Syllabus Book

3rd Year B. Tech.
Chemical Engineering

P P Savani University

School of Engineering

Department of Chemical Engineering

Effective From: 2019-20

Authored by: P P Savani University

P P SAVANI UNIVERSITY														
SCHOOL OF ENGINEERING														
TEACHING & EXAMINATION SCHEME FOR B.TECH. THIRD YEAR CHEMICAL ENGINEERING PROGRAMME														
Sem	Course Code	Course Name	Teaching Scheme					Examination Scheme						
			Contact Hours				Credit	Theory		Practical		Tutorial		Total
			Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
5	SECH3010	Heat Transfer Operations	4	2	0	6	5	40	60	20	30	0	0	150
	SECH3021	Mass Transfer Operations - II	4	2	0	6	5	40	60	20	30	0	0	150
	SECH3030	Instrumentation & Process Control	4	2	0	6	5	40	60	20	30	0	0	150
	SECH3041	Chemical Engineering Thermodynamics-II	4	0	2	6	6	40	60	0	0	20	30	150
	SEPD3010	Professional Communication & Soft Skills	1	2	0	3	2	0	0	50	50	0	0	100
	Elective-I		3			3	3							150
	SECH3910	Summer Training	4			0	4	0	0	100	0	0	0	100
	Total					**31**	**30**							**950**
6	SECH3053	Chemical Reaction Kinetics-I	4	2	0	6	5	40	60	20	30	0	0	150
	SECH3062	Process Equipment & Design-I	4	4	0	8	6	40	60	20	30	0	0	150
	SECH3071	Chemical Process Technology	4	2	0	6	5	40	60	20	30	0	0	150
	SEME4021	Renewable Energy System	3	2	0	5	4	40	60	20	30	0	0	150
	SEPD3020	Corporate Grooming & Etiquette	1	2	0	3	2	0	0	50	50	0	0	100
	Elective-II		3			3	3							100/ 150
	Total					**32**	**25**							**800/ 850**

Elective Courses															
Offered from Sem.	Course Code	Course Name	Offered By	Teaching Scheme				Credit	Examination Scheme						
				Contact Hours					Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
5	SECH3510	Pharma Technology – API & Formulation	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3520	Process Auxiliaries & Utilities in Allied Industries	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3530	Air Pollution & Control	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3540	Polymer Science & Technology	CH	3	0	0	3	3	40	60	0	0	0	0	100
6	SECH3550	Computational Methods In Chemical Engineering (Sci-Lab/Octave/Matlab)	CH	2	2	0	4	3	40	60	20	30	0	0	150
	SECH3560	Environmental Issues, Waste Management & EIA	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3570	Fundamentals to Dyes & Pigment	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3580	Processing in Agrochemical, Food Industries & Biochemical Engineering	CH	3	0	0	3	3	40	60	0	0	0	0	100

CONTENT

Semester 5

Sr. No.	Course Code	Course Name	Page No.
1	SECH3010	Heat Transfer Operations	1-4
2	SECH3021	Mass Transfer Operations - II	5-8
3	SECH3030	Instrumentation & Process Control	9-11
4	SECH3041	Chemical Engineering Thermodynamics-II	12-14
5	SEPD3010	Professional Communication & Soft Skills	15-17
6	SECH3910	Summer Training	18-19

Semester 6

Sr. No.	Course Code	Course Name	Page No.
1	SECH3052	Chemical Reaction Kinetics-I	20-22
2	SECH3062	Process Equipment & Design-I	23-25
3	SECH3071	Chemical Process Technology	26-28
4	SEME4021	Renewable Energy System	29-31
5	SEPD3020	Corporate Grooming & Etiquette	32-33

Electives

Sr. No.	Course Code	Course Name	Page No.
1	SECH3510	Pharma Technology- API and formulation	34-36
2	SECH3520	Process Auxiliaries and Utilities in Allied Industries	37-39
3	SECH3530	Air Pollution & Control	40-41
4	SECH3540	Polymer Science & Technology	42-44
5	SECH3550	Computational Methods in Chemical Engineering (MATLAB Programming)	45-47
6	SEME3560	Environmental Issues, Waste Management & EIA	48-50
7	SECH3570	Fundamentals to Dyes & Pigments	51-53
8	SECH3580	Processing in Agrochemical, Food Industries & Biochemical Engineering	54-56

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3010
Course Name: Heat Transfer Operations
Prerequisite Course(s): -

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	00	05	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand the basic concepts of conduction, convection and radiation heat transfer.
- understand how to formulate and be able to solve one- and two-dimensional conduction heat transfer problems.
- apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient.
- understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation and evaluate radiation view factors using tables and the view factor relationships.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** Modes of heat transfer - Conduction, Convection and Radiation, Material Properties of Importance in Heat Transfer - Thermal conductivity & Specific Heat Capacity.	03	05
2.	**Conduction: One Dimensional** Steady State Conduction through Constant Area, Thermal Contact Resistance, Steady State Heat Conduction through a Variable Area – Cylinder & Sphere, Heat Conduction in Bodies with Heat Sources.	05	10
3.	**Convective Heat Transfer: One Dimensional** Principle of Heat Flow in Fluids and Concept of Heat Transfer Coefficient, Individual and Overall Heat Transfer Coefficient, Heat Transfer between Fluids Separated by a Flat Solid Wall & Separated by a Cylindrical Wall, Enhanced Heat Transfer: Concept of Fins - Analytical Solution of Different Cases and Fin Efficiency, Thermal Insulation.	08	15

4.	**Forced Convective Heat Transfer** Principle of Convection, Forced Convection Mechanism: Flow over a Flat Horizontal Plate**,** Flow through a Pipe or Tube - Turbulent flow, Laminar flow, Flow through a Non-Circular duct, Flow over a Flat Plate, Flow over Cylinders and Spheres (Flow across a Cylinder, Flow across a Sphere, Flow across a Bank of tubes)**,** Momentum and Heat Transfer Analogies - Reynolds Analogy, The Chilton-Colburn Analogy, The Prandtl Analogy, The Van Karman Analogy.	08	10
5.	**Heat Transfer by Natural Convection** Introduction, Empirical Correlations for Natural-Convective Heat Transfer - Natural Convection around a Flat Vertical Plate, Horizontal Cylinder, Horizontal Flat Surface, Sphere and Enclosure, Combined Natural and Forced Convection.	06	10
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Heat Transfer in Boiling and Condensation** Heat Transfer during Boiling, Boiling of Saturated Liquid - Nucleation Boiling, Maximum Heat Flux, Film Boiling, Heat Transfer during Condensation, Film Condensation, Condensation for Horizontal Tube - Condensation Outside Horizontal Tube or Bank of tube, Single Horizontal Tube, Vertical Tube of N Horizontal Tubes, Condensation inside a Horizontal Tube, Condensation for Packed and Fluidized bed.	08	10
2.	**Radiation Heat Transfer** Basic Definition Pertaining to Radiation - Emissive Power, Radiosity, Irradiation, Absoptivity, Reflectivity, and Transmissivity, Blackbody Radiation - Planck's law, Wien's law, The Stefan-Boltzmann law for Blackbody, Special Characteristic of Blackbody Radiation, Kirchhoff's law, Grey Body, Radiative Heat Exchanger between Surfaces - View Factor, Relation between View Factors, Heat Exchange between Non Blackbodies, Radiation Shield, Electrical Network for Radiation through Absorbing and Transmitting medium, Radiation Combined with Conduction and Convection.	06	10
3.	**Heat Exchangers** Elements of Shell and Tube Heat Exchanger, Thermal Design of Heat Exchangers - Overall Heat Transfer Coefficient, Fouling Factor or Dirt Factor, Temperature Profiles in Heat Exchangers, LMTD Correction Factor, Individual Heat Transfer Coefficient, Pressure Drop in the Heat Exchanger, Correlation for Tube Side Pressure drop, Correlation for Shell Side Pressure Drop, Heat Transfer Effectiveness and Number of Transfer Units, Calculation and Designing of the Double-Pipe Heat Exchanger and Shell and Tube Heat Exchanger	10	20

