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. Chemical Engineering

(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 a leader in Chemical Engineering education providing service to society

Mission:

- To prepare graduates for responsible positions in chemical industry, academia and research.
- To prepare graduates to analyze and solve problems of chemical industry, academia and research.
- To strengthen industry-institute interaction to develop industry-oriented attributes like attitude, soft skills, team work and leadership.

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)

A Chemical Engineering graduates will be able to:

- **PSO1**: Identify, analyze, design and develop solutions to Chemical Engineering problems of practical importance to industry and society.
- **PSO2:** Demonstrate sound understanding of Chemical Engineering fundamentals to solve problems through the use of modern techniques.

Program Educational Objectives (PEOs)

- **PEO1: Competency:** To prepare competent graduates in Chemical Engineering so that they are successful in their professional career in industry, academia or research.
- **PEO2**: **Problem Solving Skills:** To prepare graduates who can identify, analyze, research and solve Chemical Engineering problems of practical importance to industry, academia or research.
- **PEO3: Leadership Skills:** To prepare graduates with effective communication, teamwork and leadership skills so that they can play effective role in industry, academia and research institutes.

B.Tech. Degree Options as per NEP

(a) B.Tech. Degree with Multidisciplinary Minor (160-176 credits).

(b) B.Tech. Honours Degree in 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.

(c) B.Tech. 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.

(d) B.Tech. 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.

A. Definition of Credit:

1 Hr. Lecture(L) per week	1 credit
1 Hr. Tutorial(T) per week	1 credit
2 Hours Practical (Lab)/week	1 credit

B. Range of credits:

A range of credits from 160 to 176 for a student to be eligible to get Undergraduate degree in Engineering. A student will be eligible to get Undergraduate degree with Honors 18 to 20 credits, Double Minor for 18 to 20 credits and/or Multidisciplinary Minors for 18 to 20 credits, if he/she completes additional credits.

C. Exit:

A student will be eligible to get Diploma in Chemical Engineering after completing an internship of 8 Credit during summer vacation in relevant Discipline.

D. General Guidelines for Examination:

The examination shall be conducted in THREE parts viz. Continuous Comprehensive Assessment (CCA), In Semester Examination (ISE) and End Semester Examination (ESE).

(i) Continuous Comprehensive Assessment (CCA): 20 Marks (Any TWO)

Continuous Comprehensive Assessment (CCA) focuses on the continuous evaluation of students' performance throughout the semester. In addition to classroom and laboratory learning, CCA activities are designed to facilitate the attainment of course outcomes through experiential, participatory, collaborative, active, self-directed, and peer-to-peer learning.

As part of the CCA framework, students shall undertake any two activities from the prescribed CCA Guidelines. The Course Teacher shall guide students in the selection and execution of the activities. The selected activities shall be assessed by the Course Teacher on a regular basis using appropriate assessment criteria. Students shall submit reports for the two selected activities as per the schedule specified by the Course Teacher.

(ii) In-semester Examination (ISE): 30 Marks

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		

(iii) END Semester Examination (ESE): 50 Marks

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

Course Content	Questions	Marks	Total Marks	Duration
Unit III	Q. 1 or Q.2	16	50	2 Hours
Unit IV	Q. 3 or Q.4	17		
Unit V	Q. 5 or Q.6	17		

S.Y.B. Tech. Chemical Engineering (2025 Pattern)

ABBREVIATIONS

Abbreviation	Title	Abbreviation	Title
BSC	Basic Science courses	AEC	Ability Enhancement Course
ESC	Engineering Science courses	HSM	Humanities Social Science and Management
PCC	Programme Core Courses	IKS	Indian Knowledge System
PEC	Programme Elective courses	VEC	Value Education Course
MDM	Multidisciplinary Minor	ELC	Experiential Learning Courses
OEC	Open Elective other than particular Programme	CCC	Liberal Learning Courses
VSE	Vocational and Skill Enhancement Course		

B. Tech. Chemical Engineering (2025 Pattern)
Distribution of Credits

Sr. No	Domains		Code	SEM-I	SEM-II	SEM-III	SEM-IV	SEM-V	SEM-VI	SEM-VII	SEM-VIII	Credits
1	Basic Science courses		BSC	8	8	0	0	0	0	0	0	16
2	Engineering Science courses		ESC	9	6	0	0	0	0	0	0	15
3	Programme Core Courses		PCC	0	3	12	12	8	8	8	0	51
4	Programme Elective courses		PEC	0	0	0	0	4	8	4	4	20
5	Multidisciplinary Minor	Multidisciplinary Courses	MDM	0	0	2	2	4	2	2	2	14
6	Open Elective other than particular Programme		OEC	0	0	2	2	2	0	0	0	6
7	Vocational and Skill Enhancement Course	Skill Courses	VSE	1	1	1	1	2	2	0	0	8
8	Humanities Social Science and Management	Ability Enhancement Course	AEC	2	0	0	2	0	0	0	0	4
		Entrepreneurship/Economics/ Management courses	HSM	0	0	2	2	0	0	0	0	4
		Indian Knowledge System	IKS	0	2	0	0	0	0	0	0	2
		Value Education Course	VEC	0	0	2	1	0	0	0	0	3
9	Experiential Learning Courses	Research Methodology	ELC	0	0	0	0	0	0	4	0	4
		CEP		0	0	1	0	0	0	0	0	1
		Project		0	0	0	0	0	2	2	0	4
		Internship		0	0	0	0	0	0	0	12	12
10	Co-curricular Courses (CC)	Liberal Learning Courses	CCC	2	2	0	0	0	0	0	0	4
Total				**22**	**22**	**22**	**22**	**20**	**22**	**20**	**18**	**168**

MDM: Artificial Intelligence

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
SEM-3	25AIMDM201A	Introduction to Data Science	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-4	25AIMDM202A	Introduction to Artificial Intelligence & Machine Learning	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-5	25AIMDM301A	Soft Sensors & Process Modeling using ML	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25AIMDM301AL	Soft Sensors & Process Modeling using ML Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-6	25AIMDM302A	Data Visualization Techniques	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-7	25AIMDM401A	Data Analytics	2	-	-	20	30	50	-	-	-	100	2	-	-	02
SEM-8	25AIMDM402A	AI Applications in Industrial Process Optimization	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Total			**13**	**2**	**0**	**120**	**180**	**300**	**25**	**0**	**0**	**625**	**13**	**1**	**0**	**14**

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

Honors I: Process Engineering Simulation

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
SEM-3	25CHHNRS201	Development of Process Flow Diagram	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-3	25CHHNRS201L	Development of Process Flow Diagram Lab	-	2	-	-	-	-	-	25		25	-	1	-	01
SEM-4	25CHHNRS202	Pipeline Sizing	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-4	25CHHNRS202L	Pipeline Sizing Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-5	25CHHNRS301	Material of Construction and P&ID	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25CHHNRS301L	Material of Construction and P&ID Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-6	25CHHNRS302	Basic Engineering Package and Process Simulation	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-6	25CHHNRS302L	Basic Engineering Package and Process Simulation Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-7	25CHHNRS401	Mini Project	-	2	1	-	-	-	-	50	50	100	-	1	1	02
Total			**12**	**10**	**1**	**80**	**120**	**200**	**25**	**125**	**50**	**600**	**12**	**05**	**01**	**18**

Honors II: Piping Design Engineering and Construction

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW*	Total	L	P	T	Total
SEM-3	25CHHNRP201	Fundamentals of Process Plant	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-3	25CHHNRP201L	Fundamentals of Process Plant Lab	-	2	-	-	-	-	-	25		25	-	1	-	01
SEM-4	25CHHNRP202	P&ID and process documents	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-4	25CHHNRP202L	P&ID and process documents Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-5	25CHHNRP301	Pipe Routing and Stress analysis basics	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25CHHNRP302L	Pipe Routing and Stress analysis basics Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-6	25CHHNRP302	Equipment, Layout Engineering and international codes	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-6	25CHHNRP302L	Equipment, Layout Engineering and international codes Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-7	25CHHNRP401	Mini Project	-	2	1	-	-	-	-	50	50	100	-	1	1	02
Total			**12**	**10**	**1**	**80**	**120**	**200**	**25**	**125**	**50**	**600**	**12**	**05**	**01**	**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 to 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 & 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 I: Environmental Engineering

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW	Total	L	P	T	Total
SEM-3	25CHMNRE201	Air Pollution Control	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-3	25CHMNRE201L	Air Pollution Control Lab	-	-	1	-	-	-	-	-	25	25	-	-	1	01
SEM-4	25CHMNRE202	Wastewater Treatment	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-4	25CHMNRE202L	Wastewater Treatment Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-5	25CHMNRE301	Solid Waste Management	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25CHMNRE301L	Solid Waste Management Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-6	25CHMNRE302	Climate Change and Sustainability	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-6	25CHMNRE302L	Climate Change and Sustainability Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-7	25CHMNRE401	Mini Project	-	2	1	-	-	-	-	50	50	100	-	1	1	02
Total			**12**	**08**	**02**	**80**	**120**	**200**	**50**	**75**	**75**	**600**	**12**	**4**	**02**	**18**

Double Minor II: Energy Engineering

Semester	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW	Total	L	P	T	Total
SEM-3	25CHMNRR201	Introduction to Energy	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-3	25CHMNRR201L	Introduction to Energy Lab	-	-	1	-	-	-	-	-	25	25	-	-	1	01
SEM-4	25CHMNRR202	Bio-energy	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-4	25CHMNRR202L	Bio-energy Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-5	25CHMNRR301	Electrochemical Energy	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-5	25CHMNRR301L	Electrochemical Energy Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
SEM-6	25CHMNRR302	Hydrogen Fuel	3	-	-	20	30	50	-	-	-	100	3	-	-	03
SEM-6	25CHMNRR302L	Hydrogen Fuel Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
SEM-7	25CHMNRR401	Mini Project	-	2	1	-	-	-	-	50	50	100	-	1	1	02
Total			**12**	**08**	**02**	**80**	**120**	**200**	**50**	**75**	**75**	**600**	**12**	**4**	**02**	**18**

S.Y. B. Tech. Chemical Engineering (2025 Pattern)
Curriculum Structure: Semester III

Course Category	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW	Total	L	P	T	Total
Program Core Course	25CHPCC201	Process Calculations	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25CHPCC202	Fluid Mechanics	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25CHPCC203	Solid-Fluid Operations	3	-	-	20	30	50	-	-	-	100	3	-	-	03
Multidisciplinary Minor	25AIMDM201A	Multidisciplinary Minor-I	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Open Elective Course	25OEC201	Open Elective Course-I	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Program Core Course Lab	25CHPCC201L	Process Calculations Lab	-	-	1	-	-	-	-	-	25	25	-	-	1	01
Program Core Course Lab	25CHPCC202L	Fluid Mechanics Lab		2	-	-	-	-	25	-	-	25	-	1	-	01
Program Core Course Lab	25CHPCC203L	Solid-Fluid Operations Lab	-	2	-	-	-	-	-	25	-	25	-	1	-	01
Vocational and Skill Enhancement Course	25CHVSE201	Vocational and Skill Enhancement Course-I	-	2	-	-	-	-	-	25	-	25	-	1	-	01
Entrepreneurship/Economics/ Management Courses	25HSM201	Entrepreneurship/Economics/ Management Course-I	-	-	2	-	-	-	-	-	50	50	-	-	2	02
Value Education Course	25VEC201	Universal Human Values	-	-	2	-	-	-	-	-	50	50	-	-	2	02
Community Engagement Project	25CHELC201	Community Engagement Project	-	2	-	-	-	-	-	-	25	25	-	-	1	01
	Total		**13**	**08**	**05**	**100**	**150**	**250**	**25**	**50**	**150**	**725**	**13**	**03**	**06**	**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.	25AIMDM201A	Introduction to Data Science

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.	25CHVSE201	Basic Chemical Engineering Calculations using Excel

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

S.Y. B. Tech. Chemical Engineering (2025 Pattern)

Curriculum Structure: Semester IV

Course Category	Course Code	Course Name	Hrs/Week			Examination Scheme and Marks							Credits			
			L	P	T	CCA	ISE	ESE	PR	OR	TW	Total	L	P	T	Total
Program Core Course	25CHPCC204	Heat Transfer	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25CHPCC205	Mathematical methods in Chemical Engineering	3	-	-	20	30	50	-	-	-	100	3	-	-	03
	25CHPCC206	Chemical Reaction Engineering -I	3	-	-	20	30	50	-	-	-	100	3	-	-	03
Multidisciplinary Minor	25AIMDM202A	Multidisciplinary Minor-II	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Open Elective Course	25OEC202	Open Elective Course-II	2	-	-	20	30	50	-	-	-	100	2	-	-	02
Program Core Course Lab	25CHPCC204L	Heat Transfer Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
Program Core Course Lab	25CHPCC205L	Chemical Engineering Thermodynamics Lab	-	-	02	-	-	-	-	-	25	25	-	-	01	01
Program Core Course Lab	25CHPCC206L	Chemical Reaction Engineering-I Lab	-	2	-	-	-	-	25	-	-	25	-	1	-	01
Vocational and Skill Enhancement Course	25CHVSE202	Vocational and Skill Enhancement Course-II	-	2	-	-	-	-	-	25	-	25	-	1	-	01
Ability Enhancement Course	25AEC201	Modern Indian Language (MIL)	2	-	-	-	-	-	-	25	25	50	-	1	1	02
Entrepreneurship/Economics/ Management Courses	25HSM202	Entrepreneurship/Economics/ Management Course-II	-	-	2	-	-	-	-	-	50	50	-	-	2	02
Value Education Course	25VEC202	Indian Constitution and Governance	-	-	1	-	-	-	-	-	25	25	-	-	1	01
	Total		**15**	**06**	**05**	**100**	**150**	**250**	**50**	**50**	**125**	**725**	**13**	**04**	**05**	**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.	25AIMDM202A	Introduction to Artificial Intelligence & Machine Learning

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.	25CHVSE202	Mini Project based on Chemical Technology

Entrepreneurship/Economics/Management Courses (HSSM)-II:

Sr. No.	Course Code	Course Name
1.	25HSM202A	Business Fundamentals for Entrepreneurs
2.	25HSM202B	Entrepreneurship Essentials
3.	25HSM202C	Financial 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

Course: Process Calculations			Code: 25CHPCC201
Teaching Scheme (Hrs /Week)		**Credit**	**Evaluation Scheme**
Lecture	3	3	CCA 20
			ISE 30
			ESE 50

Prerequisites: Basic Physics, Chemistry and Mathematics

- **Course Objectives:** The objectives of the course are to
  1. Develop ideas in dimensional analysis and to be familiar with different unit systems.
  2. Learn the fundamentals of stoichiometry and apply the material balance concept to unit operations.
  3. Learn fundamentals of stoichiometry and apply the material balance concept to unit processes.
  4. Learn the application of the general energy balance equation.
  5. Learn the analysis of the fuels and combustion.

