D. Y. Patil College of Engineering and Technology

Kasaba Bawada, Kolhapur

(An Autonomous Institute)

NBA Accredited

Accredited by NAAC with 'A' Grade

D Y PATIL

COLLEGE of

ENGINEERING & TECHNOLOGY

(AN AUTONOMOUS INSTITUTE)

KASABA BAWADA, KOLHAPUR

Structure and Syllabus

(As per NEP 2020)

for

Second Year B. Tech in Chemical Engineering

Department of Chemical Engineering

W. e. f. 2024-25

D.Y. PATIL COLLEGE OF ENGINEERING AND TECHNOLOGY, KOLHAPUR
Teaching and Evaluation Scheme From Year 2024-25 (as per NEP 2020)
Second Year B. Tech Chemical Engineering
Semester - III

Sr. No.	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/P OE	
					L	P	T						
1	231CHPCCL201	PCC	Fluid Flow Operations	3	3	-	-	20	30	50	-	-	100
2	231CHPCCL202	PCC	Mechanical Operations	3	3	-	-	20	30	50	-	-	100
3	231CHPCCL203	PCC	Process Calculations	2	2	-	-	-	-	50	-	-	50
4	231CHPCCP201	PCC	Fluid Flow Operations Lab	1	-	2	-	-	-	-	25	25	50
5	231CHPCCP202	PCC	Mechanical Operations Lab	1	-	2	-	-	-	-	25	25	50
6	231CHCEPP201	CEP/FP	Environmental Ethics and Sustainability	2	-	4	-	-	-	-	50	-	50
7	231CHMDML201	MDM-1	Petroleum Refinery Engineering	2	2	-	-	20	-	30	-	-	50
8	231CHVECL201	VEC	Leadership and Ethical Decision Making	2	2	-	-	20	30	-	-	-	50
9	231CHOECL201	OEC-1	Research & Innovations (ODL Only*)	3	3$		-	20	30	50	-	-	100
10	231CHOECP201	OEC-1	Research & Innovations (ODL Only*)	1	-	2	-	-	-	-	25	-	25
11	231CHHSSML201	HSSM	Start-up Fundamentals and Financing	1	1	-	-	-	25	-	-	-	25
12	231CHHSSMP201	HSSM	Start-up Fundamentals and Financing	1	-	2	-	-	-	-	25	-	25
13	231CHMCL201	MC	Finishing School Training III	Audit	3*	-	-	50*	-	-	-	-	Grade
14	231CHCCAL201	CCA	Liberal Learning	Audit	-	-	-	50*	-		-	-	Grade
			Total	**22**	**13**	**10**	**-**	**200**	**145**	**230**	**150**	**50**	**675**

$ - Contact Hours for online Courses ***- Values not Included in Total** **Min. Marks for Passing- 40 % of Total Marks of Individual Course**

D.Y. PATIL COLLEGE OF ENGINEERING AND TECHNOLOGY, KOLHAPUR
Teaching and Evaluation Scheme From Year 2024-25 (as per NEP 2020)
Second Year B. Tech Chemical Engineering
Semester - IV

Sr. No.	Course Code	Course Type	Name of the Course	Teaching Scheme Per Week				Theory			Practical		Total Marks
				Credits	Contact Hrs			ISE	MSE	ESE	INT	OE/POE	
					L	P	T						
1	231CHPCCL204	PCC	Heat Transfer	3	3	-	-	20	30	50	-	-	100
2	231CHPCCL205	PCC	Chemical Equipment Design	2	2	-	-	-	-	50	-	-	50
3	231CHPCCL206	PCC	Chemical Engineering Thermodynamics	3	3	-	-	20	30	50	-	-	100
4	231CHPCCP204	PCC	Heat Transfer Lab	1	-	2	-	-	-	-	25	25	50
5	231CHPCCP205	PCC	Chemical Equipment Design Lab	1	-	2	-	-	-	-	25	25	50
6	231CHMDML202	MDM-2	Petrochemical Technology	2	2	-	-	20	-	30	-	-	50
7	231CHVECL202	VEC	Environmental Studies	2	2	-	-	-	-	50	-	-	50
8	231CHHSSML202	HSSM	Innovation and Product Development	2	2	-	-	25	-	-	25	-	50
9	231CHAECL201	AEC	Problem-solving and Analytical Skills	1	1	-	-	-	25	-	-	-	25
10	231CHAECP201	AEC	Problem-solving and Analytical Skills	1	-	2	-	-	-	-	25	-	25
11	231CHOECL202	OEC-II	Waste Management	2	2	-	-	-	-	50	-	-	50
12	231CHVSECL201	VSEC	Public Speaking and Presentation Skills	1	1	-	-	25	-	-	-	-	25
13	231CHVSECP201	VSEC	Public Speaking and Presentation Skills	1	-	2	-	-	-	-	25	-	25
14	231CHMCL202	MC	Finishing School Training IV	-	2*	-	-	50*	-	-	-	-	Grade
15	231CHCCAL202	CCA	Liberal Learning	Audit	-	-	-	50*	-	-	-	-	Grade
			Total	**22**	**18**	**8**	**-**	**210**	**85**	**280**	**125**	**50**	**650**

***- Values not Included in Total**

Min. Marks for Passing- 40 % of Total Marks of Individual Course

D. Y. PATIL COLLEGE OF ENGINEERING & TECHNOLOGY

Kasaba Bawada, Kolhapur

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Department of Chemical Engineering

S. Y. B. Tech. Curriculum (as per NEP 2020 Policy)

w.e.f. A.Y. 2024-2025

Course Plan

Course Title : Fluid Flow Operations	
Course Code : 231CHPCCL201	**Semester : III**
Teaching Scheme : L-T-P : 3-0-2	**Credits : 3+1= 4**
Evaluation Scheme : MSE +Internal Marks : 20+30=50	**ESE Marks : 50**

Course Description:

In almost every chemical plant fluids have to be handled and hence study of fluids at rest and in motion is important. The information about the basic concepts and principles of hydrostatics, hydrodynamics and their applications in handling various fluids like gases, vapors, liquids and slurries are provided in this course which is required for smooth and proper operation of fluid transportations machineries. Using these concepts power requirement for pumps, blowers and compressors can be determined and friction losses through pipes and fittings can also be calculated. Therefore this course is one of the important courses since it attempts to develop these skills in students.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective (COs):

Objective of this course is to:

1	To understand the importance of unit conversion and the static fluid behavior and pressure measurement devices in the field of chemical Engineering.
2	To understand the fluid behaviour and basic equations regarding fluid flow.
3	To understand compressible and incompressible fluid behaviours and calculation of friction factor with consideration of all parameters like roughness, pipe fittings.
4	To recognize the fluid behaviour changed due to immersed bodies and related friction and

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	pressure drop of fluid due to it along with fluidization concept.
5	To aware about measurement of fluid flow, fluid behaviour in case of fluidization and all affecting factors.
6	To aware about measurement of power requirements for agitator, fluid behaviour in case of agitations of fluids

Course Outcomes (COs):
At the end of the course the student should be able to:

CHLPCC201.1	**Explain** the importance of unit conversion and capable to static fluid behavior and pressure measurement devices in the field of chemical Engineering.
CHLPCC201.2	**Memorize** the fluid behavior and state basic equations regarding fluid flow.
CHLPCC201.3	**Interpret** compressible and incompressible fluid behaviors and able to **solve** numerical calculations of friction factor with consideration of all parameters like roughness.
CHLPCC201.4	**Compare** the fluid behavior changed due to immersed bodies and to **examine** related friction and pressure drop of fluid due to it along with fluidization concept.
CHLPCC201.5	**Discuss** measurement of fluid flow and can **recognize** fluid behavior in case of fluidization and all affecting factors.
CHLPCC201.6	**Explain** an importance of fluid flowing machinery and understand concept of pump, blowers, fan and compressors in order to conduct transportation of fluid smoothly.

Prerequisite:	**Physics, Units Systems**

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs)

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	BTL
CHLPCC201.1	2	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CHLPCC201.2	2	2	2		-	-	-	-	-	-	-	-	-	-	2
CHLPCC201.3	2	2	2	2	-	-	-	-	-	-	-	-	2	-	2
CHLPCC201.4	-	-	-	2	-	-	-	-	-	-	-	-	2	-	2
CHLPCC201.5	2	2	2		-	-	-	-	-	-	-	-	-	-	3
CHLPCC201.6	2	2	2	2	-	-	-	-	-	-	-	-	-	-	2

Contents	Hours
Unit 1 - Unit systems: Physical quantities, S.I., CGS, FPS Engg. units, Dimensional analysis, Buckingham Theorem, Industry based problems. **Fluid statics and its applications**: Nature of fluids, Hydrostatic equilibrium, Barometric equation, Manometers, Example, U tube, Inclined tube manometers, Industry based problems.	7
Unit 2- Fluid flow phenomena Behavior of flowing fluid, Types of flow, Newtonian and non- Newtonian Fluids, viscosity and momentum flux, viscosities of gases and liquids, Reynolds experiment, Eddy viscosity, Boundary layer formation in straight tubes, Boundary layer separation and wake formation **Basic equations of fluids flow** : Mass balance, mass velocity, momentum balance, Bernoulli's equation without and with friction, kinetic energy correction factor, correction for fluid friction, Navier-Stokes equations, Euler's equation, Industry based problems	8

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Unit 3 - Flow of incompressible fluids in conduits and thin layers : Shear stress distribution in a cylindrical tube, relation between skin friction and wall shear, the friction factor (Moody's chart). Relations between skin friction parameters. Laminar flow in pipes, Laminar flow of Newtonian fluids. Average velocity, Hagen-Poiseullies equation. Relations between maximum and average velocities, Effect of roughness, The friction factor chart (Moody's diagram), friction factor in flow through channels of non-circular section, hydraulic radius, friction from changes in velocity or direction, Effect of fittings and valves, Flow through annuals, Industry based problems.	8
Unit 4 - Flow of compressible fluids: Mach number, continuity equation, Total energy Balance, velocity of sound, ideal gas equations, the asterisk condition, stagnation temperature. Metering of fluids: Measurement of flowing fluids. Venturimeter, orificemeter, Pitot tube, laser Doppler anemometer, particle image velocimetry, rotameter, turbine meters, positive displacement meters, magnetic meters: ultrasonic meters.	8
Unit 5 - Flow past immersed bodies : Drag coefficients of typical shapes, form drag and streamlining, Friction in flow through beds of solids, Darcy's equation, Erguns equation, Kozeny- Carman equation, Burke Plummer equation, Fluidization, Mechanism of fluidization, particulate and aggregative fluidization, minimum fluidization velocity, expansion of fluidized beds, application of fluidization.	8
Unit 6 – **Introduction to Fluid Moving Machinery** Introduction to pumps, types of pumps, N.P.S.H., Priming, Cavitation, Introduction to Fan, blower and compressor- Reciprocating & centrifugal compressor, Vacuum Pump, jet ejector - its working and application.,	6

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Text Books:

1	McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications
2	Yunus A. Cingel, John M. Cimbala, "Fluid Mechanics – Fundamentals & Applications" McGraw Hill Higher education Publications.

References Books:

1	Fox, R. W., McDonald, A. T., & Mitchell, J. W. (2020). Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons.
2	White, F. M. (1979). Fluid mechanics, 1999. Me Graw-Hill.
3	McCabe, W. L., Smith, J. C., & Harriott, P. (1993). Unit operations of chemical engineering (Vol. 5, p. 154). New York: McGraw-hill

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Department of Chemical Engineering

S. Y. B. Tech. Curriculum (as per NEP 2020 Policy)

w.e.f. A.Y. 2024-2025

Course Plan

Course Title: Mechanical Operations	
CourseCode:231CHPCCL202	Semester: III
TeachingScheme:L-T-P:3-0-0	Credits:3
Evaluation Scheme:ISE+MSEMarks:20+30	ESEMarks:50

Course Description:

Mechanical Operations deal with Science and Technology of particulate matter, which is a multidisciplinary field including Materials Science, Environmental, Biomedical, Aerospace, Agricultural, Chemistry, Microbiology and Cell Science, Pharmacy and Medicine.Mechanical unit operations course provides fundamentals of particles.This course focuses on characteristics, properties, storage and settling of solids. Corse provides knowledge of separation of solid-solid, solid-liquid and solid-gas.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective:

1	To develop the fundamental/basics of solid phase.
2	To develop the knowledge of Size reduction of solid and screening of solids.
3	To study the mixing and blending of solid-liquid & solid-solid.
4	To study the filtration and sedimentation for solid-liquid separation.
5	To calculate the terminal settling velocity.
6	To conceive the different solid-gas separation equipment.

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Course Outcomes:

CO	At the end of successful completion of course, the students will be able to…
231CHPCCL202.1	**Explain** fundamentals of solids and calculate the surface area and number of particles in mixture.
231CHPCCL202.2	**Describe** the basics of size reduction, size reduction equipment's and explain the basics of screening.
231CHPCCL202.3	**Describe** basics of mixing, blending and mixing equipment's.
231CHPCCL202.4	**Describe** the details of filtration and sedimentation.
231CHPCCL202.5	**Calculate** the terminal settling velocity.
231CHPCCL202.6	**Explain** the equipment's used for separation of solid-gas.