4.	**Evaporators** Solution Properties – Concentration, Foaming, Degradation due to High Temperature, Scaling, Equipment Material – Evaporator, Natural Circulation Evaporator, Forced Circulation Evaporator, Falling Film Evaporator, Performance of Steam Heated Tubular Evaporators - Capacity and Economy - Single and Multiple Effect Evaporators, Boiling Point Elevation, Temperature Profile in an Evaporators, Method of Feeding: Multiple Effect Evaporators, Enthalpy Balance - Single Effect Evaporator, Effect of Heat of Dilution.	06	10

List of Practical:

Sr. No	Name of Practical	Hours
1.	To determine Heat Transfer through Composite Wall at different temperature.	02
2.	Determination of Thermal Conductivity of Insulating Powder (Asbestos Powder).	02
3.	To find out Heat transfer in Double Pipe Heat Exchanger in Laminar Flow and Turbulent Flow.	04
4.	Calculation of Heat transfer Coefficient by Natural and Forced Convection	04
5.	Heat Transfer Calculation in Plate Heat Exchanger	04
6.	Shell and Tube Heat Exchanger	02
7.	Heat Transfer by Radiation: Stefan-Boltzmann Law	02
8.	Heat Transfer in Agitated Vessel	02
9.	Heat Transfer in Drop and Film wise Condensation Apparatus	04
10.	Pin-Fin Apparatus	04

Text Book(s):

Title	Author/s	Publication
Heat Transfer	Holman J. P	Mc Graw-Hill
Heat Transfer: Principles and Applications	Dutta B. K	PHI
Process Heat Transfer	Kern D. Q	Tata Mc Graw-Hill Edition

Reference Book(s):

Title	Author/s	Publication
Unit Operations of Chemical Engineering	W. L., Smith, J. C., and Harriott	McGraw-Hill
Chemical Engineering - Vol. I.	Coulson, J.M., Richardson, J.F.	Pergamon and ECBS, 1970
Heat Transfer	Chapman, A.J.	Maxwell Macmillan International Edition, 1984

Web Material Link(s):

- https://nptel.ac.in/courses/103103032/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 mark.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand basic concept of heat transfer.
- understand and solve conduction, convection and radiation problems.
- design and analyze the performance of heat exchangers and evaporators.
- design and analyze reactor heating and cooling systems.
- apply scientific and engineering principles to analyze and design aspects of engineering.
- understand systems that relate to conduction, convection and radiation heat transfer.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3021
Course Name: Mass Transfer Operations - II
Prerequisite Course(s): SECH2080-Mass Transfer operations -I

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	00	05	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- gain knowledge of basic fundamentals of mass transfer operations such as distillation, equilibrium concept, Adsorption, Absorption etc.
- gain knowledge of fundamental principles, design aspects, equations, associated problems, industrial applications of all-important unit operations such as adsorption, distillation, Leaching etc.
- equip them with the essential knowledge and skills required to appear in campus interview or work as an engineer in the chemical industries with confidence.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Distillation** Introduction, Vapor-Liquid Equilibria, P-x-y and T-x-y Diagrams, Effect of Pressure and Temperature, Relative Volatility, Ideal solutions, Rault's law, Positive Deviation, Minimum Boiling Azeotrope, Negative Deviation, Maximum Boiling Azeotrope, Types of Distillation: Flash, Steam, Simple, Batch Fractionation, Continuous Rectification, Derivation for Enriching and Stripping Section, q Line Equation, Mc-Cabe Thiele method, Concept of Minimum, Total and Optimum Reflux Ratio, Reboilers, Total and Partial Condensers, Use of Open Steam, Cold and Hot Reflux, Enthalpy Concentration Diagrams and their Characteristics, Determination of Number of Stages by Ponchon and Savarit method, Azeotropic distillation, Extractive Distillation, Numerical.	10	20

2.	**Liquid - Liquid Extraction** Liquid-liquid Extraction and their Industrial applications, Mixture Rule, Ternary Diagram, Extraction systems Effect of Temperature and Pressure Plotting the Binodal Curve, Solvent Selection Criteria, Cross and Counter current Extraction, Multistage Counter current Extraction with and without Reflux, ΔR point, Equipment for Extraction, Numerical.	10	15
3.	**Gas Absorption** Gas Absorption, Equilibrium solubility, Ideal and Non ideal solutions, Solvent Selection Criteria, Material Balance Counter Current Operations, Continuous Contact equipment, HETP, HTU, NTU, Absorption with chemical reactions, Gas Liquid Contacting equipment, Mechanical Mixing, Agitators, Tray towers and its internals, Coning ,Weeping, Loading and Flooding, Types of Trays e.g. Bubble cap, Sieve tray etc., Tray diameter, Spacing, Flow Pattern, Venturi Scrubbers, Packed tower, Types of packings and selection criteria, Numerical.	10	15
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Equipment for Gas-Liquid Operations** Gas Dispersed – Spray Vessels (Bubble Columns), Mechanically Agitated Vessels, Mechanical Agitation of Single-Phase Liquids, Mechanical Agitation (Gas Liquid Contact), Tray Towers Liquid Dispersed – Venturi Scrubber, Wetted-Wall Towers, Spray Towers and Spray Chambers, Packed Towers, Co-current Flow of Gas and Liquid, End Effects and Axial Mixing, Tray Towers vs Packed Towers.	08	15
2.	**Adsorption and Ion Exchange** Introduction, Types of Adsorption, Nature of Adsorption, Industrial Adsorbents, Adsorption Equilibria, Adsorption Hysteresis, Effect of temperature, Heat of Adsorption, Adsorption of Solute from Dilute Solutions, Applications of Freundlich Isotherm, Adsorption from Concentrated Solutions, Stage wise Operations Contact Filtration of Liquids, Single Stage, Cross Current Operations and Application of Freundlich Isotherm, Multistage Counter Current Operations, Fixed bed Absorbers, Adsorption wave, Adsorption of Vapors, Industrial Applications of Adsorption and the Equipment, Rate of Adsorption in Fixed Beds, Numerical.	10	25
3.	**Leaching** Leaching, Preparation of Solids, Unsteady State Operations, Steady State (Continuous) Operation, Leaching Equipment, Single Stage and Multistage Leaching Cross and Counter Current Leaching, Method of Calculations, Numerical.	06	10