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

CO1: Evaluate the composition of materials.

CO2: Apply material balance equations to unit operations.

CO3: Apply material balance equations to chemical reactions.

CO4: Evaluate the energy requirement for various unit operations or processes.

CO5: Evaluate properties of the fuel.

- **Course Contents:**

Unit I	Introduction	8 Hours

Introduction to unit processes and operations and their symbols, process flow sheet, Concept of steady and unsteady state operations, Units and dimensions: basic and derived units, different ways of expressing units and quantities, conversion of units, properties of pure substances, PVT behavior, ideal and real gas laws. Mole fractions and partial pressures, application of Dalton's, Amagat's, Henry's laws, concept of vapor pressure, Raoult's law and its applications, vapor pressure plots and effect of temperature on vapor pressure.

Unit II	Material Balance for Unit Operations	8 Hours

Concept, material balance calculations of various unit operations, recycling and Bypass operations. Self-study. Covalent Bonding- Introduction to VBT, Molecular orbital theory, MO structures of s-s, s-p , p-p overlaps, molecular orbital structure of butadiene, benzene, MO energy diagrams for diatomic molecules N_2, O_2 , CO. Aromaticity-conditions necessary for delocalization of electrons, resonance structures stability rules, resonance in phenol, aniline, benzaldehyde ,nitrobenzene molecules, Inductive effect, tautomeric effect, hyper conjugation effect and resonance effect on pKa and pKb values of acids and bases.

Unit III	Material Balance for Unit Processes	8 Hours

Concept, material balance calculations with chemical reactions, recycling and Bypass Operations. Self-study. Introduction to standard solutions, primary and secondary standard substances, and methods for accurate preparation and standardization, various units of concentration, including molarity, normality, molality, parts per million (ppm), and weight/volume percent, with relevance to small-scale and industrial chemical processes.

Unit IV	**Energy Balance**	**8 Hours**

Concept, energy and Thermochemistry, energy balances, heat capacity of pure substances and mixtures, latent heats, enthalpy of pure substances and mixtures, absolute enthalpy, heat of reaction, adiabatic reactions, thermochemistry of mixing processes, dissolution, liquid-liquid mixtures, gas- liquid systems,

Unit V	**Fuels and Combustion**	**8 Hours**

Calorific values, coal, liquid fuels, gaseous fuels, air requirement and flue gases, combustion calculations, case study, Types of titrations-neutralization (with titration curves), complexometric, redox and precipitation with examples. Theory of indicators in above titrations. Numericals on all above.

• **Continuous Comprehensive Assessment (Any Two)**		**20 Marks**
CCA1	**Quiz**	**10 Marks**
Quiz based on units 1 to 5		
CCA2	**Assignment**	**10 Marks**
Assignment based on units 1 to 5		
CCA3	**Seminar**	**10 Marks**
Seminar based on any topic from unit 1 to 5		

Textbooks:

1. Bhatt B.I. and Vora S.M., “Stoichiometry”, 2nd Edition, Tata McGraw Hill, New Delhi, 2004

- **Reference Books:**

1. Hougen O.A., Watson R.M. and Ragatz R.A., “Chemical Process Principles Part I”, 2nd Edition, CBS Publications, 1976. (ISBN: 9798123909539)
2. David M. Himmelblau, “Basic Principles and Calculations in Chemical Engineering”, 8th Edition, Prentice Hall of India, New Delhi, 2012. (ISBN: 0132346605)
3. Narayanan. K.V. and Lakshmikutty.B, “Stoichiometry and Process Calculations”, 2nd Edition, Prentice Hall of India, New Delhi, 2009. (ISBN: 8120329929)
4. Venkatramani V, Ananatharaman N, Sheriffa Begum, “Process Calculations”, 2nd Edition, Prentice Hall of India, 2011.
5. Richard M. Felder, Ronald W. Rousseau, “Elementary Principles of Chemical Processes”, 3rd Edition,

John Wiley and Sons, 2005.

- **MOOC / NPTEL Courses:**
  https://nptel.ac.in/courses/103103165 (Basic Principles and Calculations in Chemical Engineering by Prof. Subrata Kumar Majumder, IIT Guwahati)

Course: Fluid Mechanics				**Code: 25CHPCC202**
Teaching Scheme (Hrs. /Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basics concepts of Physics and Mathematics

- **Course Objectives:** The objectives of the course are to
  1. Introduce basic concepts of fluid mechanics and their applications in Chemical Engineering.
  2. Understand the concepts of pressure and its laws
  3. Study basic equations of fluid flow
  4. Study the major and minor head losses in internal flows
  5. Develop relationships among process or system variables using dimensional analysis
- **Course Outcomes:** After successful completion of course, students will be able to:

  CO1: Determine fluid properties and apply them to calculate stresses

  CO2: Establish the laws of fluid statics and use them to calculate pressures

  CO3: Analyze basic equations of fluid flow and their applications to determine fluid flow rate using different devices.

  CO4: Formulate mathematical equations for flow of fluid through different systems and determine different losses occurring in pipelines

  CO5: Establish different process or system variables in dimensionless groups using dimensional analysis
- **Course Contents:**

Unit I	**Fluid Properties**	**8 Hours**

Fluid, properties of fluid, classification of fluids, Newton's law of viscosity, specific volume, specific gravity, mass density, specific weight, effects of temperature and pressure on viscosity of liquids and gases, rheological classification of fluids, types of flow, lines to describe the flow, application of fluid flow in Chemical Engineering, numerical examples

Unit II	**Fluid Statics**	**8 Hours**

Introduction to Pressure, Types of pressures, atmospheric pressure, absolute pressure, partial pressure, vapor pressure, dynamic pressure, static pressure, gauge pressure and vacuum, Pascal's law, Hydrostatic law, manometers, barometer, piezometer, simple manometer, differential manometer, inclined manometer, inverted manometer, numerical examples.

Unit III	Basic Equations of Fluid Flow and Flow Measuring Devices	8 Hours

Basic equations of fluid flow: continuity equation, calculations of mass flow rates, volumetric flow rates, mass fluxes, equation of motion, Bernoulli Equation, applications of Bernoulli equation, flow measurement using venturi meter, orifice meter, rotameter, pitot tube, numerical examples.

Unit IV	Flow of Incompressible Fluids in Conduits and Channels	8 Hours

Laminar and turbulent flows, its characteristics, Analysis of flow through circular pipe for a laminar flow: Stress distribution, velocity distribution, relation between average and maximum velocity, boundary Layer, Hagen Poiseuille equation, friction factor chart, Darcy Weisbach equation, major and minor losses, numerical examples, Self Study.

Unit V	Dimensional Analysis and External Flow	8 Hours

Fundamental and derived dimensions of quantities, dimensional homogeneity, types of similarities, Dimensional analysis by Rayleigh's method, Buckingham's method, Dimensionless Numbers, external flows, boundary layer thickness, drag force, boundary layer on the external surfaces, numerical examples, Self Study.

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	List of Course Activity	10Marks
Homework Assignments		
CCA2	Case Study	10 Marks
Seminar: Any topic from unit 1 to 5		
CCA3	Case studies on the specific topics of FM/ Writing Software Program or Coding to Solve FM problems	10 Marks

- **Textbooks:**
  1. McCabe W. L. and Smith J.C., "Unit Operations in Chemical Engineering". McGraw Hill Publications.
  2. R.K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publishers.
- **Reference Books:**
  1. Y.A. Cengel, J. M. Cimbala, "Fluid Mechanics Fundamentals and Applications", Willey Publications
  2. P. Kundu, I. Cohen, "Fluid Mechanics", Academic Press publications
- **MOOC / NPTEL Courses:**
- Fluid Mechanics, Prof. Suman Chakraborty: nptel.ac.in/courses/112105171
- Fluid Mechanics, Prof. Subashisa Dutta, IIT Guwahati: Fluid Mechanics – Course,

https://nptel.ac.in/courses/105103192

- Fluid Mechanics, Prof. Sanjay Mittal, IIT Kanpur: Fluid Mechanics – Course, https://nptel.ac.in/courses/101104808

Course: Solid- Fluid Operations				**Code: 25CHPCC203**
Teaching Scheme (Hrs /Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Engineering Mathematics, Applied Science, Basic in Environmental Science/Engineering.

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

1. Study properties and characteristics of solids, separation and size reduction of solids.
2. Understand fluid- solid separations using classification, gravity settling and sedimentation.
3. Understand fluidization with its application of pneumatic conveying, and beneficiation methods.
4. Study mixing of powders, viscous materials and pastes, agitation of fluids.
5. Study of filtration and types of filters.

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

CO1: Classify equipment for screening and size reduction according to properties of solids.

CO2: Understand the use of thickeners, clarifiers and centrifuges for solid- liquid separations.

CO3: Apply fluidization technique and beneficiation methods in process industries.

CO4: Identify an appropriate type of impeller for mixing of a particular mixture and to estimate power required for agitation of fluids.

CO5: Understand basic principles of filtration equipment.

- **Course Contents:**

Unit I	**Screening and Size Reduction of Solids**	**8 Hours**

Properties and characteristics of solids, performance of screening equipment / testing sieves, U.S. Standard sieve series, Tyler Standard screen series, Sieve Shaker, types of screen analysis.

Necessity of size reduction, crushing efficiency, energy requirement calculations by using crushing laws, classification of size reduction equipment, study of Crushers, Grinders and Ultrafine Grinders. Dry versus wet grinding. Open circuit grinding and closed-circuit grinding.

Unit II	**Settling and Sedimentation**	**8 Hours**

Theory of particle movement through a fluid. Free settling & Hindered settling. Stokes' law and Newton's law of settling. Differential settling and separation of solids in Classification, Sink-and-float methods, Differential

settling methods. Basic principle of Sedimentation and its applications in water purification & wastewater treatment. Batch Sedimentation Test, Kynch theory of sedimentation, determination of thickener area and depth of thickener. Study of Thickeners, Clarifiers, and Equipment for Classification: Simple gravity settling classifier. Centrifuge equipment for Sedimentation: Tubular centrifuge and Disk bowl centrifuge.

Unit III	**Fluidization and Beneficiation Methods**	**8 Hours**

Types of fluidizations, fluidized bed systems, determination of minimum fluidization velocity, flow through packed bed, applications of fluidized bed, Ergun equation, Kozeny-Carman equation. Study and design of Pneumatic conveying systems. Study of Screw Conveyors and Bucket Elevators. Study of Flotation Cell, Cyclone Separator, Hydro-cyclone, Electrostatic Precipitator, Scrubbers, and Applications of Bag filters in Air pollution control, and Hydraulic jigs in coal and ore industries.

Unit IV	**Mixing and Agitation**	**8 Hours**

Types of Impellers, flow patterns in un-baffled and baffled tanks, draft tube, mechanically agitated vessel, power required for agitation of fluids. Agitator scale-up. Mixing of viscous material, pastes and powders. Performance of mixers- determination of mixing index. Batch and Continuous Mixers, Self Study. Solution: - definition, solution of gas in gas, gases in liquid, Henry's law, the ideal solution, Raoult'1s law of ideal solution, solutions of liquids in liquids, theory of dilute solution. Colligative properties, Definition of osmosis & osmotic pressure, Colligative properties of dilute solution- lowering of vapor pressure, Abnormal behaviour of solutions of electrolytes, Van't Hoff factor.

Unit V	**Filtration**	**8 Hours**

Basic theory of filtration, filtration equations for constant- pressure filtration, constant rate filtration, and continuous filtration. Types of filtration equipment, classification of filters. Theory and applications of Bed filters, Plate-and-frame-filter presses, Leaf filters, Continuous rotary filters. Filter media and filter aids.

Equations for washing of filter cakes. Equipment for Centrifugal filtration: Perforated rotating basket filter, Self Study.

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Seminar**	**10Marks**
1. Any one of the Solid- Fluid Operations. 2. Any one of the Solid- Fluid Operations involved for particulate Air pollution control. 3. Effect of different types of impellers on mixing of liquid- liquid mixture. 4. Effect of different types of impellers on mixing of Solid- liquid mixture. 5. Any one of the types of Scrubbers.		
CCA2	**Group Discussions**	**10 Marks**
1. Advantages, disadvantages and limitations of Pressure Filters. 2. Advantages, disadvantages and limitations of Vacuum Filters.		
CCA3	**Case Study**	**10 Marks**
Case studies on the specific topics of Solid-Fluid Operations		

Textbooks:

1. Narayanan C. M. and Bhattacharya B. C. "Mechanical Operations for Chemical Engineers- Incorporating Computer Aided Analysis", Khanna Publishers, New Delhi.
2. P. Chattopadhyay "Unit Operations of Chemical Engineering" Vol. I, Khanna Publishers, New Delhi.

- **Reference Books:**

1. McCabe W. L. and Smith J. C. "Unit Operations in Chemical Engineering", McGraw Hill Publications.
2. Christie John Geankoplis "Transport Processes and Separation Process Principles (Includes Unit Operations), Eastern Economy edition published by PHI Learning Pvt. Ltd., New Delhi.
3. Coulson J. M. and Richardson J. F. "Chemical Engineering" Vol. 2, Pergamon Press.

