient, aerofoil, bluff body, streamline body.

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Visit to a Thermal Power Plant, Boiler House, Refrigeration Plant, or HVAC Facility and prepare a report on the working principles, major components, and energy conversion processes involved.
2. Presentation on an Advanced Topic Related to Thermal and Fluid Engineering, such as Computational Fluid Dynamics (CFD), Renewable Energy Systems, Heat Recovery Systems, Green Refrigerants, Hydrogen Energy, or Smart HVAC Technologies.
3. Study and Analysis of Energy Performance of a Thermal or Fluid System, such as a heat exchanger, refrigeration system, air compressor, pump, or solar water heater, and prepare a technical report including efficiency calculations and recommendations for improvement.

- **Textbooks:**

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications.
2. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications.

- **Reference Books:**

1. Rayner Joel, "Basic Engineering Thermodynamics", AWL-Addison Wesley
2. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw-Hill
3. G.VanWylen, R. Sonntag and C. Borgnakke, "Fundamentals of Classical Thermodynamics", John Wiley & Sons

- **MOOC / NPTEL Courses:**

1. nptel.ac.in/courses/101104067
   (NPTEL1, Engineering Thermodynamics, Prof. Jayant K. Singh, IIT Kanpur)
2. nptel.ac.in/courses/112103316
   (NPTEL2, Thermal Engineering: Basic and Applied, Prof. Pranab K. Mondal, IIT Guwahati)
3. nptel.ac.in/courses/112103275
   (NPTEL3, Applied Thermodynamics for Engineers, Prof. Dipankar N. Basu, IIT Guwahati)
4. nptel.ac.in/courses/112103290
   (NPTEL4, Experimental Methods in Fluid Mechanics, Prof. Pranab K. Mondal, IIT Guwahati
5. nptel.ac.in/courses/112104117
   (NPTEL5, Fluid Machinery, Prof. Gautam Biswas, Prof. S. Sarkar, Prof. Suman Chakraborty, IIT Kanpur)

Course: **Manufacturing Engineering**				**Code: 25MSPCC203**
Teaching Scheme (Hrs /Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Physics and Chemistry.

- **Course Objectives: The objectives of the course are**

1 To KNOW about fundamentals of metal cutting process, tool wear and tool life.
2 To DESCRIBE various casting methods and aspects related to mould design.
3 To UNDERSTAND basics of Plastic processes and tooling.
4 To CLASSIFY, DESCRIBE and CONFIGURE the principles of various welding techniques.
5 To EXPLAIN various grinding and advanced finishing techniques.

- **Course Outcomes:** After successful completion course, students will be able to:

CO1: DESIGN gating systems, risers, and ANALYZE casting defects for efficient metal casting processes.
CO2: COMPUTE forces, power, and deformation in rolling, forging, and sheet metal operations.
CO3: Understand Basic Plastic component manufacturing Process and its applications
CO4: COMPARE welding techniques, interpret weld symbols, and EVALUATE defects for quality joining.
CO5: SELECT appropriate grinding and finishing processes based on surface finish requirements

- **Course Contents:**

Unit I	**Casting Processes**	**8 Hours**

Classification of casting processes (sand, die, investment, centrifugal, continuous), Pattern design: types, materials, allowances, core making, Moulding materials, properties of moulding sand & core, Solidification principles: cooling rate, Estimation of mould filling time and pouring rate, Riser design using modulus and Caine's method, directional solidification, Casting defects and remedies.

Unit II	**Forming Processes**	**8 Hours**

Fundamentals of plastic deformation and yield criteria, Hot and cold working processes: Machines, process and applications of rolling, forging, Load estimation in forging using energy equation, extrusion, drawing, Sheet metal operations: shearing, bending, deep drawing, Defects in bulk and sheet forming processes, Rolling force and torque calculation, Sheet Metal clearance and layout.

Unit III	**Plastic Component Manufacturing**	**8 Hours**

Introduction to Plastics – Types, Properties, and Applications, Compression Moulding – Process and Equipment,

Transfer Moulding, Process and Applications, Blow Moulding, Types and Industrial Uses, Injection Moulding Process, Equipment, and applications, Extrusion of Plastics, Types of Extruders and Products, Thermoforming Principle, Vacuum Forming, and Pressure Forming, Comparative Analysis of Plastic Processing Methods & Case Studies.

Unit IV	**Joining Processes**	**8 Hours**

Classification of joining processes: welding, brazing, soldering, adhesives, Arc welding processes: SMAW, MIG, TIG, FCAW, SAW, Resistance welding: spot, seam, projection, Heat generation in resistance welding, Gas welding: oxy-acetylene flames and applications, Solid-state and modern welding processes: friction, ultrasonic, electron beam, laser beam welding, Welding defects and remedies,

Self study: Efficiency comparison of welding processes.

Unit V	**Finishing and Surface Engineering**	**8 Hours**

Grinding processes: types of machines, wheel selection, dressing/truing, Machining time calculation in cylindrical grinding, Honing, lapping, superfinishing, buffing, burnishing, Advanced finishing processes: abrasive flow machining, ultrasonic finishing, magnetic abrasive finishing, Surface finish measurement techniques, Applications of fine finishing in precision industries.

Self study: Selection of finishing process for given surface roughness requirement.

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Visit to a Manufacturing Industry/Workshop and study various manufacturing processes such as casting, welding, machining, forming, or additive manufacturing. Prepare a report highlighting the process flow, equipment used, and safety practices.
2. Presentation on an Advanced Manufacturing Technology, such as CNC machining, Industry 4.0, Smart Manufacturing, Additive Manufacturing (3D Printing), Laser Machining, Robotics in Manufacturing, or Digital Manufacturing.
3. Study and Comparative Analysis of Manufacturing Processes for a selected component and prepare a report discussing process selection criteria, material suitability, production rate, cost, quality, and applications.

- **Textbooks:**

1. Manufacturing Science – A. Ghosh & A.K. Mallik
2. Manufacturing Processes for Engineering Materials – Serope Kalpakjian & Steven Schmid

- **Reference Books:**

1. Theory of Metal Cutting, M. C. Shaw, 1st Edition, Oxford and I.B.H. publishing, 1994
2. Production Technology Manufacturing Systems Vol. - I & II, R. K. Jain, Khanna Publishers
3. Production Technology - HMT, Tata McGraw Hill publication

- **MOOC / NPTEL Courses:**

1. nptel.ac.in/courses/112107219
   (NPTEL1, Fundamentals of Manufacturing Processes, Prof. Dheerendra Kumar Dwivedi, IIT Roorkee)
2. nptel.ac.in/courses/112104188
   (NPTEL2, Manufacturing Systems Technology Part I, Prof. Shantanu Bhattacharya, IIT Kanpur)
3. nptel.ac.in/courses/112104204
   (NPTEL3, Manufacturing Process Technology - II, Prof. Shantanu Bhattacharya, IIT Kanpur)

Course: Fundamentals of Artificial Intelligence and Machine Learning			**Code:** 25AIMDM201D	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

Prerequisites: Linear Algebra, Probability, Statistics, Logical Reasoning.

- **Course Objectives:**
  1. ACQUAINT with fundamentals of artificial intelligence and machine learning.
  2. LEARN feature extraction and selection techniques for processing data set.
  3. UNDERSTAND basic algorithms used in classification and regression problems.
  4. OUTLINE steps involved in development of machine learning model.
  5. FAMILIARIZE with concepts of reinforced and deep learning.

- **Course Outcomes:** After successful completion course, students will be able to :

  CO1: DEMONSTRATE fundamentals of artificial intelligence and machine learning.

  CO2: APPLY feature extraction and selection techniques

  CO3: APPLY machine learning algorithms for classification and regression problems

  CO4: EXPLAIN concepts of unsupervised and reinforced learning.

  CO5: ANALYZE the structure and learning mechanisms of artificial neural networks and interpret their applications in mechanical engineering systems.

- **Course Contents:**

Unit I	**Introduction to Machine Learning and Engineering Data**	**6 Hours**

Evolution of Artificial Intelligence and Machine Learning, Difference between conventional mathematical modelling and data-driven modelling, Types of Machine learning: Supervised learning, Unsupervised learning, Reinforcement learning, Fundamental ML terminology: dataset, features, labels, model, training, testing, Under fitting and over fitting, Nature of engineering data: experimental data, simulation data, sensor data, Scope and limitations of Machine Learning in Mechanical Engineering

Unit II	**Data Representation and Dimensionality Reduction**	**6 Hours**

Data representation for engineering problems, Types of variables: continuous, discrete, categorical, Feat ure extraction: Statistical features, Principal Component Analysis. Feature selection: Ranking, Decision tree -

Entropy reduction and information gain, Exhaustive, best first, Greedy forward & backward

Unit III	Supervised Learning – Classification and Regression	6 Hours

Classification: Binary and multi-class classification, Decision tree, Random forest classifier, K-Nearest Neighbour (k-NN)

Support Vector Machine, Naive Bayes

Regression: Linear regression model, Multiple linear regression, Polynomial regression, Model Training, Validation and Evaluation.

Unit IV	Unsupervised Learning and Reinforcement Learning	6 Hours

Unsupervised Learning: Clustering concepts, Similarity and distance measures ,K-means clustering algorithm, Hierarchical clustering, Applications of clustering in mechanical systems

Reinforcement Learning: Learning through interaction, Agent, environment, state, action and reward , Exploration vs exploitation,

Self study: Basic reinforcement learning framework, Engineering relevance of reinforcement learning

Unit V	Artificial Neural Networks and Advanced ML Concepts	6 Hours

Biological inspiration of neural networks, Artificial neuron model, Architecture of artificial neural networks,• Learning process in neural networks, Feed-forward neural networks, • Backpropagation algorithm (conceptual)

Introduction to deep learning,.

Self study: Applications of neural networks in Mechanical Engineering

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Case Study / Poster / Infographic Preparation and Presentation on AIML Applications in Mechanical Engineering
2. Term Paper Writing on Applications of AI and ML in Mechanical Engineering
3. Quizzes Based on Basic AIML Concepts

- **Textbooks:**

1. Deisenroth, Faisal, Ong, Mathematics for Machine Learning, Cambridge University Press, 2020
2. Parag Kulkarni and Prachi Joshi, “Artificial Intelligence – Building Intelligent Systems”, PHI learning Pvt. Ltd., ISBN – 978-81-203-5046-5, 2015

- **Reference Books:**

1. Solanki, Kumar, Nayyar, Emerging Trends and Applications of Machine Learning, IGI Global, 2018.

2. Mohri, Rostamizdeh, Talwalkar, Foundations of Machine Learning, MIT Press, 2018.

3. Kumar, Zindani, Davim, Artificial Intelligence in Mechanical and Industrial Engineering, CRC Press, 2021.

- **MOOC / NPTEL Courses:**
  1. https://nptel.ac.in/courses/112103280
     (NPTEL1, Fundamentals of Artificial Intelligence, Prof. Shyamanta M. Hazarika, IIT Guwahati)
  2. https://onlinecourses.nptel.ac.in/noc25_ge55/preview
     (NPTEL2, Fundamentals of Artificial Intelligence, Prof. Shyamanta M. Hazarika, IIT Guwahati)
  3. https://nptel.ac.in/courses/106102220
     (NPTEL3, An Introduction to Artificial Intelligence, Prof. Mausam, IIT Delhi)
  4. https://onlinecourses.nptel.ac.in/noc24_cs08/preview
     (NPTEL4, An Introduction to Artificial Intelligence, Prof. Mausam, IIT Delhi)
  5. https://nptel.ac.in/courses/106105079
     (NPTEL5, Artificial Intelligence, Prof. P. Dasgupta, IIT Kharagpur)
  6. https://nptel.ac.in/courses/106105078
     (NPTEL6, Artificial Intelligence, Prof. P. Mitra & Prof. S. Sarkar, IIT Kharagpur)
  7. https://onlinecourses-archive.nptel.ac.in/noc18_cs18/
     (NPTEL7, Artificial Intelligence: Knowledge Representation and Reasoning, Prof. Deepak Khemani, IIT Madras)

Course: Principles of Management and Organizational Behaviour				Code: 25OEC201A
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

Prerequisites:
- Basic knowledge of Engineering Mathematics
- Fundamentals of Economics and Accounting
- Analytical and quantitative reasoning skills

Course Objectives: The objectives of the course are -
1. To introduce the fundamental concepts, functions, and theories of management.
2. To develop an understanding of organizational behavior and individual dynamics at the workplace.
3. Evaluate leadership styles, communication processes, and team dynamics.
4. Apply decision-making, planning, organizing, and controlling techniques in practical scenarios.
5. Assess organizational culture, change management processes, and conflict resolution strategies.

Course Outcomes: At the end of the course, students will be able to:
CO1: Explain core management functions and classical as well as modern management theories.
CO2: Analyze individual behavior, personality, perception, and motivation in organizational settings.
CO3: Apply capital budgeting methods for evaluating engineering investment decisions.
CO4: Evaluate cost of capital and capital structure decisions.
CO5: Apply working capital and financial planning concepts for engineering projects.

- **Course Contents:**

Unit I	**Introduction to Management**	**6 Hours**

Definition and nature of management; functions of management (planning, organizing, staffing, directing, controlling); levels of management; managerial roles and skills; evolution of management thought (classical, behavioural, modern approaches); principles of management

Unit II	**Planning and Organizing**	**6 Hours**

Planning process; types of plans; decision-making process and techniques; organizing principles; organizational structure (line, functional, matrix); delegation, authority, and responsibility; centralization and decentralization.

Unit III	**Individual Behavior in Organizations**	**6 Hours**

Foundations of organizational behavior; personality and attitudes; perception and attribution; learning theories; motivation theories (Maslow, Herzberg, McGregor, etc.); job satisfaction and employee engagement.

Unit IV	**Group Behavior and Leadership**	**6 Hours**

Group dynamics; team development; communication process and barriers; leadership theories and styles; power and politics; conflict management; negotiation techniques; organizational culture.

Unit V	**Organizational Change and Development**	**6 Hours**

Organizational change and resistance to change; change management models; organizational development; stress management; ethics and corporate social responsibility; contemporary issues in management; digital transformation and innovation in organizations

List of Course Activities for Continuous Comprehensive Assessment (Any Two):
1. **Case Study Analysis**
   Students analyze a real organizational problem related to planning, leadership, motivation, or change management and present solutions.

2. **Group Discussion & Presentation**
   Teams discuss management topics such as leadership styles, organizational culture, or conflict management and deliver presentations.
3. **Role Play / Management Simulation**
   Students perform role plays on manager–employee communication, negotiation, decision-making, or team management scenarios.
4. **Mini Project on Organizational Study**
   Students visit or study an organization/startup and prepare a report on management practices, hierarchy, communication, and work culture.
5. **Hands-on Activity using Planning & Decision Tools**
   Students prepare organizational charts, decision trees, SWOT analysis, project planning schedules, or management process flowcharts using practical examples.

- **Textbooks:**
  1. Robbins, S. P. & Coulter, M., Management, Pearson Education.
  2. L. M. Prasad, Principles and Practice of Management, Sultan Chand & Sons.

- **Reference Books:**
  1. Robbins, S. P. & Judge, T. A., Organizational Behavior, Pearson Education.
  2. Koontz, H. & Weihrich, H., Essentials of Management, McGraw Hill.
  3. K. Aswathappa, Organizational Behavior, Himalaya Publishing House.
  4. Harold Koontz & Cyril O'Donnell, Principles of Management, McGraw Hill.
  5. P. Subba Rao, Management and Organizational Behavior, Himalaya Publishing House.

- **NPTEL/MOOCS:**
  1. NPTEL course on Principles of Management by Prof. Susmita Mukhopadhyay, Prof. S. Srinivasan, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg88
  2. NPTEL course on Organizational Behaviour by Prof. M. P. Ganesh, IIT Hyderbad: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_mg51

Course: Circular Economy for Sustainable Development				Code: 25OEC201B
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Entrepreneurship, market survey, innovation

- **Course Objectives:** The objectives of the course are
  1. Understand the fundamentals principles of circular economy, sustainability, environmental systems, and resource cycles.
  2. Apply sustainable development goals (SDGs), life-cycle thinking, and circular economy models in real-world contexts.
  3. Develop the ability to assess materials, energy, and waste flows in businesses and communities to optimize resource use and reduce environmental impact.
  4. Examine environmental governance, global sustainability policies, and circular strategies for industry and society.
  5. Foster creative and practical solutions for sustainable consumption, production, and cleaner technologies.

- **Course Outcomes:** After successful completion course, students will be able to:

  CO1: Explain the fundamental principles of circular economy and sustainable development, and differentiate between linear and circular economic systems.
  CO2: Analyse global environmental challenges and evaluate the role of Sustainable Development Goals (SDGs) in addressing sustainability issues.
  CO3: Apply life cycle thinking, material flow analysis, and resource efficiency tools to assess environmental impacts of products and processes.
  CO4: Design and evaluate circular business models incorporating strategies such as reuse, recycling, remanufacturing, and extended producer responsibility.
  CO5: Assess sustainability policies, governance mechanisms, and technological interventions to propose practical solutions for sustainable development.

- **Course Contents:**

Unit I	**Fundamentals of Circular Economy and Sustainable Development**	**6 Hours**

Concept of sustainable development; evolution of sustainability; environmental, social and economic dimensions (Triple Bottom Line); limitations of the linear economy (take–make–dispose model); principles of circular economy; relationship between circular economy and sustainability; planetary boundaries; ecological footprint; overview of global sustainability challenges; introduction to Sustainable Development Goals (SDGs) and their relevance to industry and society.