List of Practical:

Sr. No	Name of Practical	Hours
1.	York Scheibel's Extraction Unit	04
2.	Simple Batch Distillation unit	04
3.	Absorption in sieve plate column	04
4.	Fluidized Bed dryer	04
5.	Adsorption in packed bed	04
6.	Sieve Plate distillation column	04
7.	Vapor-Liquid Equilibrium Set-up	04
8.	Membrane Separation Unit	02

Text Book(s):

Title	Author/s	Publication
Mass Transfer operation	R.E. Treybal	Mc-Graw Hill International Editions
Mass Transfer	Sherwood, Pigford & Wilke	Mc-Graw Hill International Editions
Mass Transfer –II	K.A. Gavhane	Nirali Prakashan

Reference Book(s):

Title	Author/s	Publication
Perrys Chemical Engineers Handbook	Perry & Green	Mc-Graw Hill International Editions
Chemical Engineering	Coulson, J.M., Richardson, J.F.	Pergamon and ECBS, 1970
Unit operations of Chemical Engg.	W.L. McCabe, J.C. Smith & Harriott	Mc-Graw Hill International Editions

Web Material Link(s):

- https://nptel.ac.in/courses/103103032/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the various types of unit operations such as distillation, adsorption, extraction, leaching etc.
- solve problems in adsorption using theory of mass transfer as applied to adsorption columns.
- understand main categories of equipment for gas/liquid mass transfer.
- design plate columns and packed columns for adsorption or desorption or regeneration.
- understand the various methods for calculation no. of plates required in distillation column.
- apply the principles of vapor liquid equilibrium in solving distillation problems.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3030
Course Name: Instrumentation & Process Control
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	00	05	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand basics of process control and the instrumentation.
- understand topics of automatic process control which is being used in almost all the industries.
- understand modeling of static and dynamic behavior of processes, control strategies, design of feedback, feed forward and other control structures and applications to process equipment.
- elaborate the study of valve characteristics along with the working principle, specifications, and design and selection aspects of various measuring sensors.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to process control** Process control system, Variable physical element of process control system, Modelling of a process.	02	05
2.	**Laplace Transforms** Properties of Laplace transforms, Solution of linear differential equation using Laplace transform techniques, Dynamic behavior of systems, Transfer functions	06	05
3.	**Dynamic behavior of chemical processes** Analysis of first order system with different forcing functions, Analysis of second & higher order system, Components of feedback control system.	08	15
4.	**Modes of control action** Controllers and final control elements, closed loop transfer function and block diagram algebra.	06	10

5.	**Stability Criterion** Stability of control systems, controller tuning, Frequency Response Analysis, bode diagrams, Bode diagrams for first & second order systems, P, PI, PID controllers, transportation lag, Nyquist plot, phase margin & gain margin, Nyquist stability criteria.	8	15
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Advanced Control Schemes** Feedback control of systems with dead time or inverse response, Control systems with multiple loops, Feed forward and Ratio control.	08	15
2.	**Process Control Using Digital Control** Digital Computer control loops, Continuous time to discrete time systems, Z-transform to inverse Z-transform, Response of discrete dynamic system, discrete time analysis & closed loop systems.	10	10
3.	**Piping & Instrumentation (P&I) diagram** Symbols, P&I Diagram of reactors, Distillation column, Shell & tube heat exchanger etc.	02	02
4.	**Introduction of Process Measurement** Elements of instruments, Parts of instruments, Static and dynamic characteristics.	02	03
5.	**Measuring devices for flow, temperature, pressure and level.**	08	20

List of Practical:

Sr. No	Name of Practical	Hours
1.	Introduction to Instrumentation & Control Laboratory	02
2.	Calibration of pressure gauge	04
3.	Dynamics of thermometer	04
4.	Dynamics of thermal system	04
5.	Dynamics of evacuation system	04
6.	Dynamics of liquid level system	04
7.	Control of liquid level system	04
8.	Dynamics & control of heat exchanger	04

Text Book(s):

Title	Author/s	Publication
Chemical Process Control	Stephanopoulos	Prentice Hall of India
Industrial Instrumentation	Donald .P. Eckman	John Wiley & Sons Inc, New York

Reference Book(s):

Title	Author/s	Publication
Process System Analysis & Control	Coughanower and Kappel	Mc-Graw Hill International
Process dynamics and control	Seborg, D.E.,Edgar, T.F. and Mellichamp, D.A.	Wiley, NewYork
Process Instrumentation And Control	A. P. Kulkarni	Nirali Prakashan
Industrial Instrumentation & Control	S. K. Singh	Tata McGraw-Hill Education

Web Material Link(s):

- https://nptel.ac.in/courses/103105064/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the basic principles & importance of process control in industrial process plants.
- specify the required instrumentation and final elements to ensure that well-tuned control is achieved.
- understand the use of block diagrams & the mathematical basis for the design of control systems.
- design and tune process (PID) controllers.
- understand the importance and application of good instrumentation for the efficient design of process control loops for process engineering plants.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3041
Course Name: Chemical Engineering Thermodynamics-II
Pre-requisite Course: SESH2070- Chemical Engineering Thermodynamics-I

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	00	02	06	40	60	00	00	50	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand and appreciate thermodynamics as applied to various Chemical Engineering Processes.
- avail practical experience on the principles, viz., thermodynamic laws, Solution thermodynamics, Phase equilibrium and reaction equilibrium.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Thermodynamic Properties of Pure Substances** fugacity, fugacity coefficient, compressibility factor, activity.	6	10
2.	**Gibbs-Duhem Equation** General form, Various forms of Gibbs-Duhem equation, Applications, Limitations, Property changes of mixing, Excess Properties.	10	15
3.	**Criteria of Phase Equilibrium** Duhem theorem, Vapour liquid equilibrium, VLE equation, Low pressure VLE, Phase diagrams for binary solution, T-x-y and P-x-y diagrams, Effect of pressure on VLE, Azeotropes and its types.	8	15
4.	**Activity Coefficient** Equations used for the determination, Margules, Van Laar, Wilson equations, VLE at high pressures, Bubble Point, Dew Point Calculations, Thermodynamic Consistency Tests for VLE data.	6	10