Prerequisite:	Basics Physics

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	BTL
CHPCCL202.1	2	1	1	-	-	-	-	-	-	-	-	-	2	-	1
CHPCCL202.2	2	1	1	-	-	-	-	-	-	-	-	-	2	-	1
CHPCCL202.3	2	1	1	-	-	-	-	-	-	-	-	-	2	-	1
CHPCCL202.4	2	1	1	-	-	-	-	-	-	-	-	-	2	-	1
CHPCCL202.5	2	1	1	-	-	-	-	-	-	-	-	-	2	-	2
CHPCCL202.6	1	1	1	-	-	-	-	-	-	-	-	-	2	-	1

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Contents	Hours
Unit 1- Properties and handling of particulate solids Particle characterization, Particle size measuring technologies, Particle size distribution, Mean particle size, Mixed particle sizes and size analysis, Specific surface of mixture, Average particle size, Number of particles in mixture,Properties of solid masses, Storageofsolids(BulkandBin),Angleofreposeandangleoffriction,Introductiontoconveying of solids.	8
Unit 2 –Size reductions and Screening Necessity of size reduction, Energy for size reduction, Crushing laws, Methods of operating crushers, Classification of size reduction equipment's, Types of crushing equipment,Screening:Sizemeasurementswithfineparticles,Standardtestscreens,Standardsof screen,Screeneffectiveness,Comparisonofidealandactualscreens, Industrial screening equipment.	9
Unit3— Mixing of solids The degree of mixing, Rate of mixing, Criteria for mixer effectiveness, Solid-liquid mixing, Solid-Solid mixing.	6
Unit 4 – Filtration and Sedimentation Classification of filtration, Types of filtrations, Pressure drop through filter cake, Filter medium resistance, Specific cake resistance, Washing of cake, Filtermedia and selection, Preliminary treatment of slurries before filtration, Filtration equipment: Pressure filters,Vacuumfilters,Centrifugalfilters.Sedimentation:Basicprinciples,Flocculation,Thickeners,Batchsedimentationtest.	8
Unit 5 -Particle Dynamics Motion of particle in a fluid, Terminal settling velocity, Free settling, Hindered settling, Stoke's law and Newton's law of settling.	6
Unit 6 - Gas Cleaning Introduction, Gas cleaning equipment, Gravity separators, Centrifugal separators, Momentum separators, Fabric filters, Agglomeration and Coal essence.	8

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Text Books:

1	McCabe W. L. & Smith J. C. and Peter Harriott, Unit Operations of Chemical Engg. 5th ed. McGraw Hill International.
2	C.M. Narayanan, B. C. Bhattacharyya, Mechanical Operations for Chemical Engineers, Computer Aided Analysis, Khanna Publishers.
3	J.F. Richardson &J. H.Harker with J.R. Backhurst, Coulson & Richardson's, Chemical Engineering,vol2,1st ed., Pergamon Press.

Reference Books:

1	Foust A. G. et.a- Principles of Unit Operations, 3nd ed. John, Wiley & Sons, New York 1979.
2	G. C. Sekhar, unit Operations in Chemical Engineering, Pearson education (Singapore) Pte. Ltd.

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S. Y. B. Tech. Curriculum (as per NEP 2020 Policy)

w.e.f. A.Y. 2024-2025

Course Plan

Course Title: Process Calculations	
Course Code: 231CHPCCL203	**Semester: III**
Teaching Scheme: L-T-P : 2-0-0	**Credits:2**
Evaluation Scheme : NA	**ESE Marks: 50 Marks**

Course Description:

Chemical Process Calculations is a foundational course that equips students with the essential skills and methodologies required for performing material and energy balances in chemical processes. The course focuses on the application of these principles to analyse and design chemical processes, ensuring that students can accurately model and optimize chemical production systems.

Programme Specific Outcomes

Sr. No.	Statement
PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1.	Provide students thorough understanding of the fundamental principles of units, conversions.
2.	Provide students thorough understanding of ideal & non-ideal gases system calculations.
3.	Make students to develop material balances on different unit operations and unit processes.
4.	Make students to inculcate material balance with and without chemical reactions.
5.	Students to formulate energy balances on various chemical operations.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
231PCCL203.1	**Define** the basic chemical calculations, conversions of system
231PCCL203.2	**Explain** ideal & non-ideal gases system calculations
231PCCL203.3	**Develop** material balances on unit operations and processes
231PCCL203.4	**Interpret** material balance with and without chemical reactions
231PCCL203.5	**Formulate** energy balances on various chemical operations

Prior Knowledge of:	Industrial Chemistry, Chemical Engineering Thermodynamics

Course Articulation Matrix

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
PCCL203.1	2	1	-	1	-	-	-	-	-	-	-	-	-	-	1
PCCL203.2	2	1	-	1	-	-	-	-	-	-	-	-	-	-	2
PCCL203.3	2	1	-	1	-	-	-	-	-	-	-	-	-	-	3
PCCL203.4	2	1	-	1	-	-	-	-	-	-	-	-	-	-	3
PCCL203.5	2	1	-	1	-	-	-	-	-	-	-	-	-	-	3

Course Contents	Hours
Unit 1: Basic Chemical Calculations Units and Conversions, Mole Concept, Equivalent Weight, Composition of solids, Liquids and Gases, Mass fraction, Mass percent, Mole fraction, Mole percent, Volume fraction and Volume percent	06
Unit 2: Ideal & Non ideal gas behavior Ideal Gases: The Ideal Gas Equation of State, Ideal Gas Mixtures: Rault's law, Dalton's law, Amagat's law, Average molecular weight, Density of gaseous mixture, Non-ideal Gases: Behavior of gases and vapors, Vander-Waal Equation.	06
Unit 3: Material Balances without Chemical Reaction Material balances Guidelines for solving material balance problems, Material balance of important industrial unit operations (Distillation, Absorption and Striping, Extraction and Leaching, Evaporation, Dryer, Mixing, Crystallization etc.)	06
Unit 4: Material Balances with Chemical Reaction Introduction of terms involved; Generalized approach for solving problems, Material balance problems involving chemical reaction; Electrochemical reactions; Metallurgical applications.	06
Unit 5: Energy Balance Thermo-physics and Thermo-chemistry Elements of energy balance calculations, Change in pressure at constant temperature; Change in temperature, Phase change operations, mixing and solutions.Heat of Reaction: Measurement and calculation of standard heat of reaction, Hess law. Heat of formation, Heat of combustion. Effect of temperature on heat of reaction	06

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Text Books:

1.	Bhatt B. I. and Vora S. M., 'Stoichiometry', Fourth Edition, Tata McGraw-Hill Pub. Co. Ltd., 2004.
2.	Himmelblau D. M. 'Basic Principles and Calculations in Chemical Engineering', Sixth Edition, Prentice-Hall of India Pvt. Ltd., 2004.

Reference Books:

1	Felder R. M. and Rousseau R.W, 'Elementary Principles of Chemical Processes', Third Edition, John Wiley and Sons, Inc.2000.
2	K. V. Narayanan, B. Lakshmi kutty,' Stoichiometry and Process Calculations', PHI Learning Pvt. Ltd. Dec. 2016.
3	V. Venkataramani and N. Anantharaman,' Process Calculations', 2003.
4	Hougen, O.A., Watson. K.M. and Ragatz, R.A., Chemical Process Principles Part-I", John Wiley & Sons, (CBS Publishers & Distributor, New Delhi).

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S. Y. B. Tech. Curriculum (as per NEP 2020 Policy)

w.e.f. A.Y. 2024-2025

Laboratory Course Plan

Course Title: Fluid Flow Operations Laboratory	
Course Code : 231CHPCCP201	Semester: III
TeachingScheme:L-T-P:0-0-2	Credits:1
Evaluation Scheme: ISE Marks: 25	ESE(POE) Marks:25

Course Description – This course deals with fluid behavior in static as well in dynamic phase. The study of all governing laws of fluid flow, flow meters, calculation of friction factor and pressure drop with respect to varying various process parameters is included in this lab work.

Course Objective (COs):

Objective of this course is to:

1. Inculcate basic concepts of fluid flow, friction factor and metering of fluids.
2. Verify various governing laws and calculation of equivalent lengths across pipe fittings.

Course Outcomes(COs):

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

231CHPCCP201.1	**Inculcate** basic concepts of fluid flow, calculations of friction factor
231CHPCCP201.2	**Verify** various theorems and calculation of equivalent lengths across pipe fittings.

Prerequisite:	**Physics**

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Course Articulation Matrix: Mapping of Course Outcomes (Cos) with Program Outcomes (POs) and Program Specific outcomes(PSOs)

Course Outcomes (COs)	POs												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CHPCCP201.1	3	2	-	-	-	-	-	-	1	-	-	-	1	-	3
CHPCCP201.2	3	2	-	-	-	-	-	-	1	-	-	-	1	-	3

List of Experiments			
Expt. No.	Name of Experiment	Type	Hours
1	To Calibrate Rotameter	O	2
2	To evaluate coefficient of discharge at different flow rates for Given Venturimeter.	O	2
3	To evaluate coefficient of discharge at different flow rates for Given Orifice meter.	O	2
4	To calculate Euler's number of fluid flowing through spiral coil.	O	2
5	To calculate Critical Reynolds Number & friction factor of a Fluid flowing through helical coils.	O	2
6	To study laminar, transitional & turbulent flow by using Reynold's experiment.	O	2
7	To verify Bernoulli's theorem.	O	2
8	To determine experimentally the pressure drop due to friction and check friction factor for various straight pipes at different flowrates.		
9	To calculate Friction factor and equivalent length across bend and elbow of pipe.	O	2
10	To calculate Friction factor and equivalent length across reducer and expander.	O	2
11	Demonstration of particle image velocimetry– Virtual lab	O	2
12	Demonstration of a)Pitot tube b)Flow Through annular space c)Cut sections of Pumps, Fan, Blowers & Compressors	S	2

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❖S-STUDY, O-OPERATIONAL
❖Minimum10 Experiments should be conducted.

Text Books:

1	McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications
2	Yunus A. Cingel, John M. Cimbala, "Fluid Mechanics – Fundamentals & Applications" McGraw Hill Higher education Publications.

References Books:

1	Fox, R. W., McDonald, A. T., & Mitchell, J. W. (2020). Fox and McDonald's introduction to fluid mechanics. John Wiley & Sons.
2	White, F. M. (1979). Fluid mechanics, 1999. Me Graw-Hill.
3	McCabe, W. L., Smith, J. C., & Harriott, P. (1993). Unit operations of chemical engineering (Vol. 5, p. 154). New York: McGraw-hill

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w.e.f. A.Y. 2024-2025

Course Plan

Course Title: Mechanical Operations Laboratory	
Course Code: 231CHPCCP202	**Semester: III**
Teaching Scheme :L-T-P: 0-0-2	**Credits:1**
Evaluation Scheme: Internal Marks:25	**POE Marks:25**

Course Description:

Mechanical Operations deal with Science and Technology of particulate matter, which is a multidisciplinary field including Materials Science, Environmental, Biomedical, Aerospace, Agricultural, Chemistry, Microbiology and Cell Science, Pharmacy and Medicine. Mechanical unit operations course provides fundamentals of particles. This course focuses on characteristics, properties, storage and settling of solids. Corse provides knowledge of separation of solid-solid, solid-liquid and solid-gas.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective:

1	To study the fundamental of solid phase and equipment handling solids.
2	To Study the separation of solid-liquid and solid-gas separation.

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Course Outcomes:

CO	At the end of successful completion of course, the students will be able to…
231CHPCCP202.1	Calculate particle size & particle size distribution of a given material.
231CHPCCP202.2	Determine the efficiency of a given screen, leaf filter, cyclone separator, critical speed of ball mill for size reduction and area of thickener.
231CHPCCP202.3	Evaluate the critical speed of ball mill for size reduction and area of thickener.

Prerequisite:	Basics Physics

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1	BTL
CO1	2	1	-	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	1	-	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	1	-	2	-	-	-	-	-	-	-	-	2	-	2

List of Experiments			
Expt. No.	Name of Experiment	Type	Hours
1	Sieve Analysis: To determine mean particle size, surface area of mixture, and number of particles in mixture.	O	2
2	Screen Effectiveness: To determine the efficiency of screen.	O	2
3	Jaw Crusher: To determine the particle size distribution of material.	O	2
4	Ball Mill: To determine critical speed & size reduction ratio of ball mill.	O	2

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5	Batch Sedimentation: To determine area of thickener by concentrating a feed of 4% at a rate of 200 tons/day to give an underflow concentration of 55% by carrying out batch sedimentation.	O	2
6	Filter Press: To study batch filtration in plate & frame filter press.	O	2
7	Leaf Filter: To find out the resistance offered by cake & filter medium.	O	2
8	Cyclone Separator: To find the efficiency of cyclone separator.	O	2
9	Beaker Decantation: To determine the amount of given sample in the sub sieve range using beaker decantation method.	O	2
10	To study the principle, construction, working of Riffled Table.	S	2
11	To study the principle, construction, working of Mineral Jig.	S	2
12	To study the principle, construction, working of Gravity Separator.	S	2

Text Books:

1	McCabe W. L. & Smith J. C. and Peter Harriott, Unit Operations of Chemical Engg. 5th ed.McGraw Hill International.
2	C.M.Narayanan,B.C.Bhattacharyya,MechanicalOperationsforChemicalEngineers, Computer Aided Analysis, Khanna Publishers.
3	J.F. Richardson & J. H.HarkerwithJ.R. Backhurst, Coulson & Richardson's, Chemical Engineering,vol2,1st ed.,PergamonPress.

Reference Books:

1	Foust A. G. et.a- Principles of Unit Operations, 3nd ed. John, Wiley & Sons, New York 1979.
2	G. C. Sekhar, unit Operations in Chemical Engineering, Pearson education (Singapore) Pte. Ltd.

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Course Plan

Course Title: Environmental Ethics and Sustainability	
Course Code: 231CHCEPP201	**Semester: III**
Teaching Scheme: L-T-P: 0-0-2	**Credits: 2**
ISE Marks: 50	**ESE Marks: -**

Course Description:

The objective of the course is to apply principles of environmental ethics and sustainability to real-world chemical engineering scenarios. Students will investigate, analyse, and propose solutions to mitigate environmental impacts associated with chemical engineering processes and propose sustainable solutions.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objectives:

1	To study various environmental local ethical issues.
2	To propose sustainable solution for various environmental local ethical issues.
3	To apply Sustainable solutions for the benefits of industry and society.