Unit II	**Resource Efficiency and Life Cycle Approaches**	**6 Hours**

Resource scarcity and resource efficiency; material flow analysis (MFA); life cycle thinking; Life Cycle Assessment (LCA) methodology and stages (goal and scope definition, inventory analysis, impact assessment, interpretation); carbon footprint and water footprint; eco-efficiency and resource productivity indicators; waste hierarchy (reduce, reuse, recycle, recover); strategies for decoupling economic growth from resource consumption

Unit III	**Circular Business Models and Industrial Applications**	**6 Hours**

Circular business model innovation; product life extension strategies; reuse, repair, refurbishment and remanufacturing; recycling technologies; product-as-a-service (PaaS); sharing economy; eco-design and design for environment (DFE); reverse logistics and closed-loop supply chains; Extended Producer Responsibility (EPR); industrial symbiosis; sustainable manufacturing practices.

Unit IV	**Policy, Governance and Sustainable Development Frameworks**	**6 Hours**

Environmental governance and regulatory frameworks; national and international sustainability policies; climate change mitigation and adaptation strategies; green finance and sustainable investment; Environmental, Social and Governance (ESG) reporting; corporate social responsibility (CSR); sustainable procurement practices; role of government, private sector and civil society in promoting circular economy; global environmental agreements and initiatives

Unit V	**Tools, Technologies and Case Studies in Circular Economy**	**6 Hours**

Emerging technologies enabling circular economy (IoT, Artificial Intelligence, blockchain for traceability); digitalization and smart resource management; sustainable supply chain management; urban circular systems and smart sustainable cities; waste-to-energy and waste-to-resource technologies; sectoral applications (manufacturing, agriculture, construction, energy); case studies of successful circular economy initiatives; challenges and future prospects of sustainable development.

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Waste Audit & Recycling Survey**
   Students conduct a survey of waste generation in campus/home and suggest recycling or reuse strategies based on circular economy principles.
2. **Life Cycle Assessment (LCA) Mini Study**
   Analyze the life cycle of a product (plastic bottle, mobile phone, paper bag, etc.) and identify environmental impacts and sustainability improvements.
3. **Case Study Presentation on Circular Economy Models**
   Teams study companies practicing circular economy, green manufacturing, or sustainable business models and present findings.
4. **Hands-on Eco-Design / Upcycling Activity**
   Students create useful products from waste or redesign an existing product using eco-design and sustainability concepts.
5. **Sustainability Policy & SDG Mapping Project**
   Students map business/industrial activities with Sustainable Development Goals (SDGs) and prepare reports on sustainable practices.

- **Textbooks:**

1. Kirchherr, J., Reike, D., & Hekkert, M. – Conceptualizing the Circular Economy: An overview (Journal/Book compendium)
2. Ellen MacArthur Foundation – Towards the Circular Economy (Vol. 1–3)
3. Pearce, D. & Turner, R. K. – Economics of Natural Resources and the Environment
4. Bruntland Commission Report – Our Common Future (UN document foundational to sustainability thought)

- **Reference Books:**

1. Bocken, N. M. P., et al. – Product Design and Business Model Strategies for a Circular Economy
2. Geissdoerfer, M., et al. – The Circular Economy: A Critical Literature Review
3. McDonough, W. & Braungart, M. – Cradle to Cradle: Remaking the Way We Make Things
4. UNEP / UN Documents – Global Environmental Outlook Reports
5. Geyer, R., et al. – Industrial Ecology and Circularity

- **MOOC / NPTEL Courses:**

1. Coursera : Sustainability and Circular Economy, Michael J. Readey, University of Colorado Boulder https://www.coursera.org/learn/sustainability-and-the-circular-economy
2. NPTEL2, Environment and Development, Prof. By Prof. Ngamjahao Kipgen, IIT Guwahati https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs83
3. NPTEL3, Education for Sustainable Development, By Prof. Atasi Mohanty, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_hs61
4. NPTEL4, Environmental Planning and Management, By Prof. Sonal K. Thengane, IIT Roorkee

https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge08

5. NPTEL5, Corporate social responsibility By Prof. Aradhna Malik, IIT Kharagpur
https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg54

Course: Start-up Management &Venture Creation				Code: 25OEC201C
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Entrepreneurship, market survey, innovation

- **Course Objectives:** The objectives of the course are
  1. Understand the fundamentals of startup management and venture creation.
  2. Develop the ability to identify, evaluate, and validate startup ideas.
  3. Gain knowledge of business models, funding mechanisms, and startup operations.
  4. Understand legal, ethical, and IPR aspects related to startups.
  5. Build entrepreneurial skills, teamwork, leadership, and lifelong learning orientation.

- **Course Outcomes:** After successful completion course, students will be able to:

  CO1. Explain concepts, types, and lifecycle stages of start-ups and new ventures.

  CO2. Identify and analyze start up opportunities using market and customer discovery tools.

  CO3. Develop suitable business models and assess technical and financial feasibility of ventures.

  CO4. Apply knowledge of funding, legal, IPR, and government policies for startup creation.

  CO5. Prepare and present a startup business plan demonstrating teamwork, communication, ethics, and lifelong learning.

- **Course Contents:**

Unit I	**Introduction to Startups & Venture Creation**	**6 Hours**

Startup: Definition, characteristics, and types, Startup vs MSME vs traditional business, Startup lifecycle and growth stages, Role of startups in innovation and economic development Case studies of successful startups (Indian & global).

Unit II	**Idea Generation, Opportunity & Market Validation**	**6 Hours**

Entrepreneurial mindset and ideation techniques, Problem identification and solution fit, Design Thinking and Lean Startup approach, Customer discovery and validation, Market analysis and value proposition development.

Unit III	**Business Models & Feasibility Analysis**	**6 Hours**

Business Model Canvas and Lean Canvas, Technical, market, and financial feasibility, Cost structures, revenue models, and break-even analysis, Risk analysis and mitigation strategies, Sustainability and ethical considerations in startups

Unit IV	**Startup Ecosystem, Funding & Legal Aspects**	**6 Hours**

Startup ecosystem in India and globally, Government initiatives: Startup India, MSME, SIDBI, DPIIT, Sources of funding: bootstrapping, angel investors, venture capital, crowdfunding, Legal aspects: company registration, compliance, Intellectual Property Rights (IPR): patents, trademarks, copyrights

Unit V	**Startup Operations, Scaling & Business Plan**	**6 Hours**

Team formation, leadership, and culture, Operations and scaling strategies, Marketing, branding, and customer acquisition Business plan preparation and pitch deck, Future trends, failure analysis, and lifelong learning for entrepreneurs

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Startup Idea Pitching Activity**
   Students develop and present innovative startup ideas addressing real-world problems using value proposition concepts.
2. **Business Model Canvas Workshop**
   Hands-on preparation of Business Model Canvas (BMC) for a startup including customer segments, revenue streams, and value proposition.
3. **Market Survey & Customer Validation**
   Students conduct field/online surveys to identify customer needs, validate startup ideas, and analyze market opportunities.
4. **Prototype / Product Demonstration**
   Teams create a basic prototype, mock-up, or digital model of a product/service and demonstrate its functionality and usefulness.
5. **Startup Business Plan Preparation**
   Students prepare a practical business plan including funding requirements, marketing strategy, operational plan, and financial feasibility analysis.

- **Textbooks:**

1. S. S. Khanka – Entrepreneurial Development, S. Chand & Company.
2. Vasant Desai – Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House.

- **Reference Books:**

1. Steve Blank & Bob Dorf – The Startup Owner's Manual, Wiley.
2. Alexander Osterwalder & Yves Pigneur – Business Model Generation, Wiley.
3. Barringer & Ireland – Entrepreneurship: Successfully Launching New Ventures, Pearson.
4. Peter F. Drucker – Innovation and Entrepreneurship, Harper Business.
5. Steve Blank & Bob Dorf – The Startup Owner's Manual, Wiley.

- **MOOC / NPTEL Courses:**

1. NPTEL1, Entrepreneurship, By Prof. C Bhaktavatsala Rao, IIT Madras https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg70
2. NPTEL2, Entrepreneurship Essentials By Prof. Manoj Kumar Mondal, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_ge08
3. NPTEL3, Innovation, Business Models and Entrepreneurship, By Prof. Vinay Sharma, Prof. Rajat Agrawal, IIT Roorkee: https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95
4. NPTEL4, Entrepreneurship Essentials, By Prof. Manoj Kumar Mondal, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_ge03
5. Coursera : Technology & Entrepreneurship Specialization, Brent Sebold, Arizona State University https://www.coursera.org/specializations/technology-and-entrepreneurship

Course: Health and Nutrition for Professionals				Code: 25OEC201D
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.

- **Course Objectives:**
  1. To understand the importance of nutrition and healthy lifestyle for professionals.
  2. To create awareness about balanced diet and nutritional requirements.
  3. To understand lifestyle diseases and their prevention.
  4. To develop healthy habits for stress management and productivity.

- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain the basic concepts of health and nutrition.

  CO2: Understand nutritional requirements and balanced diet.

  CO3: Identify lifestyle diseases and preventive measures.

  CO4: Apply principles of healthy living and stress management.

  CO5: Analyze the role of nutrition in improving professional productivity

- **Course Contents:**

Unit I	**Introduction to Health and Nutrition**	**6 Hours**

Concept of health and wellness, Dimensions of health (physical, mental, social), Importance of nutrition for professionals, Nutrients and their functions, Macronutrients and micronutrients

Unit II	**Balanced Diet and Nutritional Requirements**	**6 Hours**

Concept of balanced diet, Dietary guidelines, recommended dietary allowance (RDA), Nutritional needs during childhood, adolescence, adulthood and old age, Special Nutritional needs for working professionals
Vegetarian vs non-vegetarian diets, Food pyramid and healthy eating habits

Unit III	**Lifestyle Diseases**	**6 Hours**

Causes of lifestyle diseases, Obesity, diabetes, hypertension, heart disease, Role of diet in prevention of diseases, Importance of physical activity, Nutritional management of common diseases, Prevention through healthy diets and lifestyle

Unit IV	**Health Management for Professionals**	**6 Hours**

Work-life balance, Stress and its management, Role of exercise and yoga, Sleep and mental health, Ergonomics and workplace health

Unit V	**Food Safety and Healthy Lifestyle**	**6 Hours**

Food hygiene and sanitation, Food adulteration, Safe food handling practices, Sustainable and healthy eating habits, Nutrition for long-term health and productivity, Importance of hydration, Healthy snacking options at work

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. **Balanced Diet Planning Activity**
     Students prepare a daily/weekly balanced diet chart for different age groups or working professionals based on nutritional requirements.

2. **Nutritional Analysis Survey**
   Conduct a survey on eating habits, junk food consumption, hydration, or lifestyle diseases and analyze the collected data.
3. **Healthy Recipe Preparation / Demonstration**
   Students prepare and present nutritious, low-cost, and healthy food recipes promoting balanced nutrition and food safety.
4. **Fitness, Yoga & Stress Management Activity**
   Practical sessions on yoga, exercise routines, meditation, posture correction, and stress management techniques for healthy living.
5. **Food Safety & Awareness Campaign**
   Students create posters, presentations, or awareness drives on food hygiene, adulteration detection, healthy snacking, and lifestyle disease prevention.

- **Textbooks:**
  1. Srilakshmi, B., Human Nutrition, New Age International (P) Ltd., Publishers, New Delhi.
  2. Joshi, Shubhangini A., Nutrition and Dietetics: With Indian Case Studies, 5th Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2021.

- **Reference Books:**
  1. Swaminathan, M., Food and Nutrition, Bangalore Printing & Publishing Co. Ltd., Bangalore.
  2. Swami Nathan, M., Essentials of Food and Nutrition, Vol. I & II, Ganesh & Co., Madras (Chennai), 1974.
  3. Dietary Guidelines for Indians. A manual by National Institute of Nutrition, ICMR
  4. Safety and Health for Engineers, Roger L. Brauer, John Wiley & Sons.

- **MOOC / NPTEL Courses /Online Resources:**
  1. Adolescent Health and Well-Being: A Holistic Approach by By Prof. Sumana Samanta, Prof. Parmeshwar Satpathy, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge102
  2. Diet Management in Health and Disease by By Dr. Vipparti Vijaya Lakshmi, The English and Foreign Languages University: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec25_hc01
  3. Food and Nutrition by By Dr. Asna Urooj, University of Mysore: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec19_ag02

Course: French Language Module-I			Code: 25OEC201E	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	**CCA**	**20**
			ISE	**30**
			ESE	**50**

- **Prerequisites:** No prerequisite required.

- **Course Objectives:**
  1. To identify basic French vocabulary and pronunciation.
  2. To develop elementary listening and speaking skills in French.
  3. To construct simple French sentences using basic grammar.
  4. To apply French language skills in everyday communication.
  5. To build a foundation for further learning of the French language.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Identify basic French vocabulary and pronunciation.

  CO2. Use simple French expressions for self-introduction and basic interactions.

  CO3. Read and write simple French sentences.

  CO4. Communicate in familiar everyday situations using basic French.

  CO5. Demonstrate awareness of French culture and etiquette.

- **Course Contents:**

Unit I	**Introduction au français (Introduction to French)**	**6 Hours**
French alphabet and pronunciation , Greetings and introductions , Numbers (1-100), days and months Classroom expressions		
Unit II	**Parler de ses loisirs et de sa famille (Talking about his hobbies and his family)**	**6 Hours**
Talking about a hobby, (Vocab: Activities, expressions + Aimer) , Family and friends , (Grammar: Subject pronouns, ER ending verbs, Family relations)		
Unit III	**La France (France)**	**6 Hours**
Reading about French city, Asking simple questions about France, Writing a post card (Vocab: Information on France and it's cities, interrogative words.)		
Unit IV	**Au café! (At the cafe!)**	**6 Hours**
Ordering in French, Fruits and vegetables , Quantities , Expressions of politeness		
Unit V	**Faire une invitation (Make an invitation)**	**6 Hours**
Letter writing , Organising a party , Accepting / refusing an invitation , Role play activities		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. Self-introduction in French: Students introduce themselves using simple French sentences.
  2. Greetings and Classroom Conversation: Students practice basic greetings and classroom expressions in French.
  3. **Listening Comprehension Exercise:** Students listen to short French audio clips and answer simple questions.
  4. **Picture Description in French:** Students describe a given picture using basic French vocabulary.
  5. French Culture Presentation: Students give a short presentation on French culture, food, or festivals.

- **Text Books:**

  1. Alter Ego A1 – Hachette (Goyal Publishers)

  2.Latitude 1 – Didier (Goyal Publishers)

- **Reference Books:**
  1. Myrna Bell Rochester, "Easy French Step-By-Step: Master High-Frequency Grammar for French Proficiency—Fast", McGraw Hill, ISBN-13 : 978-0071453875
  2. Eugene Jackson, Antonio Rubio, Julien J. Lafontant, Pamela Haze, "French Made Simple", Crown Publication, ISBN-13 : 978-0767918596
  3. Claire Miquel, "Communication Progressive du Français A1", Cle International, Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi – 110002
  4. Ranjit, Mahita & Singh, Monica, Apprenons le frangais', Part 1, Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007
  5. Ranjit, Mahita & Singh, Monica, Cahier d'exercices', (Apprenons le francais) 1., Saraswati House Pvt. Ltd., New Delhi. Second Revised Edition, 2007

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. https://www.elearningfrench.com/
  2. https://www.laits.utexas.edu/fi/index.html
  3. https://blog.rosettastone.com/french-accent-marks/
  4. https://www.frenchcircles.ca/online-free-french-resources/
  5. Proficiency course in French By Prof. Nirupama Rastogi (Retd): https://onlinecourses.swayam2.ac.in/e-learning/preview/cec19_lg04
  6. Foundations of French by Ramya Jagannathan: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg73
  7. The Complete French Course : Learn French – Beginners : https://www.udemy.com/course/french-for-beginners-a1/?couponCode=PMNVD2025
  8. Complete French Course: Learn French for Beginners : https://www.udemy.com/course/complete-french-course/?couponCode=PMNVD2025

Course: German Language Module-I			Code: 25OEC201F	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.

- **Course Objectives:**

1. To identify basic German vocabulary and pronunciation.
2. To develop elementary communication skills in German.
3. To construct simple German sentences using basic grammar.
4. To apply German language skills in everyday communication.
5. To develop awareness of German culture and traditions.

- **Course Outcomes:** At the end of the course, students will be able to

CO1. Identify basic German vocabulary and pronunciation.

CO2. Use simple German expressions for basic communication.

CO3. Read and write elementary German sentences.

CO4. Apply common German phrases in everyday situations.

CO5. Demonstrate awareness of German culture and traditions.