- **MOOC / NPTEL Courses:**

Mechanical Operations, Prof Shabina Khanam, IIT Roorkee https://nptel.ac.in/courses/103107123

Course: Introduction to Data Science				**Code: 25AIMDM201A**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic mathematics (algebra, statistics), Basic computer knowledge.

- **Course Objectives:** The students are able to
  1. Understand the fundamentals and lifecycle of data science
  2. Learn data collection, cleaning, and pre-processing techniques
  3. Develop skills in data visualization
  4. Apply basic statistical methods
  5. Introduce machine learning concepts

- **Course Outcomes:** After successful completion course, students will be able to
  - CO1. Explain data science concepts and applications
  - CO2. Perform data pre-processing and cleaning
  - CO3. Analyse data using appropriate visualization tools
  - CO4. Apply statistical methods for analysis
  - CO5. Implement basic machine learning model.

- **Course Contents:**

Unit I	**Introduction to Data Science**	**6 Hours**
Definition, importance, lifecycle, Types of data, Applications in chemical engineering, Tools overview (Python, Excel)		
Unit II	**Data Collection & Pre-processing**	**6 Hours**
Data sources (industrial sensors, experiments), Missing data handling, noise removal, Data transformation, normalization, Introduction to NumPy and Pandas		
Unit III	**Data Visualization**	**6 Hours**
Graphical representation, Line, bar, histogram, scatter plots, Matplotlib and Seaborn, Case study		
Unit IV	**Statistics for Data Science**	**6 Hours**
Mean, median, variance, Probability basics, Correlation and regression, Case study		
Unit V	**Introduction to Machine Learning**	**6 Hours**
ML basics, Supervised vs unsupervised learning, Regression and classification, Model evaluation, Case study		

• **Continuous Comprehensive Assessment (Any Two)**		**20 Marks**
CCA1	**Course Projects**	**10 Marks**
Students should work on mini-project on any topic related to the course and submit report at end of the term.		
CCA2	**Quiz**	**10 Marks**
Quiz based on units 1 to 5		
CCA3	**Assignment**	**10 Marks**
Assignment based on units 1 to 5		

Textbooks:

1. L Igual, S Seguí, Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications, 2024, 2nd Edition, Springer International Publishing.
2. PN Tan, M Steinbach, V Kumar, Introduction to Data Mining, Pearson Learning Inc, 2006.

- **Reference Books:**

1. R. Rengaswamy and R.Suresh, "Data Science for Engineers", CRC Press, 2022.
2. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015
3. S. J. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education Ltd., 2022
4. R.S. Michalski, J. G. Carbonell, T. M. Mitchell, Machine learning: An artificial intelligence approach. Springer Science & Business Media, 2013.

- **MOOC / NPTEL Courses:**

1. https://onlinecourses.nptel.ac.in/noc25_cs20/preview
2. https://onlinecourses.nptel.ac.in/noc22_cs56/preview

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

- **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:** Nil

- **Course Objectives:**
  1. To introduce students to basic French pronunciation and vocabulary.
  2. To develop elementary listening and speaking skills in French.
  3. To familiarize students with simple French sentence structures.
  4. To enable students to communicate in everyday situations.
  5. To develop readiness for beginner-level French language learning.

- **Course Outcomes:** At the end of the course, students will be able to
  CO 1. Understand basic French vocabulary and pronunciation.
  CO 2. Introduce themselves using simple French expressions.
  CO 3. Read and write basic French sentences.
  CO 4. Communicate in simple everyday situations.
  CO 5. 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**	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Nil

- **Course Objectives:**

1. To introduce students to basic German pronunciation and vocabulary.
2. To develop elementary communication skills in German.
3. To familiarize students with simple German sentence structures.
4. To enable students to communicate in everyday situations.
5. To develop awareness about German culture and traditions.

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

CO 1: Understand basic German pronunciation and vocabulary.

CO 2: Communicate using simple expressions.

CO 3: Read and write elementary German sentences.

CO 4: Use common phrases in daily situations.

CO 5: Demonstrate awareness about German culture.

- **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)
  2. Complete German Course: Learn German for Beginners : https://www.udemy.com/course/complete-german-course-learn-german-for-beginners/?couponCode=PMNVD2025
  3. German A1 - German For Complete Beginners! : https://www.udemy.com/course/german-for-complete-beginners/?couponCode=PMNVD2025
  4. DW Learn German: https://learngerman.dw.com/en/learn-german/s-9528
  5. Practise German for free (Goethe-Institut Resources) : https://www.goethe.de/en/spr/ueb.html
  6. 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	
Tutorial	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	Nihongo nyūmon (Introduction to Japanese)	8 Hours
Hiragana, Greetings and introductions, Numbers and dates, Pronunciation practice		
Unit II	**Kihon-tekina bunpō to goi (Basic Grammar and Vocabulary)**	**6 Hours**
Sentence patterns, Basic Particles, Basic verbs, Pronouns and nouns		
Unit III	**Nichijō no komyunikēshon (Everyday Communication)**	**4 Hours**
Self-introduction, Family and hobbies, Daily activities, Asking simple questions		
Unit IV	**Dokkairyoku to sakubun nōryoku (Reading and Writing Skills)**	**6 Hours**
Reading simple scripts, Daily Vocabulary, Writing practice, Sentence construction		
Unit V	**Risuningu to supīkingu no renshū (Listening and Speaking Practice)**	**6 Hours**
Japanese culture, Pronunciation practice, Role play activities, Guided communication, activities.		

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

2. **Greetings and Classroom Conversation:** Students practice basic greetings and classroom communication in Japanese.
3. **Listening Comprehension Exercise:** Students listen to short Japanese audio clips and answer simple questions.
4. **Picture Description in Japanese:** Students describe pictures using simple Japanese vocabulary.
5. **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
  2. 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
  7. 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
  4. Learn Japanese Language: Free Online Courses: https://www.busuu.com/en/course/learn-japanese-online

Course: Process Calculations Lab				**Code: 25CHPCC201L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Tutorial	1	1	Oral	Marks: 25

- **Prerequisites:** Basic Physics, Chemistry and Mathematics

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

1. Learn different methods of expressing composition of materials.
2. Understand the fundamentals of stoichiometry and apply the material balance concept to unit operation.
3. Learn the fundamentals of stoichiometry and apply the material balance concept to unit processes.
4. Understand the application of the general energy balance equation.
5. Analyze the composition of fuel and flue gas.

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

CO1: Evaluate the composition of materials.

CO2: Apply material balance equations to unit operations.

CO3: Apply material balance equations to chemical reaction.

CO4: Evaluate the energy requirement for various unit operations or processes.

CO5: Evaluate properties of the fuel.

List of Experiments

Tutorial

Tutorial based on the following title

1. Different methods of expressing composition of materials.
2. Material balance concept to unit operation.
3. Material balance concept to unit process.
4. Energy balance equation.
5. Analysis of the fuels and flue gas.

Virtual Laboratories: DWSIM – Open-Source Chemical Process Simulator

Course: Fluid Mechanics Lab				Code: 25CHPCC202L
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	Marks: 25

- **Prerequisites:** Engineering Mathematics, Engineering Mechanics, Physics and Chemistry

Course Objectives: The objectives of the course are to

1. Train the students to observe and analyze fluid flow operations.
2. Train the students to perform systematic experimentation.
3. Make the students aware of various fluid measuring devices and their application.
4. Understand various losses during fluid movement.
5. Verify various laws and principles of fluid flow.

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

CO1: Understand rheological behavior of fluids and its measurement.

CO2: Verify various laws and equations governing fluid flow operations.

CO3: Determine fluid flow rate by different devices.

CO4: Understand the characteristics of centrifugal pump.

CO5: Understand concepts of Stoke's law and Newton's law of viscosity

List of Experiments

Perform ANY Eight experiment from following list:

1. Determination of viscosity
2. Reynolds experiment to determine laminar and turbulent flow
3. Bernoulli's theorem
4. Flow through venturi meter
5. Flow through orifice meter
6. Flow through rotameter
7. Study on Major losses
8. Study on Minor losses
9. Characteristics of centrifugal pump
10. Verification of Stoke's law
11. Verification of Newton's law of viscosity

Virtual Laboratories:

- https://fm-nitk.vlabs.ac.in/
- https://me.iitp.ac.in/Virtual-Fluid-Laboratory/
- https://web.iitd.ac.in

Course: Solid- Fluid Operations Lab				**Code: 25CHPCC203L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Engineering Mathematics, Applied Science, Basic in Environmental Science/ Engineering.

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

1. Understand screen effectiveness and determination of properties of solids by screen analysis.
2. Understand principles of gravity settling, centrifugal settling and fluidization in a packed bed column.
3. Study performance of Froth flotation cell and Cyclone separator.
4. Analyze effects of different types of impellers on mixing and performance of Sigma mixer.
5. Study aspects of filters, classifier and pneumatic conveyor.

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

CO1: Classify equipment for screening, use of methods of screen analysis and ball mill in industries.

CO2: Make use of thickeners, clarifiers and centrifuges for solid- liquid separations.

CO3: Apply principles of froth floatation and cyclone separator for separation of mixtures.

CO4: Identify an appropriate type of impeller for mixing of a particular mixture and to estimate mixing index

CO5: Understand applications of filtration equipment for separation of given slurry.

List of Experiments

Any EIGHT (08) experiments of the following:

Experiment 1:

To determine properties of solids by cumulative methods of screen analysis.

Experiment 2:

To determine overall effectiveness of a given set of standard screens by using a Sieve Shaker.

Experiment 3:

To determine critical speed of a Ball Mill and average particle size of the product obtained.

Experiment 4:

To determine area of a batch thickener by conducting batch settling tests in a laboratory.

Experiment 5:

To determine minimum velocity for fluidization through a packed bed and to verify Ergun equation.

Experiment 6:

To determine collection efficiency of a Cyclone Separator based on different parameters for separation of a given mixture.

Experiment 7:

To study performance of Froth flotation cell.

Experiment 8:

To determine mixing index for agitation of a given mixture in a mechanically agitated vessel for comparison of different types of impellers.

Experiment 9:

To determine mixing index of a viscous paste in a Sigma Mixer.

Experiment 10:

To determine filter medium resistance and specific cake resistance for constant pressure filtration or constant rate filtration by using a Plate-and-Frame-Filter Press.

Experiment 11:

To determine filter medium resistance and specific cake resistance for constant pressure filtration or constant rate filtration by using a Vacuum Leaf Filter.

Experiment 12:

To determine rate of settling and settling velocity by centrifugal settling of a given slurry in an under-driven Centrifuge.

Experiment 13:

To study working principle, construction and working of Dorr/Rake Classifier.

Experiment 14:

To study working principle, construction and working of a pneumatic conveying system.

15. Industrial visit.

Virtual Laboratories:

1. Flow through a fluidized bed NIT Suratkal (https://uorepc-nitk.vlabs.ac.in/exp/flow-through-fluidized-bed/theory.html)
2. To determine the coefficient of viscosity of a given viscous liquid. (https://ph1-nitk.vlabs.ac.in/exp/viscosity-stokes/simulation.html)

Course: Basic Chemical Engg. Calculations Using Software-1 Excel				Code: 25CHVSE201
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Basic mathematics including algebra and calculus, Fundamentals of chemical engineering principles, Basic computer literacy.

Course Objectives: The objectives of the Course are to

- Introduce computational tools for solving basic chemical engineering problems.
- Develop problem-solving skills using MS-Excel.
- Apply MS Excel for numerical and graphical solutions.
- Enhance analytical and programming skills for engineering applications.

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

CO1: Use MS Excel for basic chemical engineering calculations.

CO2: Apply MS-Excel for solving algebraic and numerical problems.

CO3: Analyze material and energy balance problems using software tools.

CO4: Plot and interpret engineering data using Excel.

List of Experiments

Perform **Any Eight** experiments from following list:

1. Unit conversions and basic engineering calculations using MS-Excel.
2. Material balance on a single unit process using MS-Excel formulas.
3. Material balance on multiple unit processes using MS-Excel Solver.
4. Energy balance calculations for heating and cooling operations in MS-Excel.
5. Plotting thermodynamic property data using MS-Excel charts.
6. Regression analysis of experimental data using MS-Excel.
7. Solving linear algebraic equations in MS Excel.
8. Solving non-linear algebraic equation in MS Excel.
9. Implementation of loops and conditional statements for engineering problems in MS Excel.
10. Plotting functions and engineering data visualization using MS Excel.
11. Stoichiometric calculations of chemical reactions using MS Excel.
12. Integrated case study combining MS-Excel for material and energy balance.
13. Solving a real-life chemical engineering problem using MS-Excel.

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:**
  6. To help students understand the importance of human values in personal and professional life.
  7. To develop ethical awareness and responsible decision-making.
  8. To create harmony between individual, society, and nature.
  9. 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: 25CHELC201**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2Hrs/Week	1	Term Work	Marks: 25

- **Prerequisites:**

1. It is an experiential learning approach that combines community service, community development, education and learning.
2. Project involves students in community development and service activities and applies the experience to personal and academic development.
3. The targeted contribution of college students to the village/local development will benefit the community.

- **Course Objectives:** The course aims to:

1. Establish a mutually beneficial relationship between the college and the community.
2. Opportunities to engage with their local community, fostering empathy, teamwork, and problem-solving skills while contributing positively to their surroundings.
3. An understanding of the challenges faced by the local community and the role of engineering in addressing those challenges.
4. The ability to apply technical knowledge and skills to design solutions or interventions that create a positive impact on the community.
5. The skills to evaluate and critically analyze the outcomes of their engagement activities, deriving actionable insights for sustainable impact

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

CO1 - Identify and Analyze local community needs and challenges by engaging with stake- holders and evaluating real-world problems.
CO2- Design and Implement practical, creative, and context-specific solutions using engineer- ing principles to address community issues.
CO3 - Reflect and Evaluate the effectiveness of their interventions and articulate lessons learned through reports and presentations.

- **Guidelines:**

1. A group of 3 to 4 students or a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay/college premise.
2. Each group is allotted to a faculty member of the department as a mentor.
3. The group of students will be associated with a government official / village authorities /NGOs etc. concerned, allotted by the district administration, during the duration of the project.
4. The Community Engagement Project should be different from the regular programmes of NSS/NC-

C/Green Club/Hobby Clubs, Special Interests Groups etc.