Course Outcomes (COs): After successful completion of course, the students will be able to…

COs	Statements
CHCEPP201.1	Identify various environmental local ethical issues.

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CHCEPP201.2	Identify the sustainable solutions for identified problems.
CHCEPP201.3	Apply Sustainable solutions for the benefits of industry and society.

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs)and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
CHCEPP201.1	-	-	-	-	-	1	3	3	-	-	-	2	-	-	2
CHCEPP201.2	-	-	-	-	-	1	3	3	-	-	1	2	-	-	3
CHCEPP201.3	-	-	-	-	-	1	3	3	-	-	1	2	-	-	3

LIST OF ACTIVITY FOR PROJECT

Sr. No.	Title	Hours
A	**Carry out visits in local area (Minimum 4)**	**20**
1	Lake ecosystem- Issues, restoration	5
2	Solid Waste Management	5
3	Waste Water Management	5
4	Plastic Waste Management	5
5	E Waste Management	5
6	Noise pollution	5
7	Industrial air pollution	5
8	Traffic and Transportation	5
9	Over exploitation of local Natural resources	5
10	Deforestation in the region	5
11	River pollution	5
12	Natural disaster	5

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13	Industrial pollution	5
14	Healthcare and Hygiene	5
15	Land degradation	5
16	Urbanization	5
17	Water depletion	5
18	Climate change	5
19	Environmental Management (EIA, EMS)	5
20	Environmental Audit	5
B	**Propose the solution in the form of report**	**6**
C	**Present the theme in the form Poster / model / documentary / CAD design/ video**	**4**

Useful Link/ Web resources:

Environmental English Book 1-3-2022 Final Corrected copy_compressed.pdf
Manual on Municipal Solid Waste Management- Ministry of Urban Development, Govt. of India

Text Books:

1	obert Brinkmann and Sandra Garren, "Introduction to Sustainability", MacEwan Open Books
2	ndrew Light and Holmes Rolston, "Environmental Ethics: An Anthology", Blackwell Publishing, Oxford
3	Handbook of Environmental Studies by Dr. G. R. Parihar, Publisher: Satyam Publishers and Distributors (1 January 2013)

Reference Books:

1	APHA Books, APHA Books in India, Standard Methods for the Examination of Water and Wastewater
2	Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery, AECOM

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Course Plan

Course Title : Petroleum Refinery Engineering	
Course Code : 231CHMDML201	Semester : III
Teaching Scheme : L-T-P : 2-0-0	Credits : 2
Evaluation Scheme : ESE	ESE Marks : 50

Course Description: Petroleum Refinery Engineering subject deals with study of various survey methods for crude oil along with all essential practices to explore the crude oil by using various drilling methods to derive various cuts of hydrocarbons at respective temperature and pressure by using atmospheric and vacuum distillation.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective (COs): Objective of this course is :

1	Students completing this course are expected to understand what is crude oil, petroleum resources & scenario of petroleum refineries in India as well across the world.
2	Students must aware about origin of petroleum, exploration techniques and drilling techniques in details.
3	Students are expected to get aware about composition, classification, distillation & separation techniques including pre-treatment.
4	Student must know properties & specification of petroleum products and overall separation processes and various conversion processes, Treatment methods and post production operations of Petroleum refineries.
5	Students must know recent trends, advancement in Petroleum refineries.

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Course Outcomes (COs): At the end of semester; students are expected to..

231CHMDML201.1	**Explain** basic information about crude, resources and overall scenario of refineries in India as well across the world.
231CHMDML201.2	**Describe** about origin, exploration techniques, Drilling Rigs and Drilling techniques in detailed manner.
231CHMDML201.3	**Discuss** composition, Classify crude oil and able to **explain** various distillation processes & separation methods.
231CHMDML201.4	**Compare** properties and specification of petroleum products and **relate** Overall separation processes.
231CHMDML201.5	**Differentiate** various conventional and non conventional conversion processes, treatments and **Judge** recent trends in Petroleum refining and explore alternatives to crude oil products.

Prerequisite:	Mass Transfer

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program specific outcome(PSOs)

Course Outcomes(COs)	POs												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CHMDML201.1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CHMDML201.2	2	2	-	-	-	-	-	-	-	-	-	-	-	-
CHMDML201.3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CHMDML201.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHMDML201.5	2	3		2	-	-	-	-	-	-	-	-	-	-
CHMDML201.6	3	-	1	-	-	2	-	-	-	-	-	-	2	-

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Contents	Hours
Unit –I **Introduction to Crude oil & petroleum refineries:** Resources of petroleum, Origin of petroleum, Surveys to find petroleum feed stocks, content of Petroleum products, Introduction to refinery, Composition of crude oil, classification of crude, Indian and world reserve of crude oil and its processing capacity	05
Unit –II **Exploration of Crude oil** Exploration techniques, Derrek Riggs, drilling rigs, drilling techniques, storage of crude oil, Transportation of crude oil, Housekeeping, Storage of Crude oil, pretreatment of crude.	06
Unit –III **Natural Gas & Properties and specifications of petroleum products** Introduction to Natural gas, Gas Hydrates, Shell gas, Purification of Natural gas., ASTM, TBP,. Properties and specifications of fuel gas, LPG, gasoline, naphtha, jet fuel, kerosene, diesel, lubricating oils, greases, waxes, coke, etc.	07
Unit IV **Refining of Crude Oil & Thermal Conversion process:** Types of distillation methods –ADU, VDU, Thermal cracking, Vis breaking, coking, catalytic cracking, thermal reforming, catalytic reforming, hydro-cracking, hydro processing, alkylation, Isomerization and polymerization	08
Unit V **Recent trends in petroleum refineries:** Recent trends in petroleum in terms of Distillation Market demand & supply of petroleum Fractions. Packing materials, Catalyst, Non conventional fuels, Necessity of Bio-fuels, Trans-esterification process, etc. Note A Case study on the petroleum refineries may be taught	04

Text Books:

1	Dr.Ram Prasad Petroleum Refinery Engineering
2	B.K.Bhaskara Rao Modern Petroleum Refining Processes

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References Books:

1	Gary J H, Handwerk G E, Petroleum refining
2	Nelson W. L., —Handbook of Petroleum Refinery Engg.l, McGraw Hill, International, Auckland,1982
3	Hobson G.D., Phol W., —Modern Petroleum Technology-Il, 5th ed., Halsted Division of Wiley Eastern New York, 1984.
4	Guthre, V.B., —Petroleum Productsl, Hand-Book McGraw Hill. Kobe, K.Q. Mcketta, J.J. —Advances in Petroleum Chemistry and Refining l Interscience.
5	J. M. Spight, —The chemistry and technology of petroleum

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Course Plan

Course Title: Leadership & Ethical Decision Making	
Course Code: 231CHVECL201	**Semester: III**
Teaching Scheme: L-T-P : 2-0-0	**Credits:2**
ISE Marks: 20	**MSE Marks: 30**

Course Objectives:

1.	To gain a comprehensive understanding of classical and contemporary leadership theories and models.
2.	To study various ethical frameworks and principles that guide decision making in leadership roles.
3.	To learn to apply ethical decision-making models to real-world business scenarios.
4.	To critically analyze case studies to identify ethical dilemmas and leadership challenges
5.	To develop a personal philosophy of ethical leadership and understand its impact on organizational culture and performance.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
CHVECL201.1	Explain various leadership theories and their application in different organizational contexts.
CHVECL201.2	Identify ethical issues in business and leadership contexts.
CHVECL201.3	Apply ethical decision-making models to resolve dilemmas in professional and organizational settings.
CHVECL201.4	Implement strategies to foster an ethical organizational culture.
CHVECL201.5	Execute to lead teams and organizations in a socially responsible manner, integrating ethical considerations into strategic decisions.

Pre-requisite:	Professional communication

Course Articulation Matrix

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
CHVECL201.1	-	-	-	-	-	-	-	2	2	-	-	1	-	-	2
CHVECL201.2	-	-	-	-	-	-	-	2	1	-	-	1	-	-	2
CHVECL201.3	-	-	-	-	-	-	-	2	1	2	-	1	-	-	3
CHVECL201.4	-	-	-	-	-	-	-	2	2	-	-	1	-	-	3
CHVECL201.5	-	-	-	-	-	-	-	3	1	-	-	1	-	-	3

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Curriculum Details

Course Contents	Hours
Unit 1: Introduction to Leadership & Its Theories Overview of the course, Definitions and theories of leadership, Leadership vs. Management, Trait Theory, Behavioral Theories, Contingency Theories	06
Unit 2: Ethics in Leadership Definition and importance of ethics in leadership, Ethical theories and principles, Characteristics of ethical leaders, The role of values in leadership	06
Unit 3: Ethical Decision-Making Models Utilitarianism, Deontology, Virtue Ethics, Ethical Decision-Making Frameworks, Analysis of real-world case studies, Group discussions and presentations	06
Unit 4: Ethical Dilemmas and Ethical Culture in Organizations Common ethical dilemmas leaders face, Strategies for resolving ethical conflicts, Building and sustaining an ethical culture, Role of leaders in shaping organizational ethics	06
Unit 5: Global Perspectives and Future Trends in Leadership and Ethics Cross-cultural ethical issues, Leading in a global context, Emerging challenges and opportunities, The future of ethical leadership	06

Text Books:

1.	"Leadership: Theory and Practice" by Peter G. Northouse, 6th Edition, SAGE Publications, 2013
2.	"Ethics and the Conduct of Business" by John R. Boatright, 7th edition, Pearson, 2014

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Reference Books:

1.	"The Ethical Executive: Becoming Aware of the Root Causes of Unethical Behavior" by Robert Hoyk and Paul Hersey, Stanford University Press, 2010

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Course Plan

Course Title: Research & Innovations	
Course Code: 231CHOECL201	Semester: III
TeachingScheme:L-T-P:3-0-0	Credits:3
Evaluation Scheme:ISE+MSEMarks:20+ 30	ESEMarks:50

Course Description:

This course provides an introduction to principles of responsible research and innovation. Research and innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objectives:

1	To study the fundamentals of research.
2	To identify the research problem
3	To study the types of research.
4	To study the Exploring and Executing innovations.
5	To study the Exploiting and Renewing innovations.
6	To study the Support System to Develop Culture of Research and Innovation

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Course Outcomes:

CO	At the end of successful completion of course, the students will be able to…
231CHOECL201.1	Understand the fundamentals of research.
231CHOECL201.2	Identify the research problem.
231CHOECL201.3	Describe the types of research.
231CHOECL201.4	Explain Exploring and Executing Innovations.
231CHOECL201.5	Understand Exploiting and Renewing innovations.
231CHOECL201.6	Understand Support System to Develop Culture of Research and Innovation.

Prerequisite:	Engineering Basics

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	BTL
CHOECL201.1	-	-	-	1	-	-	-	-	-	-	-	1	2	-	2
CHOECL201.2	-	-	-	2	-	-	-	-	-	-	-	1	2	-	1
CHOECL201.3	-	-	-	1	-	-	-	-	-	-	-	1	2	-	1
CHOECL201.4	-	-	-	2	1	-	-	-	-	-	-	1	2	-	2
CHOECL201.5	-	-	-	1	-	-	-	-	-	-	-	1	2	-	2
CHOECL201.6	-	-	-	1	-	-	-	-	-	-	-	1	2	-	2

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Contents	Hours
Unit 1 – Foundations of Research Meaning, Objectives, Motivation, Utility. Concept of theory, empiricism, deductive and inductive theory. Characteristics of scientific method - Understanding the language of Research - Concept, Construct, Definition, Variable. Research Process.	7
Unit 2 – Problem Identification Research Question - Investigation Question - Measurement Issues - Hypothesis - Qualities of a good Hypothes is Null Hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & Importance.	7
Unit 3 – Qualitative and Quantitative Research Qualitative research - Quantitative research - Concept of measurement, causality, generalization, replication. Merging the two approaches, Sampling.	7
Unit 4-Exploring and Executing innovations The processes used to explore innovations along the technology, market and strategy dimensions as the innovation moves from idea to market. The structures and incentives organizations must put into place to effectively allow talented individuals (from different functions) to execute innovation processes.	8
Unit 5 –Exploiting and Renewing innovations The strategies that a firm must consider to most effectively exploit the value of their innovation, including innovation platforms that incorporate multiple product options, portfolios and standards. The processes, structures and strategies for exploring, executing and exploiting innovations that established firms can use to renew their innovation foundations in the face of potentially disruptive innovations.	8
Unit 6- Support System to Develop Culture of Research and Innovation Developing a Culture of research and Innovation, Undergraduate education and research, Leadership in research and development, Research opportunities in the Indian context, Indian funding agencies, Grant proposal writing, The Roles of Incubators, Accelerators, Co-working Spaces, Mentors, and Events in the support system to develop culture of research and innovation.	8

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NPTEL: Research, Innovation and Social Relevance, By Prof. R. K. Dixit, National Institute of Technical Teachers' Training and Research, Bhopal.

Text Book:

1	Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th editions
2	Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.
3	C. R. Kothari , Research Methodology, New Age International (P) Limited,

Reference Books:

1	Organizational Behavior Essentials You Always Wanted To Know (Self-Learning Management) by Vibrant Publishers

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Laboratory Course Plan

Course Title: Research & Innovations Laboratory	
Course Code: 231CHOECP201	**Semester: III**
Teaching Scheme:L-T-P:0-0-2	**Credits:1**
Evaluation Scheme: Internal Marks: 25	**POE Marks:-**

Course Description:

This course provides an introduction to principles of responsible research and innovation. Research and innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objectives:

1	To conduct research in scientific and technological areas.
2	Encourage creativity and out of box thinking.

Course Outcomes:

CO	**At the end of successful completion of course, the students will be able to…**
231CHOECP201.1	Describe research that is concerned with the effectiveness.
231CHOECP201.2	Develop the innovative ideas, critical thinking.