Section II			
Module No.	Content	Hours	Weightage in %
1.	**Solution Thermodynamics** Fundamental Property Relation, The Chemical Potential as a Criterion for Phase Equilibria, Partial Properties, Equations Relating Molar and Partial Molar Properties , The Partial Molar Gibbs Energy and the Generalized Gibbs-Duhem Equation, Partial Properties in Binary Solutions, Relations among Partial Properties, The Ideal Gas Mixture , The Partial Molar Gibbs Energy and Fugacity, Fugacity and Fugacity Coefficient: Pure Species, Fugacity and Fugacity Coefficient: Species in Solution ,The Ideal Solution Model , The Lewis/Randall Rule , Excess Properties , The Excess Gibbs Energy and the Activity Coefficient, Nature of Excess Property,	8	18
2.	**Liquid Phase Properties** Liquid-Phase Properties from VLE Data ,Composition Dependence of Liquid- Phase Fugacities for Species in a Binary Solution, Excess Gibbs Energy, Data Reduction, Thermodynamic Consistency, Integral or Area Test Method , Models for the Excess Gibbs Energy, Margules Equations, Van Laar Equations, Calculations with Margules and Van Laar Equations, Local Composition Models, NRTL Equation, UNIQUAC Equation, UNIFAC Method, Enthalpy/ Concentration Diagrams**.**	8	12
3.	**Chemical Reaction Equilibrium** Criteria of equilibrium, Reaction stoichiometry, equilibrium constant, Gibbs free energy change, Choice of standard state, Feasibility of Chemical reactions, Effect of temperature on Equilibrium Constant, Evaluation of van't Hoff Constant, Effect of parameters like temperature, pressure, composition on the equilibrium conversion.	8	15
4.	**Phase Equilibria** The Gamma / Phi Formulation of VLE, Equilibrium and stability, Liquid-liquid equilibrium, Solid- Liquid Equilibrium, Osmotic Equilibrium and Osmotic pressure	6	5

Text Book(s):

Title	Author/s	Publication
Introduction to Engineering Thermodynamics	J.M. Smith, Hendrick Van Ness, Michael M. Abbott,	McGraw Hill, New York, 2005.
Chemical Engineering Thermodynamics	S. Sundaram	Ahuja Publishers, New Delhi, 2001
A Textbook of Chemical Engineering Thermodynamics	K.V. Narayanan	PHI Learning, 2004

Reference Book(s):

Title	Author/s	Publication
Chemical Engineering Thermodynamics	B.F. Dodge	McGraw Hill, New York, 1971
Chemical Engineering Thermodynamics	Y.V.C. Rao	Universities Press (1997)
Chemical Process Thermodynamics 3rd Ed	B.G. Kyle	Prentice Hall India, 1994
Chemical Process Principles Part II	Hougen, O.A., Watson, K.M. and Ragatz, R.A.	John Wiley & Sons, (CBS Publishers & Distributors, New Delhi)

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of performance of Tutorials which will be evaluated out of 10 marks for each Tutorial and average of the same will be converted to 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- understand state the conditions of equilibrium for multiphase systems.
- understand and apply fugacity to phase equilibria problems.
- compute the vapor pressure for single-component multiphase systems.
- apply partial molar quantities to compute mixture properties.
- apply models for excess Gibbs free energy in non-ideal mixtures.
- construct binary phase diagrams for multiple phase systems correcting for non-ideal behaviour using fugacity coefficients and activity coefficients.
- perform calculations for vapor-liquid equilibrium.
- determine the equilibrium composition for a reacting system given the reaction stoichiometry, temperature and pressure.

P P Savani University
School of Engineering

Centre for Skill Enhancement & Professional Development

Course Code: SEPD3010
Course Name: Professional Communication & Soft Skills
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
01	02	00	02	00	00	50	50	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand multifaceted Professional Speaking Process.
- learn the writing etiquettes for professional purposes.
- gain basic knowledge, skills and the right attitude to succeed in future professional working environment.
- develop confidence, enhance their professional communication ability in civilized, harmonized manner.
- sharpen communication skills with reference to organizational structure.
- expose themselves to the modern modes of communication

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Self-Management & Career Building** • Self-Evaluation, discipline and criticism • SWOT analysis to identify personal strength/ weakness • Planning & Goal setting • MBTI test for self-analysis • Profiling on Online Platforms	01	7
2.	**Interpersonal Organizational Communication** • Interpersonal Behavioral Skills • Understanding empathy and comprehend other's opinions/ points of views, Managing Positive and negative emotions • Healthy and Unhealthy expression of emotions. • Mutuality, Trust, Emotional Bonding and handling situation in interpersonal relationship	04	25

3.	**Professional Communication (Speaking) - I** • Professional Communication and Rhetorics • Art of Telephonic Conversation • Public Speaking	03	18
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Professional Communication (Speaking) – II** • Group Discussion (Concept, importance, Methods, Dos and Don'ts, Paralinguistic and Nonverbal Etiquettes) • Personal Interview (Concept, Importance, Methods, Dos and Don'ts, Type, Paralinguistic and Nonverbal Etiquettes)	03	20
2.	**Professional Communication (Writing)** • Cover Letter and Resume Building • E mail writing • Report Building • Technical/ Academic Writing (Reference/ citation/ plagiarism)	04	30

List of Practical:

Sr. No	Name of Practical	Hours
1.	SWOT analysis & Profiling	04
2.	MBTI Test	02
3.	Interpersonal Organizational Communication	02
4.	Group Discussion	04
5.	Personal Interview	04
6.	Cover Letter and Resume	06
7.	E mail and Report Writing	04
8.	Technical Academic Writing	04

Reference Book(s):

Title	Author/s	Publication
Professional Communication	Sheekha Shukla	2010, WordPress
Professional Communication Skills	Rajesh Kariya	Paradise Publication, Jaipur
Soft Skills and Professional Communication	Petes S. J., Francis.	Tata McGraw-Hill Education, 2011
Effective Communication and Soft Skills	Nitin Bhatnagar	Pearson Education India
Behavioural Science: Achieving Behavioural Excellence for Success	Dr. Abha Singh	John Wiley & Sons, 2012
The Hard Truth about Soft Skills	Klaus, Peggy, Jane Rohman & Molly Hamaker	London: Harper Collins

Course Evaluation:

Practical

- Continuous Evaluation consists of Performance of Practical to be evaluated out of 10 for each practical and average of the same will be converted to 30 marks.
- Internal Viva consists of 20 marks.
- Practical performance/quiz/drawing/test/submission of 25 marks during End Semester Exam.
- Viva/Oral performance of 25 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the importance self-analysis for career building.
- learn tactics of communication in professional/ organizational ambience.
- master the art of conversation and public speaking.
- expose themselves for placement processes.
- develop writing etiquettes pertaining to placement and organizational context.