- **Course Contents:**

Unit I	Willkommen! (Welcome!)	6 Hours

Topics and Vocabulary: Greetings, Introductions, Numbers, Countries & languages

Grammar: Alphabet, Pronunciation, Personal pronouns

Skills

- Speaking: self-introduction
- Listening: simple conversations
- Reading: name cards, dialogues
- Writing: short introduction paragraph

Unit II	Familie, Freunde und ich (Family, Friends and I)	6 Hours

Topics and Vocabulary: Family members, Hobby and work

Grammar: Nominative case, Articles- der, die, das, Regular verb conjugation

Skills

- Speaking: describe family, ask about profession, introduce others
- Reading: small paragraphs about nuclear and joint families

Activity

Family tree presentation

Unit III	Orte und Dinge (Places and things)	6 Hours

Grammar: Sentence structure , Definite articles- der, die, das, Indefinite articles- ein, eine, ein,

Negative markers- kein, keine, kein, nicht

Skills

- Speaking**:** describing surroundings and objects
- Reading**:** simple descriptive passages and labels
- Writing**:** short descriptions using simple sentences

Activities

- Vocabulary Hunt
- Mystery Object Game

Picture Description

Unit IV	Studentenleben & Alltag (Student life & everyday life)	6 Hours

Topics and Vocabulary: Daily routine , University life , Subjects , Time expressions

Grammar: Time, Nominative case- personal pronouns, Nominative case- possessive Pronouns

Skills: Speaking and Writing: daily routine discussion

Listening: schedules at university and at the work place

Unit V	Revision & Mini Project	6 Hours

Integrated Skills : Students prepare: self-introduction , poster , dialogue , simple presentation

Suggested Project

My dream study trip to Germany/ Cultural connectivity between Germany and India/ Any other topic related to German language and culture.

Assessment

- Speaking viva
- Listening test
- Vocabulary quiz
- Listening exercises
- Pronunciation practice
- Role play activities

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Self-introduction in German:** Students introduce themselves using simple German sentences.
2. **Greetings and Basic Conversation:** Students practice greetings and everyday expressions in German.
3. **Listening Comprehension Exercise:** Students listen to short German audio clips and answer questions.
4. **Picture Description in German:** Students describe simple pictures using basic German vocabulary.
5. **German Culture Presentation:** Students present topics related to German culture, food, or festivals.

- **Text Books:**
  1. Stefanie Dengler, “Netzwerk A1 (Textbook + Workbook + Glossar)”, Hachette , ISBN: 9788183077033, (Goyal Publishers)
  2. Monika Reimann Daniela Niebisch , Sylvette Penning-Hiemstra , Angela Pude , Franz Specht , Monika Bovermann, “ Schritte international Neu 1: Deutsch als Fremdsprache / Kursbuch + Arbeitsbuch mit Audios online”, Hueber Publications, GOYAL Publishers & Distributors Pvt. Ltd, ISBN-13 : 978-3193610829

- **Reference Books:**
  1. Deepak Kushwaha, “German Made Easy Part 1 + German Made Easy Part 2 with Answer”, Goyal Publishers
  2. Arnold Leitner, “German Made Simple”, Crown Publications, Penguin Random House India Pvt Ltd
  3. Kurs Und Ubungsbuch, “Studio-D A1 - Combo of 3 (German)”, Goyal Publishers & Distributers
  4. Funk and Kuhn, “Studio D A1Deutsch Buch “, Cornelsen Verlag (Goyal Publishers India)

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. Learn German Language: Complete German Course – Beginners (Udemy): https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/
  2. German A1 - German For Complete Beginners! : https://www.udemy.com/course/german-for-complete-beginners/?couponCode=PMNVD2025
  3. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
  4. Practise German for free (Goethe-Institut Resources) : https://www.goethe.de/en/spr/ueb.html
  5. Duolingo German : https://www.duolingo.com/course/de/en/Learn-German

Course: Japanese Language Module-I			Code: 25OEC201G	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** No prerequisite required.

- **Course Objectives:** The objectives of the course are-
  1. To identify basic Japanese pronunciation, scripts, and vocabulary.
  2. To develop pre-elementary listening and speaking skills in Japanese.
  3. To construct simple Japanese sentences using basic grammar.
  4. To apply simple Japanese expressions in everyday communication.
  5. To develop awareness of Japanese culture and etiquette.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Identify basic Japanese pronunciation, scripts, and vocabulary.

  CO2. Use simple Japanese expressions for basic communication.

  CO3. Read and write basic Japanese characters and sentences.

  CO4. Participate in elementary conversations using simple Japanese expressions.

  CO5. Demonstrate awareness of Japanese culture and etiquette.

- **Course Contents:**

Unit I	**Unit I**	**Unit I**
Hiragana, Greetings and introductions, Numbers and dates, Pronunciation practice		
Unit II	**Unit II**	**Unit II**
Sentence patterns, Basic Particles, Basic verbs, Pronouns and nouns		
Unit III	**Unit III**	**Unit III**
Self-introduction, Family and hobbies, Daily activities, Asking simple questions		
Unit IV	**Unit IV**	**Unit IV**
Reading simple scripts, Daily Vocabulary, Writing practice, Sentence construction		
Unit V	**Unit V**	**Unit V**
Japanese culture, Pronunciation practice, Role play activities, Guided communication, activities.		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  - **Self-introduction in Japanese:** Students introduce themselves using simple Japanese expressions.

1. **Greetings and Classroom Conversation:** Students practice basic greetings and classroom communication in Japanese.
2. **Listening Comprehension Exercise:** Students listen to short Japanese audio clips and answer simple questions.
3. **Picture Description in Japanese:** Students describe pictures using simple Japanese vocabulary.

- **Japanese Culture Presentation:** Students present topics related to Japanese culture, food, or festivals.

- **Text Books:**
  1. 3A Corporation, "Minna No Nihongo 1-1,1-2,2-1,2.2 Main Textbook elementary", ISBN-13: 9789388141147, Goyal Publishers & Distributors Pvt. Ltd, India

1. Eri Banno, Yoko Ikeda, Yutaka Ohno, Chikako Shinagawa, Kyoko Tokashiki, "Genki 1 Textbook: An Integrated Course in Elementary Japanese", ISBN-13 : 978-4789014403

- **Reference Books:**
  1. The Japan Foundation, "Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Activities", Goyal Publishers
  2. The Japan Foundation, "Marugoto Starter (A1) Rikai - Course Book For Communicative Language Competences", Goyal Publishers, ISBN-13: 9788183078047
  3. The Japan Foundation, "Marugoto Starter (A1) Katsudoo", Goyal Publishers
  4. "Japanese for Busy People,3rd edition", Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.,
  5. Tae Kim, "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", Createspace Independent Pub, ISBN-13 : 978-1495238963, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
  6. Nyumon Nihongo- ALC Press, U.K

  1. Nihongo Soomatome N5, ASK Publishing, Tokyo

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. Online Japanese Beginner Course (Udemy): https://www.udemy.com/course/online-japanese-beginner-course
  2. JF-Japanese e-learning : https://minato-jf.jp/
  3. Introduction to Japanese Langauge : Prof Vatsala Misra (NPTEL) : https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_hs83

- Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online

Course: Solid Mechanics Laboratory				**Code: 25MSPCC201L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

1. Prerequisites: Engineering Physics, Engineering Mathematics, Engineering

- **Course Objectives:** The objectives of the Course are

1 To provide practical understanding of material behavior under different types of loading.

2 To develop skills in conducting mechanical testing experiments and interpreting results.

3 To familiarize students with national and international testing standards (IS and ASTM).

4 To introduce experimental techniques such as strain measurement and contact stress analysis.

5 To relate theoretical concepts of stress and strain to real-life engineering components.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Conduct tensile, compression, torsion, shear, and bending tests and interpret the stress–strain behavior of materials.

CO2: Determine mechanical properties such as Young's modulus, shear modulus, yield strength, and spring stiffness from experimental data.

CO3: Apply IS and ASTM standards while performing material testing experiments.

CO4: Measure strain using strain gauges and compare experimental results with theoretical values.

CO5: Correlate laboratory results with real-life engineering components such as beams, shafts, columns, and springs.

List of Experiments

1 Tensile Test: Conducted on mild steel and cast iron to determine stress-strain characteristics.

2 Compression Test: Performed on mild steel and cast iron.

3 Torsion Test: Conducted on mild steel rods.

4 Shear Test: Direct shear tests on mild steel rods, plates

5 Bending Test: Bending test on mild steel specimens.

6 Deflection Test: Deflection test on a beam.

7 Study of Indian Standards for tensile and compression testing (IS 1608, IS 13780)

8 Study of ASTM for tensile and compression testing (ASTM E8/E9, ASTM 3039)

9 Use of Strain Gauges for Strain Measurement

10 Study of Contact Stresses (Report Writing or Presentation) (**Self study)**

11 Identification real life examples / cases for any two of the following (**Self study)**

a) Beam Types & Shafts

b) Tension / Compression / Shear / Bending / Thermal Stresses

c) Types of Sections of Beams (in Mechanical as well as Civil Engineering)

d) Types of End Conditions for Columns (in Mechanical as well as Civil Engineering)

e) Types of Mechanical Springs with different end conditions

Virtual Laboratories: Carry out any experiment through a virtual lab platform.

Course: Thermal and Fluid Engineering Laboratory				**Code: 25MEPCC202L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

Prerequisites: Thermodynamics and Fluid Mechanic Knowledge

Course Objectives: The objectives of the Course are

1 To provide practical understanding of basic thermodynamic principles such as heat, work, energy conversion, and steam properties through laboratory experiments.

2 To familiarize students with thermal measurement instruments and sensors used for temperature, flow, pressure, and viscosity in real thermal systems.

3 To develop hands-on skills for evaluating the performance of boilers, calorimeters, pipelines, and flow measuring devices.

4 To enable students to analyze fluid flow behavior, including major and minor losses, discharge coefficients, and validation of Bernoulli's equation.

5 To expose students to industrial thermal systems through practical trials and industrial visits, bridging the gap between theory and real-world applications.

- **Course Outcomes:** At the end of the course, students will be able to:
  - **CO1:** Explain and apply the principles of Joule's experiment, heat transfer, and steam properties in thermal engineering applications.
  - **CO2:** Identify and use various temperature sensors, viscometers, calorimeters, and flow measurement devices used in thermal and fluid systems.
  - **CO3:** Evaluate boiler performance parameters such as boiler efficiency, equivalent evaporation, dryness fraction, and heat balance.
  - **CO4:** Analyze fluid flow systems by determining major and minor losses in pipelines and verifying modified Bernoulli's equation.
  - **CO5:** Correlate laboratory experiments with industrial practices in boilers, food processing plants, and automobile service stations, enhancing professional and practical competence

List of Experiments	
1	Study of Joules Experiment
2	Survey of temperature sensors used in various thermal systems
3	Trial on boiler to determine boiler efficiency, equivalent evaporation and Heat Balance Sheet
4	Determination of dryness fraction of steam using combined separating and throttling calorimeter
5	Determination of Major/ Minor Losses in Pipe Lines (Metal / Plastic).
6	Measurement of Pressure using Manometers, Pressure gauge
7	Verification of Modified Bernoulli's Equation
8	Determination of Coefficient of discharge, of Venturimeter / orifice meter.
9	Determination of kinematic viscosity of any oil using Redwood Viscometer. (**Self study)**
10	Industrial Visit: Visit to relevant Industry/Plant.
Any 3 experiments out of Sr No. 1 to 4, Any 4 experiments out of Sr. no. 5 to 9 and Experiment 10 is compulsory.	
Virtual Laboratories: Carry out any experiment through a virtual lab platform.	

Course: Intelligent Mechanical Systems Laboratory			**Code:** 25MEPCC203L
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical Marks: 25

Prerequisites: Basic knowledge of engineering mathematics including linear algebra, probability, and statistics, fundamentals of programming with exposure to Python or any equivalent high-level language. Understanding of mechanical engineering systems.

Course Objectives: The objectives of the Course are

1 ACQUIRE and explore engineering datasets to understand mechanical system behavior through exploratory data analysis.

2 APPLY feature extraction and feature selection techniques to prepare effective training datasets from engineering data.

3 IMPLEMENT supervised learning models for classification and regression problems relevant to mechanical engineering applications.

4 DEVELOP and EVALUATE machine learning models using appropriate performance measures and validation strategies.

5 IMPLEMENT and ANALYZE artificial neural network models for parameter estimation, system identification, and control-related mechanical engineering problems.

- **Course Outcomes:** At the end of the course, students will be able to:

CO No.	Course Outcome
CO1	Acquire and analyze engineering datasets using exploratory analysis techniques
CO2	Extract and select relevant features from engineering datasets to form effective training data for machine learning models.
CO3	Develop and evaluate classification and regression models for solving mechanical engineering problems.
CO4	Apply reinforcement learning and evolutionary optimization concepts to engineering system optimization
CO5	Apply artificial neural networks for parameter estimation, system identification, and tuning of control algorithms in mechanical engineering applications.

List of Experiments	
1	Acquire engineering datasets and perform exploratory analysis for understanding system behavior
2	To extract features from given data set and establish training data.
3	To select relevant features using suitable technique.
4	To develop classification model and evaluate its performance
5	To develop regression model and` evaluate its performance
6	Reinforcement learning concepts through applications such as engineering system optimization or robotic guidance and navigation problems.
7	Path planning in robotics using suitable software.
8	To apply artificial neural networks for parameter estimation and system identification.
9.	Analysis of AIML deployment for predictive and intelligent applications in mechanical systems. (**Self study)**
(Students shall refer to high-quality peer-reviewed research papers on AIML applications in mechanical systems and present their understanding through a structured report and presentation.)	
Virtual Laboratories: Carry out any experiment through a virtual lab platform. Machine Learning - Virtual Lab (https://ml-iitr.vlabs.ac.in/Introduction.html)	

Course: Workshop Practices			**Code:** 25MEVSE201
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Practical	Marks: 25

Prerequisites: Physics and First Year workshop practice

Course Objectives: The objectives of the Course are

1 To understand safety practices and sustainable manufacturing concepts.
2 To understand primary manufacturing processes.
3 To learn sheet metal operations.
4 To manufacture and assemble a simple mechanical component.
5 To understand metal joining techniques.

Course Outcomes: At the end of the course, students will be able to:

CO1: IDENTIFY and ANALYZE safety standards and safety measures applicable to various sections of mechanical workshops and effectively communicate these through the preparation of informative posters or reports.

CO2: READ, INTERPRET Casting Process and its stages.

CO3: READ, INTERPRET, and ANALYZE industrial drawings by applying standard industrial practices to effectively communicate design and manufacturing intent.

CO4: UNDERSTAND and APPLY the principles of GD&T as well as INTERPRET surface finish and welding symbols to enhance design accuracy and manufacturability.

CO5: PLAN and EXECUTE the production of an assembly job by performing a sequence of machining operations while selecting appropriate materials and processes to meet functional and assembly requirements.

List of Experiments

1 Workshop Safety & Sustainability (Skill Awareness)

Study safety rules in: Machine shop, Welding shop, Foundry shop

Identify hazards and Personal Protective Equipment (PPE)

Prepare: Short presentation/report on workshop/industry safety.

2 Casting or Forging Process

Option A (In-house): Produce a small component using: Sand casting / wax casting / smithy

Option B (Industry Exposure): Industrial visit to foundry or forging unit

Study of Process steps, Defects and Quality aspects

Prepare short technical visit report with sketches/photos

3 Sheet Metal & Press Work

Activities: Layout calculation of sheet metal part

Perform any two operations: Shearing, Bending, Punching, Blanking

4 Machining & Assembly of Simple Job (Core Skill)

Job Description:

A. Assembly consisting of 2–3 components

B. Includes operations like Cutting (hacksaw), Turning (lathe / CNC), Milling / slotting / drilling, Tapping / threading (two or more)

5. Finishing (grinding / polishing) Material selection (ferrous/non-ferrous), Process planning (simple process sheet), Working machines & tools, Calculation of cutting speed, Power, inspection.

6. Welding & Joining Processes

Activities (Any one):

Perform welding using: Arc / MIG / TIG / Gas welding

OR

Demonstration of welding process

(**Self-study):** Comparison of Welding vs Brazing vs Soldering and Common welding defects (visual study)

Virtual Laboratories: Carry out any experiment through a virtual lab platform.

Course: Entrepreneurship/Economics/ Management Course-I				Code: 25HSM201
Teaching Scheme (Hours/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	Term work	Marks: 50

GUIDELINES FOR SELECTING HSM COURSE

1. HSSM courses shall be offered through Institute-approved Swayam/ NPTEL courses. The minimum duration of the course must be **8 weeks**.
2. 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'. The faculty has to register for the selected course as a course mentor.
3. Students shall complete the prescribed online lectures, assignments, and learning activities during the semester.
4. Swayam/ NPTEL certification examination is optional and students shall not be required to pay certification fees for successful completion of the course.
5. Any plagiarism, misrepresentation of course completion, or submission of forged certificates shall be treated as academic misconduct.
6. The decision of the Institute regarding course mapping, evaluation, and award of credits shall be final.

SELECTION OF HSSM COURSE

List of Courses to be opted (Any one) under HSSM-I

1. Engineering Economic Analysis – IIT Roorkee, Prof. P. K. Jha :https://nptel.ac.in/courses/112107209
2. Entrepreneurship – IIT Madras, Prof. C. Bhaktavatsala Rao: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg114
3. Project Management – IIT Kanpur, Prof. Raghu Nandan Sengupta: https://nptel.ac.in/courses/110104073
4. Financial Accounting, IIT Bombay Prof. Varadraj Bapat: https://nptel.ac.in/courses/110101131

Assessment of HSSM Course:

1. Term Work (50 Marks) shall be evaluated by the Faculty Mentor based on:
   - 25 Marks: NPTEL assignment score.
   - 25 Marks: Institute level examination.
   - For DSE students there will be 50 Marks institute level end semester examination.
2. 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. The cumulative marks obtained in the online assignments shall be proportionately converted to a maximum of 25 marks for the purpose of term work assessment.