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Prerequisite:	Engineering Basics

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	E
CHOECP201.1	-	-	1	2	-	-	-	1	1	-	-	-	2		
CHOECP201.2	-	-	1	1	-	-	-	1	1	-	-	-	2		

Expt. No.	List of Experiment	Type	Hours
1	**Introduction to Research Concepts** Discussion on the meaning, objectives, and utility of research, articulating different research purposes and objectives.	O	2
2	**Understanding Theory and Empiricism** Analyze an empirical research study to identify its theoretical and methodological components	O	2
3	**Formulating Research Questions and Hypothesis** Developing effective research and investigation questions, Create and refine null and alternative hypotheses for a given research problem. |Perform a mock hypothesis test using provided data.	O	2
4	**Research Methodologies** Writing a literature review, searching sources of literature, using databases and search engines. Conducting a mini literature review on a chosen topic	O	2
5	**Qualitative Data Collection** Qualitative data collection exercise (e.g., interviews, focus groups). **Quantitative Data Collection:** Design and administer a survey for quantitative data collection	O	2
6	**Data Analysis** Statistical tools and software (e.g., SPSS, Excel). Activity on data analysis using sample data sets.	O	2

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	Group activity: Analysing collected data and interpreting results.		
7	**Use Techniques for Research** Using databases and search engines for research, Hands-on activity to locate information using encyclopedias and research guides, using Zotero/Mendeley for managing references	O	2
8	**AI Tools for Research** Connected Papers, Iris.ai ,IBM Watson Studio, RapidMiner, Orange Data Mining	O	2
9	**AI Tools for Writing Research Papers and Project Reports** Grammarly, QuillBot, SciNote, Design-Expert	O	2
10	**Research Paper/Report Formatting Software Training** Formatting research papers using LaTeX/MS Office, Mendeley,Use software to check for plagiarism in sample documents, citation and referencing techniques	O	2
11	**Exploring and Executing Innovations** Brainstorming session to generate innovative ideas, conducting a market analysis for a selected innovation, evaluating the technological feasibility of an innovative idea, Simulate the development of a strategy to bring an innovation to market.	O	2
12	**Exploiting and Renewing Innovations** Creating an innovation platform with multiple product options, Develop and manage a portfolio of innovations, strategies for renewing innovation foundations in an established firm	O	2

NPTEL: Research, Innovation and Social Relevance, By Prof. R. K. Dixit, National Institute of Technical Teachers' Training and Research, Bhopal.

Text Book:

1	Business Research Methods- Donald Cooper & Pamela Schindler, TMGH, 9th editions
2	Business Research Methods- Alan Bryman & Emma Bell, Oxford University Press.

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3	C. R. Kothari , Research Methodology, New Age International (P) Limited,

Reference Books:

1	Organizational Behavior Essentials You Always Wanted To Know (Self-Learning Management) by Vibrant Publishers

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Course Plan

Course Title: Start-up Fundamentals and Financing	
Course Code:231CHHSSML201	Semester: III
Teaching Scheme: L-T-P : 1-0-0	Credits: 1
Evaluation Scheme: MSE:25 Marks	ESE Marks: NA

Course Description:

The Start-up Fundamentals and Financing course is designed to provide aspiring entrepreneurs with the knowledge and skills necessary to launch and finance a successful start-up. Covering the essentials of starting a new business, this course delves into key aspects such as idea validation, business planning, market research, funding options, and financial management.

Programme Specific Outcomes

Sr. No.	Statement
1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1.	To understand the fundamental concepts of entrepreneurship and start-up management.
2.	To learn how to develop a comprehensive business plan.
3.	To explore various funding sources available for start-ups.
4.	To understand financial management principles critical to start-up success.
5.	To identify and analyse the unique challenges and opportunities faced by start-ups.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
HSSML201.1	Understand the key concepts and principles of entrepreneurship and start-up management.
HSSML201.2	Develop and present a detailed business plan.
HSSML201.3	Identify and evaluate various funding options for start-ups.
HSSML201.4	Understand financial management techniques to manage start-up finances effectively.
HSSML201.5	Identify the challenges and opportunities faced by start-ups and propose solutions.

Pre-requisites	Introduction to Business, Financial Accounting

Course Articulation Matrix

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
HSSML201.1	-	-	-	-	-	-	-	1	1	-	2	-	-	-	2
HSSML201.2	-	-	-	-	-	-	-	1	1	-	2	-	-	-	3
HSSML201.3	-	-	-	-	-	-	-	1	1	-	2	-	-	-	1
HSSML201.4	-	-	-	-	-	-	-	1	1	-	2	-	-	-	2
HSSML201.5	-	-	-	-	-	-	-	1	1	-	2	-	-	-	1

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Course Contents	Hours
Unit 1: Start-ups, Funding Options and development phases Definition, Startups ecosystem: support organizations, big companies, universities, funding organizations, service providers, research organizations, Ideating, conception, committing, validating, scaling, establishing, Startup business partnering, Startup culture, Co-founders	05
Unit 2: Preparing to Launch Essential Components, Intellectual Property, Branding, Strategy, Financing startups: Different stages of financing; Cofounders, FFF, Angels; Venture Capitals, Acquisition/ mergers, Strategic alliances; IPO,Factors of success and failures, Restarts, Trends and obstacles.	05
Unit 3: Fundamentals of start-up Finance Need for Fund, Types of Fund, Sources of Funds Business Feasibility report,Unit economics, Break even, Run rate, Commercial viability of the project, Bankable.	05
Unit 4: Social Start-up Support Ecosystem India, Make in India, Case study on Startup village, Kochi; 10000 Start-ups of NASSCOM and Silicon Valley, USA, Startup policies of Central Government and some leading State Governments, Technology Business Incubator (TBI), Role of National Science and Technology Entrepreneurship Development Board (NSTEDB),DST guidelines for Seed Support System (SSS) for Startups in Incubators.	05

Text Books:

Sr. No.	Title
1.	Kathleen R Allen, Launching New Ventures, An Entrepreneurial Approach, Cengage Learning.
2.	Anjan Raichaudhuri, Managing New Ventures Concepts and Cases, Prentice Hall International. Operations Research- N V R Naidu, G. Rajendra, T Krishna kumar, I K international Publishing house, Pvt. Ltd. 2011.

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Reference Books:

Sr. No.	Title
1.	S. R. Bhowmik & M. Bhowmik, Entrepreneurship, New Age International.
2.	Steven Fisher, Ja-nae' Duane, The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, McGraw Hill Education India Pvt. Ltd.
3.	Byrd Megginson, Small Business Management An Entrepreneur's Guidebook, 7th ed, McGrawHill
4.	A Fayolle Entrepreneurship and new value creation, Cambridge, Cambridge University Press

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Laboratory Course Plan

Course Title: Start-up Fundamentals and Financing Laboratory	
Course Code :231CHHSSMP201	**Semester: III**
Teaching Scheme: L-T-P:0-2-0	**Credit : 01**
Evaluation Scheme: ISE:25 Marks	**ESE Marks: NA**

Course Description:

The Start-up Fundamentals and Financing Laboratory is an immersive, hands-on course designed to complement theoretical knowledge with practical experience in launching and financing start-ups. This laboratory course provides students with the opportunity to apply entrepreneurial concepts and financial strategies through interactive projects, real-world simulations, and collaboration with peers.

Sr. No.	Statement
1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1	To provide practical experience in developing and presenting a business plan.
2	To enable students to identify and evaluate funding sources for start-ups.
3	To analyze real-world start-up challenges and opportunities through case studies.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
HSSMP201.1	**Develop** a comprehensive business plan and present it effectively.
HSSMP201.2	**Evaluate** and **select** appropriate funding sources for a start-up.
HSSMP201.3	**Analyze** real-world start-up case studies to identify challenges and propose solutions.

Pre-requisite	Introduction to Business, Financial Accounting

Course Articulation Matrix

Mapping of Course Outcomes (Cos) with Program Outcomes (PO's)

PO's / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
HSSMP201.1	-	-	-	1	-	-	-	1	1	-	2	-	2	-	3
HSSMP201.2	-	-	-	1	-	-	-	1	1	-	2	-	2	-	3
HSSMP201.3	-	-	-	1	-	-	-	1	1	-	2	-	2	-	4

List of Experiments

Exp. No.	Title of Experiments	Type	Hours
01	Business Idea Generation	O	02
02	Market Research and Analysis	O	02
03	Developing a Business Plan	O	02
04	Identifying Funding Sources	O	02
05	Pitch Deck Creation & Simulated Investor Pitch	O	02
06	Financial Statement Preparation	O	02

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Exp. No.	Title of Experiments	Type	Hours
07	Budgeting, Forecasting and Cash Flow Management	O	02
08	Case Study Analysis	O	02
09	Team-building Activities	O	02
10	Problem-solving Exercises	O	02
11	Prototyping and MVP Development	O	02
12	Networking and Mentorship	O	02

Text Books:

Sr. No.	Title
1.	Kathleen R Allen, Launching New Ventures, An Entrepreneurial Approach, Cengage Learning.
2.	Anjan Raichaudhuri, Managing New Ventures Concepts and Cases, Prentice Hall International. Operations Research- N V R Naidu, G. Rajendra, T Krishna kumar, I K international Publishing house, Pvt. Ltd. 2011.

Reference Books:

Sr. No.	Title
1.	S. R. Bhowmik & M. Bhowmik, Entrepreneurship, New Age International.
2.	Steven Fisher, Ja-nae' Duane, The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, McGraw Hill Education India Pvt. Ltd.
3.	Byrd Megginson, Small Business Management An Entrepreneur's Guidebook, 7th ed, McGraw Hill
4.	A Fayolle Entrepreneurship and new value creation, Cambridge, Cambridge University Press

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Course Plan

Course Title : **Process Intensification & Development**	
Course Code : **231CHCCAL201**	**Semester : III**
Teaching Scheme : L-T-P : 0-0-0	Credits : Audit
Evaluation Scheme : ISE=50	ESE Marks : NA

Course Description:

This course explores advanced techniques in process intensification (PID) and their application in development across various industries. It covers fundamental principles, design methodologies, and case studies to illustrate the integration of PI in optimizing processes and enhancing quality.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective (COs):

Objective of this course is to:

1	To introduce students to the concept of process intensification and its significance in modern engineering practices.
2	To provide an in-depth understanding of various techniques and tools used in process intensification.
3	To analyse case studies and examples demonstrating successful implementation of process intensification in development.
4	To develop students' skills in designing and optimizing processes using PI principles

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5	To encourage critical thinking and problem-solving abilities through project work and case studies.

Course Outcomes (COs):
At the end of the course the student should be able to:

231CHCCAL201.1	Describe the principles and importance of process intensification in industrial applications.
231CHCCAL201.2	Evaluate different process intensification techniques and select appropriate methods for specific applications.
231CHCCAL201.3	Apply computational tools and simulations for optimizing intensified processes.
231CHCCAL201.4	Analyze case studies to identify challenges and solutions in implementing process intensification.
231CHCCAL201.5	Design and propose optimized processes for enhancing quality and efficiency.

Prerequisite:	**Fluid Flow Operations, Mass transfer, Heat Transfer, Chemical reaction engineering, Process Calculation**

Contents	Hours
Week 1: Introduction to Process Intensification Definition and history of process intensification, Importance and benefits of PI in modern industrial processes, Overview of traditional vs. intensified processes	
Week 2: Techniques and Tools in Process Intensification Heat integration and heat exchanger design, Microreactors and continuous flow processes, Membrane separations and pervaporation	

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Week 3: Process Intensification in Chemical Engineering Reactive distillation and reactive separation, Supercritical fluids and their applications, Case study: Application of PI in pharmaceutical manufacturing	
Week 4: Process Intensification in Food and Beverage Industry High-pressure processing (HPP) and pulsed electric field (PEF), Ultrasonication and membrane filtration, Case study: Application of PI in food preservation techniques	
Week 5: Process Intensification in Renewable Energy Biofuels ion and enzymatic reactions, Solar energy applications and intensified photovoltaic systems, Case study: PI in biomass conversion processes	
Week 6: Design and Optimization of Intensified Processes Process integration methodologies, Tools for process simulation and optimization, Practical exercises: Designing an intensified process	
Week 7: Challenges and Future Directions in Process Intensification Economic considerations and scalability of intensified processes, Environmental impact and sustainability aspects, Future trends in PI research and development	
Week 8: Introduction to Chemical Product Development The Chemical Industry and Product Development, Market Analysis and Opport Weeky Identification, Product Design Framework	
Week 9: Product Design Fundamentals Chemical Engineering Principles for Product Design (Material & Energy Balances, Reaction Engineering), Product Properties and Characterization, Formulation and Design of Chemical Products	
Week 10: Process Design and Optimization	

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Process Selection and Design Fundamentals, Process Simulation Software for Product Design, Economic Analysis and Cost Estimation	
Week 11: Product Development and Commercialization Intellectual Property and Patents, Regulatory Requirements and Approvals, Marketing and Sales Strategies	
Week 12: Case Studies and Project Presentations Group presentations on case studies and project work, Peer review and feedback session	

Text Books:

1	**"Process Intensification: Engineering for Efficiency, Sustainability and Flexibility"** by G. Stankiewicz and J. Moulijn
2	**Integrated Design and Simulation of Chemical Processes"** by Alexandre C. Dimian, CostinSorinBildea, and Anton A. Kiss
3	**"Process Intensification Technologies for Green Chemistry: Engineering Solutions for Sustainable Chemical Processing"** edited by KameliaBoodhoo and Adam Harvey
4	**"Process Design Principles: Synthesis, Analysis, and Evaluation"** by Warren D. Seider, J. D. Seader, Daniel R. Lewin, and SoemantriWidagdo
5	**"Product Design for Chemical Engineers"** by R. Smith
6	**"Chemical Process Design and Integration"** by Robin Smith

References Books:

1	**"Chemical Process Intensification: Engineering for Efficiency, Sustainability and Flexibility"** edited by A. J. Atkins and T. A. K. McKenna
2	**"Handbook of Process Integration (PI)"** edited by Jiri J. Klemes, FerencFriedler, and

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	Ian D. Wilson
3	**" and Process Design Principles: Synthesis, Analysis, and Evaluation"** by Warren D. Seider, J. D. Seader, Daniel R. Lewin, and SoemantriWidagdo
4	**"Chemical Process Design and Integration"** by Robin Smith
5	**"Process Integration and Intensification: Saving Energy, Water and Resources"** edited by J. J. Klemes, F. Friedler, and I. D. Wilson

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Course Plan

Course Title : **Advance Soft Computing Club**	
Course Code : **231CHLCCA101**	**Semester : III**
Teaching Scheme : L-T-P : 0-0-0	Credits : Audit
Evaluation Scheme : ISE =50	ESE Marks : NA

Course Description:

This course offers a comprehensive introduction to essential software tools used in the field of chemical engineering. It aims to equip students with the skills needed to effectively utilize MATLAB, Scilab, Python AutoCAD and open source software's for various engineering applications.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective (COs):

1	Familiarize students with the functionalities and applications of each software tool in chemical engineering.
2	Enable students to become proficient in using these tools for modelling, simulation, design, and optimization of chemical processes.
3	Provide hands-on experience in applying these tools to solve real-world chemical engineering problems.
4	Teach students how to integrate different software tools to enhance process design and optimization capabilities.