P P Savani University
School of Engineering

Department of Civil Engineering

Course Code: SECV3910
Course Name: Summer Training
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
00	00	00	02	00	00	100	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- have first-hand experience the real time situations in industrial scenario.
- get familiar with engineering applications in industrial spectrum
- learn to adapt themselves in professional scenario

Outline of the Course:

Sr. No	Content
1.	Selection of Companies
2.	Company Information collection
3.	Report Writing
4.	Presentation & Question-Answer

Course Evaluation:

Sr. No.	Evaluation criteria	Marks
1	Actual work carried & Report Submission	50
2	Final Presentation & Question-Answer session	50
	Grand Total:	**100**

Course Outcome(s):
After completion of the course, the student will be able to
- apply their theoretical knowledge into reality.
- learn to adapt the workplace situations when they will be recruited.
- be prepared for the real world situations in their future.

Report Writing Guidelines

A. Report Format:

1. Title Page (to be provided by the respective supervisor)

The title page of the project shall give the following information in the order listed:

- Full title of the project as approved by the Mentor;
- The full name of the student/Group of students with enrollment number;
- The qualification for which the project is submitted;
- The name of the institution to which the project is submitted;
- The month and year of submission.

2. Project Certification Form
   [The form should be duly filled signed by the supervisors.]
3. Acknowledgements
   [All persons (e.g. supervisor, technician, friends, and relatives) and organization/authorities who/which have helped in the preparation of the report shall be acknowledged.]
4. Table of Contents/Index with page numbering
5. List of Tables, Figures, Schemes
6. Summary/abstract of the report.
7. Introduction/Objectives of the identified problem
8. Data Analysis and Finding of Solution
9. Application of the identified solution
10. Future Scope of enhancement of the Project and Conclusion
11. "Learning during Project Work", i.e. "Experience of Journey during Project Duration"
12. References(must)
13. Bibliography
14. Annexures (if any)

B. Guideline for Report Formatting:

- Use A4 size page with 1" margin all sides
- Header should include Project title and footer should contain page number and enrollment numbers
- Chapter Name should be of Cambria font, 20 points, Bold
- Main Heading should be of Cambria font, 14 points, Bold
- Sub Heading should be of Cambria font, 12 points, Bold
- Sub Heading of sub heading should be of Cambria font, 12 points, Bold, Italic
- Paragraph should be of Cambria font, 12 points, no margin at the start of the paragraph
- Line spacing for all content – 1.15, before - 0, after - 0
- No chapter number for references
- Before chapter 1, give page numbers in roman letter

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3052
Course Name: Chemical Reaction Kinetics - I
Prerequisite Course(s): SECH2010 – Chemical Process Calculations
SESH1220 – Chemistry

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	00	05	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand the basic principles of kinetics and chemical reaction engineering by the application of Stoichiometry, thermodynamics and mathematical analysis.
- utilize this knowledge in the design of industrial chemical reactors.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Fundamentals of Reaction Engineering** Overview of chemical reaction engineering, Rate of Reaction, Elementary and non-elementary homogeneous reactions, Molecularity and order of reaction, Mechanism of reaction, Temperature dependency from thermodynamics, Collision and Activated complex theories.	06	10
2.	**Rate Laws, Kinetics and Mechanisms of Homogeneous and Heterogeneous Reactions** Kinetic models for non-elementary reactions, Testing kinetic models, Temperature dependent term of rate equations from Arrhenius theory and comparison with collision and transition state theory, Activation energy and temperature dependency, Predictability of reaction rate from theory.	08	10
3.	**Analysis of Rate Data** Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.	06	10

4.	**Introduction to Reactor Design** Interpretation of variable volume batch reactions for zero, first and second order reactions, design equation for batch, continuous stirred tank, plug flow reactors for isothermal reaction.	10	20
Section II			
Module	Content	Hours	Weightage in %
1.	**Design of industrial reactors** Optimum reactor size, plug flow/mixed flow reactors in series and parallel, recycle reactor.	10	15
2.	**Design of reactors for single and parallel reaction** Size comparison of single reactors, multiple reactor systems, recycles reactor and autocatalytic reactions. Introduction to multiple reactions, qualitative and quantitative treatment of product distribution and of reactor size, the selectivity.	12	15
3.	**Residence time distributions** Residence time distribution of fluids in vessels, E, F and C curves, Dispersion model, Tank in series model. Non-Isothermal PFR and CSTR, Safety issues in Non-Isothermal Reactors.	08	20

List of Practical:

Sr. No.	Name of Practical	Hours
1.	To study the interpretation of Batch Reactor Data.	02
2.	To determine energy of activation of reaction between ethyl acetate with sodium hydroxide.	04
3.	To determine reaction equilibrium constant of reaction of acetic acid with ethanol.	04
4.	To measure the kinetics of a reaction between ethyl acetate and sodium hydroxide under condition of excess ethyl acetate at room temperature.	04
5.	To determine the kinetics of the reaction between ethyl acetate and sodium hydroxide at room temperature by the integral method of analysis.	04
6.	To determine the kinetics of the reaction between ethyl acetate and sodium hydroxide at room temperature by the differential method of analysis.	04
7.	To determine reaction equilibrium constant of reaction between acetic acid with ethanol.	04
8.	To study the kinetics of saponification reaction between acetic acid and sodium hydroxide in a batch reactor and establish the rate law.	04

Text Book(s):

Title	Author/s	Publication
Chemical Engineering Kinetics - 3rd Edition	J. M. Smith	McGraw-Hill (1990)
Chemical Reaction Engineering - 3rd Edition	O. Levenspiel	John Wiley (1998)

Reference Book(s):

Title	Author/s	Publication
Elements of Chemical Reaction Engineering	H. Scott Fogler	Prentice Hall of India Pvt. Ltd
The Engineering of Chemical Reactions	L. D. Schmidt	Oxford Press

Web Material Link(s):

- https://nptel.ac.in/courses/103106116/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- apply the concepts of thermodynamics such as heat capacity, latent heat, heat of reaction, heat of combustion, and heat of formation.
- understand kinetics of competing reactions and their influence on product yield and selectivity.
- understand fundamentals of kinetics including definitions of rate and forms of rate expressions and relationships between moles, concentration, extent of reaction and conversion.
- derive batch, CSTR, and PFR performance equations from general material balances.
- performance calculations on isothermal plug, mixed, and batch reactors for a homogeneous and heterogeneous reaction from given rate data or a rate expression.
- develop skills to choose the right reactor among single, multiple, recycle reactors etc.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3062
Course Name: Process Equipment & Design - I
Prerequisite Course(s): SECH3010 – Heat Transfer Operations
SECH3021 – Mass Transfer operations - II