5. An activity book has to be maintained by each of the students to record the activities undertaken/involved and will be countersigned by the concerned mentor/HoD.
6. Project report shall be submitted by each student/group of students.
7. An internal evaluation shall also be conducted by a committee constituted by the HoD.
8. Evaluation to be done based on the active participation of the student and marks could be awarded by the mentor/HoD.
9. Students' groups can conduct an awareness programme on Health and Hygiene or in Organic Farming or in Fisheries or in advocating prohibition of liquor or about renewable energy, e- waste management or any other activity in an area of their studies and as per his/her aptitude.

- **List of topics:**

The below lists are not exhaustive and open for HoD's or mentors to add, delete or modify. It is expected that the focus should be on specific local issues in their nearby areas. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a student/group of students shall.

- Use and/or miss-use of cell phones
- Career orientation of youth
- Water facilities and drinking water availability
- Health and hygiene of the school going students, home makers and old personals
- Health intervention and awareness programmes
- Horticulture Herbal and Nutrition
- Traditional and Modern health care methods
- Food habits
- Air /Sound /Water pollution
- Plantation and Soil protection
- Renewable energy and Solar Systems
- Yoga awareness and practice
- Health care awareness programmes and their impact
- Organic farming, IoT implementations
- Food adulteration
- Incidence of Diabetes and other chronic diseases
- Blood groups and blood levels
- Chemicals in daily life
- Music and dance
- Women education and empowerment

Project Scope:

- Conduct workshops or awareness drives on topics like digital literacy, environmental sustain- ability, mental health, or career planning for local stakeholders.
- Develop a simple prototype or solution that addresses a real-world problem (e.g., a water-saving device, simple mobile apps, or tools for community use).
- Organize clean-up drives, tree plantations, recycling campaigns, or energy conservation initiatives.
- Promote health through awareness programs on hygiene, nutrition, and exercise.
- Teach basic computer or technical skills to students, staff, or the community

- **Text Books:**

1. Waterman, A. Service-Learning: A Guide to Planning, Implementing, and Assessing Student Projects. Routledge, 1997.

2. Beckman, M., and Long, J. F. Community-Based Research: Teaching for Community Impact. Stylus Publishing, 2016.

- **MOOC / NPTEL/YouTube Links:**
  Ecology and Society https://onlinecourses.nptel.ac.in/noc20_hs77/preview
- **Web Links:**
  1. UNESCO: Education for Sustainable Development https://www.unesco.org
  2. EPICS (Engineering Projects in Community Service) https://engineering.purdue.edu/EPICS
  3. Ashoka: Innovators for the Public https://www.ashoka.org
  4. Design for Change https://www.dfcworld.com

Course: Development of Process Flow Diagram (HONORS-I)			**Code: 25CHHNRS201**	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Chemical Engineering fundamentals, Mass and energy balances, unit operations, process flow diagram, Engineering drawing

- **Course Objectives: The objectives of the course are to**
  1. Understand industrial processes and their representation
  2. Develop skills in preparing block flow diagrams and process flow diagrams
  3. Learn standard symbols and conventions used in Process Flow Diagrams (PFDs)
  4. Perform mass and energy balance for process systems
  5. Prepare detailed process descriptions for industrial applications
- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Interpret and analyze industrial process systems

  CO2: Develop block flow diagrams and process flow diagrams

  CO3: Apply standard symbols and conventions in PFD preparation

  CO4: Perform mass and energy balance calculations

  CO5: Prepare detailed process descriptions for real systems
- **Course Contents:**

Unit I	**Process Understanding**	**6 Hours**

Overview of chemical process industries, Types of industrial processes (batch, continuous), Identification of process units (Reactors, Separators, Heat Exchangers), Raw Materials, Products and Utilities, Introduction to

process documentation, Design Basis Memorandum, Equipment List, Stream List, Utility Summary and Datasheets

Unit II	Block Flow Diagram (BFD)	6 Hours

Definition and importance of BFD, Representation of major process steps, Identification of input/output streams, Simplification of complex processes, Case study: Preparation of BFD for a simple chemical plant

Unit III	PFD Symbols and Standards	6 Hours

Difference between BFD, PFD, and P&ID, Standard symbols for equipment (reactors, pumps, heat exchangers), Stream representation and labelling, Industry standards (ISO, ANSI conventions) , Introduction to software tools (e.g., Aspen HYSYS, Aspen Plus), Awareness of ISA, API and PIP standards

Unit IV	Stream Identification and Mass-Energy Balance	6 Hours

Stream numbering and tagging, Material balance calculations (steady state), Energy balance (heat duty, work interactions), Integration of balances into PFD, Example problems and case studies

Unit V	Process Description and Industrial Applications	6 Hours

Writing process description reports, Integration of BFD, PFD, and calculations, Industrial case study (distillation/reaction process), Documentation and reporting standards, Introduction to simulation-based PFD development

• Continuous Comprehensive Assessment (Any Two)	20 Marks

CCA1	Assignment	10Marks

- Assignment

CCA2	Poster Presentation	10 Marks

- Poster presentation on any topic

CCA3	Group Discussion / Seminar / Blog Writing	10 Marks

Group Discussion / Seminar / Blog Writing on any topic

- **Textbooks:**

1. Peters, M. S., Timmerhaus, K. D., and West, R. E. (2003). Plant Design and Economics for Chemical Engineers (5th ed.). McGraw-Hill.
2. Ludwig, E. E. (1997). Applied Process Design for Chemical and Petrochemical Plants (3rd ed.). Gulf Publishing.

- **Reference Books:**

1. Bausbacher, E., and Hunt, R. (1993). Process Plant Layout and Piping Design. Prentice Hall.
2. Aerstin, F., and Street, G. (1978). Applied Chemical Process Design. Springer.

3. Wells, G. L., and Rose, L. M. (1961). The Art of Chemical Process Design. Elsevier.

- **MOOC / NPTEL Courses:**
  Computational process design, Prof. Hariprasad Kodamana, Prof. Manojkumar Ramteke|IIT Delhi
  https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ch47

Course: Development of Process Flow Diagram (HONORS-I)				**Code: 25CHHNRS201L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Basic knowledge of Chemical Engineering fundamentals, Mass and Energy Balances, Unit Operations, Process Flow Diagrams (PFDs), and basic computer skills.

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

1. Develop practical skills in preparing Block Flow Diagrams (BFDs) and Process Flow Diagrams (PFDs).
2. Familiarize students with process simulation software for flowsheet development.
3. Apply material and energy balance concepts to process simulation.
4. Develop industrial documentation and reporting skills.
5. Interpret and analyze industrial process flowsheets.

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

CO1: Develop Block Flow Diagrams and Process Flow Diagrams using simulation software.

CO2: Perform material and energy balance calculations through process simulation.

CO3: Create and analyze process flowsheets for chemical processes.

CO4: Generate simulation reports and technical documentation.

CO5: Demonstrate the ability to model and optimize industrial process systems.

List of Experiments

Any six (06) experiments of the following:

1. Familiarization with process simulation software and creation of a new simulation project.
2. Preparation of a Block Flow Diagram (BFD) for a selected chemical process.
3. Development of a Process Flow Diagram (PFD) with standard equipment symbols and stream numbering.
4. Simulation of a mixing and splitting operation with material balance verification.
5. Simulation of a heat exchanger and determination of heat duty and outlet conditions.
6. Development and simulation of a reactor process (Batch/CSTR/PFR).

7. Simulation of a distillation process and preparation of its Process Flow Diagram.
8. Material and energy balance calculations using process simulation software.
9. Preparation of a complete process description report with BFD, PFD, simulation results, and stream table.
10. Any other related to Development of Process Flow Diagram

Course: Fundamentals of Process Plant (HONORS-II)				**Code: 25CHHNP202**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Chemical Engineering fundamentals, Understanding of unit operations and process equipment, Familiarity with engineering drawing and plant layout concepts

- **Course Objectives: The objectives of the course are to**
  1. Understand fundamentals of process plant layout and design
  2. Study various process units and equipment classification
  3. Learn material handling systems in process industries
  4. Understand safety principles in plant design
  5. Develop basic knowledge of plant engineering practices

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

  CO1: Explain process plant layout and its importance

  CO2: Identify and classify process equipment

  CO3: Understand material handling systems in industries

  CO4: Apply safety principles in plant design

  CO5: Analyze basic process plant engineering practices

- **Course Contents:**

Unit I	**Plant Layout Basics**	**6 Hours**

Definition and importance of plant layout, Types of plant layouts (product, process, fixed position), Factors affecting plant layout (location, economics, safety), Space requirements and equipment arrangement, Introduction to plant layout diagrams

Unit II	**Process Units in Chemical Plants**	**6 Hours**

Overview of major process units, Reactors, heat exchangers, distillation columns, separators, Utilities: boilers, cooling towers, compressors, Integration of process units in plant layout, Case study of a simple chemical plant

Unit III	Equipment Classification	6 Hours
Classification based on function (processing, storage, transport), Static and rotary equipment, Selection criteria for equipment, Material of construction (MOC), Equipment standards and specifications		
Unit IV	**Material Handling Systems**	**6 Hours**
Importance of material handling in process plants, Types: solid, liquid, and gas handling, Equipment: conveyors, pumps, pipelines, Storage systems (tanks, silos), Economic and safety considerations		
Unit V	**Safety Basics in Process Plants**	**6 Hours**
Introduction to process safety, Hazards in chemical industries, Safety measures and protective systems, Basics of HAZOP and risk assessment, Industrial safety standards and regulations development		

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**
• Assignment		
CCA2	**Poster Presentation**	**10 Marks**
• Poster presentation on any topic		
CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**
Group Discussion / Seminar / Blog Writing on any topic		

- **Textbooks:**
  1. Peters, M. S., Timmerhaus, K. D., and West, R. E. (2003). Plant Design and Economics for Chemical Engineers (5th ed.). McGraw-Hill.
  2. Towler, G., and Sinnott, R. (2021). Chemical Engineering Design (3rd ed.). Elsevier.

- **Reference Books:**
  1. Bausbacher, E., and Hunt, R. (1993). Process Plant Layout and Piping Design. Prentice Hall.
  2. Aerstin, F., and Street, G. (1978). Applied Chemical Process Design. Springer.
  3. Wells, G. L., and Rose, L. M. (1961). The Art of Chemical Process Design. Elsevier.

- **MOOC / NPTEL Courses:**
  Principles and Practices of Process Equipment and Plant Design, By Prof. Gargi Das, Prof. S. Ray, | IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ch47

Course: Fundamentals of Process Plant Lab (HONORS-II)		**Code: 25CHHNP202L**
Teaching Scheme (Hrs./Week)	**Credit**	**Evaluation Scheme**

Practical	2	1	Oral	Marks: 25

- **Prerequisites:** Basic knowledge of Chemical Engineering fundamentals, Unit Operations, Process Equipment, Engineering Drawing, and Plant Layout.

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

1. Develop practical understanding of process plant layout and equipment arrangement.
2. Identify and classify major process equipment used in chemical industries.
3. Familiarize students with material handling systems and utilities.
4. Understand plant safety practices and engineering standards.
5. Develop skills in preparing basic plant engineering documentation.

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

CO1: Prepare basic process plant layouts considering engineering requirements.

CO2: Identify and classify process equipment and utilities used in chemical plants.

CO3: Select suitable material handling systems for different process applications.

CO4: Apply safety principles and hazard identification techniques in process plants.

CO5: Develop basic engineering drawings and technical reports related to process plants.

List of Experiments

Any six (06) experiments of the following:

1. Study of process plant layout drawings and identification of major process units.
2. Identification and classification of static and rotary equipment used in chemical industries.
3. Preparation of a basic plant layout for a simple chemical process considering equipment spacing and utilities.
4. Study and selection of materials of construction (MOC) for various process equipment.
5. Study of material handling equipment: pumps, compressors, conveyors, pipelines, storage tanks, and silos.
6. Preparation of equipment layout and piping routing using engineering drawing/CAD software.
7. Study of plant utility systems (steam, cooling water, compressed air, refrigeration, and power distribution).
8. Hazard identification and safety audit of a process plant using safety checklists.
9. Introduction to HAZOP and basic risk assessment through an industrial case study.
10. Any other related to Fundamentals of Process Plant

SEMESTER-IV

Course: Heat Transfer				Code: 25CHPCC204
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Fundamental knowledge of Mathematics, Thermodynamics and Fluid Mechanics

- **Course Objectives: The objectives of the course are to**
  1. Explain the fundamentals of heat transfer by conduction, convection and radiation.
  2. Analyze heat transfer mechanisms in steady and unsteady state systems.
  3. Apply heat transfer correlations for phase change and convection operations.
  4. Design and evaluate heat exchangers and evaporators for industrial applications.
  5. Solve engineering problems related to heat transfer equipment and energy conservation.

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

CO1: Develop an equation for heat conducted through the system

CO2: Calculate heat transfer coefficients and heat transfer rates in convection and phase change processes.

CO3: Demonstrate basic principles, mechanism and calculations of radiation heat transfer.

CO4: Design heat exchange equipment based on the need that fits the application.

CO5: Solve engineering problems involving conservation of energy in evaporation processes.

- **Course Contents:**

Unit I	**Conduction**	**8 Hours**

Introduction, Heat Transfer and Thermodynamics, Modes of heat transfer, Heat transfer fluxes and resistances, Thermal conductivity, Fourier's law of conduction, General equation for conduction. Conduction through plane, cylindrical and spherical and composite walls, Heat losses and insulation, Critical insulation thickness, introduction to heat transfer with heat sources. Unsteady State Conduction. Fins and their importance, The concept of fin efficiency and fin effectiveness.

Unit II	**Convection**	**8 Hours**

Heat Transfer without Phase Change:

Thermal boundary layer, natural and forced convection, heat transfer coefficients, thermal resistances, convection correlations for laminar and turbulent flow, Reynolds and Chilton–Colburn analogies, dimensional analysis and dimensionless groups.