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Course Outcomes (COs): At the end of the course the student should be able to:

231CHLCCA101.1	Effectively use MATLAB, Scilab, Python, AutoCAD, and open source software.
231CHLCCA101.2	Apply these tools to model, simulate, and optimize chemical processes.
231CHLCCA101.3	Demonstrate the ability to solve complex engineering problems using these software tools.
231CHLCCA101.4	Integrate multiple software tools to create innovative solutions for chemical engineering challenges.

Contents	Hours
Week 1-2: Introduction to MATLAB • Overview of MATLAB and its applications in chemical engineering • Basics of MATLAB programming: variables, arrays, functions • Data analysis and visualization • Introduction to Simulink for dynamic system modeling • **Practical Session:** Implementing a simple chemical process model using MATLAB	08
Week 3-4: Introduction to Scilab • Basic commands and syntax, Variables and data types, Arithmetic operations, Built-in functions • Scripts and functions-Writing and executing scripts, Defining functions • Application in control systems, Signal processing, Image processing • **Practical Session:** Plotting 2D graph	08
Week 5-6: Introduction to AutoCAD • Overview of AutoCAD and its applications in plant design	08

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• Basic drawing and editing tools • Creating 2D diagrams: Piping and Instrumentation Diagrams (P&IDs) • Introduction to 3D modeling • **Practical Session:** Creating a P&ID for a simple chemical process	
Week 7-8: Introduction to Open Source Software's • Overview of open source software's and its applications in process simulation • Interface and navigation: creating and configuring flow sheets • Learn Property methods and thermodynamic models • Process simulation: reactors, separation processes, heat integration • **Practical Session:** Simulating a chemical reactor in any one open source software	08
Week 9-10: Introduction to COMSOL Metaphysics • Overview of COMSOL Metaphysics and its applications in chemical engineering • Interface and navigation: creating and configuring models • Metaphysics coupling: fluid flow, heat transfer, chemical reactions • Solver settings and result analysis • **Practical Session:** Modeling a coupled heat and mass transfer process in COMSOL	08
Week 11-12: Introduction to Python • Overview of Python- History and development, Installation and setup (Anaconda distribution) • Python environment and tools-Jupyter Notebooks, Spyder IDE • Variables and data types-Integers, floats, strings, lists, tuples, dictionaries • Basic operations and functions- Arithmetic operations, Built-in functions	08

• **Practical Session:** To solve any chemical engineering problem using Python	

Text Books/ References Books:

1	**"MATLAB for Engineers"** by Holly Moore
2	**"Mastering AutoCAD 2021 and AutoCAD LT 2021"** by Brian C. Benton and George Omura
3	**"Chemical Process Design and Simulation: Aspen Plus and Aspen Hysys Applications"** by Juma Haydary
4	**"Introduction to COMSOL Multiphysics"** by Roger W. Pryor
5	**"Introduction to Scientific Computing with SciLab"** by Daniel J. Vega

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Course Plan

Course Title: Heat Transfer	
Course Code : 231CHPCCL204	Semester: IV
TeachingScheme:L-T-P:3-0-0	Credits:3
Evaluation Scheme :ISE+MSE Marks:20+30	ESE Marks: 50

Course Description – This is one of the most fundamental course which deals with heat flow through various modes of heat transfer viz. Conduction, Convection & Radiation. This course includes all governing principles about evaporation, condensation, correlations, study of individual and overall heat transfer coefficient as well heat exchange equipments and design approach of heat exchangers.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course objective of this course is to:

CHPCCL204.1	Understand basic knowledge of modes of heat transfer and various aspect of heat propagation.
CHPCCL204.2	Understand principal of heat flow.
CHPCCL204.3	Understand how to calculate heat flux with respect to geometrical dimensions and various modes of heat transfer.
CHPCCL204.4	Understand heat transfer without and with phase change.
CHPCCL204.5	To design heat exchange equipments with respect to process requirement as well process conditions in optimistic way.
CHPCCL204.6	Become aware about evaporation and would technically sound to design and operate evaporator.

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Course Outcomes(COs):

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

CHPCCL204.1	**Explain** the importance of basic knowledge of modes of heat transfer and Variouss aspect of heat propagation.
CHPCCL204.2	**Understand & memorize** the principal of heat flow.
CHPCCL204.3	**Interpret** heat flux with respect to geometrical dimensions and various modes of heat transfer pipe fittings.
CHPCCL204.4	**Understand and compare** heat transfer without and with phase change.
CHPCCL204.5	**Understand** & **distinguish** heat exchange equipments with respect to process Requirement as well process conditions in optimistic way.
CHPCCL204.6	**Solve** and **apply** knowledge about evaporation and would technically sound to design and operate evaporator.

Prerequisite:	----

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes

(POs)and Program Specific outcomes(PSOs)

Course Outcomes (COs)	Pos												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CHPCCL204.1	2	2	2	2	-	-	-	-	-	-	-	-	-	-	2
CHPCCL204.2	3	3	2		-	-	-	-	-	-	-	-	-	-	1
CHPCCL204.3	3	3	3	3	-	-	-	-	-	-	-	-	-	-	3
CHPCCL204.4	-	-	-	2	-	-	-	-	-	-	-	-	2	-	4
CHPCCL204.5	3	3	3		-	-	-	-	-	-	-	-	2	-	2
CHPCCL204.6	3	3	2	3	-	-	-	-	-	-	-	-	-	-	3

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Contents	Hours
Unit 1 - Mechanism of heat flow with governing laws: Conduction, Convection, Radiation. **Heat transfer by conduction in solids:** Fourier's law, steady state heat conduction through walls, single and multilayer. Heat flow through a cylinder, Sphere, introduction to semi-infinite solid and critical radius of lagging, Problems.	6
Unit 2 - Principles of heat flow in fluids: Typical heat exchange equipment, co- current and counter current flow. Energy balances, rate of heat transfer, overall and individual heat transfer coefficient. Calculation of overall heat transfer co-efficient from Individual heat transfer coefficients, fouling factors, Problems.	8
Unit 3 - Heat transfer to fluids without phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow. Laminar flow heat transfer to flat plate, the Graetz and Peclet number. effect of tube length, empirical equations, estimation of wall temperature, analogy equations, heat transfer to liquid metals, heat transfer by forced convection outside tubes, natural convection, Problems.	8
Unit 4 - Heat transfer to fluids with phase change: Heat transfer from condensing Vapors drop wise and film wise condensation, coefficients for film type condensation, derivation and practical use of Nusselt equation, condensation of superheated vapors, effect of non-condensable gases, Problems. Heat transfer to boiling liquids : Types of boiling,boilingofsaturatedliquidmaximumfluxandcriticaltemperaturedrop, Minimum heat flux film boiling and sub cooled boiling, Problems.	8
Unit 5 - Heat exchange equipment: Types of heat exchangers, single and multipass exchangers, correction of LMTD for cross flow. Simple design calculations of heat exchangers,introductiontocompactheatexchangeri.e.platetypeheatexchanger, differenttypesofcondensersandboilers,aircooledheatexchangers,introductionto	8
Unit 6 - Evaporation: Liquid characteristics, types of evaporators, single evaporator capacity, economy, boiling point elevation and Duhring's rule. Heat transfer co- efficients Enthalpy balance for single effect evaporator, multiple effect evaporators, types, methods of feeding, enthalpy balance of multiple effect evaporators, problems. Introduction to heat transfer to packed and fluidized beds: General heat transfer characteristics, Calculation for Heat transfer co-efficient.	7

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Text Books:

1	McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications
2	SukhatmeS.P.,"HeatTransfer",5thedition.,UniversityPressIndiaLtd.,1996.

References Books:

1	William H. Mcadams, "Heat transmission",3rd ed. McGraw Hill Series
2	Alan J.Chapman. "HeatTransfer",4thed.MacmilanPublishingCompany, New York
3	Frank Kreith & Mark S.Bohn.,"Principles of Heat Transfer",4thed.HarperandRow Publishers, New York,
4	Coulson J.M.& RichardsonJ.F.,"Chemical Engineering" ,3rded. Vol.1
5	J.P.Holman. , "Heat Transfer", 8thed.Mc-GrawHillInc.1997.
6	Text Book: McCabe Smith,Peter Harriot,"Unit operations of Chemical Engineering" McGraw Hill Publications

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Course Plan

Course Title: Chemical Equipment Design	
Course Code:231CHPCCL205	**Semester: IV**
Teaching Scheme: L-T-P :02-0-0	**Credits:02**
Evaluation Scheme: NA	**ESE Marks:50 Marks**

Course Description:

Chemical process plants include a number of important equipment such as reactors, distillation columns, absorbers, heat exchangers, evaporators, crystallizers, etc. Design of such equipment should be carried out a priory to set-up a process plant and thus, it is basic step in a chemical process.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objectives:

1.	To acquire basic understanding of design parameters and equipment testing methods commonly used in design of process equipment's
2.	To design pressure vessels subjected to internal and external pressures
3.	To design storage vessel for internal pressures and various parts of vessels (e.g. supports)
4.	To design special vessels (e.g. tall vessels and agitator system)
5.	To acquire knowledge of shell & tube heat exchanger and reactor design.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
PCCL205.1	Identify various design preliminaries and equipment testing methods.
PCCL205.2	Evaluate and design various parts of Pressure equipment
PCCL205.3	Design storage vessel with internal pressure various supports of process equipment's
PCCL205.4	Determine stresses in tall vessel and agitator equipment systems
PCCL205.5	Calculate mechanical design formulae for Heat Exchanger and reactor

Pre-requisites	Mechanics of Material, Heat Transfer

Course Articulation Matrix

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
PCCL205.1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
PCCL205.2	1	2	1	1	-	-	-	-	-	-	-	-	-	-	3
PCCL205.3	1	2	1	1	-	-	-	-	-	-	-	-	-	-	3
PCCL205.4	1	2	1	1	-	-	-	-	-	-	-	-	-	-	3
PCCL205.5	1	2	1	1	-	-	-	-	-	-	-	-	-	-	3

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Course Contents	Hours
Unit 1 - Design preliminaries and Equipment Testing Methods Design codes, Maximum working pressure, Design pressure, Design temperature, Various mechanical properties of material, Different methods of fabrication, Joint efficiency, Design stress, Corrosion allowance, Design wall thickness, Hydrostatic Pressure test, Pneumatic pressure test, Dye penetrant test, Magnetic test, Ultrasonic test, Freon test, Radiography test.	04
Unit 2: Design of Pressure Equipment Classification of pressure vessels, Codes and Standards for pressure vessels, Design of pressure vessels under internal and external pressures, Design of thick walled high pressure vessels, Design of Gasket, Flanges, Nozzle, Design of spherical vessels, Industrial based Numericals.	08
Unit 3: Design of Storage Tanks and Supports Storage of fluids, Different types of storage vessels, Design of cylindrical storage vessels with roof, Support & their classifications, Design of Bracket Support & Lug Support, Design of Skirt Support & Saddle support, Industrial based Numericals	06
Unit 4: Design of tall and agitator vessels Define tall vessel & their types, Stress distribution in design of tall vessel, Types of agitators, Baffling, Power requirements for agitation, Design of agitation system components, Industrial based Numericals.	06
Unit 5: Design of Heat Exchanger and reactor Types of heat exchangers, Special type of heat exchangers, Design of Shell & Tube Heat Exchanger, Classification of reaction vessel, Heating systems, Design consideration, Industrial based Numericals.	06

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Text Books:

1.	B. C. Bhattacharya, "Introduction to chemical equipment design" (Mechanical accepts) 1985.
2.	M. V. Joshi, "Process equipment design" McMillan India Ltd. 1981.
3.	Dr. S.D. Dawande, "Process Design of Equipment", Central Techno Publication, 1st Edition 1999.

Reference Books:

1	B. C. Bhattacharya, "Introduction to chemical equipment design" (Mechanical accepts)1985.
2	M. V. Joshi, "Process equipment design" McMillan India Ltd. 1981.