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	04	00	06	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand modifications and additions to existing plants or creating design layouts of plant / Equipment.
- rapidly increase rate in the advancement of knowledge and relevant application for equipment design.
- observe conclusively the practices in using the reference literature and software.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Basic Consideration in Process Equipment Design** Introduction to Computer Aided Design of Equipment and Process Flow Sheeting, General Design Procedure, Materials of Construction and Design Considerations, Pressure Vessels - Classification, Applications and Design Considerations (Factors influencing the Design of Vessels, Design Pressure, Design Temperature, Factor Safety and Welding Joint Efficiency) - Numerical Problem on Design of Pressure Vessel Subjected to Internal Pressure.	10	20
2.	**Enclosures, Flanges, Nozzles and Supports** Various Types of Enclosures (Heads or Cover) used for the Pressure Vessels - Classifications of Enclosures and their Applications - Numerical Problem on Various Types of Enclosures, Types of Flanges, Nozzles and Supports used for Pressure Vessel - Selection Criteria for Flanges, Nozzles and Supports, Numerical Problem on Flanges, Nozzles and Supports	10	20

3.	**Reaction/Agitated Vessels, Basket Centrifuge, Gravity Thickener and Cyclone Separator** Introduction, Classification and Design Consideration of Reaction Vessel - Numerical Problem on the Design of Reaction/Agitated Vessel, Theory and Numerical problem on the Design of Basket Centrifuge, Gravity Thickener and Cyclone Separator.	10	10
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Heat Exchangers, Evaporators and Crystallizers** Introduction –Types of Heat Exchangers and Numerical Problem on Design of Shell and Tube Heat Exchanger, Theory of Evaporators and Numerical Problem on Design of Single Effect Evaporator, Theory of Crystallizers and Numerical Problem on the Design of Crystallizers.	10	25
2.	**Distillation Column, Absorption Column and Rotary Drier** Theory and Design Aspects of Distillation Column - Numerical Problem on the Design of Distillation for Binary System, Theory and Design Aspects of Absorption Column, Numerical Problem on the Design of Absorption Column, Theory and Design Aspects of Rotary Drier, Numerical Problem on the Design of Rotary Drier.	20	25

Drawing of Process Equipment:

Sr. No	Process Equipment	Hours
1.	Flow sheeting, pressure vessel, and enclosures	04
2.	Flanges, nozzles and supports	08
3.	Agitated vessel and basket centrifuge	08
4.	Gravity thickener	04
5.	Cyclone separator	04
6.	Heat exchangers	08
7.	Evaporators	04
8.	Crystallizer	08
9.	Distillation and absorber column	08
10.	Rotary dryer	04

Text Book(s):

Title	Author/s	Publication
Chemical Engineering - Volume 6, 3rd Edn	Sinnott. R.K, Coulson & Richardson's	Butterworth Heinemann, New Delhi, 1999
Chemical Engineers Handbook - Perry's, 7th Edn	Perry. R.H., et al.	McGraw Hill, NewYork, 1997
Process Equipment Design	Bownell, L.E., and Young, E.M	Wiley Eastern, 1968

Introduction to Process Engineering and Design	S B Thakore and B I Bhatt	Tata McGraw Hill, 1st Edition, 2007
Process Equipment Design	Joshi. M.V. and Mahajani. V.V	Macmillan India Limited, New Delhi, 1996

Reference Book(s):

Title	Author/s	Publication
Chemical Process Equipment: Design and Drawing (Vol. I)	Maidargi, Suresh C.	Prentice Hall India, 2015
Introduction to Chemical Equipment Design: Mechanical Aspects	Bhattacharyy, B C.	CBS Publisher, 2012

Web Material Link(s):

- https://nptel.ac.in/courses/103103027/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Tutorial:

- Continuous Evaluation consists of performance of tutorial which will be evaluated out of 10 marks for each tutorial and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- design process equipment and modify the design of existing equipment to new process conditions or new required capacity.
- build a bridge between theoretical and practical concepts used for designing the equipment in any process industry.
- create understanding of equipment design.
- review the importance of design concepts in process industry.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3071
Course Name: Chemical Process Technology
Prerequisite Course(s): SECH2030 – Unit Processes in Organic synthesis

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	00	05	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand various chemical allied industries and their operations.
- know the wide field of chemical engineering in various sectors.
- get basic knowledge of industries like chlor-alkali, petrochemicals, pesticides, cement etc.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Fuel and Energy** Classification of Fuel, Various Types of Coal, Coal as Chemical Feed Stock, Coal Carbonization and Coke Oven Plant, Gasifiers, Gasification of Coal, Petro coke And Biomass.	06	10
2.	**Chlor-Alkali Industry** Production of Common Salt, Caustic Soda, Chlorine, Hydrochloric Acid and Soda Ash.	06	10
3.	**Pulp and Paper Industries** Raw Materials, Pulping Processes, Stock Preparation and Paper Making, Chemical Recovery from Black Liquor.	06	10
4.	**Pesticides Industries** Processes for Manufacturing of Insecticides, Fungicides and Herbicides.	04	05
5.	**Polymer and Synthetic Fibre Industries** Introduction to Polymerization, Commodity Polymers, Rayon, Polyester, Polyamide, Acrylic Fibre and Nylons.	08	15

Section II			
Module No.	Content	Hours	Weightage in %
1.	**Petrochemicals and Petro Industries** Origin, Occurrence and Characteristics of Crude Oil, Crude Oil Distillation and Secondary Processing, Manufacturing Processes of Formaldehyde, Acetaldehyde, Acetic acid, Acetic Anhydride, Maleic Anhydride, Nitrobenzene, Ethylene Oxide, Ethylene Glycol.	06	10
2.	**Industrial Gases** Technology Options of Producing Producer Gas, Syn gas, Pyro gas, Nitrogen, Oxygen and Carbon dioxide.	04	10
3.	**Oil, Fat, Soap and Detergent Industries** Vegetable Oil Extraction Method using Mechanical and Solvent Extraction Process, Hydrogenation of oil, Introduction to Soap and Detergent, Soap Making and Recovery of Glycerine, Synthetic Detergent and Linear Alkyl Benzene.	06	10
4.	**Fermentation Industry** Introduction to Sugar, Fermentation Industry and Manufacture of Alcohol, Ethanol as Biofuel and Chemical Feed Stock.	04	05
5.	**Cement & Glass Manufacturing Industries** Lime Stone Beneficiation and Manufacturing of Cement, Types of Cement, Manufacturing of Glass, Types of Glass.	04	05
6.	**Sulphur, Phosphorus and Nitrogen Industries** Origin and Extraction of Sulphur, Production Routes of Suphuric Acid and Oleum, Manufacturing of Phosphorus, Phosphoric Acid and Phosphatic Fertilizers, Manufacturing of Ammonia, Nitric Acid, Nitrogenous and Mixed Fertilizers.	06	10

List of Practical:

Sr. No	Name of Practical	Hours
1.	To check the hardness of given water sample.	02
2.	To determine the loss on igniting the cement sample.	01
3.	To determine the total silica in the given sample.	02
4.	To determine the amount of potassium in the given sample of fertilizer.	04
5.	To determine the total insoluble residue in the cement sample.	04
6.	To determine % available chlorine in bleaching powder.	04
7.	To determine the amount of calcium in the given sample of fertilizer volumetrically	04
8.	Determine the acid value of the given sample of oil.	04
9.	Preparation of detergent.	01
10.	Preparation of Boric acid by acidified solution of Borax ($Na_2B_4O_7$).	02
11.	Preparation of CaCl2 from HCl and lime (CaCO3).	02

Text Book(s):

Title	Author/s	Publication
Dryden's Outlines of Chemical Technology - 3rd Edition	Gopala Rao. M. and Marshall Sittig	East-West Press, New Delhi, 2008
Shreve's Chemical Process Industries	George. T Austin	McGraw-Hill International Editions, Singapore, 1984

Reference Book(s):

Title	Author/s	Publication
Chemical vol. I, II, III, & IV	Chemical Engineering Education Development Centre	IIT Madras, 1975-78.
Introduction to Chemical Equipment Design: Mechanical Aspects	Bhattacharyya, B C.	CBS Publisher, 2012

Web Material Link(s):

- https://nptel.ac.in/courses/103103027/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam

Course Outcome(s):

After completion of the course, the student will be able to

- apply knowledge of science, and engineering.
- design and conduct experiments, as well as to analyze and interpret data.
- run the process to meet desired needs within realistic constraints such as manufacturability, and sustainability.
- understand, identify, formulate and solve engineering problems.

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME4021
Course Name: Renewable Energy Systems
Prerequisite Course(s): SEME3011 - Heat Transfer operations

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	02	00	04	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- identify which are the different renewable energy sources available and their national scenario.
- interpret Solar energy and related terminology along with their possible applications and conversions.
- understand Wind energy and related terminology along with their conversion to produce electricity.
- explore the geothermal and ocean energy with their possible conversions.

Course Content:

Section I			
Module. No.	Content	Hours	Weightage in %
1.	**Renewable Energy Scenario** Scope for renewable energy, Advantages and Limitations of Renewable Resources, Present Energy Scenario of Conventional and Non-conventional Resources, Government Policies, National Missions.	04	10
2.	**Solar Energy** Energy Available from the Sun, Spectral Distribution, Sun-Earth angles and their relations, Measuring techniques and Estimation of Solar Radiation Outside and the Earth's Atmosphere, Radiation on tilted surface **Solar Power generation** Photovoltaic system for power generation, Types of solar cell modules and arrays, Solar cell types, Grid Connection, Payback Period Calculation, Advantages and Disadvantages, Site Selection and Other Parameters.	19	40

	Solar Applications Conversion of Solar Energy into Heat, Solar thermal collectors, Solar concentrators analysis and performance evaluation, solar energy thermal storage, Solar based devices like: Solar Pumping, Solar Cooker, Solar still, Solar drier, Solar Refrigeration and Air Conditioning, solar pond, heliostat, solar furnace.		
Section II			
Module. No.	Content	Hours	Weightage in %
1.	**Wind Energy** Principle and basics of wind energy conversion, Energy available from wind, basics of lift and drag, effect of density, angle of attack and wind speed. **Wind Power Conversion** wind turbine rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, Site selection and basics of wind farm, Solar-wind hybrid system.	09	20
2.	**Bio energy** Energy from biomass, Sources of biomass, different species, conversion process, advantages and disadvantages, Properties of biomass, biomass energy. **Biogas Generation** Conversion of biomass into fuels, gasification and combustion, aerobic and anaerobic bio-conversion, Types of biogas plants, Design and operation, factors affecting biogas generation, gasification, types and applications of gasifiers.	07	15
3.	**Geothermal energy** Availability, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications. **Ocean Energy** Ocean thermal energy conversion, availability, advantages and limitations; open, closed and hybrid cycle OTEC system, wave and tidal energy, estimation of tidal power, tidal power plants, single and double basin plants, site requirements.	06	15

List of Practical:

Sr. No.	Name of Practical	Hours
1.	To Prepare one mathematical model using the Sun angles relations for particular any one solar application.	06
2.	Demonstration of Solar air heater, solar cooker, Solar pyranometer, Solar collector, biogas plant, gasifier.	06
3.	To estimate the solar day time with the help of sunshine recorder.	02
4.	To perform efficiency test of solar water heater with its different parameters.	04
5.	To evaluate distilled water output under solar desalination system	04

	considering different water depth and day-night performance and calculation of payback period.	
6.	To estimate the solar power generation using PV panel and estimation of Payback period.	04
7.	To calculate the wind power generation using the small wind mill.	04

Text Book(s):

Title	Author/s	Publication
Solar Energy-Fundamentals, Design, Modelling and Applications.	G. N. Tiwari	Narosa Publishers
Non-conventional energy resources.	Shobh Nath Singh	Pearson India

Reference Book(s):

Title	Author/s	Publication
Principles of Solar Engineering	F. Kreith and J.F. Kreider	McGraw Hill
Solar Energy thermal processes	J.A. Duffie and W.A. Beckman	J. Wiley
Wind energy Theory and Practice	Ahmed	PHI, Eastern Economy Edition
Renewable Energy Sources and Emerging Technologies	Kothari	PHI, Eastern Economy Edition

Web Material Link(s):

- https://nptel.ac.in/courses/112107216/ (Review of Thermodynamics)
- https://nptel.ac.in/courses/108105058/8 (Thermal Power Plants)
- https://nptel.ac.in/courses/112106133/15 (Capacity of Steam Power Plant)

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of performance of Practical which will be evaluated out of 10 marks for each practical and average of the same will be converted to 10 marks.
- Internal Viva consists of 10 marks.
- Practical performance/quiz/drawing/test of 15 marks during End Semester Exam.
- Viva/Oral presentation consists of 15 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- interpret national energy scenario and its possible utilization to become self-reliant in the field of renewable energy.
- define the availability of bio energy and its utilization in rural as well urban areas to use natural wastes and their conversion in biogas along with power generation.
- identify the types of renewable energies with their eco-friendly applications.

P P Savani University
School of Engineering

Centre for Skill Enhancement & Professional Development

Course Code: SEPD 3020
Course Name: Corporate Grooming & Etiquette
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
01	02	00	02	00	00	50	50	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- learn corporate and professional structure and mannerisms.
- acquire self-development skills to balance casual and formal situation.
- polish their personal skills for apt behavior in the context of corporate structure.
- develop adequate Skill set required for the workplace.
- become aware about the professional etiquettes and tactics to follow them.