Course: Universal Human Values			Code: 25VEC201	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	TW	50

- **Prerequisites:** The course requires openness to self-reflection and willingness to understand ethical and value-based perspectives in personal and professional life.

- **Course Objectives:**
  1. To help students understand the importance of human values in personal and professional life.
  2. To develop ethical awareness and responsible decision-making.
  3. To create harmony between individual, society, and nature.
  4. To encourage engineers to contribute towards sustainable and value-based development.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1: Explain the concept of human values and self-exploration, and recognize their importance in personal life, professional life, and the role of engineers in society.

  CO2: Understand the importance of sustainable development, environmental responsibility, and ecological balance, and evaluate the impact of technology on society and nature.

  CO3: Apply values such as trust, respect, empathy, and responsibility to maintain harmony in family and society and practice ethical behavior in social interactions.

  CO4: Demonstrate professional ethics, value-based decision making, leadership, and teamwork in engineering practice for the welfare of society.

  CO5: Understand the relationship between self and body, differentiate their needs, and develop self-awareness and balanced lifestyle practices for personal well-being.

- **Course Contents:**

Unit I	**Introduction to Human Values**	**6 Hours**

Meaning and importance of human values, Basic needs of values, need for value based education in Engineering, Types of Human Values, Importance of human values to full fill happy and successful life, Values in personal life and professional life,, Factors affecting human values- Cultural, societal factors, personal factors , experiences, Concept of self-exploration, How to cultivate both values and skill in person's life that navigate him to face life's challenges and opportunities, Role of Engineer in society. Technology and values.

Unit II	**Harmony in Nature**	**6 Hours**

Understanding of harmony in Nature, Four orders of nature, Physical, Bio, Animal, Human order, interconnectedness and mutual fulfilment among four orders. Basic characteristic of nature, perseverance, bravery, Generosity, recyclability and self-regulation in nature, Holistic perception of harmony at all levels of existence, human being as a cause of imbalance in nature-pollution, depletion of resources, and role of technology in nature. Understanding existence of human being as a co-existence of mutually interacting units -in all pervasive space. Sustainable development, Environmental responsibility, Resource conservation, Ecological balance, Technology and its impact on society.

Unit III	**Harmony in Family and Society**	**6 Hours**

Family as the basic unit of society: role of family in developing values, mutual understanding, and responsibility. Values in relationships: trust, respect, affection, care, guidance, and gratitude in maintaining harmony in family and society. Ethical behaviour in society: honesty, responsibility, empathy, cooperation, and respect for diversity in social interactions.

Social harmony and responsible citizenship: duties and responsibilities of individuals towards society and community. Professional ethics and social responsibility: role of engineers and professionals in promoting ethical practices and sustainable development. Role of values in building a harmonious society: importance of value-based decision making in personal, social, and professional life.

Unit IV	Holistic Development and Professional Ethics	6 Hours

Holistic approach to life and education: integration of intellectual, emotional, ethical, and social development for balanced personal and professional growth. Human values and ethical principles: understanding honesty, integrity, empathy, responsibility, and respect in personal and social life. Professional ethics: ethical conduct in professional practice, integrity in work, accountability, and commitment to societal welfare. Ethical decision making: identifying ethical dilemmas and applying value-based reasoning in professional situations. Social and environmental responsibility of professionals: contribution of engineers and professionals towards sustainable development and societal well-being. Role of values in leadership and teamwork: importance of trust, cooperation, and ethical behaviour in professional environments.

Unit V	Harmony Between Self and Body	6 Hours

Understanding the Self and the Body: distinction between the conscious self (I) and the physical body. Self–body coexistence: relationship between the self as the experiencer and the body as the instrument of action. Needs of the self and the body: physical needs (food, rest, health) and psychological needs (happiness, values, purpose). Harmony in the individual: maintaining balance between mental well-being and physical health through responsible living. Role of self-awareness and self-regulation: understanding thoughts, emotions, and behaviour for a balanced life. Importance of healthy lifestyle: discipline, proper habits, and value-based living for overall well-being.

- **Textbooks:**
  1. R. R. Gaur, R. Sangal, and G. P. Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, New Delhi.
  2. R. R. Gaur, R. Sangal, and G. P. Bagaria, Universal Human Values – Understanding Harmony AICTE / Excel Books.

- **Reference Books:**
  1. Mike W. Martin and Roland Schinzinger, Ethics in Engineering McGraw Hill.
  2. Charles B. Fleddermann, Engineering Ethics Pearson.

- **MOOC / NPTEL Courses:**

1. Exploring Human Values – Visions of Happiness and Perfect Society by Prof. A. K. Sharma, IIT Kanpur: https://nptel.ac.in/courses/109104068
2. Moral Thinking – An Introduction to Values and Ethics by Prof. Vineet Sahu, IIT Kanpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs169
3. Human Values and Professional Ethics By Dr. Kounsar Jan, Deptt of education University of Kashmir: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg125
4. Universal Human Values by Reliance Foundation Skilling Academy: https://www.skillindiadigital.gov.in/courses/detail/d7db86f0-d2d8-42aa-a8c0-502467563b5a

- **Activities for term work Evaluation:**
  1. Group Discussion on Human Values and Ethics
  2. Case Study Analysis on Ethical Issues in Society and Profession
  3. Reflective Journal Writing on Self-Development and Values
  4. Role Play / Skit on Social Responsibility and Moral Values

5. Debate on Contemporary Ethical and Social Issues
6. Community Service / Social Outreach Activity Report
7. Seminar / Presentation on Professional Ethics and Leadership
8. Essay Writing on Family Values, Harmony, and Responsibility
9. Participation in Workshops, Expert Talks, and Value-Based Activities

Course: Community Engagement Project				**Code: 25ELC201**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Term Work	Marks: 25

Prerequisites: Social study, emotional skill

Course Objectives: The Objectives of the Course are to

1 Understand societal needs, community problems, and local challenges through direct engagement.

2 Apply engineering knowledge and skills to address real-world community issues.

3 Develop ethical values, social responsibility, and sustainability awareness.

4 Enhance teamwork, leadership, and communication skills in a community setting.

5 Promote lifelong learning through reflective practice and experiential learning.

- **Course Outcomes:** At the end of the course, students will be able to:

CO No.	Course Outcome
CO1	Identify and analyze societal and community-based problems using systematic approaches.
CO2	Apply appropriate engineering or technological solutions to address community needs.
CO3	Demonstrate ethical behaviour, inclusiveness, and sustainability in community interventions.
CO4	Work effectively in multidisciplinary teams and communicate outcomes to stakeholders.
CO5	Reflect on learning experiences to develop self-learning and lifelong learning capabilities.

List of Experiments

Module I: Community Orientation & Need Identification

- Introduction to community engagement and social responsibility
- Survey of local community / village / urban neighborhood
- Interaction with stakeholders (local bodies, NGOs, beneficiaries)
- Identification of community problems (water, sanitation, energy, health, education, environment)
- Problem definition and documentation

Module II: Project Planning & Proposal Development

- Selection of community problem and objectives
- Feasibility study and impact assessment
- Resource planning and scheduling
- Team formation and role assignment
- Preparation of project proposal and approval

Module III: Design & Implementation

- Application of engineering / technological solutions
- Development of low-cost, sustainable, and appropriate solutions
- Field implementation and testing
- Safety, ethical, and environmental considerations
- Mid-term review and feedback

Module IV: Monitoring, Evaluation & Community Interaction

- Performance monitoring and outcome measurement
- Interaction with beneficiaries for feedback
- Social, economic, and environmental impact analysis
- Documentation of challenges and solutions
- **Self study:** Modifications based on feedback

Module V: Reporting, Reflection & Dissemination

- Final report preparation
- Presentation to faculty, community representatives, or NGOs
- Reflection on learning outcomes and societal impact
- Documentation of best practices and lessons learned
- **Self study:** Linking project outcomes to SDGs and lifelong learning

Virtual Laboratories: Carry out any experiment through a virtual lab platform.

SEMESTER IV

Course: Mathematical Foundation for Mechanical Engineering				Code: 25MEPCC204
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Differential & Integral calculus, Differential equations of first order & first degree, Fourier series, Collection, classification and representation of data and Vector algebra.

- **Course Objectives: The objectives of the course are**

1 To introduce the Linear Differential equations and their applications.

2 To familiarize the concepts and techniques of Transforms and their applications.

3 To understand Statistical methods, Probability theory and their applications.

4 To study Numerical Methods with techniques to understand advanced level mathematics.

5 To familiarize the concepts and techniques of Vector calculus and their applications.

- **Course Outcomes:** After successful completion course, students will be able to:

CO No.	Course Outcome
CO1	SOLVE higher order linear differential equations and its applications to model and analyze mass spring systems.
CO2	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.
CO3	APPLY Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to reliability engineering.
CO4	APPLY Probability theory in testing and quality control.
CO5	PERFORM Vector differentiation & integration, ANALYZE the vector fields and APPLY to fluid flow problems.

- **Course Contents:**

Unit I	**Linear Differential Equation**	**8 Hours**

LDE of nth order with constant coefficients, Complementary Function, Particular Integral, General method, Short-cut methods, Method of variation of parameters, Cauchy's and Legendre's DE. Modelling of problems on whirling of shafts and mass spring systems. Maxima and minima (single and multivariable), applications in optimization problems in mechanical engineering.

Unit II	**Transform:**	**8 Hours**

Fourier transforms: Fourier integral theorem, Fourier transform, Fourier sine and cosine integrals, Fourier

transforms, Fourier Sine and Cosine transforms, **Laplace Transform:** Introduction, Laplace Transform of some standard and special functions, Inverse Laplace Transform, Application of Laplace Transform to solve LDE.

Unit III	**Statistics**	**8 Hours**

Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression. statistical quality control, applications in reliability and engineering data analysis.

Unit IV	**Probability Distributions**	**8 Hours**

Probability, Theorems on Probability, Mathematical Expectation, Binomial, Poisson, Normal Distributions and **Self study:** Hypothesis testing: Chi-Square test.

Unit V	**Vector Calculus**	**8 Hours**

Vector Differentiation: Introduction, Vector differential operators, Gradient, Divergent, Curl, Directional Derivatives, Solenoidal and Irrotational fields. Vector Integration and Applications: Introduction to Line Integral,

Self study: Work-done and Green's Lemma.

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Study and Application of Mathematical Techniques in Mechanical Engineering Problems such as optimization, rate of heat transfer, fluid flow analysis, vibration analysis, or machine design calculations. Prepare a report on the mathematical modeling and solution approach.
2. Presentation on an Advanced Topic Related to Engineering Mathematics, such as Numerical Methods, Fourier Series, Laplace Transforms, Differential Equations in Engineering, Optimization Techniques, or Mathematical Modeling in Mechanical Engineering.
3. Use of Mathematical Software/Tools (MATLAB, Scilab, Python, Excel, etc.) to solve engineering problems involving matrices, differential equations, numerical integration, interpolation, or statistical analysis, and prepare a report on the results obtained.

- **Textbooks:**

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

- **MOOC / NPTEL Courses:**

1. https://nptel.ac.in/courses/111106086/
   (NPTEL1, Discrete Mathematics, Prof. SouravChakraborty, Chennai Mathematical Institute)
2. https://nptel.ac.in/courses/111106100/
   (NPTEL2, Differential Equations for Engineers, Prof. Srinivasa Rao Manam, IIT Madras)
3. https://nptel.ac.in/courses/111105122/

(NPTEL3, Integral and Vector Calculus, Prof. Hari Shankar Mahato, IIT Kharagpur)

4. https://nptel.ac.in/courses/111106151/
   (NPTEL4, Algebra - II, Prof. Sankaran Viswanath Prof. Amritanshu Prasad, IMSc)
5. https://nptel.ac.in/courses/111106152/
   (NPTEL5, Mathematical Methods In Physics 2, Prof. Auditya Sharma, IISER Bhopal)

Course: IC Engines & Electrical Vehicle			**Code: 25MEPCC205**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**
Lecture	3	3	CCA: 20
			ISE: 30
			ESE: 50

Prerequisites: Systems in Mechanical Engineering, Basics of Engineering Thermodynamics, Engineering Mathematics

- **Course Objectives: The objectives of the course are**

1 Understand the fundamental principles, construction, and thermodynamic cycles of internal combustion engines.

2 Analyse combustion processes, fuel injection systems, knocking phenomena, and alternative fuels used in IC engines.

3 Evaluate engine performance, testing methods, and emission control technologies to meet current emission standards.

4 Understand engine subsystems and recent trends including ignition systems, cooling, lubrication, and advanced IC engine technologies.

5 Understand the principles, architecture, components, and operation of electric vehicles, including motors, batteries, power electronics, and charging systems

- **Course Outcomes:** At the end of the course, students will be able to:

CO No.	Course Outcome
CO1	Explain the fundamentals of IC engines, engine components, valve timing, intake and exhaust systems, and analyze air-standard, fuel-air, and actual cycles.
CO2	Describe combustion in SI & CI engines, fuel injection systems, knocking, and alternative fuels
CO3	Analyze engine performance parameters, testing methods, emission formation, and control technologies
CO4	Explain engine subsystems and discuss recent trends such as EMS, HCCI, AI-based diagnostics
CO5	Explain EV architecture, motors, batteries, power electronics, charging systems, and safety

- **Course Contents:**

Unit I	Fundamentals of IC Engines & Fuel, Air and Actual Cycle Cycles	8 Hours

Fundamentals of IC Engines: Engine Terminology, Engine classification, Applications, I.C. Engine construction - components and materials, Valve timing diagram, Intake and exhaust system.

Fuel, Air and Actual Cycle: Air-standard cycles- Otto, Diesel & Dual Cycle (Derivation of Efficiencies & MEP), fuel air cycles, and actual cycles, Effects of variables on performance, various losses and Comparison of Air standard with Fuel and Actual cycle.

Unit II	Combustion in IC Engines & Fuel Technology	8 Hours

Combustion in IC Engines: Stages of combustion in SI and CI Engines, Fuel injection system in SI & CI Engines Combustion in SI and CI engines and factors affecting efficiency, detonation/knocking in SI and CI engines, Combustion Chambers used in SI & CI Engine.

Fuel Technology: Properties of fuels, Biofuels, hydrogen, synthetic fuels, LPG, CNG, ethanol/methanol. Role of octane and cetane numbers, fuel additives.

Unit III	Engine Performance & Testing, Emission Control Technologies	8 Hours

Engine Testing Procedure and Engine parameters, Indicated power, Brake power, fuel consumption, Air Consumption, Measurement of friction power by Willan's Line Method and Morse Test, heat balance sheet of IC Engines and performance Characteristic curves. Supercharging and turbocharging

Emission Control Technologies: Pollutants from engines- CO, HC, NOx, PM, and their impact on air quality, Emission reduction strategies: Exhaust Gas Recirculation (EGR), Selective Catalytic Reduction (SCR), Diesel Particulate Filters (DPF), Three-Way Catalysts (TWC), emission norms.

Unit IV	Engine Systems & Recent Trends in I.C Engine	8 Hours

Ignition system: Battery and magneto ignition system, Electronics Ignition (CDI- Capacitor Discharge Igniter, TCI-Transistor Controlled Igniter). **Cooling system:** Air Cooling, Liquid cooling. **Lubrication system:** Objectives of lubrication system, properties of lubricant, lubrication systems, **Recent Trends in IC Engine:** Introduction to engine management systems (EMS) and ECU-controlled ignition,

Self study: Advanced combustion technologies: HCCI, RCCI, PCCI, and digital twins in IC engines

Unit V	Electric Vehicle Technology	8 Hours

Introduction to Electric Vehicles: Need of EV, Classification of electric vehicles, Comparison of IC engine vehicles and EVs, EV Architecture and Powertrain, **Electric Motors for EV Applications:** Traction motor requirements, Types of motors used in EVs, Torque–speed characteristics, Motor selection criteria for EVs.

Battery fundamentals, Type of batteries, Battery parameters, Battery pack configuration, Introduction to Battery Management System (BMS). DC–DC converters and inverters, Motor controller functions, Regenerative braking and energy recovery. EV charging methods, On-board and off-board chargers, charging levels and charging time estimation, Electrical and battery safety,

Self study: Thermal issues in EVs, Environmental impact.

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Visit to any automobile showroom and study the specifications of engine and complete vehicle.
2. Presentation on any advanced topic related to IC engine or electric vehicle.
3. Visit to any automobile service station and prepare report.
4. Study of battery management system of electric vehicle.

- **Textbooks:**

1. V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill
2. M. L. Mathur and R.P. Sharma, "A course in Internal combustion engines", Dhanpat Rai & Co

- **Reference Books:**

1. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw-Hill.
2. Domkundwar & Domkundwar, "Internal Combustion Engine", Dhanpat Rai & Co.
3. R. Yadav, "Internal Combustion Engine", Central Book Depot, Ahmedabad

- **MOOC / NPTEL Courses:**

1. https://nptel.ac.in/courses/112103262/
   (NPTEL1, IC Engines and Gas Turbines, Prof. Pranab K. Mondal & Prof. Vinayak N. Kulkarni, IIT Guwahati)
2. https://onlinecourses.nptel.ac.in/noc25_me19/preview
   (NPTEL2, Engine System and Performance, Prof. Pranab K. Mondal, IIT Guwahati)
3. https://nptel.ac.in/courses/108106170
   (NPTEL4, Fundamentals of Electric vehicles: Technology & Economics, Prof. Ashok Jhunjhunwala, Prof. Prabhjot Kaur, Prof. Kaushal Kumar Jha, Prof. L Kannan, IIT Madras)
4. nptel.ac.in/courses/108103009
   (Introduction to Hybrid and Electric Vehicles, Prof. S. Majhi, Dr. Praveen Kumar, IIT Guwahati)

Course: Engineering Materials and Metallurgy				Code: 25MEPCC206
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Physics and Chemistry, including atomic structure, bonding, and basic mechanical concepts.