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Course Plan

Course Title: Chemical Engineering Thermodynamics	
Course Code: 231CHPCCL206	Semester: III
Teaching Scheme: LTP: 3-0-0	Credits: 3
Evaluation Scheme: ISE+MSE=20+30=50	ESE Marks: 50

Course Description:

Thermodynamics sets hard limits on performance of processes and equipment. This course gives students the formalism and insights necessary to do a preliminary thermodynamic analysis of a chemical process.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1	To learn fundamentals of thermodynamics such as types of properties, processes and laws of thermodynamics for flow and non flow process.
2	To Understand the clear concepts on PVT behavior, Equations of state, thermodynamic diagrams and compressibility charts, entropy, irreversibility and problem solving skills.
3	To Learn the thermodynamic properties of pure fluids, energy relations and fugacity concepts
4	To Study the estimation of partial molar properties, property changes of mixing, and ideal and non ideal solutions.
5	To Learn the fundamentals of phase equilibrium, concept of chemical potential and generation and consistency check for VLE data.
6	To Understand fundamentals of chemical reaction equilibrium to find feasibility and extent of conversion for the industrial reactions.

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Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
CHPCCL206.1	**Understand** the significance of thermodynamic properties of pure fluids & fluids in mixture.
CHPCCL206.2	**Apply** the laws of thermodynamics to chemical engineering processes.
CHPCCL206.3	**Learn** thermodynamic properties, data from appropriate sources.
CHPCCL206.4	**Explain** differences in thermodynamic properties using equation of state, charts, and tables.
CHPCCL206.5	**Understand** thermodynamic calculations orientated to the analysis and design & efficiency of various energy related chemical processes.
CHPCCL206.6	**Determine** the efficiency of processes involving heat into work, refrigeration and liquefaction.

Prerequisite:	Engineering Mathematics, Chemistry

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
CHPCCL206.1	1	1	1	1	-	-	-	-	-	-	-	-	1	-	2
CHPCCL206.2	1	1	1	1	-	-	-	-	-	-	-	-	1	-	3
CHPCCL206.3	1	1	1	1	-	-	-	-	-	-	-	-	1	-	2
CHPCCL206.4	1	1	1	1	-	-	-	-	-	-	-	-	1	-	2
CHPCCL206.5	1	1	1	1	-	-	-	-	-	-	-	-	1	-	2
CHPCCL206.6	1	1	1	1	-	-	-	-	-	-	-	-	1	-	2
231CHPCCL206	1	1	1	1	-	-	-	-	-	-	-	-	1	-	2

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Content	Hours
Unit 1: First and Second law of thermodynamics System, Surrounding and processes, Closed and Open systems, state and Properties, Intensive and Extensive Properties, State and Path functions, equilibrium state and Phase rule, Zeroth law of thermodynamics, Heat reservoir and Heat engines, Reversible and Irreversible processes. General statement of First law of thermodynamics, First law for cyclic process and nonflow processes, effect of temperature on standard General statements of the Second law, Concept of Entropy, The Carnot Principle, calculation of entropy changes, Entropy and Third law of Thermodynamics.	6
Unit 2 –Volumetric properties of pure fluids PVT behaviour of pure fluids, Equations of state and ideal gas law, Processes involving ideal gas law: Constant volume, constant pressure, and constant temperature, adiabatic and polytrophic processes. Equation of state for real gases: vander Waals equation, Redlich – Kwong equation, Peng – Robinson equation, Virial equation	6
Unit 3- Thermodynamic properties of pure fluids: Property relation of homogeneous phase, residual property, Residual property by equation of state, Two phase systems, Thermodynamis diagrams, Generalized property correlations of gases.	6
Unit 4-Solution thermodynamics: Reference Properties, Energy Properties, Derived Properties, Gibbs free energy, Relationships among thermodynamic properties, Exact differential equations, Fundamental property relations, Maxwell's equations, Entropy heat capacity relations, Modified equations for U & H, Effect of temperature on U, H & S, Relationships between, Fugacity, Fugacity coefficient, Effect of temperature and pressure on Fugacity, Determination of Fugacity of pure gases, Fugacities of solids and liquids, Activity, Effect of temperature and pressure on activity, Thermodynamic diagrams	6
Unit 5 Properties of Solution and Phase Equilibria Partial molar properties, Chemical potential, Fugacity in solutions, Henry's law and dilute solutions, activity in solutions, Activity coefficients, Gibbs – Duhem's equation, Property changes of mixing, excess properties. Criteria of phase	6

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Equilibria, Criterion of stability, Duhem's theorem, Vapor – Liquid Equilibria, VLE in ideal solutions, NonIdeal solutions. Activity coefficient models,	
Unit 6 – Chemical Reaction Equilibria Reaction Stoichiometry, Criteria of chemical reaction equilibrium, Equilibrium constant and standard free energy change, Effect of temperature, Pressure on equilibrium constants and other factors affecting equilibrium conversion, Liquid phase reactions, heterogeneous reaction equilibrium, phase rule for reacting systems. Phase equilibria, dew point and bubble point calculation.	6

Text Books:

1	J.M. Smith and H.C. Van Ness, "Introduction to Chemical Egg.", Thermodynamics 8th Edition, International student edition, McGraw Hill publication.
2	K.V. Narayanan, "Chemical Engg. Thermodynamics", Prentice Hall India, New Delhi

Reference Books:

1	B.F. Dodge, "Chemical Egg. Thermodynamics", International student edition McGraw Hill Publication.
2	D.A. Hougen, K.M. Watson and R.A. Ragatz, "Chemical Process Principles", (Vol. II 2nd Edn. Asia Publishing House.

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Laboratory Course Plan

Course Title: Heat Transfer Operations Laboratory	
Course Code: 231CHPCCP204	**Semester: IV**
Teaching Scheme :L-T-P:0-0-2	**Credits:1**
Evaluation Scheme: ISEMarks:25	**ESE(POE) Marks:25**

Course Description – This is one of the fundamental course which deals with study of heat flow through various modes of heat transfer Viz. Conduction, Convection & Radiation. In lab work; verification of governing laws by varying various variable parameters is done.

Course Objective (COs):

1. Inculcate basic concepts of Heat flow, verifying governing laws of various modes of heat transfer viz. conduction, Convection and radiation.
2. To explain working of various heat exchange equipments used in chemical industries and calculation of an Individual and Overall heat transfer coefficients.

Course Outcomes(COs):

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

CHPCCP204.1	**Calculate** heat flux, thermal conductivity, Temperature gradient and heat transfer area.
CHPCCP204.2	**Calculate** Individual as well as Overall heat transfer coefficients, LMTD of various heat exchange equipments.

Prerequisite:	--

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific outcomes (PSOs)

Course Outcomes (COs)	Pos												PSO	PSO	BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CHPCCP204.1	3	1	-	-	-	-	-	-	1	-	-	-	1	-	3
CHPCCP204.2	3	2	-	-	-	-	-	-	1	-	-	-	1	-	3

List of Experiments			
Expt. No.	Name of Experiment	Type	Hours
1	To determine thermal conductivity of an insulating powder.	O	2
2	To plot radial temperature distribution with determination of thermal conductivity.	O	2
3	To find out thermal conductivity of metal rod.	O	2
4	To determine surface heat transfer coefficients for vertical tube Using heat by natural convection.	O	2
5	To find out heat transfer coefficient of forced convection.	O	2
6	To study and compare temperature distribution, heat transfer rate &Overall heat transfer coefficients in parallel flow and counter flow.	O	2
7	To determine the overall and individual heat transfer coefficients in 1:2 Shell & Tube heat exchanger.	O	2
8	To study drop wise and film wise condensation and to calculate Average coefficient of entire tube.	O	2
9	To determine emissivity of plate.	O	2
10	To study Critical heat flux.	O	2
11	To determine the overall and individual heat transfer coefficients In Finned tube heat exchanger.	O	2
12	To determine effective thermal conductivity of a packed bed.	O	2
13	Demonstration of–a)Single effect evaporator	S	2

❖S-STUDY, O-OPERATIONAL
❖Minimum10 Experiments should be conducted

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Text Books:

1	McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications
2	SukhatmeS.P.,"HeatTransfer",5thedition.,UniversityPressIndiaLtd.,1996.

References Books:

1	William H. Mcadams, "Heat transmission",3rd ed. McGraw Hill Series
2	Alan J.Chapman. "HeatTransfer",4thed.MacmilanPublishingCompany, New York
3	Frank Kreith & Mark S.Bohn.,"Principles of Heat Transfer",4thed.HarperandRow Publishers, New York,
4	Coulson J.M.&RichardsonJ.F.,"ChemicalEngineering" ,3rded. Vol.1
5	J.P.Holman. , "Heat Transfer", 8thed.Mc-GrawHillInc.1997.
6	Text Book: McCabe Smith, Peter Harriot, "Unit operations of Chemical Engineering" McGraw Hill Publications

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Laboratory Course Plan

Course Title: Chemical Equipment Design Laboratory	
Course Code :231CHPCCP205	Semester: IV
Teaching Scheme: L-T-P:0-0-2	Credit :01
Evaluation Scheme: ISE:25 Marks	ESE Marks:25 Marks

Course Description:

The Chemical Equipment Design Laboratory course provides hands-on experience in the design, operation, and analysis of chemical process equipment. Through practical experiments and projects, students will apply theoretical concepts learned in the Chemical Equipment Design course to real-world scenarios, enhancing their understanding of equipment performance, troubleshooting, and optimization.

Course Objectives:

1.	To learn basic Standard equipment symbols and instrumentation symbols used in the chemical process industry
2.	To study how to design and draw Heads and closures, Keys and couplings, supports for vessels
3.	To understand the design details of operations for systematic drawing

Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
PCCP205.1	Identify equipment and process involved in process flow diagrams
PCCP205.2	Design and draw Heads and closures, Keys and couplings, Supports for vessels
PCCP205.3	Understand the basic concepts and operations of various chemical equipment's and flow sheets related to chemical engineering design and drawing

Pre-requisites	Basics of Auto CAD, Graphics design

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Course Articulation Matrix

Mapping of Course Outcomes (Cos) with Program Outcomes (PO's)

PO's / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
CHP106.1	-	1	2	1	1	-	-	-	-	-	-	-	-	-	1
CHP106.2	-	1	2	1	1	-	-	-	-	-	-	-	-	-	3
CHP106.3	-	1	2	1	1	-	-	-	-	-	-	-	-	-	3

List of Experiments

Exp. No.	Title of Experiments	Type	Hours
01	Standard equipment symbols , Standard instrumentation symbols	O	02
02	Heads or closures and Flanges	O	02
03	Drawing of Pressure Vessel	O	02
04	Drawing of Storage Vessel	O	02
05	Drawing of Supports-Bracket, Lug, skirt and Saddle support	O	02
06	Drawing of Fractional distillation column	O	02
07	Drawing of heat exchangers- Shell and tube heat exchanger	O	02
08	Drawing of reaction vessel	O	02
09	Drawing of evaporator	O	02
10	Drawing of agitation system	O	02
11	Drawing centrifugal separator	O	02
12	Drawing filtration Equipment	O	02

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Text Books:

1.	B. C. Bhattacharya, "Introduction to chemical equipment design" (Mechanical accepts) 1985.
2.	M. V. Joshi, "Process equipment design" McMillan India Ltd. 1981.
3.	Dr. S.D. Dawande, "Process Design of Equipment", Central Techno Publication, 1st Edition 1999.

Reference Books:

1	B. C. Bhattacharya, "Introduction to chemical equipment design" (Mechanical accepts)1985.
2	M. V. Joshi, "Process equipment design" McMillan India Ltd. 1981.

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Course Plan

Course Title: Petrochemical Technology	
Course Code: 231CHMDML202	**Semester: IV**
Teaching Scheme: L-T-P: 2-0-0	**Credits: 2**
ISE Marks: 20	**ESE Marks: 30**

Course Description:

Petrochemical Technology explores the chemical processes involved in the production of petrochemicals, which are essential building blocks for various industries including polymers, pharmaceuticals and chemical. This course provides an in-depth examination of the conversion of raw petroleum and natural gas into valuable chemical intermediates and end-products. Topics covered include feedstock selection, refining techniques, chemical reactions, separation processes, catalysts and product purification. Emphasis is placed on understanding the principles behind petrochemical production, the role of technology in optimizing efficiency and yield and the environmental and economic implications of petrochemical processes. Through theoretical study and industrial visits, students will gain practical insights into the operation, management, and innovation within the petrochemical sector.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1	To provide students with a comprehensive understanding of the fundamental principles and technologies involved in the petrochemical industry
2	o familiarize students with the various raw materials and feedstocks used in the

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	production of petrochemicals, including natural gas and crude oil
3	To explore and explain the key chemical reactions and processes, such as cracking, reforming, polymerization, and alkylation, that convert raw materials into petrochemical products.
4	To examine the critical unit operations involved in petrochemical processing, including distillation, separation, catalytic processes, and reactor design.
5	To explore the latest advancements and future trends in petrochemical technology, including bio-based feedstocks, digitalization, and smart manufacturing.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
MDML202.1	To understand the fundamental principles of petrochemical processes and technologies
MDML202.2	o understand the major raw materials and their conversion into petrochemical products
MDML202.3	To understand the various unit operations and chemical reactions used in petrochemical production
MDML202.4	To analyze the economic and environmental aspects of the petrochemical industry.
MDML202.5	To examine the latest advancements and future trends in petrochemical technology.