Heat Transfer with Phase Change:

Latent heat, pool and film boiling, critical heat flux, condensation modes, Nusselt equation, and condensation on plates and pipes.

Unit III	**Radiation**	**8 Hours**

Radiant energy distribution, Various laws of radiation and their derivatives, Plank's law, Wein's law The Stefan-Boltzmann law for blackbody, Kirchhoff's law, black body, gray body, emissive power Exchange of energy between two surfaces; View factors, combined heat transfer by conduction, convection and radiation, Furnace calculations.

Unit IV	**Heat Exchanger**	**8 Hours**

Types of heat exchangers; Co-current and counter-current flows, fouling factors, choice of thermic fluids, Equivalent diameter; LMTD, correction factors, Temperature profiles in heat exchangers, pressure drop, Process design of heat exchangers including double pipe heat exchanger, multi-pass exchangers, shell and tube heat exchanger, effectiveness of cocurrent and counter-current heat exchangers, cross flow heat exchangers, Heat transfer equipment auxiliaries: Steam trap, Self Study.

Unit V	**Evaporation**	**8 Hours**

Introduction, solution properties, foaming, degradation due to high temperature, scaling, equipment material, types of evaporators, material and energy balance for single effect systems, boiling point elevation, capacity and economy, multiple effect evaporators. Design of evaporators, Self Study.

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**
• Assignment/Numerical problem solving		
CCA2	**Poster Presentation**	**10 Marks**
• Poster presentation on any topic of heat transfer		
CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**
Group Discussion / Seminar / Blog Writing on any topic of heat transfer		

Textbooks:

J. P Holman, Souvik Bhattacharyya, 10th Edition, McGraw Hill Education Private Ltd.

Coulson., Richardson J.E., "Chemical Engineering", Vol-I, Pergamon Press.

Sinnott R. K., "Chemical Engineering" Vol- VI, 4th Edition, Chemical Engineering Design, Elsevier.

- **Reference Books:**

1. Kern, D.Q., Process Heat Transfer, Tata McGraw-Hill (2008).
2. "Heat Transfer-Principles & Applications" Binay K Dutta, PHI Learning Private Ltd, 2011.
3. McCabe, W.L., Smith J.C., and Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill (2005).
4. Cengel Y.A. "Heat and Mass Transfer" 3 rd Edition Tata McGraw Hill Publications New Delhi(2007)

- **MOOC / NPTEL Courses:**
  1. Heat Transfer, Prof Sunando Dasgupta, IIT Kharagpur https://archive.nptel.ac.in/courses/103/105/103105140/
  2. Conduction And Convection Heat Transfer Prof. Suman Chakraborty, Prof. Sankar Kumar Som, IIT Kharagpur https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_me63
  3. Heat Transfer, Prof. Ganesh Viswanathan, IIT Bombay https://archive.nptel.ac.in/courses/112/105/112105271/

Course: Mathematical Methods in Chemical Engineering			**Code: 25CHPCC205**	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of calculus, differential equations, matrices, and multiple integrals studied in Engineering Mathematics I and II.

- **Course Objectives: The objectives of the course are to**
  1. Study the basic concepts of probability and statistics.
  2. Study types of error and various numerical methods.
  3. Study Laplace Transform techniques.
  4. Study Fourier Transform techniques.
  5. Study partial differential equations.

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

CO1: Analyze experimental data and uncertainties using probability and statistical methods.

CO2: Understand types of errors and obtain approximate solutions of engineering problems using numerical methods.

CO3: Solve differential equations arising in chemical process systems using Laplace transform techniques.

CO4: Apply Fourier transform techniques in solving boundary value problems in transport processes.

CO5: Solve partial differential equations related to heat and mass transfer problems.

- **Course Contents:**

Unit I	**Probability and Statistics**	**6 Hours**

Measures of central tendency, Measures of dispersion, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Reliability of Regression estimates. Probability, density function, Probability distributions: Binomial, Poisson, Normal, Test of hypothesis: Chi-square test.		
Unit II	**Numerical Methods**	**6 Hours**
Errors in computation, Bisection and Newton–Raphson methods, Interpolation, Numerical differentiation, Trapezoidal and Simpson's rule		
Unit III	**Laplace transform**	**6 Hours**
Laplace transform: Definition and properties, Laplace transform of standard functions, Inverse Laplace transform Convolution theorem, Solution of linear differential equations, Applications to process systems		
Unit IV	**Fourier transform**	**6 Hours**
Fourier transform and inverse, Properties, Sine and cosine transforms, Convolution theorem, Applications in boundary value problems, Self Study		
Unit V	**Partial Differential Equations & optimization techniques**	**6 Hours**
Solution of PDE by separation of variables, Wave equation, Heat equation, Laplace equation, Applications in Engineering, Optimization, Self Study		

• **Continuous Comprehensive Assessment: (Any Two)**		**20 Marks**
CCA 1	**Report Writing / Mini-Project**	**10 Marks**

List of Topics:

1. Application of Laplace Transform in Chemical Process Dynamics and Control Systems
2. Numerical Solution of Nonlinear Chemical Engineering Equations using Newton–Raphson Method
3. Statistical Analysis of Experimental Data from a Chemical Process
4. Heat Transfer Modeling using Heat Equation and Separation of Variables
5. Fourier Transform Applications in Diffusion and Mass Transfer Processes

CCA 2	**Seminar / Blog Writing**	**10 Marks**

List of Topics:

1. Role of Probability and Statistics in Chemical Process Industries
2. Numerical Methods for Process Simulation and Optimization
3. Applications of Laplace Transform in Chemical Reactor Analysis
4. Fourier Transform Techniques in Transport Phenomena
5. Partial Differential Equations in Heat and Mass Transfer Operations

CCA 3	**Case Study / Survey**	**10 Marks**

List of Topics:

1. Analysis of Temperature Distribution in a Heat Exchanger using PDEs
2. Process Control of a Continuous Stirred Tank Reactor (CSTR) using Laplace Transform
3. Statistical Quality Control in Chemical Manufacturing Processes
4. Numerical Estimation of Reaction Rate Parameters from Experimental Data
5. Application of Fourier Transform in Diffusion and Separation Processes

Textbooks:

1. B. S. Grewal – Higher Engineering Mathematics
2. Erwin Kreyszig – Advanced Engineering Mathematics
3. S. S. Sastry – Introductory Methods of Numerical Analysis

- **Reference Books:**

1. B. V. Ramana – Higher Engineering Mathematics
2. Murray Spiegel – Schaum's Outline of Advanced Mathematics
3. H. K. Dass & Er. Rajnish Verma – Higher Engineering Mathematics
4. Steven C. Chapra & Raymond P. Canale, Numerical Methods for Engineers, 5th Edition, Tata McGraw-Hill, 2007.
5. Santosh K. Gupta, Numerical Methods for Engineers, New Age International, 1995.
6. Thomas F. Edgar, David M. Himmelblau, Leon S. Lasdon, Optimization of Chemical Processes, 2nd Edition, McGraw Hill, 2002.
7. S. Balgurusamy, Numerical Methods, Tata McGraw Hill, 2008.
8. Curtis F. Gerald, Patrick O. Wheatley, Applied Numerical Analysis, 6th Edition, Pearson Education Asia, 2002.
9. K. E. Atkinson, An Introduction to Numerical Analysis, Wiley Publication.

- **MOOC / NPTEL Courses:**

  - Numerical Methods for Engineers, IIT Madras, Prof Niket Kaisare, https://nptel.ac.in/courses/127106019
  - Advanced Engineering Mathematics, IIT Rookee, Prof P N Agarwal https://nptel.ac.in/courses/111107119
  - Probability and Statistics, IIT Kharagpur, Prof Somesh Kumar, https://nptel.ac.in/courses/111105090

Course: Chemical Reaction Engineering-I				**Code: 25CHPCC206**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30

			ESE	50

Prerequisites: Chemistry, Process Calculations, Introduction to Chemical Engineers, Introduction to Computational Tools.

- **Course Objectives: The objectives of the course are to**
  - Understand the fundamentals of homogeneous reaction kinetics.
  - Interpret experimental kinetic data and determine reaction parameters.
  - Study design and performance of ideal reactors.
  - Analyze and optimize reactor and product distribution
  - Introduce non-ideal flow behavior using Residence Time Distribution (RTD).

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

  CO1: Explain the fundamentals of chemical kinetics and rate laws.

  CO2: Analyse reaction rate data and determine kinetic parameters.

  CO3: Apply design equations for ideal reactors such as batch, CSTR, and PFR.

  CO4: Evaluate multiple reactions and product distribution.

  CO5: Analyse non-ideal reactor behaviour using RTD and modern computational tools.

- **Course Contents:**

Unit I	**Fundamentals of Chemical Reaction Engineering**	**8 Hours**

Introduction to chemical reaction engineering; classification of reactions; homogeneous and heterogeneous reactions; molecularity and order of reaction; elementary and non-elementary reactions; rate of reaction and rate expressions; temperature dependence of reaction rate; Arrhenius equation; activation energy; kinetic models for non-elementary reactions, searching mechanism, rate controlling step.

Unit II	**Interpretation of Reaction Rate Data**	**8 Hours**

Analysis of reaction rate data obtained from batch reactors; differential and integral methods of analysis; determination of reaction order and rate constants; half-life method. Self-Study. reaction - mechanism, kinetics, stereochemistry, factors favoring it. Electrophonic aromatic substitution in benzene and mono substituted benzenes, activating and deactivating groups.

Unit III	**Ideal Reactors and Reactor Design**	**8 Hours**

Design and performance of ideal reactors; batch reactor design equations; constant and variable volume batch reactors; continuous stirred tank reactor (CSTR); plug flow reactor (PFR); space time and space velocity; comparison of reactor performance; reactors in series and parallel.

Unit IV	**Multiple Reactions and Reactor Optimization**	**8 Hours**

Types of multiple reactions including series, parallel, and complex reactions; selectivity, yield, and conversion; strategies for maximizing desired product; effect of reactor type and operating conditions on product distribution, Self Study. Introduction, conformation isomerism of ethane, propane, butane, cyclohexane, optical isomerism

Unit V	Non-Ideal Reactors and Residence Time Distribution (RTD)	8 Hours
Introduction to non-ideal flow in reactors; causes of non-ideal flow behavior; residence time distribution concepts; RTD functions E(t) and F(t); experimental determination of RTD using tracer techniques; mean residence time and variance; RTD for ideal reactors (CSTR and PFR); models for non-ideal reactors such as dispersion model and tanks-in-series model, Self Study.		

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Design of reactor using Excel**	**10Marks**
• Design of any reactor using MS-Excel which includes rate constants, Activation energy etc.		
CCA2	**Quiz**	**10Marks**
• Quiz based on five units of reaction engineering		
CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**
Group Discussion / Seminar / Blog Writing on any topic of reaction engineering		

Textbooks:

- Elements of Chemical Reaction Engineering – H. Scott Fogler
- Chemical Reaction Engineering – Octave Levenspiel

- **Reference Books:**
  1. Chemical Reaction Engineering – J. M. Smith
  2. Introduction to Chemical Engineering Kinetics and Reactor Design- Charles G Hill, T W Root, 2nd Edition

MOOC / NPTEL Courses:

- Chemical Reaction Engineering, IISc Bangalore, Prof Jayant Modak, https://nptel.ac.in/courses/103108097
- Chemical Reaction Engineering, IIT, Guwahati, Prof Bishnupada Mandal, https://onlinecourses.nptel.ac.in/e-learning/preview/noc19_ch20

Course: Introduction to Artificial Intelligence and Machine Learning				**Code: 25AIMDM202A**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	2	2	CCA	20
			ISE	30
			ESE	50

- **Prerequisites:** Basic programming, Mathematics fundamentals

- **Course Objectives: The objectives of the course are to:**
  1. Understand Artificial Intelligence (AI) fundamentals
  2. Learn Machine Learning (ML) techniques
  3. Study learning algorithms
  4. Develop ML models
  5. Explore applications

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

  CO1: Explain AI/ML concepts

  CO2: Identify suitable algorithms

  CO3: Build basic ML models

  CO4: Evaluate model performance

  CO5: Apply ML in engineering

- **Course Contents:**

Unit I	**Introduction to AI**	**6 Hours**
Definition, history, AI applications in industry, Intelligent agents		
Unit II	**Machine Learning Basics**	**6 Hours**
Types of ML, Data, features, training, Over-fitting and under-fitting		
Unit III	**Supervised Learning**	**6 Hours**
Linear regression, Logistic regression, Classification methods		
Unit IV	**Unsupervised Learning**	**6 Hours**
Clustering (K-means), Dimensionality reduction, Evaluation metrics, Case study		
Unit V	**Introduction to Deep Learning**	**6 Hours**
Neural networks, Activation functions, Applications, Case study		

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Course Projects**	**10Marks**
Students should work on mini-project on any topic related to the course and submit report at end of the term.		
CCA2	**Quiz related to Course**	**10 Marks**
Quiz based on units 1 to 5		
CCA3	**Assignment**	**10 Marks**
Assignment based on units 1 to 5		

Textbooks:

1. S. J. Russel and P. Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education Ltd., 2022.
2. V Elaine Rich, Kevin Knight, and Shivashankar Nair, Artificial intelligence. Tata McGraw Hill, 2009.

- **Reference Books:**
  1. R.S. Michalski, J. G. Carbonell, T. M. Mitchell, Machine learning: An artificial intelligence approach. Springer Science & Business Media, 2013.
  2. S. S. Tambe, P. B. Deshpande, B. D. Kulkarni, and S. Ramani, "Elements of Artificial Neural Networks with Selected Applications in Chemical Engineering, and Chemical & Biological Sciences", Simulation & Advanced Controls, Incorporated, 1996.
  3. D. R. Dhooge, D. Constales, G. S. Yablonsky, G. B. Marin, "Advanced Data Analysis and Modeling in Chemical Engineering", Elsevier Science Ltd, 2016.
  4. J. A. Romagnoli, L. Briceño-Mena, V. Manee, "AI in Chemical Engineering: Unlocking the power within Data", CRC Press, 2024.