- **Course Objectives: The objectives of the course are**

1 To introduce the structure of materials and their influence on properties.

2 To understand phase diagrams and solidification behavior of metals and alloys.

3 To study mechanical properties and testing methods of materials.

4 To explain heat treatment processes and their effects on microstructure.

5 To familiarize students with engineering materials selection and applications.

- **Course Outcomes:** After successful completion course, students will be able to :

CO No.	Course Outcome
CO1	Explain crystal structures, imperfections, and diffusion mechanisms in materials
CO2	Apply phase diagrams to analyze alloy behaviour and transformations
CO3	Evaluate mechanical properties using destructive and non-destructive testing methods
CO4	Understand heat treatment processes and their effects on microstructure and properties
CO5	Analyze and apply appropriate engineering materials for specific applications

- **Course Contents:**

Unit I	**Crystal Structure and Imperfections**	**8 Hours**

Classification of engineering materials, Atomic structure and interatomic bonding, Crystal structures: SC, BCC, FCC, HCP, Miller indices and crystal planes, Point, line, surface, and volume defects, Diffusion mechanisms and Fick's laws

Unit II	**Phase Diagrams and Heat Treatment**	**8 Hours**

Phase, phase equilibrium, and Gibbs phase rule, Binary phase diagrams –Isomorphous and eutectic systems, Iron–Iron carbide phase diagram, Heat treatment of steels: Annealing, Normalizing, Hardening, Tempering, Case hardening processes: Carburizing, Nitriding

Unit III	**Mechanical Properties and Material Testing**	**8 Hours**

Stress–strain behavior of materials, Mechanical properties: strength, hardness, toughness, ductility, Destructive testing: Tensile, compression, hardness, impact tests, Non-destructive testing: Magnetic Particle testing, Ultrasonic, radiography, eddy current test, dye penetrant test, Introduction to microscopic and macroscopic examinations.

Unit IV	Engineering Materials and Alloys	8 Hours

Classification of ferrous and non-ferrous materials, Plain carbon steels: classification, properties, and applications, Alloy steels: low alloy and high alloy steels, Stainless steels: types, properties, and applications, Cast irons: grey, white, malleable, ductile cast iron, Aluminium and aluminium alloys – properties and applications.

Self study: Copper and copper alloys – properties and applications

Unit V	Material Selection, Failure, and Advanced Materials	8 Hours

Criteria for engineering material selection, Failure mechanisms: fatigue, creep, wear, and corrosion, Prevention of material failure and corrosion control methods Introduction to composite materials – types and applications, Introduction to smart materials and nano materials.

Self study: Industrial applications of advanced materials

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Visit to a Metallurgical Industry, Foundry, Heat Treatment Shop, or Material Testing Laboratory and study the processing, testing, and characterization of engineering materials. Prepare a report on the observations and industrial practices.
2. Presentation on an Advanced Topic Related to Metallurgical Engineering and Material Science, such as Advanced Composite Materials, Nanomaterials, Smart Materials, Surface Engineering, Powder Metallurgy, Additive Manufacturing of Metals, or Sustainable Materials.
3. Study of Microstructure and Properties of Engineering Materials by examining ferrous and non-ferrous materials and correlating their microstructure with mechanical properties and industrial applications. Prepare a technical report.

- **Textbooks:**

1. William D. Callister, Materials Science and Engineering – An Introduction, Wiley
2. V. Raghavan, Materials Science and Engineering, PHI Learning

- **Reference Books:**

2. Avner S. H., Introduction to Physical Metallurgy, McGraw-Hill
3. Smith & Hashemi, Foundations of Materials Science and Engineering, McGraw-Hill
4. Shackelford, Introduction to Materials Science for Engineers, Pearson

- **MOOC / NPTEL Courses:**

1. https://onlinecourses.nptel.ac.in/noc26_mm19/preview
   (NPTEL1, Introduction to Materials Science and Engineering, Prof. Rajesh Prasad, IIT Delhi)
2. https://nptel.ac.in/courses/113106032/
   (NPTEL2, Introduction to Materials Science and Engineering, IIT Madras)
3. https://onlinecourses.nptel.ac.in/noc24_mm12/preview

(NPTEL3, Materials Science and Engineering, Prof. Vivek Pancholi, IIT Roorkee)

4. https://onlinecourses-archive.nptel.ac.in/noc18_mm07/course
   (NPTEL4, Heat Treatment and Surface Hardening, Prof. Kallol Mondal, IIT Kanpur)
5. https://onlinecourses-archive.nptel.ac.in/noc18_mm12
   (NPTEL5, Advanced Materials and Processes, Dr. Jayanta Das, IIT Kharagpur)

Course Artificial Intelligence in Quality Control				Code: 25AIMDM202D
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Engineering Physics, Engineering Mathematics (Probability, Statistics) , Basics of Metrology & Instrumentation , Fundamentals of Quality Control / TQM , Basic Programming (Python)

- **Course Objectives: The objectives of the course are to:**
  1. Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.
  2. To integrate AI & ML techniques with metrology and quality control systems.
  3. To enhance measurement accuracy using intelligent data analysis.
  4. To develop predictive and diagnostic models for quality assurance.
  5. To understand smart metrology in Industry 4.0 environments

- **Course Outcomes**: After **successful completion course, students will be able to:**

  CO1 : To understand the fundamentals of metrology and measurement system.
  CO2: Apply statistical quality control tools such as control charts and process capability indices for process monitoring.
  CO3: Analyze measurement and quality data using AI tools.
  CO4 : Apply machine learning models for error prediction and correction.
  CO5: Implement AI-based solutions in smart manufacturing environments.

- **Course Contents:**

Unit I	**Advanced Metrology Fundamentals & Measurement Systems**	**6 Hours**

Basics of Engineering Metrology : Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, **Calibration:** Concept and procedure, traceability, Geometric Form Measurement: Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate. **Design of Gauges:** Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, limit gauge and gauge materials. Considerations of gauge design (numerical).

Unit II	**Quality Engineering & Statistical Methods**	**6 Hours**

Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability (Indices: cp, cpk, ppk), Statistical Process Control (Numerical). Production Part Approval Method (PPAP).TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications. Integration of AI with statistical quality tools for intelligent decision-making.

Unit III	**Data-Driven Quality Analytics & Machine Learning**	**6 Hours**

Data Acquisition & Statistical Analysis in Metrology: Data acquisition systems and sensors in metrology, Data preprocessing: noise filtering, normalization, feature extraction, Statistical analysis of measurement data, Data cleaning, normalization, feature engineering; Ensemble methods (Random Forest, Gradient Boosting); Dimensionality reduction (PCA); Model validation and cross-validation; AI for root cause analysis; Predictive quality models.

Advances : Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes Machine Vision Systems: vision system measurement – Multisensory systems. Interferometer: Principle, NPL Interferometer

Unit IV	**AI-Based Inspection, Machine Vision & Metrology Automation**	**6 Hours**

Fundamentals of computer vision; Image acquisition and preprocessing; Feature extraction and pattern recognition; Deep learning techniques (CNN, transfer learning) for defect detection; Automated optical inspection (AOI); AI in non-destructive testing (NDT); Robotic inspection systems; Digital image correlation; Real-time quality monitoring using embedded AI systems.

Self study: Integration of AI with CMM and vision-based metrology.

Unit V	**Advanced Applications & Industry Integration of AI & ML**	**6 Hours**

Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT). Measurement of Thread form: Measurement errors: types, sources, uncertainty analysis Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle and Pitch, Floating Carriage Micrometre (Numerical). Gear Metrology: Errors in Spur Gear form, Gear tooth Vernier, Constant chord, Base tangent (Numerical), Gear Rolling Tester. Profile Projector, Tool maker's microscope and their applications.

Smart manufacturing and Industry 4.0;Digital twin for measurement and inspection; AI-driven predictive maintenance; Fault diagnosis using AI; Edge AI in quality inspection; Cloud-based quality analytics; Blockchain for quality traceability.

Self study: Human-AI collaboration in inspection; Sustainability and green quality practices; Ethical issues and future trends in AI-driven quality engineering.

List of Course Activities for Continuous Comprehensive Assessment (Any Two):

1. Measurement Data Collection, Analysis, and Visualization Activity
2. Mini Project / Simple AI Model Demonstration for quality assurance
3. Preparation and analysis of control charts using suitable statistical software.

- **Textbooks:**

1. Jain R.K., Engineering Metrology, Khanna Publication.
2. I. C. Gupta, Engineering Metrology, Dhanpath Rai.
3. Pattern Recognition and Machine Learning – Christopher M. Bishop

- **Reference Books:**

1. Galyer J.F & Shotbolt C.R., Metrology for engineers
2. Machine Learning: A Probabilistic Perspective – Kevin P. Murphy
3. Artificial Intelligence: A Modern Approach – Stuart Russell, Peter Norvi

- **MOOC / NPTEL Courses:**

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_me88
   (NPTEL1, Fundamentals of Artificial Intelligence, Prof. Shyamanta M. Hazarika, IIT Guwahati)
2. https://nptel.ac.in/courses/106102220
   (NPTEL3, An Introduction to Artificial Intelligence, Prof. Mausam, IIT Delhi)
3. https://nptel.ac.in/courses/106105079
   (NPTEL5, Artificial Intelligence, Prof. P. Dasgupta, IIT Kharagpur

Course: Leadership and Team Dynamics			Code: 25OEC202A	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic communication and interpersonal skills

- **Course Objectives:** The objectives of the course are-

1. Introduce concepts of leadership, organizational behavior, and group dynamics.
2. Develop communication, interpersonal, and collaborative leadership skills.
3. Explain leadership styles, motivation theories, and team processes.
4. Enhance conflict resolution, negotiation, and decision-making abilities.
5. Prepare students for leadership roles in multicultural and multidisciplinary organizations

- **Course Outcomes:** At the end of the course, students will be able to

CO 1. Explain leadership theories, organizational behavior, and group dynamics concepts.
CO 2. Apply communication and interpersonal skills in team environments.
CO 3. Analyze leadership styles, group processes, and motivational approaches.
CO 4. Evaluate team effectiveness, conflict management, ethics, and leadership challenges.
CO 5. Develop leadership strategies for professional and global organizational environments.

- **Course Contents:**

Unit I	**Foundations of Leadership and Organizational Behaviour**	**6 Hours**
Introduction to leadership and team management, Leadership versus management , Leadership myths and leadership development , Organizational behavior fundamentals , Groups and types of groups , Stages of group development , Emotional intelligence and self-awareness		
Unit II	**Leadership Theories and Leadership Development**	**6 Hours**
Trait and behavioural leadership theories , Situational and contingency leadership models, Path-goal theory and Leader-Member Exchange (LMX) theory , Transformational and transactional leadership , Power, influence, and persuasion , Leadership ethics, values, and credibility		
Unit III	**Communication, Motivation, and Interpersonal Behaviour**	**6 Hours**
Communication process and barriers, Verbal and non-verbal communication , Social networks, rumors, and grapevine , Motivation theories and leadership , Transactional analysis and JOHARI Window , Coaching, mentoring, and feedback mechanisms		
Unit IV	**Team Dynamics and Conflict Management**	**6 Hours**
Group dynamics and team processes , Team formation and team effectiveness , Cooperation, competition, and cohesiveness , Delegation and empowerment , Conflict management and negotiation , Virtual and multicultural teams		
Unit V	**Organizational Ethics and High-Performance Leadership**	**6 Hours**
Organizational justice and ethical behavior , Corporate Social Responsibility (CSR) , Positive organizational scholarship , Building trust and credibility in teams , High-performance team development , Global leadership and leadership challenges in modern organizations		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Leadership Style Role Play**
   Students perform role plays demonstrating different leadership styles, communication approaches, and conflict management situations.
2. **Team Building & Group Dynamics Activity**
   Practical activities/games to study teamwork, cooperation, delegation, trust-building, and group decision-making.
3. **Case Study Analysis on Organizational Behaviour**
   Analyze real-life organizational situations related to motivation, leadership challenges, ethics, or team conflicts and present solutions.
4. **Communication & Negotiation Workshop**
   Hands-on practice sessions on verbal/non-verbal communication, negotiation skills, feedback mechanisms, and interpersonal behaviour.
5. **Self-Assessment & Leadership Development Report**
   Students prepare a report based on personality tests, emotional intelligence assessment, JOHARI window, or leadership skill evaluation with improvement plans.

- **Text Books:**

1. Hughes, R.L., Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the Lessons of Experience, 9th Edition, McGraw Hill Education, 2019.

- **Reference Books:**

1. Robbins, S.P., Judge, T.A. & Vohra, N., Organizational Behavior, 18th Edition, Pearson Education, 2019.
2. Parek, U. & Khanna, S., Understanding Organizational Behavior, 4th Edition, Oxford University Press, 2018.
3. Greenberg, J. & Baron, R., Behavior in Organizations, 10th Edition, Pearson-Prentice Hall, 2009.
4. Luthans, F., Organizational Behavior, 10th Edition, McGraw-Hill, 2004.
5. Cameron, K.S. & Spreitzer, G.M., The Oxford Handbook of Positive Organizational Scholarship, Oxford University Press, 2012.
6. Baron, R.A. & Byrne, D., Social Psychology, 10th Edition, Pearson Education, 2004.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. Organizational Behaviour: Individual Dynamics in Organization by Prof. Abraham Cyril Issac: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg20
2. Leadership and Team Effectiveness by Prof. Santosh Rangnekar: https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_mg39
3. Leadership & Management : https://swayam-plus.swayam2.ac.in/courses/course-details?id=F_WADHW_26
4. Harvard Business Review Leadership Resources : https://hbr.org/topic/subject/leadership-and-managing-people
5. https://www.edx.org/learn/leadership

Course: Green Practices & ESG Frameworks				Code: 25OEC202B
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic knowledge of environmental science and sustainability, Understanding of industrial processes and resource utilization, Basic awareness of corporate management and ethics

- **Course Objectives:** The Objectives of the Course are

1. To introduce the principles of sustainability and green practices in engineering and industry.
2. To understand Environmental, Social, and Governance (ESG) frameworks used in modern organizations.
3. To analyse environmental impacts and promote sustainable resource management.
4. To study social responsibility and governance practices for sustainable development.
5. To apply ESG reporting standards and sustainability assessment tools in organizations.

- **Course Outcomes:** After successful completion of the course, students will be able to:

CO1: Explain the concepts of sustainability, green practices, and ESG frameworks.

CO2: Analyse environmental impacts and adopt green technologies for sustainable development.

CO3: Evaluate social responsibility and stakeholder engagement practices in organizations.

CO4: Understand governance principles, ethical leadership, and regulatory frameworks.

CO5: Apply ESG reporting standards and sustainability assessment methods in industries.

- **Course Contents:**

Unit I	**Fundamentals of Sustainability and Green Practices**	**6 Hours**

Concept of sustainability and sustainable development, Environmental challenges: climate change, global warming, biodiversity loss, resource depletion, Principles of green practices and environmental responsibility, Green economy and circular economy concepts, Sustainable Development Goals (SDGs) and global sustainability initiatives, Sustainable consumption and production patterns, Role of engineering and technology in sustainable development, Importance of green practices in industrial and organizational activities.

Unit II	**Environmental Sustainability and Green Technologies**	**6 Hours**

Environmental sustainability and environmental protection strategies, Environmental Impact Assessment (EIA) and its importance, Carbon footprint analysis and greenhouse gas emissions, Carbon management strategies and carbon neutrality initiatives, Renewable energy technologies: solar, wind, hydro, biomass, Energy efficiency and energy conservation methods, Waste management techniques: reduce, reuse, recycle (3R concept), Water resource management and pollution control, Green manufacturing, eco-friendly materials, and cleaner production technologies

Unit III	**Social Responsibility and Sustainable Development**	**6 Hours**

Concept and importance of Corporate Social Responsibility (CSR), Employee welfare, workplace health, and safety standards, Labour rights and fair working conditions, Diversity, equity, and inclusion in organizations, Stakeholder engagement and community development initiatives, Social impact assessment and community

sustainability programs, Ethical business conduct and responsible supply chain management, Role of organizations in social and economic development

Unit IV	Governance and Ethical Business Practices	6 Hours

Concept and principles of corporate governance, Governance structures and roles of board of directors, Transparency, accountability, and ethical leadership, Risk management and compliance mechanisms, Business ethics and anti-corruption policies, Legal and regulatory frameworks related to corporate governance, Sustainability governance and corporate responsibility policies, Governance practices for long-term organizational sustainability.