Prerequisite:	Basic Chemistry, Introduction to Chemical Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
MDML202.1	3	2	2	-	-	2	1	-	-	-	-	1			2
MDML202.2	3	3	2	-	-	2	1	-	-	-	-	1			2

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MDML202.3	3	3	3	-	-	2	2	-	-	-	-	-			2
MDML202.4	3	3	3	-	-	2	2	-	-	-	-	-			4
MDML202.5	-	-	-	-	-	2	2	-	-	-	-	1			4

Content	Hours
Unit 1. Introduction to Petrochemical Industries Definition and classification of petrochemicals, history of petrochemical industry, development of petrochemical industry in India, product profile of petrochemicals, general cost considerations, economics of R&D, sources of petrochemicals, Natural Gas processing. General idea of LNG, CNG, NGL, LPG and their generation, Steam reforming	6
Unit 2. Raw Materials In Petrochemical Industries Organic chemicals, Coal, Biomass Petroleum. Chemicals from Methanol and Synthesis gas: Methanol, Formaldehyde, Carbon-di-sulphide, Hydrogen cyanide.	6
Unit 3. Low Molecular Weight Alkanes Chemicals from Ethane, Ethylene & Acetylene: Ethanol, Acetaldehyde, Acetic acid, Vinyl acetate, Acrylonitrile, Chemicals from Propane & Propylene: Isopropanol, Acetone, Propylene oxide, Isoprene	6
Unit 4. High Molecular Weight Alkanes and Polymers Chemicals from Butanes & Pentanes: Butadiene, Butyl acetate, Methyl-Ethyl Ketone. Chemicals from aromatics: Nitrobenzene, Benzoic acid, Nitrotolune, Isopthalic acid, Adipic acid, Aniline Polyvinyl Chloride	6

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Unit 5. Recent Trends in Petrochemicals Energy crises in Petrochemical industry, Natural gas as Petrochemical feedstock, Import of heavy feedstock on Petrochemicals, Ecology and energy crises, Synthetic fuels, Trends in Petrochemical Industry.	6

Text Books:

1	B.K. Bhasker Rao - A Text on Petrochemicals, 2nd Edition, Khanna publishers, 1996.
2	Sukumar Maiti - Introduction to Petrochemicals Oxford & IBH publishing Co. Pvt. Ltd., 1991.
3	Ram Prasad - Petroleum Refinery Technology, Khanna publications.

Reference Books:

1	J. H. Gary, G. E. Handwerk and M. J. Kaiser - Petroleum Refining Technology and Economics, 5th Edition, CRC press Taylor & Francis Group, 2007.
2	A.V.G. Halm - The Petrochemical Industry, McGraw Hill 1970.
3	A.L. Waddams - Chemicals from Petroleum, Chemical publishing Co.
4	M.J Astle - The Chemistry of Petrochemicals, Reinhold.
5	C.E. Dryden - Outlines of Chemical Technology, Affiliated East-West Press, 1973. F. Keys - Industrial Chemicals.
6	Advanced Petrochemicals: Dr. G. N. Sarkar, Khanna Publishers
7	Petrochemical processes: Chauvel ,Gulf Publishing

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Course Plan

Course Title :Environmental Studies	
Course Code : 231CHVECL202	Semester :III /VI
Teaching Scheme : L-T-P : 2-0-0	Credits :2
Evaluation Scheme : ISE—MSE--=Marks :	ESE Marks :-- 50

Course Description: The main objective of course is to create awareness among students regarding environmental issues and its impact on society. Knowledge regarding environmental components, its degradation and protection of environment is need for sustainable future ahead.

Course Objectives:

1. Understand the scope and importance of Environmental Studies and sustainable development
2. Understand connection between environmental health and developmental activities
3. Understand the importance of Environmental Management for its protection through technical and legislative point of view
4. Acquire problem solving skills through visits to different locations, identifying the Environmental problems and proposing solution for societal benefits

Course Outcomes (COs):

Upon successful completion of this course, the students will be able to:

CHVECL202.1	Understand the scope and importance of Environmental awareness and Sustainable development
CHVECL202.2	Understand various Environmental issues due to development
CHVECL202.3	Understand various modes of Environmental management through technoly and legislation
CHVECL202.4	Acquire problem solving attitude through actual field experience, reporting it in the form of Field project work.

Prerequisite:	Understanding of Environmental Education course

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Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	Pos												PSOs		BTL
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
CHVECL202.1	-	-	-	-	-	1	3	2	-	-	-	2	-	-	2
CHVECL202.2	-	-	-	-	-	1	3	1	-	-	-	2	-	-	2
CHVECL202.3	-	-	-	-	-	1	3	1	-	-	-	2	-	-	3
CHVECL202.4	-	-	-	-	-	2	3	1	-	1	1	2	-	-	3

Content	Hours
Unit 1: Our Environment Introduction to Environment, Scope of Environmental studies, importance of environmental awareness (1) Concept of sustainability, Sustainable Development- history and Goals, environmental ethics, Sustainability ethics (3) Population growth of world and reduced health content of the environment (1)	05
Unit 2: Development and Environmental health I. **Natural resources** (8) Types(renewable and non-renewable), developmental benefits Forest- Benefits, problems (Deforestation) Biodiversity-- importance, threats, conservation Ecosystems- importance, problem associated with major ecosystems, ecological restoration Air- Benefits, problems (Pollution, climate change) Water- Benefits, problems (Depletion, pollution) Soil/ Land- Benefits, problems (Degradation, loss of fertility, desertification)	10

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Mineral- Benefits, problems (Mining, over exploitation, depletion, pollution) Energy resources- Benefits, problems (depletion, energy crisis) II. **Urbanization and Environmental health (2)** Urban problems, Solid waste- Effects of MSW, Plastic waste, Hazardous waste, E- waste	
Unit 3: Environmental Management Renewable energy technologies- current, new(Bio gas, Bio fuel, hydrogen, etc) (1) Pollution abetment –5R, ZLD, carbon credit, bio remedies (1) Soil/ land reclamation, Sustainable agriculture (1) Concept of EIA, Environmental audit, ISO certification (ISO 14001) (2) Role of CPCB and MPCB in Environmental protection of India (1) Emerging technologies for environmental management- GIS, Remote sensing, Smart bin, IoT integration, **Waste-to-Energy Technologies, Recycling Automation, Advanced Data Analytics, Circular Economy Practices, Sustainable Packaging Solutions, Community Engagement and Education, Decentralized Waste Treatment, Zero-Waste Initiatives, Legislative and Regulatory Changes (2)** Environmental legislation- Environmental Protection Act, Air Act, Water Act, Solid waste Management Act, Hazardous waste Management Rule, E- Waste (Management) Rules, 2022 (2)	10
Unit 4: Field project work Case studies based on site visit (Each candidate has to go for field visit and complete a project work on Environmental issues and probable solutions)	05

Text Books:

1	Handbook of Environmental Studies by Dr. G. R. Parihar, Publisher: Satyam Publishers and Distributors (1 January 2013)
2	Environmental Studies by Anubha Kaushik, New Age International Private Limited (1 January 2007)
3	Introduction to Environmental Engineering and Science 3e, by Masters, Publisher : Pearson Education India; 3rd edition (1 January 2015)
4	Solid Waste Management in developing countries, by Bhide A. D. and Sundersen B. B.-

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	Indian National Scientific Documentation Centre, New Delhi

Reference Books:

1	Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I &II, Environmental Media
2	Ecology And Environment Pb, by P. D. Sharma, Rastogi Publications (1 January 2011)

Online Resources:

Environmental English Book 1-3-2022 Final Corrected copy_compressed.pdf

Manual on Municipal Solid Waste Management- Ministry of Urban Development, Govt. of India

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Course Plan

Course Title: Innovation & Product Development	
Course Code: 231CHHSSML202	Semester: IV
Teaching Scheme: L-T-P: 2-0-0	Credits: 2
ISE Marks: 25	Internal Marks: 25

Course Description:

This course explores the dynamic processes involved in innovation and product development. Emphasizing theoretical foundations and practical applications, students will examine the critical stages of innovation from ideation to commercialization. Key topics include creativity techniques, market analysis, prototyping, project management and strategic planning. The course also addresses the role of technology, consumer behaviour trends and ethical considerations in shaping successful innovation strategies. By the end of the course, students will be equipped with a comprehensive understanding of how innovation and product development contribute to organizational growth and competitive advantage in a global marketplace.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1	To understand the fundamentals of innovation and its importance in product development.
2	o explore various methodologies and tools for product design and development.
3	To analyze market needs and transform them into viable product ideas.

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4	To develop skills in prototyping, testing, and iterating products.
5	To gain insights into the commercialization process and strategies for launching new products.

Course Outcomes (COs):

COs	At the end of successful completion of course, the students will be able to…
HSSML202.1	Identify and articulate the role of innovation in product development.
HSSML202.2	nderstand various tools and techniques for effective product design.
HSSML202.3	Conduct market research and apply findings to product ideas.
HSSML202.4	Understand prototypes and conduction of testing to refine product concepts.
HSSML202.5	Understand the processes and strategies for successfully bringing a product to market.

Prerequisite:	Foundational concepts in business, Creativity, Problem solving skills

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

POs/ COs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
HSSML202.1	1	-	1	-	1	-	2	-	-	-	-	2			2
HSSML202.2	1	-	1	1	1	-	2	-	-	-	-	2			2
HSSML202.3	1	-	1	-	1	-	2	-	-	-	-	2			3
HSSML202.4	1	-	1	-	1	-	2	-	-	-	-	2			2
HSSML202.5	1	-	1	-	1	-	2	-	-	-	-	2			2

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Content	Hours
Unit 1. Introduction to Innovation and Product Development Definition and Types of Innovation, The Role of Innovation in Business Growth, Overview of Product Development Process, Case Studies of Successful Innovations	6
Unit 2. Ideation and Concept Development Techniques for Idea Generation (Brainstorming, SCAMPER, etc.), Concept Development and Screening, Creating Value Propositions, Design Thinking Process	6
Unit 3. Market Research and Analysis Understanding Customer Needs and Wants, Market Segmentation and Targeting, Competitor Analysis, Trend Analysis	6
Unit 4. Prototyping and Testing Types of Prototypes (Low-Fidelity vs. High-Fidelity), Prototyping Tools and Techniques, Usability Testing, Iterative Design Process	6
Unit 5. Commercialization and Product Launch Go-to-Market Strategies, Product Life Cycle Management, Intellectual Property Rights, Launch Planning and Execution	6

Text Books:

1	Product Design and Development by Karl T. Ulrich and Steven D. Eppinger, 7th edition, McGraw-Hill, 2020
2	Innovation and Entrepreneurship: Practice and Principles by Peter F. Drucker, Harper & Row, 1986
3	Lean Product and Process Development by Allen C. Ward, 2nd edition, Lean Enterprises Institute, 2014

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Reference Books:

1	The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail by Clayton M. Christensen, Harvard Business School Press, 1997
2	Design Thinking: Integrating Innovation, Customer Experience, and Brand Value by Thomas Lockwood, Allworth, 2010
3	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries, Crown, 2011
4	Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers by Geoffrey A. Moore, Harper Business, 1999
5	Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant by W. Chan Kim and Renée Mauborgne, Harvard Business School Press, 2005
6	The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design Firm by Tom Kelley, Harper Collins Business, 2001
7	Managing Innovation: Integrating Technological, Market and Organizational Change by Joe Tidd and John Bessant, 6th edition, Wiley, 2018

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Course Plan

Course Title: Problem-solving and Analytical Skills	
Course Code:231CHAECL201	Semester: IV
Teaching Scheme: L-T-P :1-0-0	Credits:01
Evaluation Scheme: MSE= 25 Marks	ESE Marks: NA

Course Description:

The Problem-Solving and Analytical Skills course is designed to empower students with the ability to approach complex problems systematically and analytically. This course focuses on developing critical thinking, logical reasoning, and effective decision-making skills. Through a combination of theoretical knowledge and practical applications, students will learn to identify problems, analyse data, generate solutions, and implement strategies in various contexts.

Programme Specific Outcomes

Sr. No.	Statement
PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1	To introduce students to various problem-solving techniques and frameworks.
2	To develop critical thinking skills essential for effective problem analysis.
3	To equip students with analytical tools for data interpretation and decision-making.
4	To foster the ability to approach problems methodically and develop creative solutions.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
AECL201.1	Understand and apply various problem-solving techniques and frameworks.
AECL201.2	Develop and demonstrate critical thinking skills in problem analysis.
AECL201.3	Utilize analytical tools and techniques for data interpretation and decision-making.
AECL201.4	Approach problems systematically and develop innovative solutions.

Pre-requisites	Basic understanding of mathematics and statistics, Familiarity with fundamental business concepts

Course Articulation Matrix

Mapping of Course Outcomes (COs) with Program Outcomes (POs)

POs / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
AECL201.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	2
AECL201.2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3
AECL201.3	2	1	1	-	-	-	-	-	-	-	-	-	-	-	2
AECL201.4	2	1	-	-	1	-	-	-	-	-	-	-	-	-	3

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Course Contents	Hours
Unit 1:Introduction to Problem-solving Problem-solving Overview, Definition and Importance of Problem-solving, Types of Problems, Problem-solving Techniques, Brainstorming, Root Cause Analysis, Mind Mapping.	05
Unit 2:Critical Thinking Skills Fundamentals of Critical Thinking, Definition and Components of Critical Thinking, Barriers to Critical Thinking, Critical Thinking Techniques, Questioning Techniques, Logical Reasoning, Analysis	05
Unit 3:Analytical Tools and Techniques Data Analysis Fundamentals, Types of Data, Data Collection Methods, Statistical Tools, Descriptive Statistics, Inferential Statistics, Data Visualization, Graphs and Charts, Software Tools (e.g., Excel, Tableau).	05
Unit 4:Systematic Problem-solving Approach Problem-solving Frameworks, PDCA (Plan-Do-Check-Act), DMAIC (Define-Measure-Analyze-Improve-Control), Creative Problem-solving, Lateral Thinking, TRIZ (Theory of Inventive Problem Solving)	05

Text Books:

1.	Ken Watanabe, Problem solving 101- the simple book for smart people, Restseller publication
2.	Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.