- **MOOC / NPTEL Courses:**
  1. Artificial Intelligence, IIT Delhi, Prof Mausam, https://nptel.ac.in/courses/106102220
  2. Fundamentals of Artificial Intelligence, IIT Guwahati, Prof. Shyamanta M. Hazarika https://nptel.ac.in/courses/112103280

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 MacmillanYear: 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**	
Tutorial	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-

1. Introduce concepts of innovation, creativity, and business strategy.
2. Develop strategic thinking and innovation management skills.
3. Explain business models, entrepreneurship, and technology innovation processes.
4. Familiarize students with sustainability, intellectual property rights, and innovation ecosystems.
5. 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:**

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

- **Reference Books:**

1. Drucker, Peter F., Innovation and Entrepreneurship, Routledge.
2. Harvard Business Review Series, Innovation and Entrepreneurship, Harvard Business School Publishing.
3. Osterwalder, A. & Pigneur, Y., Business Model Generation, Wiley.
4. Kim, W. Chan & Mauborgne, Renée, Blue Ocean Strategy, Harvard Business Review Press.
5. 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 Hrs/Week	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**	
Tutorial	2	2	**CCA**	**20**
			ISE	**30**
			ESE	**50**

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

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

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

  CO 1: Use basic French expressions confidently.
  CO 2: Understand simple dialogues and instructions.
  CO 3: Read and write short paragraphs.
  CO 4: Participate in guided conversations.
  CO 5: Apply French in practical 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**	
Tutorial	2	02	CCA	20
			ISE	30
			ESE	50

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

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

1. To strengthen beginner-level communication skills in German.
2. To improve reading, writing and listening abilities.
3. To develop confidence in practical conversations.
4. To introduce travel and public communication vocabulary.
5. To prepare students for Goethe A1 level competency.

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

CO 1: Use beginner-level German expressions confidently.
CO 2: Understand simple dialogues and instructions.
CO 3: Read and write short passages.
CO 4: Participate in practical conversations.
CO 5: Apply German 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	
Tutorial	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	Kihon bunpō (tsudzuki) (Basic Grammar Continuation)	8 Hours
Katakana, Adjectives types, Particle usage, Katakana Pronunciation		
Unit II	**Jissen-tekina komyunikēshon (Practical Communication)**	**4 Hours**
Culture & Etiquette, Asking directions, Basic Communication		
Unit III	**Risuningu to supīkingu no sukiru (Listening and Speaking Skills)**	**6 Hours**
Pronunciation improvement, Listening comprehension, Dialogue practice, Group conversation		
Unit IV	**Yomikaki (Reading and Writing)**	**6 Hours**
Numbers, Dates & Time, Vocabulary enhancement, Translation practice		
Unit V	**Bunka-teki oyobi shakai-teki komyunikēshon (Cultural and Social Communication)**	**6 Hours**
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.
5. **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
2. 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/
6. JLPT N5 Practice Material: https://www.jlpt.jp/e/samples/sampleindex.html

Course: Heat Transfer Lab				Code: 25CHPCC204L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical/Tutorial	2	1	Practical	Marks: 25

- **Prerequisites:** Fundamental knowledge of Mathematics, Thermodynamics and Fluid Mechanics

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

1. Understand practical aspects of heat transfer by conduction, convection and radiation.
2. Perform experiments for evaluating heat transfer coefficients and thermal properties.
3. Analyze heat transfer behavior in boiling, condensation and evaporation processes.
4. Design and evaluate heat exchangers and evaporators using experimental and software tools.
5. Apply heat transfer principles for solving industrial engineering problems.

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

CO1: Determine thermal conductivity and heat transfer rates in conduction systems.

CO2: Calculate heat transfer coefficients in convection and phase change processes.

CO3: Evaluate emissivity and radiation heat transfer characteristics.

CO4: Design and analyze heat exchangers and evaporators using experimental and software methods.

CO5: Apply energy balance concepts to heat transfer equipment and industrial processes.

List of Experiments

Perform **ANY EIGHT** experiments from following list:

1. Heat conduction- Determination of thermal conductivity
2. Convection (Natural/Forced)-Calculation of heat transfer coefficient
3. Thermal radiation-determination of emissivity
4. Construction of pool boiling curve
5. Determination of heat transfer coefficient of Double pipe heat exchanger
6. Determination of heat transfer coefficient of Shell and tube heat exchanger
7. Material balance and energy balance of Single effect evaporator
8. Design of shell and tube heat exchanger/ Calculations using HTRI software
9. Design of multiple effect evaporators using software (Excel, Chemcad, Python, UNISIM, ASPEN Etc.)
10. Study of Finned tube heat transport
11. Heat transfer analysis of Plate Heat exchanger
12. Heat transfer in agitated vessels

Virtual Laboratories:

- https://aero04-iitb.vlabs.ac.in/exp3/index.html

Course: Chemical Engineering Thermodynamics Laboratory			**Code: 25CHPCC205L**	
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Tutorial	02	1	Oral	Marks: 25

- **Prerequisites:** Physical Chemistry and Basic Mathematics

- **Course Objectives: The objectives of the course are to**
  1. Understanding of Core Thermodynamic Concepts
  2. Apply Thermodynamic Models to Practical Problems
  3. Enhance Analytical Skills for Complex Systems like non-ideal behaviour, fugacity, fugacity coefficients
  4. Introduce Advanced Thermodynamic Topics like activity coefficients, residual properties.
  5. Bridge Theory to Industrial Applications such as multiphase equilibria and reaction engineering

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

  CO1: Understand Thermodynamic Properties in terms of state- path functions and apply these concepts in closed and open systems.

  CO2: Solve solution thermodynamics problems to perform calculations for ideal and non-ideal mixtures.

  CO3: Apply Raoult's Law, dew point and bubble point calculations for vapour- liquid equilibrium.

  CO4: Interpret experimental data to analyse phase equilibria for prediction of system behaviour.

  CO5: Analyse chemical reaction equilibria calculations and predict equilibrium conversion for multi-reactions.

Tutorial Contents:

Unit I	**Solution Thermodynamics**	**8 Hours**

State and path functions, intensive and extensive properties, Fundamental property relations for closed systems, Maxwell relationships, residual properties, chemical potential, effect of T and P on chemical potential, criteria for phase equilibrium, partial properties, ideal gas mixtures, fugacity and fugacity coefficients for pure species, Poynting factor, for species in solution, generalized correlations, ideal solutions.

Unit II	**Solution Thermodynamic applications**	**8 Hours**

Excess properties, VLE data, fugacity, activity coefficients, excess Gibb's energy, Margules equation, Van Laar equation, property changes of mixing.

Unit III	**Vapor-liquid equilibrium**	**8 Hours**

The nature of equilibrium, criteria of equilibrium, effect of T and P on VLE, azeotropes, the phase rule, Duhem's theorem, Henry's law, Raoult's law, VLE by modified Raoult's law, dew point and bubble point calculations, VLE from K-value correlations, Flash calculations.

Unit IV	**Phase Equilibria**	**8 Hours**

Equilibrium and stability, liquid-liquid equilibrium, solid-liquid equilibrium, osmotic equilibrium and osmotic pressure, thermodynamic consistency, Self Study.

Unit V	**Chemical Reaction Equilibria**	**8 Hours**

The reaction coordinates, Application of the criteria for equilibrium to chemical reactions, the standard Gibbs free energy change and the equilibrium constant, effect of temperature on equilibrium constant, evaluation of the equilibrium constant. Relation of equilibrium constant to composition, calculation of equilibrium conversion for single reactions, The phase rule and Duhem's theorem for reacting systems, multi-reaction equilibria, Self Study.

Textbooks:

1. Introduction to Chemical Engineering Thermodynamics, 8th Edition, by J. M. Smith, H. C. Van Ness, and M. M. Abbott, McGraw Hill edition
2. Chemical Engineering Thermodynamics, K. V. Narayanan, A Textbook of Chemical Engineering Thermodynamics, 2nd Edition, PHI Learning Pvt. Ltd., 2013.
3. Chemical Engineering Thermodynamics, Y. V. C. Rao, Chemical Engineering Thermodynamics, 1st Edition, Universities Press (or Sangam Books Ltd., London), 1997.

- **Reference Books:**

1. Principles of Chemical Equilibrium: Kenneth Denbigh.
2. Chemical Engineering Thermodynamics: B. F. Dodge
3. Chemical Engineering Thermodynamics: T. E. Daubert
4. Thermodynamics for Chemists: Glasstone S.
5. Thermodynamics for Chemical Engineers: Weber and Meissner
6. Chemical and Process Thermodynamics: B. G. Kyle
7. Molecular Thermodynamic: Praunitz

- **MOOC / NPTEL Courses:**
  - https://onlinecourses.nptel.ac.in/noc24_ch31/preview
  - https://nptel.ac.in/courses/103104151
  - https://www.udemy.com/course/engineering-thermodynamics/?srsltid=AfmBOooqBiZxXgGj-LQzVSG21h8aPYZXF3CGBO0Ia-Rl6EeGjopfeaV6
  - https://www.coursera.org/learn/chemtherm1
  - https://www.coursera.org/learn/chemtherm2

Course: Chemical Reaction Engineering -I Laboratory				Code: 25CHPCC206L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	Marks: 25

- **Prerequisites:** Chemistry, Process Calculations, Introduction to Chemical Engineers, Introduction to Computational Tools

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

1. Understand second order and pseudo first order reactions experimentally
2. Determine reaction kinetics using conductivity methods
3. Study performance of batch reactor for different reactions
4. Analyze effect of concentration on reaction rate
5. Determine activation energy using Arrhenius law

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

CO1: Perform experiments on second order and pseudo first order reactions

CO2: Determine rate constants using conductivity measurements

CO3: Analyse batch reactor data for reaction kinetics

CO4: Evaluate effect of concentration on reaction behaviour

CO5: Calculate activation energy using Arrhenius plot

List of Experiments

Perform **ANY EIGHT** experiments from following list:

1. Second Order Reaction
2. Pseudo First Order Reaction
3. Second Order Reaction by conductivity meter
4. Pseudo First Order Reaction by conductivity meter
5. Batch reactor: Second order reaction
6. Batch reactor: Pseudo First Order Reaction
7. Study of Second Order Reaction for Unequal Concentration of Reactants
8. Arrhenius Law
9. Batch Reactor
10. CSTR
11. PFR
12. Rate constant of first order reaction of acid catalysed hydrolysis of ester.
13. To investigate the rate constant of an autocatalytic reaction between potassium permanganate and oxalic acid.

14. Preparation of aspirin from salicylic acid.
15. Preparation of nitrobenzene Sulphonation of benzene/toluene.
16. Preparation of Glucosazone derivative of Glucose.
17. Preparation of Paracetamol from p-Aminophenol.

Virtual Laboratories:

1. Reaction kinetic studies in a batch reactor. NIT Surathkal
2. Reaction kinetic studies in a mixed flow reactor, NIT Surathkal
3. Reaction kinetic studies in a plug flow reactor, NIT Surathkal

Course: Mini Project based on Chemical Technology				**Code: 25CHVSE202**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Oral	Marks: 25

Prerequisites: Basic Physics, Chemistry and Mathematics.

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

1 Undertake literature survey
2. Select suitable process from various synthesis methods
3. Analyse thermodynamic feasibility
4. Calculate Material Balances
5. Calculate Energy Balances

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

CO1: Undertake literature survey
CO2: Select suitable process from various synthesis methods
CO3: Analyse thermodynamic feasibility.
CO4: Create Material Balances
CO5: Create energy Balances.

List of Experiments

Mini Project based on Chemical Technology:

1. Department should display the list of approved teachers (guides)
2. The students should be given liberty to choose the project area and project guide of their own choice. Project area must be based on chemical technology - theoretical or practical
3. They shall work on the designated problem in groups (maximum two students per group) and present their work in terms of project report.

Project report content:

1. Define the research problem.
2. Write a research proposal, which should contain –

a. Project title

b. Introduction

c. Origin of the problem

d. Literature review of research and development at national & international level

e. Significance of the problem

f. Objective

g. Methodology

h. Details of collaboration (if any)

3. Carry out preliminary experimental or theoretical investigations.
4. Material balance and energy balance of practical or theoretical work.
5. Summarize the results and conclusion.

*** The student is required to prepare a month wise **work plan immediately after the allotment of the project**

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

- **Course Objectives:**

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- **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	□□□ □	**६ तास**

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Unit II	□□□ □	**६ तास**

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Unit III	□□□ □	**६ तास**

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Unit IV	□□□ □	**६ तास**

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Unit V	□□□ □	**६ तास**

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

- **Textbooks:**

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Term Work Evaluation

Subject teacher should frame minimum 10 assignments-based covering on all five units

1. □□□□□□ □□□□ (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 . □□□□□□□ (Translation Assignment)

Students translate text from **English to Marathi**.

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Example

- Short technical paragraph translation
- Daily communication sentences

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3. □□□□ □□□□ (Letter Writing)

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Types

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4. □□□□□□□□□ (**Group Activity)**

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Example

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5. □□□□□□□ (Presentation Assignment)

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Students present a topic in Marathi.

Examples

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6. □□□□□□□ (Group Discussion)

विद्यार्थ्यांनी गटांमध्ये एखाद्या विषयावर चर्चा करावी.

Students discuss a topic in groups.

Example Topics

- सोशल मीडियाचा प्रभाव
- ऑनलाइन शिक्षणाचे फायदे व तोटे

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

8. □□□□□□ □□□□□□□ (Book Review)

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

9. □□□□□□□ □□□□□□□ **(**Marathi film Review)

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

10. □□□□□□□□□□□□□ □□□□□ **(Participation in Competition)**

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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, निबन्धलेखनम्		
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 निभन्धसोपनः

Reference Books:

1. Panini Ashtadhyayi – Panini

Selected Sanskrit texts related to science and mathematics.

Term Work Evaluation

Subject teacher should frame minimum 10 assignments-based covering on all five units

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

- **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

Course: Honors-I: Pipeline Sizing				**Code: 25CHHNRS202**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Chemical Engineering fundamentals, Mass and energy balances, unit operations, process flow diagram, Engineering drawing, Fluid Mechanics.