Unit V	ESG Reporting, Assessment, and Implementation	6 Hours

Introduction to ESG metrics and sustainability performance indicators, ESG reporting frameworks and standards, Global Reporting Initiative (GRI) guidelines, Integrated reporting and sustainability disclosure practices, ESG ratings, benchmarking, and performance evaluation, Green finance, sustainable investments, and climate finance, Implementation of ESG strategies in organizations, Challenges in ESG adoption and reporting, Case studies of ESG implementation in industries and multinational companies.

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Campus Green Audit & Waste Segregation Study**
   Students conduct a sustainability audit of the campus/department by analysing waste generation, segregation practices, energy usage, and water consumption. Submit findings with improvement recommendations.
2. **Carbon Footprint Calculation Project**
   Students calculate the carbon footprint of a household, classroom, or small organization using standard carbon calculators and prepare a report suggesting carbon reduction strategies.
3. **ESG Reporting Case Analysis**
   Students select a company and study its ESG or sustainability report (based on GRI/SDG framework). Prepare a presentation evaluating environmental, social, and governance practices.
4. **Sustainable Product / Process Design Activity**
   Teams design an eco-friendly product, packaging solution, or green operational process applying principles of reduce–reuse–recycle and resource efficiency.
5. **Community Awareness & Social Responsibility Campaign**
   Organize and document an awareness activity such as tree plantation, plastic-free drive, energy conservation campaign, or social impact survey, followed by submission of outcomes and reflections.

- **Textbooks:**

1. Understanding Sustainability Principles and ESG Policies**:** Colin Read, Springer Nature, **Year:** 2023
2. The ESG and Sustainability Deskbook for Business, Kristyn Noeth, Springer, 2024

- **Reference Books:**

1. Values at Work: Sustainable Investing and ESG Reporting, Daniel C. Esty, Todd Cort, Palgrave Macmillan,**Year:** 2020
2. Business Responsibility and Sustainability in India, Bimal Arora, Pawan Budhwar, Divya Jyoti **Publisher:** Palgrave Macmillan,**Year:** 2019
3. Looking at and Beyond Corporate Governance in India,**Authors:** Seema Joshi, Ruchi Kansil **Publisher:** Springer / Palgrave Macmillan**Year:** 2023
4. Dharmanomics: An Indigenous and Sustainable Economic Model,**Author:** Sriram Balasubramanian

Publisher: Bloomsbury India,**Year:** 2024

- **MOOC / NPTEL Courses /Online Resources Online Resources:**
  1. Sustainability through Green Manufacturing Systems An applied approach, By Prof. Deepu Philip and Prof. Amandeep Singh, IIT Kanpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg85
  2. Sustainable Energy Technology By Prof. Sayak Banerjee, IIT Hyderabad: https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_me138
  3. Corporate social responsibility By Prof. Aradhna Malik, IIT Kharagpur : https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_mg54
  4. Implementing ESG and Sustainability in Business By Dr. Aditya Gupta, Indian Institute of Management, Bangalore: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg77
  5. Business Ethics and Corporate Governance By Dr. Sweta Banerjee, Dr. Leena Dam, Sri Balaji University, Pune: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg62

Course: Innovation and Business Strategy			Code: 25OEC202C	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic understanding of technology, creativity, and problem-solving concepts.

- **Course Objectives:** The objectives of the course are-

2. Introduce concepts of innovation, creativity, and business strategy.
3. Develop strategic thinking and innovation management skills.
4. Explain business models, entrepreneurship, and technology innovation processes.
5. Familiarize students with sustainability, intellectual property rights, and innovation ecosystems.
6. Prepare students for innovation-driven business and entrepreneurial environments

- **Course Outcomes:** At the end of the course, students will be able to

CO 1. Explain concepts of innovation, creativity, and business strategy.
CO 2. Apply innovation management and strategic thinking tools for business problem-solving.
CO 3. Analyze business models, technology innovation, and entrepreneurial strategies.
CO 4. Evaluate sustainability, intellectual property, and innovation management practices.
CO 5. Develop innovative business solutions and strategic growth approaches.

- **Course Contents:**

Unit I	**Foundations of Innovation and Creativity**	**6 Hours**
Innovation and creativity: concepts and importance, Innovation in the current business environment , Types of innovation , Schools of innovation , Challenges of innovation , Divergent and convergent thinking		
Unit II	**Innovation Management and Design Thinking**	**6 Hours**
Innovation management process, Idea management systems, Design thinking and entrepreneurship Experimentation and prototyping , Co-creation and idea championship , Incubation and entrepreneurship ecosystems		
Unit III	**Business Models and Strategic Innovation**	**6 Hours**
Business models and value proposition , Entrepreneurship and social entrepreneurship , Blue Ocean Strategy , Strategic positioning and competitive advantage , Business model failure: reasons and remedies , Innovation-driven business growth		
Unit IV	**Technology Innovation and Intellectual Property Rights**	**6 Hours**
Technology innovation process , Technology forecasting and planning , Technological innovation management strategies , Management of innovation , Intellectual Property Rights (IPR) Patents, copyrights, and patents in India		
Unit V	**Sustainable Innovation and Future Business Trends**	**6 Hours**
Sustainability innovation and entrepreneurship, Innovation for sustainable development , SME involvement in sustainability , Material efficiency and sustainable business models , Managing investors for innovation , Future markets and innovation opportunities for India		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Innovation Idea Pitch Presentation**
   Students identify a real-world problem and present an innovative product, service, or business solution using creativity and design thinking tools.

2. **Business Model Canvas Workshop**
   Teams prepare a Business Model Canvas for a startup or sustainable business idea, explaining value proposition, customer segments, revenue streams, and competitive advantage.
3. **Prototype Development & Demonstration**
   Students create a basic prototype/mock-up of an innovative product or digital solution and demonstrate its functionality and market relevance.
4. **Case Study Analysis on Successful Innovations**
   Analyze companies known for innovation and strategy (e.g., startups or technology firms) and present factors behind their success, business strategy, and innovation practices.
5. **IPR & Patent Search Activity**
   Students perform a patent/trademark search related to a chosen innovation area and prepare a short report on intellectual property protection and commercialization opportunities.

- **Text Books:**

2. Krishnan, R.T. & Dabholkar, V., 8 Steps to Innovation: Going from Jugaad to Excellence, Harper Collins India.

- **Reference Books:**

- Drucker, Peter F., Innovation and Entrepreneurship, Routledge.
- Harvard Business Review Series, Innovation and Entrepreneurship, Harvard Business School Publishing.
- Osterwalder, A. & Pigneur, Y., Business Model Generation, Wiley.
- Kim, W. Chan & Mauborgne, Renée, Blue Ocean Strategy, Harvard Business Review Press.
- Tidd, J. & Bessant, J., Managing Innovation, Wiley Publications.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. Innovation Business Models and Entrepreneurship by Prof. Vinay Sharma, Prof. Rajat Agrawal : https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_mg95
2. Entrepreneurship & IP strategy by Prof. Gouri Gargate : https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_hs213
3. Managing Innovation by Rishikesha T Krishnan and Vinay Dabholkar: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb19_mg05
4. Business Strategy Specialization by University of Virginia: https://www.coursera.org/specializations/business-strategy
5. Design Thinking for Beginners: Develop Innovative Ideas (Udemy): https://www.udemy.com/course/design-thinking-for-beginners/?couponCode=PMNVD2025
6. Strategic Management Resources : https://www.hbsp.harvard.edu/catalog/collections/strategic-management-resources
7. https://www.edx.org/learn/innovation

Course: Stress Management and Mental Well Being				Code: 25OEC202D
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic awareness about personal health, emotions, and daily life challenges.

- **Course Objectives:**
  1. To introduce the concept of stress, mental health, and wellbeing.
  2. To help students identify stressors in academic and professional life.
  3. To develop effective coping strategies and stress management skills.
  4. To promote emotional intelligence and resilience.
  5. To encourage healthy lifestyle habits for long-term wellbeing.

- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain the concepts of stress, mental health, and wellbeing

  CO2: Identify sources of stress and analyse their impact

  CO3: Apply stress management techniques

  CO4: Demonstrate emotional intelligence and coping strategies

  CO5: Design a personal wellbeing and stress management plan

- **Course Contents:**

Unit I	**Fundamentals of Stress and Mental Health**	**6 Hours**

Concept and definition of stress and mental wellbeing, Types of stress: Eustress and Distress, Stress response and General Adaptation Syndrome (GAS), Causes and symptoms of stress, Mind–body relationship, Impact of stress on academic performance and productivity. Difference between stress, anxiety, and depression.

Unit II	**Sources of Stress and Emotional Awareness**	**6 Hours**

Academic, professional, social, and personal stressors; Personality types and stress (Type A and Type B personality);
Emotional intelligence: Self-awareness, Self-regulation, Motivation, Empathy, Social skills; Identifying negative thinking patterns

Unit III	**Stress Management Techniques**	**6 Hours**

Relaxation techniques: Deep breathing, Progressive muscle relaxation; Meditation and mindfulness, Yoga and physical exercises for stress reduction, Time management and goal setting, Positive thinking and cognitive restructuring

Unit IV	**Mental Wellbeing and Healthy Lifestyle**	**6 Hours**

Importance of sleep, nutrition, and physical activity, managing emotions: anxiety, anger, frustration, Building resilience and self-confidence, Work–life balance, Digital wellbeing and social media stress

Unit V	**Personal Development and Coping Strategies**	**6 Hours**

Interpersonal communication and relationship management, Coping strategies for change and uncertainty,

Conflict management and emotional regulation, Developing a personal wellbeing plan, Case studies on stress management in student and workplace environments.

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Stress Diary & Self-Assessment Activity**
   Students maintain a weekly stress journal to identify stress triggers, emotional responses, and coping methods, followed by a reflective analysis report.
2. **Mindfulness and Relaxation Practice Session**
   Conduct guided activities such as meditation, deep breathing, yoga, or progressive muscle relaxation and submit observations on stress reduction outcomes.
3. **Case Study Analysis on Mental Wellbeing**
   Analyze real-life or workplace/student stress management cases and suggest coping strategies, emotional intelligence techniques, and wellbeing solutions.
4. **Work–Life Balance & Digital Wellness Survey**
   Students design and conduct a survey on stress, screen time, sleep, or work–life balance among peers, then present findings with recommendations.
5. **Personal Wellbeing and Stress Management Plan**
   Prepare an individual wellness plan including fitness, sleep, nutrition, time management, and emotional wellbeing strategies for long-term mental health improvement.

- **Textbooks:**

1. Leahy, Robert L. The Worry Cure. Three Rivers Press, 2006.
2. Carnegie, Dale. How to Stop Worrying and Start Living. Simon & Schuster, 1948.
3. Johnstone, Matthew. I Had a Black Dog. Robinson Publishing, 2005.

- **Reference Books:**

1. Goleman, Daniel. Emotional Intelligence: Why It Can Matter More Than IQ. Bantam Books, 1995.
2. Kabat-Zinn, Jon. Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life. Hyperion, 1994.
3. Covey, Stephen R. The 7 Habits of Highly Effective People. Free Press, 1989.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. NPTEL course on Stress Management by Prof. Rajlakshmi Guha, IIT Kharagpur: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_hs163
2. NPTEL course on Psychology of Stress, Health and Well-being by Prof. Dilwar Hussain, IIT Guwahati: https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_hs29

Course: French Language Module-II			Code: 25OEC202E	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	**CCA**	**20**
			ISE	**30**
			ESE	**50**

- **Prerequisites:** French Language Module-I

- **Course Objectives:** The objectives of the course are-
  1. To strengthen basic communication skills in French.
  2. To develop listening, reading, and writing skills in French.
  3. To enhance confidence in practical conversations.
  4. To apply French vocabulary and expressions in travel and public communication contexts.
  5. To prepare students for DELF A1 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

  CO1. Use basic French expressions confidently in familiar situations.

  CO2. Interpret simple dialogues and instructions in French.

  CO3. Read and write short paragraphs on familiar topics.

  CO4. Participate in guided conversations using appropriate French expressions.

  CO5. Apply French language skills in practical and everyday situations.

- **Course Contents:**

Unit I	**Voyages (Travel)**	**6 Hours**
Talking about one's dream travel destination, The near future tense , Prepositions , Giving a reason (parce que / car)		
Unit II	**Au magasin… au restaurant (At the store… at the restaurant)**	**6 Hours**
Clothes and accessories , Shopping dialogues , French cuisine and some famous dishes , Restaurant communication		
Unit III	**La vie quotidienne (Daily life)**	**6 Hours**
Pronominal verbs , Talk about one's routine , Talk about one's favourite outings , Conversation to plan outings		
Unit IV	**Quand j'était petie …(When I was little…)**	**6 Hours**
Past tense (Le passé compose), Talk about some activities in the past, Past continuous (L'imparfait) Talk about one's childhood		
Unit V	**La francophonie (The French-speaking world)**	**6 Hours**
Francophone countries , Talking about seasons and climate , Expressing emotions, Conversations		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**

1. **Shopping Role Play:** Students perform shopping conversations using French vocabulary and expressions.
2. Restaurant Communication Activity: Students practice ordering food and interacting in French.
3. Travel Conversation Simulation: Students perform dialogues related to travel and directions.
4. **Travel Conversation Simulation:** Students perform dialogues related to travel and directions.
5. **Paragraph Writing in French:** Students write short paragraphs on daily routines or hobbies.
6. **French Culture Presentation:** Students present information on French-speaking countries or traditions.

- **Text Books:**

1. Véronique M Kizirian, Emmanuelle Daill, Annie Berthet, Catherine Hugot, "Alter Ego+ (A1)", Hachette , ISBN: 9782011558107, (Goyal Publishers)
2. Nathalie Hirschsprung, Tony Tricot, "Cosmopolite 1-A1", Textbook +Workbook (2 Book Set) (Goyal Publishers), ISBN: 9788194434108

- **Reference Books:**

1. Annie Heminway, "Practice Makes Perfect: Complete French Grammar", McGraw-Hill Education, ISBN-13 : 978-1259642371
2. Claire Miquel, "Vocabulaire progressif du francais - Niveau debutant (A1)", Cle International, ISBN-13 : 978-2090380170, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
3. Evelyne Siréjols, "Communication En Dialogues", CLE international, ISBN: 9782090380637 (Goyal Publishers)
4. Myrna Bell Rochester, "Easy French Step-By-Step: Master High-Frequency Grammar for French Proficiency—Fast", McGraw Hill, ISBN-13 : 978-0071453875
5. Claire Miquel, "Communication Progressive du Français A1", CLE International, Atlantic Publishers and Distributors (P) Ltd., 7/22, Ansari Road, Darya Ganj, New Delhi – 110002
6. Ranjit, Mahita & Singh, Monica, Apprenons le frangais', Part 2, Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007
7. Ranjit, Mahita & Singh, Monica, Cahier d'exercices', (Apprenons le francais) Part 2., Saraswati House Pvt. Ltd.,New Delhi. Second Revised Edition, 2007

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. The Complete French Course : Learn French – Beginners : https://www.udemy.com/course/french-for-beginners-a1/?couponCode=PMNVD2025
2. Francés Introductorio: https://www.coursera.org/learn/frances-introductorio
3. Français Débutant A1 : https://www.coursera.org/learn/french-beginner
4. The Complete French Course : Learn French - Low Intermediate : https://www.udemy.com/course/the-complete-french-course-learn-french-low-intermediate/?couponCode=PMNVD2025
5. Complete French Course: Learn French for Beginners : https://www.udemy.com/course/complete-french-course/?couponCode=PMNVD2025

Course: German Language Module-II			Code: 25OEC202F	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** German Language Module-I

- **Course Objectives: The objectives of the course are-**

1. To strengthen basic communication skills in German.
2. To develop listening, reading, and writing skills in German.
3. To enhance confidence in practical conversations.
4. To apply German vocabulary and expressions in travel and public communication contexts.
5. To prepare students for Goethe A1 level competency.

- **Course Outcomes:** At the end of the course, students will be able to

CO1. Use basic German expressions confidently in familiar situations.
CO2. Interpret simple dialogues and instructions in German.
CO3. Read and write short passages on familiar topics.
CO4. Participate in practical conversations using appropriate German expressions.
CO5. Apply German language skills in everyday situations.

- **Course Contents:**

Unit I	Wohnen und Leben (Housing and life)	6 Hours

Topics and Vocabulary: house (different types of houses and things inside a house), furniture , renting

Grammar: Accusative case, Definite, Indefinite articles in accusative case, Accusative case – Personal Pronouns, Accusative case – Possessive Pronouns

Skills: Speaking: describe room/home, Reading: advertisements , Writing: a message to friends to invite for celebration

Unit II	Stadt und Orientierung (City and Orientation)	6 Hours

Topics and Vocabulary: Places in city , Means of transport , Directions , Travel , Planning and hotel booking

Grammar: Types of sentences and formation- statement, interrogative sentence, imperative sentence, Past tense formation- haben, sein

Skills : Speaking: asking/giving directions, Listening: friends planning a trip, Writing: My last trip, Reading: trip blogs and experiences

Activity: Navigation task

Unit III	Essen und Trinken (Food and Drink)	6 Hours

Topics and Vocabulary: Food, Beverages, Restaurant expressions, Shopping and cooking

Grammar: Perfekt tense introduction - haben/sein, Adjectives

Skills: Reading and writing: food blogs, Speaking: ordering food, expressing likes/dislikes

Activity: café role-play

Unit IV	Gesundheit und Körper (Health and body)	6 Hours

Topics and Vocabulary: Body parts , Symptoms , Medicine ,

Grammar: Conjunctions, Modal auxiliary- function, usage, structure

Skills: Email writing/ message writing- unable to attend an event because of illness, Reading- health related small text,

Activity: doctor-patient conversations

Unit V	Intercultural Communication (Intercultural Communication)	6 Hours

Topics: German etiquette, punctuality, university culture, workplace culture

Skills: intercultural awareness , formal communication

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  1. **Shopping Role Play:** Students perform shopping conversations using German vocabulary and expressions.
  2. **Restaurant Communication Activity:** Students practice food ordering conversations in German.
  3. **Travel Conversation Simulation:** Students perform dialogues related to travel situations and directions.
  4. **Paragraph Writing in German:** Students write short paragraphs on familiar topics in German.
  5. **German Culture Presentation:** Students present information about German-speaking countries and traditions.