Reference Books:

1.	Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055
2.	Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3.	Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata McGraw Hill

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Laboratory Course Plan

Course Title: Problem-solving and Analytical Skills Laboratory	
Course Code :231CHAECP201	Semester: IV
Teaching Scheme: L-T-P:0-2-0	Credit :01
Evaluation Scheme: ISE:25 Marks	ESE Marks: NA

Course Description:

The Problem-Solving and Analytical Skills Laboratory is designed to equip students with the essential tools and techniques needed to tackle complex problems and make informed decisions. Through a combination of theoretical instruction and hands-on practice, students will develop critical thinking, analytical reasoning, and creative problem-solving abilities.

Programme Specific Outcomes

Sr. No.	Statement
1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modelling, and optimization in all aspects.

Course Objectives:

1	To apply problem-solving techniques in practical scenarios.
2	To enhance critical thinking skills through real-world exercises.
3	To utilize analytical tools and methods for data interpretation and decision-making.
4	To integrate theoretical knowledge with practical applications in various domains.

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Course Outcomes (COs): After successful completion of the course, students will be able to:

CO	Statements
AECP201.1	Apply problem-solving techniques in practical scenarios.
AECP201.2	Demonstrate critical thinking skills in analyzing and solving problems.
AECP201.3	Use analytical tools for data interpretation and informed decision-making.
AECP201.4	Integrate theoretical knowledge with practical applications.

Pre-requisite	Basic understanding of mathematics and statistics, Familiarity with fundamental business concepts

Course Articulation Matrix

Mapping of Course Outcomes (Cos) with Program Outcomes (PO's)

PO's / Cos	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2	BTL
AECP201.1	2	1	-	1	-	-	-	-	-	-	-	-	-	-	3
AECP201.2	2	1	-	1	-	-	-	-	-	-	-	-	-	-	3
AECP201.3	2	1	-	1	-	-	-	-	-	-	-	-	-	-	1
AECP201.4	2	1	-	1	-	-	-	-	-	-	-	-	-	-	3

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List of Experiments

Exp. No.	Title of Experiments	Type	Hours
01	Brainstorming and Mind Mapping	O	02
02	Root Cause Analysis	O	02
03	Logical Reasoning and Argument Analysis	O	02
04	Case Study Analysis	O	02
05	Data Collection and Descriptive Statistics	O	02
06	Data Visualization with Excel	O	02
07	Data Visualization with Tableau	O	02
08	PDCA (Plan-Do-Check-Act) Cycle	O	02
09	DMAIC (Define-Measure-Analyze-Improve-Control) Methodology	O	02
10	Business Problem-solving Simulation	O	02
11	Group Project on Real-world Problem	O	02
12	Group Project on Real-world Problem	O	02

Text Books:

1.	Ken Watanabe, Problem solving 101- the simple book for smart people, Rest seller publication
2.	Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.

Reference Books:

1.	Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar, New Delhi-110055
2.	Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.
3.	Quantitative Aptitude for Competitive Examination by AbhijitGuha, Tata McGraw Hill

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Course Plan

Course Title: Waste Management	
Course Code: 231CHOECL202	Semester:IV
Teaching Scheme :L-T-P:2-0-0	Credits:2
Evaluation Scheme:ISE+MSEMarks: -	ESEMarks:50

Course Description:

This course aims to give a deeper knowledge in the problems and possibilities of waste management from a national and global perspective. The course focuses on municipal solid waste issues and takes a holistic view on waste management solutions, as well as technical aspects

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objectives:

1	To acquire deep knowledge in solid waste management
2	To learn the treatment techniques for the scientific disposal of solidwaste
3	To comprehend the sources and effects of environmental pollution

Course Outcomes:

CO	At the end of successful completion of course, the students will be able to…
231CHOECL202.1	Describe the solid waste collection and transport.
231CHOECL202.2	Understand the waste processing.

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231CHOECL202.3	Understand the bioreactor.
231CHOECL202.4	Identify the hazardous waste.
231CHOECL202.5	Discuss the techniques for biomedical waste disposal.

Prerequisite:	Basics of Chemical Engineering

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	P1	P2	P3	P4	P5	P6	P7	P8	P9	PO 10	PO 11	PO 12	PSO 1	PSO 2	BTL
CHOECL202.1	1	-	-	-	-	-	2	-	-	-	-	-	2	-	1
CHOECL202.2	1	-	-	-	-	-	2	-	-	-	-	-	2	-	2
CHOECL202.3	2	-	-	-	-	-	2	-	-	-	-	-	2	-	2
CHOECL202.4	1	-	-	-	-	-	2	-	-	-	-	-	2	-	2
CHOECL202.5	1	-	-	-	-	-	2	-	-	-	-	-	2	-	1

Contents	Hours
Unit 1 –Municipal Solid Waste Management Introduction, Waste Generation Indiaabroad, Sources, reduction of solid waste, Hazardous Wastes (Handling and Management) Rules1998,5R concepts, methods of solid waste collection, composition and properties, sampling and characterization, e-waste managemen.	5
Unit 2 – Waste Processing Storage and processing including segregation, transfer and transport, handling equipments, Processing techniques: purpose of processing, volume reduction by incineration, process description, mechanical volume reduction (compaction), mechanical size reduction (shredding), component separation (manual and mechanical methods). Compost (Composting and Vermi compost) and Biogas. Incineration and energy recovery. Municipal	7

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solid waste rules.	
Unit 3 - Bioreactor Bioreactor, Types of bioreactor, Biodigesters, Biological treatments for phytoremediation.	5
Unit4- Hazardous Waste Management Introduction Definitions and identification, Sources and characteristics, Impacts, transportation – modes and regulations, control, minimization –compatibility, handling and storage and recycling.	6
Unit 5-Chemical and Biomedical wastes Biomedical wastes – Types – handling – control of biomedical wastes-Disposal methods. Chemical wastes – Sources – Industrial - Inorganic pollutants – effects – Need for control – Treatment and disposal techniques – Physical, chemical and biological processes – Health and environmental effects.	7

Text Books:

1	Gupta.D.K, Sonarkar, Nimbalkar, Solid waste Management,2010.
2	Bhide and Sundaresan, Solid Waste management in Developing countries – Indian National Scientific documentation center-, New Delhi. 2000.
3	LaGrega, M.D.Buckingham,P.L. and Evans, J.C. Hazardous Waste Management, McGraw Hill International Editions, New York, 2010.
4	Tapobrata Panda, Bioreactors: Analysis and Design, 1st Edition, McGraw Hill Education Pvt. Ltd.

Reference Books:

1	John Pichtel, Waste Management Practices, CRC Press, Taylor and Francis Group 2005.
2	Richard J. Watts, Hazardous Wastes - Sources, Pathways, Receptors John Wiley and Sons, New York, 2008
3	Lie, D.H.F. and Liptak, B.G. Hazardous Wastes and Solid Wastes- Lewis publishers, New York. 2000.
4	La Grega, M.D., Buckingham, P.L. and Evans J.C.Hazardous Waste Management, II Ed, , Mc Graw HillInc., 2001

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Course Plan

Course Title: Public Speaking & Presentation Skills	
Course Code: 231CHVSECL201	Semester: IV
Teaching Scheme: L-T-P: 1-0-0	Credits:1
Evaluation Scheme: ISE Marks:25	ESE Marks: -

Course Description:

Students learn the organization, development, and delivery of a variety of formal public speeches. The course includes public speeches and a variety of other speaking exercises to help students adapt to audiences and contexts, solve delivery problems and build confidence. This unique program gives learners the techniques and skills necessary for an effective presentation and helps them engage an audience with confidence. Public speaking and presentation skills are very closely related abilities.

Program Specific Outcomes (PSOs):

PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
PSO2	Proficiency in using modern engineering tools, techniques, and software for process simulation, modeling, and optimization in all aspects.

Course Objective:

1	To study the importance of public speaking in technical field.
2	To study the importance of presentation skills in technical field.

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Course Outcomes:

CO	At the end of successful completion of course, the students will be able to…
231CHVSECL201.1	Understand the basics of public speaking.
231CHVSECL201.2	Demonstrate the basics of public speaking.
231CHVSECL201.3	Understand the basics of presentation skills.
231CHVSECL201.4	Execute the basics of presentation skills.

Prerequisite:	--

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	BT L
CHVSECL2 01.1	-	-	-	-	-	-	-	-	1	2	-	1	-	-	2
CHVSECL2 01.2	-	-	-	-	-	-	-	-	1	2	-	1	-	-	2
CHVSECL2 01.3	-	-	-	-	-	-	-	-	1	2	-	1	-	-	2
CHVSECL2 01.4	-	-	-	-	-	-	-	-	1	2	-	1	-	-	2

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Contents	Hours
Unit 1 – Introduction to public speaking Introduction to Public Speaking, Communication Process and Roadblocks, Use of Rhetoric in Public Speaking, Role of Listening in Public Speaking, Role of Ethics in Public Speaking, Techniques of Public speaking.	5
Unit 2 –Prerequisites for Public Speaking - Converting Ideas into Action Relevance of Public Speaking, Audience Awareness and Creating Credibility, Content Creation and Organization, Role of Personality in Public Speaking, Use of Technology in Public Speaking, Cultural Awareness in Public Speaking, Breaking the Ice: Impress to Express, Emotional Intelligence, Role of Positivity in Public Speaking.	5
Unit 3– Introduction to presentation skills Know Your Audience, Plan your Presentation, Technology- The Importance, Setting clearly defined Objectives, Importance of Openings and Closings, Adapting yourself to the presentation space in advance, Drafting your Presentations, Gathering substance and content for the presentation, Designing the presentation, Practice, self-rehearsals, and improvising.	5
Unit 4 –Important aspects of presentation The relation between preparation, Relaxation, and Stress, Confidence and Control, Transforming nervousness to enthusiasm, Psychology and Chemistry of stress and fear, Body language, Eye contact, Technical presentation skills.	5

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Text Books:

1	Avidson, Jeff. The complete guide to public speaking. Breathing Space Institute, 2003.
2	Goleman, Daniel. Working with Emotional Intelligence. London: Banton Books. 1998.
3	Hall, Calvin S. et al. Theories of Personality. New Delhi: Wiley. rpt. 2011
4	Presentation Zen: Simple Ideas on Presentation Design and Delivery by Garr Reynolds
5	The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience by Carmine Gallo.

Reference Books:

1	Thorpe, Edgar and Showick Thorpe. Winning at Interviews. Pearson Education. 2004.
2	Turk, Christopher. Effective Speaking. South Asia Division: Taylor & Francis. 1985
3	Zarefsky, David. Public speaking: Strategies for success. Allyn & Bacon, Incorporated, 1999.
4	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds by Carmine Gallo

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Laboratory Course Plan

Course Title: Public Speaking & Presentation Skills Laboratory	
Course Code: 231CHVSECP201	**Semester: IV**
Teaching Scheme :L-T-P:0-0-2	**Credits:1**
Evaluation Scheme: Internal Marks:25	**POE Marks:-**

Course Description:

Students learn the organization, development, and delivery of a variety of formal public speeches. The course includes public speeches and a variety of other speaking exercises to help students adapt to audiences and contexts, solve delivery problems and build confidence. This unique program gives learners the techniques and skills necessary for an effective presentation and helps them engage an audience with confidence. Public speaking and presentation skills are very closely related abilities.

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PSO1	Chemical engineering graduates are able to handle real world problems within realistic constraints of safety, economic, environmental and societal considerations of Chemical and allied industries.
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Course Objective:

1	To study the importance of public speaking in technical field.
2	To study the importance of presentation skills in technical field.

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Course Outcomes:

CO	At the end of successful completion of course, the students will be able to…
231CHVSECP201.1	Demonstrate the importance of public speaking in technical field.
231CHVSECP201.2	Implement the importance of presentation skills in technical field.

Prerequisite:	--

Course Articulation Matrix:

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

	PO 1	P O2	PO 3	P O4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	BT L
CHVSECP201.1	-	-	-	-	-	-	-	-	1	2	-	1	-	-	2
CHVSECP201.2	-	-	-	-	-	-	-	-	1	2	-	1	-	-	2

List of Practical's:

List of Experiments			
Expt. No.	**Name of Experiment**	**Type**	**Hours**
1	Sounds and Pronunciation.	O	2
2	Role Play.	O	2
3	Situational Conversation.	O	2
4	Impromptu speech.	O	2
5	Extempore speech.	O	2

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6	Technical speech.	O	2
7	Professional etiquettes.	O	2
8	Use of visual aids in presentation.	O	2
9	Technical Presentation.	O	2
10	Group Discussion	O	2
11	Telephonic Interview	O	2
12	Case study	O	2

Text Books:

1	Avidson, Jeff. The complete guide to public speaking. Breathing Space Institute, 2003.
2	Goleman, Daniel. Working with Emotional Intelligence. London: Banton Books. 1998.
3	Hall, Calvin S. et al. Theories of Personality. New Delhi: Wiley. rpt. 2011
4	Presentation Zen: Simple Ideas on Presentation Design and Delivery by Garr Reynolds.
5	The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience by Carmine Gallo.

Reference Books:

1	Thorpe, Edgar and Showick Thorpe. Winning at Interviews. Pearson Education. 2004
2	Turk, Christopher. Effective Speaking. South Asia Division: Taylor & Francis. 1985
3	Zarefsky, David. Public speaking: Strategies for success. Allyn & Bacon, Incorporated, 1999.
4	Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds by Carmine Gallo.
5	The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience by Carmine Gallo.

HOD (Chemical Engg.)

Dean (Academics)

Principal

Department of Chemical Engineering DYPCET Kolhapur