- **Course Objectives: The objectives of the course are to**
  1. Understand fluid properties and their effect on flow behavior
  2. Study flow regimes and their significance in pipeline design
  3. Learn methods for pressure-drop calculation in pipelines
  4. Develop skills for selecting appropriate pipe diameter
  5. Understand pump sizing and industrial design standards

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

  CO1: Explain fluid flow behavior and properties in pipelines

  CO2: Identify flow regimes and apply relevant correlations

  CO3: Calculate pressure drop in pipelines accurately

  CO4: Select suitable pipe diameter for industrial applications

  CO5: Perform basic pump sizing and follow industrial standards

- **Course Contents:**

Unit I	**Fluid Properties**	**6 Hours**
Definition and classification of fluids, Properties: density, viscosity, specific gravity, Effect of temperature and pressure on properties, Newtonian and non-Newtonian fluids, Industrial fluids: water, oils, slurries		
Unit II	**Flow Regimes**	**6 Hours**
Laminar, transitional, and turbulent flow, Reynolds number and its significance, Velocity profiles in pipes, Flow behavior in different regimes, Applications in chemical industries		
Unit III	**Pressure Drop Calculation**	**6 Hours**
Major losses: Darcy-Weisbach equation, Friction factor and Moody chart, Minor losses: fittings, valves, bends, Equivalent length method, Numerical problems and case studies		
Unit IV	**Pipe Diameter Selection**	**6 Hours**
Criteria for pipe sizing, Economic pipe diameter, Velocity considerations, Design of pipe systems (series and parallel), Optimization of pipeline design, pipe schedules, valve selection, and pipe material selection in Pipeline Sizing.		
Unit V	**Pump Sizing and Industrial Standards**	**6 Hours**
Basics of pumps (centrifugal pumps), Head calculation and pump selection, System curve and pump curve, NPSH and cavitation, Introduction to industrial standards (ISO, ANSI, ASME) , Safety and design considerations in industry		

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**

- Assignment

CCA2	Poster Presentation	10 Marks

- Poster presentation on any topic

CCA3	Group Discussion / Seminar / Blog Writing	10 Marks

Group Discussion / Seminar / Blog Writing on any topic

Textbooks:

1. De Nevers, N. (2013). Fluid Mechanics for Chemical Engineers (3rd ed.). McGraw-Hill.
2. Coulson, J. M., Richardson, J. F., Sinnott, R. K., and Towler, G. (2019). Chemical Engineering Vol 1 Fluid Flow Heat Transfer and Mass Transfer (6th ed.). Elsevier.

- **Reference Books:**

1. Geankoplis, C. J. (2003). Transport Processes and Unit Operations (4th ed.). Prentice Hall.
2. Ludwig, E. E. (1997). Applied Process Design for Chemical and Petrochemical Plants (3rd ed.). Gulf Publishing.

- **MOOC / NPTEL Courses:**

Urban Utilities Planning: Water Supply, Sanitation and Drainage, IIT Kharagpur, Prof. Debapratim Pandit, https://nptel.ac.in/courses/124105158

Course: Honors-I: Pipeline Sizing				**Code: 25CHHNRS202L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	Marks: 25

- **Prerequisites:** Basic knowledge of Chemical Engineering fundamentals, Fluid Mechanics, Mass and Energy Balances, Unit Operations, Engineering Drawing, and Process Flow Diagrams.

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

1. Develop practical skills in pipeline hydraulic calculations.
2. Analyze fluid flow behavior under different operating conditions.
3. Perform pressure drop calculations for industrial piping systems.
4. Select suitable pipe diameters and pumps for process applications.
5. Familiarize students with industrial pipeline design software and standards.

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

CO1: Determine fluid properties required for pipeline design.

CO2: Analyze laminar and turbulent flow in piping systems.

CO3: Calculate pressure losses in pipelines with fittings and valves.

CO4: Select appropriate pipe sizes and pumping systems for industrial applications.

CO5: Develop and analyze complete piping systems using engineering software and industrial standards.

List of Experiments

Any six (06) experiments of the following:

1. Determination of fluid properties (density, viscosity and specific gravity) and their influence on pipeline design.
2. Calculation of Reynolds number and identification of flow regimes for different industrial fluids.
3. Determination of friction factor using the Moody chart and Darcy–Weisbach equation.
4. Calculation of major and minor pressure losses in pipelines with valves, elbows, tees and other fittings.
5. Pipe diameter selection based on flow rate, allowable velocity and pressure drop.
6. Hydraulic analysis of series and parallel pipeline systems.
7. Pump head calculation and selection of centrifugal pumps using manufacturer performance curves.
8. Development and analysis of system curves and pump curves to determine the operating point.
9. Pipeline hydraulic simulation using engineering software (AFT Fathom/PIPE-FLO/Aspen HYSYS/MS Excel).
10. Any other related to pipeline sizing

Course: Honors-II: P&ID and Process Documentation				**Code: 25CHHNRP202**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Chemical Engineering fundamentals, Understanding of process flow diagrams (PFD) and unit operations, Familiarity with process equipment and plant layout basics.

- **Course Objectives: The objectives of the course are to**
  1. Understand the difference between PFD and P&ID in process industries
  2. Learn preparation and interpretation of line lists and equipment lists
  3. Develop skills in preparing equipment datasheets
  4. Understand process documentation practices
  5. Study industrial standards used in process documentation

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

  CO1: Differentiate between PFD and P&ID and interpret both

  CO2: Prepare and analyze line lists and equipment lists

  CO3: Develop basic equipment datasheets

  CO4: Develop documentation in process industries

  CO5: Apply industrial standards in process documentation

- **Course Contents:**

Unit I	**PFD vs P&ID**	**6 Hours**
Definition and importance of PFD and P&ID, Key differences between PFD and P&ID, Symbols and representation in P&ID, Instrumentation basics (valves, sensors, controllers), Reading and interpretation of P&ID diagrams		
Unit II	**Line Lists**	**6 Hours**
Definition and purpose of line list, Line numbering systems, Components of line list (size, material, service, insulation), Preparation of line list, Industrial examples		
Unit III	**Equipment Lists and Datasheets**	**6 Hours**
Equipment list: purpose and structure, Types of equipment (static and rotary), Equipment datasheets (pumps, heat exchangers, vessels), Key parameters in datasheets, Introduction to vendor data		
Unit IV	**Process Documentation**	**6 Hours**
Importance of documentation in process industries, Types: PFD, P&ID, datasheets, manuals, Document control and revision management, Preparation of process description documents, Integration of documents in project lifecycle		
Unit V	**Industrial Standards**	**6 Hours**
Overview of standards (ASME, ANSI, ISO, API), Standard symbols and codes in P&ID, Documentation standards in industry, Safety and compliance requirements, Case studies from industry		

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**
• Assignment		
CCA2	**Poster Presentation**	**10 Marks**
• Poster presentation on any topic		
CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**
Group Discussion / Seminar / Blog Writing on any topic		

Textbooks:

1. Bausbacher, E., and Hunt, R. (1993). Process Plant Layout and Piping Design. Prentice Hall.
2. Towler, G., and Sinnott, R. (2021). Chemical Engineering Design (3rd ed.). Elsevier.

- **Reference Books:**

1. Couper, J. R., Penney, W. R., Fair, J. R., and Walas, S. M. (2012). Chemical Process Equipment Selection and Design (3rd ed.). Elsevier.
2. Ludwig, E. E. (1997). Applied Process Design for Chemical and Petrochemical Plants (3rd ed.). Gulf Publishing.

- **MOOC / NPTEL Courses:**

Process Control and Instrumentation, IIT Guwahati, Dr. P.K. Saha, https://nptel.ac.in/courses/103103037

Course: Honors-II: P&ID and Process Documentation				**Code: 25CHHNRP202L**
Teaching Scheme (Hrs./Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	Marks: 25

- **Prerequisites:** Basic knowledge of Chemical Engineering fundamentals, Process Flow Diagrams (PFDs), Unit Operations, Process Equipment, Engineering Drawing, and Plant Layout.

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

1. Develop practical skills in preparing and interpreting P&IDs.
2. Prepare industrial line lists, equipment lists, and equipment datasheets.
3. Familiarize students with industrial process documentation practices.
4. Understand document control and revision management.
5. Apply industrial standards in preparing engineering documents.

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

CO1: Develop and interpret Process and Instrumentation Diagrams (P&IDs).

CO2: Prepare line lists and equipment lists for process plants.

CO3: Develop equipment datasheets using industrial formats.

CO4: Prepare process documentation following industrial standards.

CO5: Apply documentation standards and revision control practices in engineering projects.

List of Experiments

Any six (06) experiments of the following:

1. Familiarization with P&ID symbols, instrumentation symbols, and ISA/ISO standards.

2. Preparation of a P&ID for a simple chemical process from an existing Process Flow Diagram (PFD).
3. Development of line lists including line numbering, pipe size, material specification, fluid service, insulation, and design conditions.
4. Preparation of equipment lists for a process plant including static and rotary equipment.
5. Preparation of equipment datasheets for centrifugal pumps, heat exchangers, pressure vessels, and storage tanks.
6. Development of valve and instrumentation schedules from a Process and Instrumentation Diagram.
7. Preparation of a process description document integrating PFD, P&ID, equipment list, and line list.
8. Study and implementation of document numbering, revision control, and engineering document management procedures.
9. Preparation of complete process documentation for a selected industrial process using standard engineering formats.
10. Any other related to P&ID and Process Documentation

Course: Air Pollution Control **(Double Minor-I: Environmental Engineering)**			**Code: 25CHMNRE201**	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Environmental Engineering, Understanding of fluid mechanics and thermodynamics, Familiarity with chemical engineering unit operations

- **Course Objectives: The objectives of the course are to**
  1. Understand sources and types of air pollutants
  2. Study the effects of air pollution on health and environment
  3. Learn mechanisms of pollutant formation and dispersion
  4. Understand various air pollution control technologies
  5. Develop skills in design and selection of control equipment
- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Identify and classify air pollutants and their sources

  CO2: Analyze the impact of air pollution on environment and health

  CO3: Apply principles of pollutant dispersion and transformation

  CO4: Select suitable air pollution control devices

CO5: Perform basic design and evaluation of control systems

- **Course Contents:**

Unit I	Introduction to Air Pollution	6 Hours

Definition and classification of air pollutants, Primary and secondary pollutants, Sources: natural and anthropogenic, Air quality standards (ambient and emission standards), Effects on human health, vegetation, and materials.

Unit II	Meteorology and Dispersion of Pollutants	6 Hours

Atmospheric structure and composition, Wind patterns and atmospheric stability, Temperature inversion, Plume behaviour and dispersion models, Gaussian plume model basics

Unit III	Control of Particulate Matter	6 Hours

Characteristics of particulate pollutants, Settling chambers and cyclone separators, Fabric filters (baghouse), Electrostatic precipitators (ESP), Design considerations and efficiency

Unit IV	Control of Gaseous Pollutants	6 Hours

Absorption (scrubbers), Adsorption (activated carbon), Condensation techniques, Combustion and incineration, Selection of appropriate control method

Unit V	Industrial Air Pollution Control and Monitoring	6 Hours

Air pollution control in industries (cement, thermal power, chemical plants), Stack design and emission monitoring, Air quality monitoring techniques, Environmental regulations and compliance, Case studies and emerging technologies

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**

- Assignment

CCA2	**Poster Presentation**	**10 Marks**

- Poster presentation on any topic

CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**

Group Discussion / Seminar / Blog Writing on any topic

Textbooks:

1. De Nevers, N. (2017). Air Pollution Control Engineering (3rd ed.). Waveland Press.
2. Rao, M. N., and Rao, H. V. N. (2007). Air Pollution. Tata McGraw-Hill.

- **Reference Books:**

1. Vallero, D. A. (2014). Fundamentals of Air Pollution (5th ed.). Academic Press.
2. Phalen, R. F., and Phalen, R. N. (2012). Introduction to Air Pollution Science. Jones & Bartlett

Learning.

- **MOOC / NPTEL Courses:**

Air Pollution and Control, Prof. Bhola Ram Gurjar, IIT Roorkee, https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ce14

Course: Air Pollution Control Laboratory (Double Minor-I: Environmental Engineering)				Code: 25CHHNR201L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	1	1	Term work	Marks: 25

Prerequisites: Basic knowledge of Environmental Engineering, Understanding of air pollution control theory, Familiarity with fluid flow and unit operations, Basic laboratory safety practices

- **Course Objectives: The objectives of the course are to**
  1. Provide hands-on experience in air pollution monitoring techniques
  2. Study performance of air pollution control equipment
  3. Measure particulate and gaseous pollutants
  4. Understand sampling and analysis methods
  5. Develop skills in data analysis and interpretation

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

  CO1: Conduct air sampling and monitoring experiments

  CO2: Analyze particulate and gaseous pollutant concentrations

  CO3: Evaluate performance of pollution control devices

  CO4: Interpret experimental data and compare with standards

  CO5: Prepare technical reports based on laboratory findings

- **Course Contents:**

Air Quality Monitoring Experiments (Any 8)

1. Measurement of particulate matter (PM10/PM2.5) using air sampler
2. Determination of sulphur dioxide (SO_2) concentration
3. Determination of nitrogen oxides (NOx) concentration
4. Measurement of carbon monoxide (CO) levels
5. Study of ambient air quality monitoring techniques
6. Calibration of air sampling instruments
7. Study of cyclone separator performance
8. Study of electrostatic precipitator (ESP) model
9. Study of packed bed scrubber
10. Study of fabric filter (baghouse)
11. Determination of collection efficiency of control devices
12. Pressure drop measurement across control equipment
13. Advanced / Mini Project (Optional)
14. Design and analysis of cyclone separator / scrubber

15. Air quality assessment of local area / industry
16. Case study on industrial air pollution control system
17. Any virtual lab based on the above experiments

- **Textbooks:**
  1. De Nevers, N. (2017). Air Pollution Control Engineering (3rd ed.). Waveland Press.
  2. Rao, M. N., and Rao, H. V. N. (2007). Air Pollution. Tata McGraw-Hill.