- **Text Books:**
  1. Stefanie Dengler, “Netzwerk A1 (Textbook + Workbook + Glossar)”, Hachette , ISBN: 9788183077033, (Goyal Publishers)
  2. Kurs Und Ubungsbuch, “Studio-D A1 - Combo of 3 (German)”, Goyal Publishers & Distributers

- **Reference Books:**
  1. Martin Durrell, “Hammer's German Grammar and Usage”, Fifth Edition: Volume 1, Hodder Education
  2. Harriette Lanzer, Anne Lise Gordon, “German Vocabulary Builder”, OUP Oxford
  3. Funk and Kuhn, “Studio D A1Deutsch Buch “, Cornelsen Verlag (Goyal Publishers India)

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
2. Practise German for free (Goethe-Institut Resources) : https://www.goethe.de/en/spr/ueb.html
3. Learn German Easily: https://learn-german-easily.com/
4. BBC Languages German: https://www.bbc.co.uk/languages/german/
5. Gothe Exam A1 practice material : https://www.goethe.de/ins/mm/en/spr/prf/gzsd1/ueb.html
6. Best Way to Learn German Language: Full Beginner (A1.1): https://www.udemy.com/course/best-way-to-learn-german-full-beginner-starter-kit/?couponCode=PMNVD2025
7. Best Way to Learn German Language: Beginner Level 2 (A1.2) : https://www.udemy.com/course/learn-german-for-the-advancing-beginner-a1-a2/?couponCode=PMNVD2025

Course: Japanese Language Module-II			Code: 25OEC202G	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Japanese Language Module-I

- **Course Objectives:**
  1. To strengthen beginner-level Japanese communication skills.
  2. To improve reading and writing abilities in Japanese.
  3. To develop confidence in practical conversations.
  4. To introduce travel and public communication vocabulary.
  5. Learn about Japanese festivals, food and travel.

- **Course Outcomes:** At the end of the course, students will be able to
  - CO 1. Communicate using beginner-level Japanese expressions.
  - CO 2. Understand short dialogues and passages.
  - CO 3. Read and write basic Japanese sentences.
  - CO 4. Participate in practical conversations.
  - CO 5. Apply Japanese in everyday situations.

- **Course Contents:**

Unit I	Unit I	Unit I
Katakana, Adjectives types, Particle usage, Katakana Pronunciation		
Unit II	**Unit II**	**Unit II**
Culture & Etiquette, Asking directions, Basic Communication		
Unit III	**Unit III**	**Unit III**
Pronunciation improvement, Listening comprehension, Dialogue practice, Group conversation		
Unit IV	**Unit IV**	**Unit IV**
Numbers, Dates & Time, Vocabulary enhancement, Translation practice		
Unit V	**Unit V**	**Unit V**
Japanese culture and etiquette, social conversations, Telephone communication, Presentation activities		

- **List of Course Activities for Continuous Comprehensive Assessment (Any Two):**
  - 1.Shopping Role Play: Students perform shopping conversations using Japanese vocabulary and expressions.

2. **Restaurant Communication Activity:** Students practice ordering food and basic interaction in Japanese.
3. **Travel Conversation Simulation:** Students perform dialogues related to travel and directions in Japanese.
4. **Paragraph Writing in Japanese:** Students write short paragraphs on daily routines or hobbies.

- **Japanese Culture Presentation:** Students present information about Japanese traditions or festivals.

- **Text Books:**

1. 3A Corporation, "Minna No Nihongo 1-1,1-2,2-1,2.2 Main Textbook elementary", ISBN-13: 9789388141147, Goyal Publishers & Distributors Pvt. Ltd, India
6. Banno Eri, "Genki: An Integrated Course in Elementary Japanese II Textbook [third Edition]", ISBN-13 : 978-4789017329, Japan Times

- **Reference Books:**

1. The Japan Foundation, "Marugoto: Japanese Language and Culture Starter A1 Coursebook for Communicative Language Activities", Goyal Publishers
2. The Japan Foundation, "Marugoto Starter (A1) Rikai - Course Book For Communicative Language Competences", Goyal Publishers, ISBN-13: 9788183078047
3. The Japan Foundation, "Marugoto Starter (A1) Katsudoo", Goyal Publishers
4. "Japanese for Busy People,3rd edition", Association for Japanese Language Teaching, Kodansha Tokyo Japan Kodansha International, November, 2011.,
5. Tae Kim, "A Guide to Japanese Grammar: A Japanese Approach to Learning Japanese Grammar", Createspace Independent Pub, ISBN-13 : 978-1495238963, Bookswagon, 2/13 Ansari Road, Daryaganj, New Delhi 110002
6. Timothy G. Stout , Kaori Hakone, "Japanese Kanji for Beginners: (JLPT Levels N5 & N4) First Steps to Learn the Basic Japanese Characters", Tuttle Publishing UK, Verseas Press India Pvt Ltd.

- **MOOC / NPTEL Courses /Online Resources Online Resources:**

1. Online Japanese Beginner Course (Udemy): https://www.udemy.com/course/online-japanese-beginner-course
2. JF-Japanese e-learning : https://minato-jf.jp/
3. Introduction to Japanese Langauge : Prof Vatsala Misra (NPTEL): https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_hs83
4. Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online
5. Marugoto Online : https://www.marugoto-online.jp/info/

4. JLPT N5 Practice Material: https://www.jlpt.jp/e/samples/sampleindex.html

Course: Metrology and Quality Control				Code: 25MEPCC204L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

- **Prerequisites: Engineering Physics, Engineering Drawing / Engineering Graphics, Engineering Mathematics, Manufacturing Processes**

- **Course Objectives: The objectives of the course are to:**
  1. Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements
  2. Calibrate measuring instruments and also design inspection gauges
  3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc
  4. Select and apply appropriate Quality Control Technique for given application
  5. Select and Apply Appropriate Quality Management Tool and suggest appropriate Quality Management System (QMS).

Course Outcomes: After successful completion course, students will be able to:

CO1 Identify various linear, angular, and surface measurement instruments and explain their working principles.

CO2 Demonstrate the use of precision instruments like micrometer, venire calipers, dial gauge, sine bar, slip gauges, and profile projector for dimensional inspection.

CO3 Perform calibration of instruments and machines to ensure accuracy and repeatability in measurements.

CO4 Apply statistical quality control tools (e.g., control charts, histograms, Cp/Cpk) for process evaluation.

CO5 Analyze measurement data, identify deviations, and suggest quality improvement strategies based on inspection outcomes.

List of Experiments

1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.
2. Introduction of subject Fundamentals of measurements and Calibration process by using Dead Weight Tester/Strain Gauges/Pressure Gauge
3. Calibration of measuring instrument. Example – Dial gauge, Micrometre, Vernier (any one) (Refer ISO 17025).
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator. [An assignment with this experiment write-up as, Introduction to use of Standard CODE viz. ASME-Y14.5, ISO-1101].
5. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester.
6. Identification of surface patterns of given specimen by using Optical Flat.
7. Measurement of thread parameters using floating carriage diameter measuring machine.
8. Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometre / Gear Rolling Tester.
9. Determination of geometry and dimensions of given composite object / single point tool, using

profile projector and tool maker's microscope.

10. Verification of dimensions and geometry of given components using Electric/Mechanical/Optical/Pneumatic comparator in context of manufacturing. (**Self study)**

Part: B] Statistical Quality Control (SQC) (Any Two) Note - Use of computational tools [such as Minitab / Matlab / MS Excel] are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application. Submission of these assignments USING STANDARD FORMATS.

2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM).(**Self study)**

Part: C] Industrial visit to:

- Demonstration of CMM with the help of software and its futuristic improvements as per Industry 4.0 requirements.
- Design of Go –No Go gauges and Sensor applications with modernization as per IOT and Industry 4.0
- Calibration Process as per NABL accreditation norms.
- Laser Metrology and its relevant setup functions to be carried out by engineers along with safety precautions to reduce measurement lead time and uncertainty

Virtual Laboratories: Carry out any experiment through a virtual lab platform.

Course: IC Engines Laboratory				**Code: 25MEPCC205L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Systems in Mechanical Engineering, Basics of Engineering Thermodynamics, Engineering Mathematics

- **Course Objectives: The objectives of the course are to**
  1. Conduct performance and friction power tests on IC engines and interpret experimental results
  2. Analyze energy distribution and heat losses in IC engines through heat balance calculations.
  3. Study and understand the working of major IC engine subsystems such as fuel injection, ignition, cooling, and lubrication systems.
  4. Measure and analyze engine exhaust emissions and smoke levels using standard diagnostic instruments.
  5. Gain practical exposure to electric vehicle architecture and real-world automotive systems through laboratory study and industrial visits.

- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Conduct IC engine experiments to determine **friction power, performance parameters, and thermal efficiencies** using standard testing methods.

  CO2: Prepare and analyze the **heat balance sheet of an IC engine** and evaluate various heat losses under different load conditions.

  CO3: Identify and explain the **construction and working of IC engine subsystems**, including fuel injection, ignition, cooling, and lubrication systems.

  CO4: Measure and interpret **exhaust emissions (CO, HC, NOx, CO_2) and smoke density**, and relate results to engine operating conditions and emission norms.

  CO5: Explain the **basic architecture and powertrain components of electric vehicles** and relate laboratory knowledge to **real-world automotive practices** through industry exposure.

List of Experiments

1. Assembly and dismantling of IC Engine.
2. Heat Balance Sheet of an SI Engine: Calculation of heat input, heat output, and heat losses at different load conditions.
3. Performance Test on Multi Cylinder Four-Stroke SI Engine: To determine brake power, brake specific fuel consumption, and thermal efficiencies
4. Performance Test on Single Cylinder Four-Stroke CI Engine: Evaluation of engine performance characteristics and preparation of performance curves
5. Study of Fuel Injection System in CI Engine: Functional study of fuel pump, injector, and injection timing.
6. Determination of Friction Power using Morse Test
7. Measurement of CO, HC, NOx, and CO_2 using an exhaust gas analyser & smoke using smoke meter
8. Study of EV Battery Technologies (**Self study)**
9. Study of Electric Vehicle Architecture and Powertrain Components (**Self study)**
10. Visit to Automobile service station

Any 7 experiments out of Sr No. 1 to 9 and Experiment No 10 is compulsory.

Virtual Laboratories: Carry out any experiment through a virtual lab platform.

Course: Materials and Metallurgical Testing Laboratory			**Code: 25MEPCC206L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Basic knowledge of **Physics and Chemistry**, including atomic structure, bonding, and basic mechanical concepts.

- **Course Objectives: The objectives of the course are**

1 To introduce students to destructive and non-destructive testing methods for evaluating mechanical properties and material integrity.

2 To develop understanding of hardness testing techniques and their applications for different engineering materials.

3 To familiarize students with specimen preparation techniques and microscopic examination of metallic materials.

4 To enable students to identify and interpret microstructures of ferrous and non-ferrous metals under optical microscopy.

5 To expose students to industrial practices related to materials testing, heat treatment, and quality evaluation through laboratory work and industrial visits.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Apply appropriate **destructive testing methods** to evaluate hardness and impact strength of engineering materials.

CO2: Perform and interpret results of **non-destructive testing techniques** for defect detection in materials.

CO3: Prepare metallographic specimens and **analyze microstructures** of steels, cast irons, and non-ferrous metals

CO4: Correlate **heat treatment processes** with changes in microstructure and hardness of steels.

CO5: Demonstrate understanding of **industrial material testing practices** through industrial visits and technical reporting.

List of Experiments

1 Destructive testing - Hardness testing (Rockwell/Vickers) Hardness conversion number.

2 Brinell and Poldi hardness Test.

3 Impact Test for Steel, Aluminum, Brass and Copper (Charpy/Izod)

4 Non Destructive testing - Dye Penetrant Test/ Magnetic Particle test/ Ultrasonic Test.

5 Steps for Specimen Preparation for microscopic examination & Demonstration of Optical Metallurgical microscope

6 Observation and Drawing of Microstructure of Steels, Cast Iron of various compositions.

7 Observation and Drawing of Microstructure of Non Ferrous Metals of various compositions.

8 Heat Treatment of steels based on relative hardness.

9 Creep and Fatigue Test (Virtual Lab).**(Self study)**

10 The Industrial Visit must be preferably to

Material & Metallurgy related like Engineering Cluster, NDT Lab, and Nearby NABL lab or Any manufacturing unit with material orientation.

Student must submit a properly documented Industrial Visit Report.

(Any 8 experiments from above list)

Virtual Laboratories: Carry out any experiment through a virtual lab platform.

Course: Solid Modeling and Drafting Laboratory				Code: 25MEVSE202
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	Marks: 25

Prerequisites: Engineering Graphics, Solid Mechanics, Engineering Materials and Metallurgy, Engineering Mathematics, Computer Fundamentals

- **Course Objectives: The objectives of the course are to**

1 Understand and navigate the CAD software interface, including sketching, parametric modelling, and part/assembly management.

2 Apply 3D modelling techniques to create simple and advanced machine components with accurate dimensions and material properties.

3 Design sheet metal parts, generate flat patterns, and prepare manufacturing-ready drawings.

4 Perform basic simulations and analyze stress, deformation, and motion in mechanical components and assemblies.

5 Prepare detailed 2D drawings, including assembly drawings, BOM, tolerances, and GD&T symbols, suitable for manufacturing.

- **Course Outcomes:** At the end of the course, students will be able to:

CO1: Demonstrate proficiency in Creo Parametric for sketching, part modeling, and assembly creation.

CO2: Create parametric and advanced machine components with accurate mass properties and material assignment.

CO3: Design sheet metal components and generate flat patterns for production.

CO4: Simulate mechanisms and motions, and perform basic structural, thermal, and modal analyses.

CO5: Prepare professional engineering drawings for parts and assemblies, including tolerances, GD&T, and BOMs.

List of Experiments

Exp. No	Title	Hrs
Students should perform a total of 8 experiments. Experiments 1 to 7 are compulsory. Perform any one out of 8,9 and 10. The practical exam will be based on the experiments covered during practical.		
1	**Experiment 1 Introduction to CAD Software:** CAD Software interface & navigation, Model tree management, Datum planes, axes & coordinate systems, Units & templates	2

	Practical Work: Understand effective use of above mentioned tools	
2	**Experiment 2 Sketching** Drawing tools (line, circle, arc, polygon, etc.) Modifying tools (move, copy, trim, offset, mirror, etc.) and Constraints, Fully defined sketches. Practical Work: Simple sketching of any five objects by using the above mentioned commands	2
3	**Experiment 3 Basic Part Modeling** Sketch-based modeling (by using commands like extrude, revolve, hole tool, Round, chamfer, shell, Pattern (linear & circular) etc.), Constraints (geometric and dimensional), Material and Mass property calculations Practical Work: Creating any two simple 3D parts by using 3D modeling software and calculation of mass properties by applying suitable material.	4
4	**Experiment 4 Advanced Part Modeling** Sketch-based modeling using Sweep, helical sweep, blend, Variable section sweep, Draft feature, Thin features, Cosmetic thread Practical Work: Creating any two 3D parts by using minimum two features mentioned above	4
5	**Experiment 5 Assembly Modeling** Types of assemblies, Component placement, Assembly constraints, Assembly motion and interference checking, Exploded view, concept of Sub-assembly creation and its application. Practical Work: Creating assembly of model consisting of minimum 5 parts	4
6	**Experiment 6 Drafting & Production Drawing** Drawing creation from 3D model, Generating views from 3D parts and assemblies, Sectional views, Detail views, Bill of Materials (BOM), GD&T symbols, Dimensioning, Surface finish symbols Practical Work: Generation of 2D working drawings (minimum 2 views) of parts and assembly created in experiment 5 above (Complete production drawing : Detailed and assembly drawings are expected)	2
7	**Experiment 7 Model a live product/assembly and generate complete production**	4

	drawings. Practical Work: Pick a real mechanical product/assembly, Measure it (or use catalog data), Model it, Prepare assembly, Prepare detail and assembly drawings as if for manufacturing.	
8	**Experiment 8 Sheet metal modelling** **Introduction to Sheet Metal, features and operations.** Practical Work: Create a basic sheet metal part using various sheet metal operations.	2
9	**Experiment 9 Simulation and Analysis** Introduction to Simulation, Pre processing, solving and post processing. Practical Work: Create a simple mechanical component and do static structural/thermal/ model analysis. Interpret the results.	2
10	**Experiment 10 Mechanism & Motion Study (Self study)** Introduction to Mechanism Design, Mechanism Connections, Motion Simulation, Analysis & Measurement. Practical Work: Create any one simple mechanism and simulate the motion. Plot displacement vs time graph.	2

Course: Modern Indian Language (Marathi)			Code: 25AEC201A	
Teaching Scheme (Hrs/Week)		Credit	Evaluation Scheme	
Lecture	02	02	TW	25
			OR	25

- **Prerequisites:** No prerequisite is required.

- **Course Objectives:**

अभ्यासक्रमाची उद्दिष्ट्ये :

१. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.

२. प्रसारमाध्यमातील संज्ञापनातील स्वरूप आणि स्थान स्पष्ट करणे.

३. व्यक्तिमत्त्व विकास आणि भाषा यांच्यातील सहसंबंध स्पष्ट करणे

४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांचे परस्पर संबंध स्पष्ट करणे.

५. प्रसारमाध्यमांची लेखनक्षमता विकसित करणे.

- **Course Outcomes:**

हा अभ्यासक्रम पूर्ण केल्यानंतर विद्यार्थी पुढील बाबी साध्य करू शकतील :

CO१. मराठी भाषेतील प्रगत भाषिक कौशल्यांचा प्रभावीपणे वापर करून संवाद साधू शकतील.

CO२. प्रसारमाध्यमांतील संज्ञापनाचे विविध प्रकार, स्वरूप व समाजातील त्यांचे स्थान स्पष्ट करू शकतील.

CO३. व्यक्तिमत्त्व विकासामध्ये भाषेचे महत्त्व ओळखून प्रभावी संवादकौशल्य विकसित करू शकतील.

CO४. लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे यांतील परस्परसंबंधांचे विश्लेषण करू शकतील.

CO५. प्रसारमाध्यमांसाठी विविध प्रकारचे लेखन कौशल्य आत्मसात करून प्रभावी लेखन करू शकतील.

- **Course Contents:**

Unit I	घटक १	६ तास

- मराठी भाषेची आविष्कार रूपे
- भाषा आणि व्यक्तिमत्त्व विकास: सहसंबंध
- लोकशाहीतील जीवनव्यवहार आणि प्रसारमाध्यमे

Unit II	घटक २	६ तास

- वृत्तपत्रासाठी बातमीलेखन आणि मुद्रितशोधन
- आकाशवाणीसाठी भाषणाची संहितालेखन
- दूरचित्रवाणीसाठी माहितीपटासाठी संहितालेखन
- समीक्षणात्मक लेखन: पुस्तक समीक्षण, चित्रपट समीक्षण

Unit III	**घटक ३**	**६ तास**

- भाषा, जीवन व्यवहार आणि नवमाध्यमे, समाजमाध्यमे
- नवमाध्यमे आणि समाजमाध्यमांचे प्रकार: ब्लॉग, फेसबुक, ट्विटर
- नवमाध्यमे आणि समाजमाध्यमांविषयक साक्षरता, दक्षता, वापर, परिणाम

Unit IV	**घटक ४**	**६ तास**

- वेबसाईट आणि ब्लॉग, ट्विटरसाठी लेखन, ई-मेल
- व्यावहारिक लेखन कौशल्य : अर्जलेखन व पत्रलेखन

Unit V	**घटक ५**	**६ तास**

- अनुवाद कौशल्य (Translation): इंग्रजी किंवा इतर भाषांमधून मराठीत अनुवाद करणे.
- कथा/कादंबरी/संवाद लेखन: सर्जनशील साहित्याची निर्मिती, पटकथा आणि संवाद लेखन.

- **Textbooks:**

१. सायबर संस्कृती : डॉ. रमेश वरखडे

२. व्यावहारिक मराठी: डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर

३. उपयोजित मराठी : संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई

४. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात , दीपक शिक्रापूरकर, उज्ज्वल मराठे, उत्कर्ष प्रकाशन, पुणे

५. व्यावहारिक मराठी, पुणे विद्यापीठ प्रकाशन, पुणे

६. प्रसारमाध्यमांसाठी लेखन कौशल्य, यशवंतराव चव्हाण मुक्त विद्यापीठ, नाशिक

Course Activities for Term Work Evaluation:

1. सारांश लेखन (Summary Writing)

विद्यार्थ्यांनी उतारा वाचून स्वतःच्या शब्दात एक संक्षिप्त सारांश लिहावा. (Students read a passage and write a **short summary** in their own words.)

2. भाषांतर (Translation Assignment) (Students translate text from **English to Marathi**.)

विद्यार्थ्यांनी इंग्रजी भाषेतील मजकूर मराठीमध्ये भाषांतरित करावा.

Example

- Short technical paragraph translation
- Daily communication sentences

3. पत्र लेखन (Letter Writing)

विद्यार्थ्यांनी वेगवेगळ्या प्रकारची औपचारिक व अनौपचारिक पत्रे लिहावी

Types

- औपचारिक पत्र (Formal Letter)
- अनौपचारिक पत्र (Informal Letter)
- अर्ज लेखन

4. **गट्क्रिया** (**Group Activity)**

विद्यार्थ्यांनी खालीलपैकी एक गट क्रियाकलाप करावा.

Example

- रोड शो
- स्किट प्ले
- एकांकिका

5. सादरीकरण (Presentation Assignment)

विद्यार्थ्यांनी तंत्रज्ञान, पर्यावरण, सामाजिक इ . कोणत्याही एका विषयावर सादरीकरण करावे.

Students present a topic in Marathi.

Examples

- तंत्रज्ञानातील नवीन शोध
- पर्यावरण विषयक सादरीकरण

6. गटचर्चा (Group Discussion)

विद्यार्थ्यांनी गटांमध्ये एखाद्या विषयावर चर्चा करावी.

Students discuss a topic in groups.

Example Topics

- सोशल मीडियाचा प्रभाव
- ऑनलाइन शिक्षणाचे फायदे व तोटे

7. मराठी ब्लॉग लिहणे

विद्यार्थ्यांनी त्यांच्या अभ्यासाच्या क्षेत्रातील विकासावर २०० शब्दांपर्यंत ब्लॉग लिहून पोस्ट लिहून सोशल मीडियावर पोस्ट कराव्या.

Write blogs and posts on social media up to 200 words on recent development in their field of study.

8. पुस्तक परीक्षण (Book Review)

विद्यार्थ्यांना मराठी पुस्तक किंवा लेख वाचावे आणि त्यावर समीक्षा लिहावी.

Students read a Marathi book or article and write a **review**.

9. चित्रपट परीक्षण (Marathi film Review)

विद्यार्थ्यांनी उपलब्ध असलेला सामाजिक मराठी चित्रपट पाहावा आणि त्यावर समीक्षा लिहून, ती त्यांच्या आवडीच्या सोशल मीडियावर पोस्ट करावी.

Social Marathi movie available and write a review on post it on social media of their choice.

10. स्पर्धांमध्ये सहभाग (Participation in Competition)

पुरुषोत्तम, फिरोदिया, दाजीकाका गाडगीळ करंडक, आणि श्रीटेज करंडक या स्पर्धांमध्ये सहभाग नोंदवावा.Participation in Purushottam karandam, Firodia karandak, Dajikaka Gadgil Karandak and Shreetej Karandak.

Course: Modern Indian Language (Sanskrit)				Code: 25AEC201B
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	OR	25
			TW	25

- **Prerequisites:** Basic ability to read Devanagari script is helpful but not mandatory.

- **Course Objectives:**
  1. To introduce engineering students to the basic structure of the Sanskrit language.
  2. To highlight the relevance of Sanskrit in modern fields such as Computational Linguistics and Artificial Intelligence.
  3. To encourage appreciation of Indian Knowledge Systems and their applications in modern engineering and research**.**

- **Course Outcomes:** At the end of the course, students will be able to:
  CO1: Understand the basic structure, phonetics, and grammar of the sanskrit language.
  CO2: Construct simple Sanskrit sentences using basic grammatical rules.
  CO3: Interpret selected Sanskrit verses related to science, mathematics, and philosophy.
  CO4: Recognize the contributions of ancient Indian scholars to science and engineering.
  CO5: Appreciate the relevance of Sanskrit in modern fields such as computational linguistics, knowledge

- **Course Contents:**

Unit I	**Introduction to Sanskrit Language**	**6 Hours**

Importance and historical development of Sanskrit, Characteristics of Sanskrit as a scientific language, Sanskrit alphabet (Varnamala): vowels and consonants, Pronunciation rules and phonetics, Basic introduction to Sanskrit grammar. (पठित अवबोधनम् | गद्यान्श् अपेक्षित कार्य : प्रश्नोत्तरामी तथा निर्देशानुसार कृतयः, पठित अवबोधनम् | पद्यान्श)

Unit II	**Basic Sanskrit Grammar**	**6 Hours**

Introduction to nouns (Subanta), Gender and number (Vachana), Case system (Vibhakti), Introduction to verbs (Dhatu), Present tense forms, Formation of simple sentences (सन्धिकार्यम् समास प्रत्ययाः त्यकार अव्ययाः समय लेखनम् - अनुप्रयुक्त-व्याकरणम्)

Unit III	**Reading and Interpretation of Sanskrit Texts**	**6 Hours**

Reading simple Sanskrit shlokas, Vocabulary building for scientific and technical terms, Translation of selected Sanskrit passages, Interpretation of verses related to logic, mathematics, and nature, Practice exercises in sentence construction and translation

Unit IV	**Reading and Interpretation of Sanskrit Texts**	**6 Hours**

Translation of selected Sanskrit passages, Interpretation of verses related to logic, mathematics, and nature Practice exercises in sentence construction and translation,(लेखनकौशलम् वृत्तान्तलेखनम्, चित्रपटवर्णनम्, निबन्ध

लेखनम्)

Unit V	Sanskrit and Modern Science & Technology	6 Hours

Sanskrit and computational linguistics, Logic and knowledge representation in Sanskrit texts, References to engineering concepts in ancient texts, Sanskrit terminology used in mathematics, astronomy, and architecture. Mathematical problems from **Lilavati** by **Bhaskara II,** Structure of Sanskrit grammar and its relevance to computer science, Applications of Sanskrit in modern research, Overview of Sanskrit influence on Artificial Intelligence and language processing

Textbooks:

1. सरस्वती - मणिका संस्कृत व्याकरणम

2. नवम तथा दशम कक्षा 'मणिका' पुस्तकम

3. संस्कृत आल्हादः - दादशी कक्षा तथा निभन्धसोपन:

Reference Books:

1. Panini Ashtadhyayi – Panini
Selected Sanskrit texts related to science and mathematics.

Course Activities for Term Work Evaluation:

1. Summary Writing: Students read a passage and write a short summary in their own words.
2. Translation Assignment: Students translate text from English to Sanskrit.
3. Short technical paragraph translation
4. Daily communication sentences
5. Letter Writing
6. Group Discussion
7. Book Review
8. Film review
9. Blog writing
10. Participation in a Competition

Course: Entrepreneurship/Economics/ Management Course-II				Code: 25HSM202
Teaching Scheme (Hours/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	2	2	Term work	Marks: 50

GUIDELINES FOR SELECTING HSM COURSE

1. HSSM courses shall be offered through Institute-approved Swayam/ NPTEL courses. The minimum duration of the course must be **8 weeks**.
2. 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'. The faculty has to register for the selected course as a course mentor.
3. Students shall complete the prescribed online lectures, assignments, and learning activities during the semester.
4. Swayam/ NPTEL certification examination is optional and students shall not be required to pay certification fees for successful completion of the course.
5. Any plagiarism, misrepresentation of course completion, or submission of forged certificates shall be treated as academic misconduct.
6. The decision of the Institute regarding course mapping, evaluation, and award of credits shall be final.

SELECTION OF HSSM COURSE

List of Courses to be opted (Any one) under HSSM-II

1. NPTEL course on Business Fundamentals for Entrepreneurs by Prof. Devdip Purkayastha, IIT Bombay : https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_mg11
2. NPTEL course on Entrepreneurship Essentials by Prof. Manoj Kumar Mondal, Department of Multidisciplinary IIT Kharagpur : https://nptel.ac.in/courses/127105007
3. NPTEL course on Financial Management for Managers by Prof. Anil K. Sharma, IIT Roorkee: https://nptel.ac.in/courses/110107144
4. NPTEL course on Business Intelligence and Analytics by Prof. Saji K Mathew, Department of Management Studies IIT Madras: https://nptel.ac.in/courses/106106361

Assessment of HSSM Course:

1. Term Work (50 Marks) shall be evaluated by the Faculty Mentor based on:
   - 25 Marks: NPTEL assignment score
   - 25 Marks: Institute level examination
   - For DSE students there will be 50 Marks institute level end semester examination.
2. 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. The cumulative marks obtained in the online assignments shall be proportionately converted to a maximum of 25 marks for the purpose of term work assessment.

Course: Indian Constitution and Governance				Code: 25VEC202
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	1	1	TW	25

- **Prerequisites:** Basic awareness of Indian history, civic studies at school level, and general understanding of social and political systems.

- **Course Objectives: The objectives of the course are**
  1. To introduce students to the philosophy, features, and framework of the Indian Constitution.
  2. To understand the structure, powers, and functions of the Union and State governments.
  3. To explain Fundamental Rights, Duties, and Directive Principles and their role in democracy.
  4. To familiarize students with constitutional bodies and governance mechanisms in India.
  5. To develop awareness of contemporary issues related to constitutional values, governance, and citizenship.

Course Outcomes: At the end of the course, students will be able to:

CO1. Explain the historical background, features, and structure of the Indian Constitution.
CO2. Describe Fundamental Rights, Directive Principles, and Fundamental Duties and their significance
CO3. Apply constitutional provisions to analyze the functioning of Union and State governments.
CO4. Analyze the role of constitutional and statutory bodies in Indian governance
CO5. Evaluate contemporary governance issues with reference to constitutional values and ethics.

- **Course Contents:**

Unit I	**Introduction to Indian Constitution**	**3 Hours**

Meaning and importance of Constitution Historical background and making of the Indian Constitution Salient features of the Indian Constitution Preamble: objectives and significance Citizenship – provisions and amendments

Unit II	**Fundamental Rights, Duties, and Directive Principles Fundamental Rights**	**3 Hours**

Types, scope and limitations Right to Equality, Freedom, Religion, Constitutional Remedies Directive Principles of State Policy – objectives and classification Fundamental Duties and their relevance Relationship between Fundamental Rights and DPSPs

Unit III	**Union and State Government Structure Union Government**	**3 Hours**

President, Vice-President, Prime Minister, Council of Ministers Powers and functions of Parliament State Government: Governor, Chief Minister, State Legislature Center–State relations: legislative, administrative, and financial

Unit IV	**Constitutional and Statutory Bodies Election Commission of India**	**3 Hours**

Composition, powers, and functions Union Public Service Commission (UPSC) and State Public Service Commissions (SPSC): roles and responsibilities Comptroller and Auditor General (CAG) of India: duties and significance in financial accountability Finance Commission: composition, functions, and role in centre–state financial relations Judiciary in India: structure, jurisdiction, and role of the Supreme Court and High Courts

Unit V	**Governance, Democracy and Contemporary Issues Concept of democracy and good governance Local self-government**	**3 Hours**

Panchayati Raj and Urban Local Bodies Constitutional amendments and landmark judgments Ethical governance and citizen participation Current issues related to Indian Constitution and governance

- **Textbooks:**
  1. M. V. Pylee, An Introduction to the Constitution of India, Vikas Publishing
  2. D. D. Basu, Introduction to the Constitution of India, LexisNexis

- **Reference Books:**
  1. Granville Austin, The Indian Constitution: Cornerstone of a Nation, Oxford University Press
  2. Subhash Kashyap, Our Constitution: An Introduction to India's Constitution and Constitutional Law, National Book Trust

- **MOOC / NPTEL Courses:**
  1. NPTEL1, Introduction to Indian Constitution, By Prof. Priyanca Mathur, Dr. Amrita Purkayastha, Dr. Sneha Yadav, JAIN (Deemed to be University), Bangalore : https://onlinecourses.swayam2.ac.in/e-learning/preview/imb26_mg151
  2. NPTEL2, Constitution Law and Public Administration in India, By Prof. Sairam Bhat, National Law School of India University: https://onlinecourses.nptel.ac.in/e-learning/preview/noc24_lw05
  3. NPTEL3, Constitutional Studies, By Prof. Sudhir Krishnaswamy, National Law School of India University: https://onlinecourses.nptel.ac.in/e-learning/preview/noc20_lw03
  4. NPTEL4, Public Policy and Governance, By Dr. A. Sridhar Raj, Institute of Public Enterprise: https://onlinecourses.swayam2.ac.in/e-learning/preview/cec24_hs38

- **Course Activities for Term Work Evaluation:**
  1. Group Discussion on Fundamental Rights and Duties
  2. Debate on Constitutional and Contemporary Governance Issues
  3. Case Study Analysis on Indian Judiciary and Landmark Judgments
  4. Seminar / Presentation on Indian Constitution and Democratic Values
  5. Poster Making on Fundamental Rights, Duties, and Good Governance
  6. Essay Writing on Role of Citizens in Democracy and Nation Building
  7. Mock Parliament / Mock Election Activity
  8. Assignment on Constitutional Bodies and Their Functions
  9. Field Visit / Report on Local Self-Government Institutions
  10. Quiz / Awareness Activity on Indian Constitution and Governance Systems

Dr M R Phate
Chairman, BoS (Mechanical Engineering)

Dr D Y Dhande
Dean (Academics)

Dr D S Bormane
Principal

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