Course: Introduction to Energy **(Double Minor-II: Energy Engineering)**				**Code: 25CHMNRR201**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Thermodynamics, Understanding of basic physics and chemistry, Familiarity with energy concepts and units

- **Course Objectives: The objectives of the course are to**
  1. Understand different forms and sources of energy
  2. Study conventional and non-conventional energy systems
  3. Analyse energy conversion and efficiency
  4. Understand energy demand and sustainability issues
  5. Develop awareness of energy conservation techniques

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

  CO1: Classify various energy sources

  CO2: Explain energy conversion processes

  CO3: Analyze energy systems and efficiencies

  CO4: Evaluate renewable energy technologies

  CO5: Apply energy conservation methods

- **Course Contents:**

Unit I	**Fundamentals of Energy**	**6 Hours**

Definition and forms of energy (mechanical, thermal, electrical, chemical),Energy units and conversions, Global and national energy scenario, Energy demand and supply trends

Unit II	**Conventional Energy Sources**	**6 Hours**

Fossil fuels: coal, petroleum, natural gas, Thermal power plants, Nuclear energy basics, Environmental impacts of conventional energy

Unit III	**Renewable Energy Sources**	**6 Hours**

Solar energy (thermal and photovoltaic), Wind energy, Hydropower, Geothermal and tidal energy

Unit IV	Energy Conversion and Storage	6 Hours

Energy conversion systems, Efficiency and losses, Batteries and fuel cells, Hydrogen energy

Unit V	Energy Management and Sustainability	6 Hours

Energy conservation techniques, Energy auditing, Sustainable energy systems, Environmental and economic aspects

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**

- Assignment

CCA2	**Poster Presentation**	**10 Marks**

- Poster presentation on any topic

CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**

Group Discussion / Seminar / Blog Writing on any topic

- **Textbooks:**
  1. Dincer, I., and Rosen, M. A. (2013). Energy Resources and Systems (2nd ed.). Wiley.
  2. Rai, G. D. (2011). Non Conventional Energy Sources. Khanna Publishers.

- **Reference Books:**
  1. Twidell, J., and Weir, T. (2015). Renewable Energy Resources (3rd ed.). Routledge.
  2. Boyle, G. (Ed.). (2012). Renewable Energy Power for a Sustainable Future (3rd ed.). Oxford University Press.

- **MOOC / NPTEL Courses:**

Energy Conversion Technologies (Biomass And Coal), IIT Guwahati, Prof. Vaibhav V. Goud, https://nptel.ac.in/courses/103103222

Course: Introduction of Energy Laboratory (Double Minor-II: Energy Engineering)				Code: 25CHMNRR201L
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Tutorial	1	1	Termwork	Marks: 25

Prerequisites: Basic knowledge of Thermodynamics, Understanding of basic energy concepts and units, Basic skills in presentation (PowerPoint / communication)

- **Course Objectives: The objectives of the course are to**
  1. Introduce students to various forms and sources of energy
  2. Develop understanding of conventional and renewable energy systems
  3. Enhance technical presentation and communication skills
  4. Encourage self-learning through literature survey
  5. Develop analytical thinking on energy-related challenges
- **Course Outcomes:** At the end of the course, students will be able to:

  CO1: Explain different energy sources and technologies

  CO2: Analyze current energy trends and challenges

  CO3: Present technical topics effectively using appropriate tools

  CO4: Interpret scientific and technical literature

  CO5: Demonstrate improved communication and critical thinking skills
- **Course Contents:**

Seminar Based on Below topics:

- Forms of energy (mechanical, thermal, electrical, chemical)
- Energy units and conversions
- Global and Indian energy scenario
- Energy demand and supply trends
- Seminar topics allocation
- Coal, petroleum, natural gas
- Thermal power plants
- Nuclear energy basics
- Environmental impact
- Student seminars on conventional energy
- Solar energy (thermal and PV)
- Wind energy
- Hydropower
- Geothermal and tidal energy
- Student seminars on renewable energy
- Energy conversion systems
- Efficiency and losses
- Energy conservation techniques
- Energy auditing basics
- Hydrogen energy
- Fuel cells and storage systems
- Smart energy systems
- Sustainable development goals (SDGs)
- Any other topic related to energy

Books:

1. Dincer, I., and Rosen, M. A. (2013). Energy Resources and Systems (2nd ed.). Wiley.
2. Rai, G. D. (2011). Non-Conventional Energy Sources. Khanna Publishers.

Course: Wastewater Treatment (Double Minor-I: Environmental Engineering)			Code: 25CHMNRE202	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Environmental Engineering, Understanding of chemical engineering fundamentals, Familiarity with mass transfer and reaction engineering basics.

- **Course Objectives: The objectives of the course are to**
  1. Understand sources and characteristics of wastewater
  2. Study physical, chemical, and biological treatment methods
  3. Learn design principles of treatment units
  4. Understand sludge treatment and disposal methods
  5. Develop skills for selection of appropriate treatment processes

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

  CO1: Identify wastewater sources and characteristics

  CO2: Analyze treatment requirements based on wastewater quality

  CO3: Apply principles of physical, chemical, and biological treatment

  CO4: Design basic wastewater treatment units

  CO5: Evaluate treatment efficiency and environmental compliance

- **Course Contents:**

Unit I	**Introduction to Wastewater**	**6 Hours**

Sources: domestic and industrial wastewater, Physical, chemical, and biological characteristics, BOD, COD, TOC, pH, solids, Environmental and health impacts, Discharge standards and regulations

Unit II	**Primary Treatment Methods**	**6 Hours**

Screening and grit removal, Sedimentation and clarification, Oil and grease removal, Equalization tanks, Design considerations and efficiency

Unit III	**Secondary (Biological) Treatment**	**6 Hours**

Microbial growth kinetics, Activated sludge process, Trickling filters, Aerated lagoons, Design and operation of biological reactors

Unit IV	**Tertiary and Advanced Treatment**	**6 Hours**

Filtration and membrane processes, Adsorption (activated carbon), Advanced Oxidation Process, Disinfection (chlorination, UV), Cavitation

Unit V	**Sludge Treatment and Disposal**	**6 Hours**

Sludge characteristics, Thickening and digestion, Dewatering methods (filter press, centrifuge), Sludge disposal and reuse, Introduction to advanced techniques (e.g., cavitation, AOPs)

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**
• Assignment		
CCA2	**Poster Presentation**	**10 Marks**
• Poster presentation on any topic		
CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**
Group Discussion / Seminar / Blog Writing on any topic		

Textbooks:

1. Davis, Mackenzie L., Water and Wastewater Engineering: Design Principles and Practice, 2nd Edition, McGraw-Hill, New York, 2010.
2. Metcalf and Eddy, Wastewater Engineering: Treatment and Resource Recovery, Fifth Edition, Metcalf & Eddy, Inc., McGraw-Hill Publishers, New York, 2013.

- **Reference Books:**

1. Crittenden, J.C., et al., Water Treatment Principles and Design, 2nd Ed., Montgomery, Inc., John Wiley and Sons, New York, 2005.
2. Reynolds, T.D., Richards, P.A., Unit Operations and Processes in Environmental Engineering, PWS ublishing Company, Boston, 1996.

- **MOOC / NPTEL Courses:**

Water and waste water treatment, IIT Roorkee, Prof. Bhanu Prakash Vellanki, https://nptel.ac.in/courses/105107207

Wastewater Treatment and Recycling, IIT Kharagpur, Prof. Manoj Kumar Tiwari https://nptel.ac.in/courses/105105178

Course: Wastewater Treatment Laboratory (Double Minor-I: Environmental Engineering)				**Code: 25CHMNRE202L**
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	25

Prerequisites: Basic knowledge of Environmental Engineering, Understanding of wastewater treatment processes (theory), Familiarity with chemical analysis and laboratory practices.

- **Course Objectives: The objectives of the course are to**
  1. Provide hands-on experience in wastewater analysis
  2. Study performance of treatment processes
  3. Measure key wastewater quality parameters
  4. Understand biological and chemical treatment methods experimentally
  5. Develop skills in data analysis and reporting

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

  CO1: Conduct wastewater quality analysis using standard methods

  CO2: Evaluate treatment efficiency of different processes

  CO3: Analyze physical, chemical, and biological parameters

  CO4: Interpret experimental data and compare with standards

  CO5: Prepare technical laboratory reports

- **Course Contents:**

Wastewater Characterization (**Any 8** Experiments)

1. Determination of pH of wastewater
2. Determination of Total Solids (TS), TDS, and TSS
3. Determination of Biochemical Oxygen Demand (BOD)
4. Determination of Chemical Oxygen Demand (COD)
5. Determination of Dissolved Oxygen (DO)
6. Determination of Alkalinity and Acidity
7. Determination of Chlorides / Hardness
8. Study of coagulation and flocculation process
9. Study of sedimentation characteristics
10. Study of aeration and oxygen transfer
11. Study of activated sludge process (lab-scale)
12. Study of adsorption using activated carbon
13. Study of filtration process
14. Performance evaluation of lab-scale wastewater treatment system
15. Study of industrial wastewater sample analysis
16. Application of advanced oxidation processes (AOPs)

Textbooks:

1. Tchobanoglous, G., Stensel, H. D., Tsuchihashi, R., and Burton, F. (2014). Wastewater Engineering Treatment and Resource Recovery (5th ed.). McGraw-Hill Education.
2. Peavy, H. S., Row, D. R., and Tchobanoglous, G. (1985). Environmental Engineering. McGraw-Hill.

Course: Bio-Energy (Double Minor-II: Energy Engineering)				Code: 25CHMNRR202
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Lecture	3	3	CCA	20
			ISE	30
			ESE	50

Prerequisites: Basic knowledge of Biochemical Engineering, Understanding of reaction engineering basics, Familiarity with renewable energy concepts

- **Course Objectives: The objectives of the course are to**
  1. Understand biomass as an energy source
  2. Study bioenergy conversion technologies
  3. Learn production of biofuels
  4. Analyze environmental and economic aspects
  5. Explore advanced bioenergy systems

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

  CO1: Explain biomass resources and characteristics

  CO2: Describe thermochemical conversion processes

  CO3: Explain biochemical conversion processes

  CO4: Analyze biofuel production methods

  CO5: Evaluate environmental impacts of bioenergy

- **Course Contents:**

Unit I	Biomass and Bioenergy Basics	6 Hours

Definition and classification of biomass, Sources: agricultural, industrial, municipal waste, Properties of biomass, Energy potential of biomass

Unit II	Thermochemical Conversion Processes	6 Hours

Combustion, Gasification, Pyrolysis, Torrefaction, Process parameters and applications

Unit III	Biochemical Conversion Processes	6 Hours

Anaerobic digestion (biogas production), Fermentation (bioethanol) , Biodiesel production , Enzymatic processes

Unit IV	Biofuels and Applications	6 Hours

Types of biofuels (solid, liquid, gaseous), Bioethanol, biodiesel, biogas, Applications in transportation and power Performance and efficiency

Unit V	Sustainability and Advanced Bioenergy	6 Hours

Environmental impacts, Life cycle analysis (LCA), Economic feasibility, Advanced biofuels (algae, biohydrogen) Future trends

• Continuous Comprehensive Assessment (Any Two)		20 Marks
CCA1	**Assignment**	**10Marks**
• Assignment		
CCA2	**Poster Presentation**	**10 Marks**
• Poster presentation on any topic		
CCA3	**Group Discussion / Seminar / Blog Writing**	**10 Marks**
Group Discussion / Seminar / Blog Writing on any topic		

Textbooks:

1 Introduction to Bioenergy (Energy and the Environment) by Vaughn C. Nelson (Author), Kenneth L. Starcher (Author)

2 Bioenergy: Biomass to Biofuels by Anju Dahiya

- **Reference Books:**
  1. Bioenergy: Principles and Applications by Yebo Li and Samir Kumar Khanal
  2. Bioenergy by Judy D. Wall and Caroline S. Harwood

- **MOOC / NPTEL Courses:**

Bioenergy, IIT Kanpur, Prof. Mainak Das, https://nptel.ac.in/courses/102104057

Course: Bio-Energy Practical (Double Minor-II: Energy Engineering)			Code: 25CHMNRR202L	
Teaching Scheme (Hrs/Week)		**Credit**	**Evaluation Scheme**	
Practical	2	1	Practical	25

Prerequisites: Basic knowledge of Biochemical Engineering, Understanding of biological processes and reactions, Familiarity with basic laboratory practices.

- **Course Objectives: The objectives of the course are to**
  1. Provide practical knowledge of bioenergy systems
  2. Study biomass characterization techniques
  3. Perform biofuel production experiments
  4. Analyze bioenergy processes
  5. Develop experimental and analytical skills

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

  CO1: Analyze biomass properties

  CO2: Perform biofuel production experiments

  CO3: Evaluate performance of bioenergy systems

  CO4: Interpret experimental results

  CO5: Apply bioenergy concepts in practical systems

- **Course Contents:**

Bioenergy (**Any 8** Experiments)

1. Determination of moisture content of biomass
2. Determination of ash content
3. Determination of volatile matter
4. Determination of fixed carbon
5. Proximate analysis of biomass
6. Determination of calorific value
7. Production of biogas (lab-scale digester)
8. Production of bioethanol (fermentation)
9. Production of biodiesel (transesterification)
10. Study of anaerobic digestion process
11. Study of gasification process (model/demo)
12. Yield and efficiency analysis
13. Bioenergy production from waste materials
14. Comparative study of biofuels
15. Study of advanced bioenergy systems (algae/BSF)

Textbooks:

1. Introduction to Bioenergy (Energy and the Environment) by Vaughn C. Nelson (Author), Kenneth L. Starcher (Author)
2. Bioenergy: Biomass to Biofuels by Anju Dahiya

Dr A V Mohod
Chairman, BoS (Chemical Engineering)

Dr D Y Dhande
Dean (Academics)

Dr D S Bormane
Principal

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