Course Content:

Section – I			
Module No.	Content	Hours	Weightage in %
1.	**Corporate Grooming** • Introduction to corporate culture • Corporate Expectations • Need of Self-Grooming to the Corporate Expectations • Understanding and importance of Professionalism	03	25
2.	**Personal Skills** • Behavioral skills • Language Skills • Knowledge Skills • Problem Solving Skills • Developing professional attitude	04	25
Section – II			
Module No.	Content	Hours	Weightage in %
1.	**Management Skills** • Self-management • Time management • Work life balance	04	25

2.	**Organizational Etiquettes** • General Workplace Etiquettes • Presentation Etiquettes • Meeting Etiquettes	04	25

List of Practical:

Sr. No	Name of Practical	Hours
1.	Corporate Grooming (Video session/ Role Play/ Skit)	04
2.	Personal Skills (Games/ Quiz/ Activities)	08
3.	Management Skills (Management Activities/ Video Sessions)	06
4.	Organizational Etiquettes (Case Study/ Activities/ Video Sessions)	06
5.	Computer Assisted Activities of Corporate Grooming	06

Reference Book(s):

Title	Author/s	Publication
Grooming and Etiquette for Corporate Men and Women	John Chibaya Mbuya	2009
Effective Communication Skills for Public Relations	Andy Green	Kogan Page, 2006
Personality Development and Soft Skills	Barun Mitra	Oxford University Press, 2016
The EQ Edge: Emotional Intelligence and Your Success	Stein, Steven J. & Howard E. Book	Wiley & Sons, 2006.
Cross Cultural Management: Concepts and Cases	Madhavan	Oxford University Press, 2016
Corporate Grooming and Etiquette	Sarvesh Gulati	Rupa Publications India Pvt. Ltd., 2012
Behavioural Science: Achieving Behavioural Excellence for Success	Dr. Abha Singh	John Wiley & Sons, 2012

Course Evaluation:

Practical

- Continuous Evaluation consists of Performance of Practical to be evaluated out of 10 marks for each practical and average of the same will be converted to 30 marks.
- Internal Viva consists of 20 marks.
- Practical performance/quiz/drawing/test/submission of 25 marks during End Semester Exam.
- Viva/Oral performance of 25 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the importance of professional etiquettes and ways to improve the same.
- gain the knowledge and practice of skill sets required in corporate set up.
- learn personal management skills in the organizational context.
- develop an awareness about the corporate etiquettes.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3510
Course Name: Pharma Technology – API and Formulation
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	0	0	3	40	60	0	0	0	0	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- have basic knowledge of the design and operation of pharmaceutical units and of the steps of development of dosage forms through to the final product and submission to the Health authorities for Production license and marketing.
- clear the concept and the importance of particle size and particle shape in drug formulation.
- understand of the mechanism of basic pharmaceutical operations including size reduction, mixing, separation processes, filtration, drying and freeze-drying, its importance in drug formulation and practical application on a laboratory scale.

Course Content:

Section I - Active Pharmaceutical Ingredients – API			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Basic Pharmaceutical and Fine Chemical Industry** Definitions of Basic Pharmaceuticals, Intermediates, Fine Chemicals, Heavy Chemicals, Technology involved in Manufacturing of Pharmaceuticals, Unit Processes in Synthesis, Biochemical Processes in Synthesis.	06	15
2.	**Unit Processes involved in Pharma Industry** Study of the Following Chemical Processes (With References to Reagents, Mechanisms, Equipment and Manufacture of Drugs given below): Acylation, Esterification, Alkylation, Amination, Halogenation, Hydrolysis, Nitration, Oxidation and Reduction.	06	10
3.	**Unit Operations involved in Pharma Industry** Operation of Reactor, Centrifuge, Dryer, Cooling Tower, Heat Exchanger – Design, Working Principle, Validation and Cleaning Strategies, Powder Processing Area (PPA) – Conditions, Validation and Cleaning processes.	10	25

Section II – Formulations			
Module No..	Content	Hours	Weightage in %
1.	**Solid Formulation** Basics of Process Automation of Solid Dosage Form Production, Study of Newer Excipients used in Gastro Retentive, Mucoadhesive Systems and Colon Specific and Sustained Release, Pulsatile Drug Delivery Systems, Formulation Development of Mouth Dissolving Tablets, Taste Masking Formulation, Sublingual and Buccal Formulations.	07	15
2.	**Liquid Formulation** Study of Advances in Liquid Formulation including Multiple Emulsion, Micro Emulsion including Self Emulsified Drug Delivery Systems and Self Micro Emulsified Drug Delivery Systems.	05	10
3.	**Semisolids Formulation** Semisolid Formulation with Special Reference to Penetration Enhancers, Emulgels, Semisolids based on Liposomes, Niosomes.	04	10
4.	**Inhalation Aerosols** Inhalation Products- Types and Clinical Role, Basic Components of Aerosol Formulations, Therapeutic Aerosols, Metered Dose Inhalers, Dry powder Inhalers, Detailed Discussion on Propellants, Package and Filling Technology, Quality Assurance of Components and Formulations	07	15

Text Book(s):

Title	Author/s	Publication
Modern Pharmaceutics - Fourth Edition	Gilbert and S. Banker and Christofer T. Rhodes	Marcel Decker Series
Advanced Pharmaceutics: Physicochemical principles	Cherng-Ju uim	CRC Press – 2004
Unit Processes in Pharmacy	Ganderton David	Elsevier Ltd.
The Theory and Practice of Industrial Pharmacy	L. Lachman	CBS Publishers

Reference Book(s):

Title	Author/s	Publication
Physical characterization of Pharmaceutical Solids - Volume 70	H. T. Brittain	Marcel-Decker Series

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- understand basic unit processes and unit operations involved in pharma industry.
- understand the role of individual in the chemical pharmaceuticals.
- relate the different equipment with usage and applications.
- differentiate API and Formulation in the pharmaceutical industries.
- apply knowledge of basic science in dosage and Formulation to enhance the plant efficiency.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3520
Course Name: Process Auxiliaries and Utilities in Allied industries
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand the designing the process plants or creating design layouts of plant.
- understand fundamentals of chemical engineering viz. development of flow diagrams, importance of various design consideration during the development and design of any process.
- rapidly increase advancement of knowledge and relevant importance and application of various process auxiliaries and utilities used in industries.
- deals with the basics as well as advanced understanding of various process auxiliaries and utilities used in chemical plant.

Course Content:

Section I – Process Auxiliaries in Allied Industries			
Module No.	Content	Hours	Weightage in %
1.	**Process Auxiliaries** Basic Considerations and Flow Diagrams in Chemical Engineering Plant Design.	03	05
2.	**Piping Design** Selection of Material, Pipe Sizes, Working Pressure, Basic Principles of Piping Design, Piping Drawings, Pipe Installations, Overhead Installations, Process Steam Piping, Selection and Determination of Steam – Pipe Size, Piping Insulation, Application of Piping Insulation, Weather Proof and Fire Resisting Pipe Insulation Jackets, Piping Fittings, Pipe Joints.	10	20
3.	**Valves** Types of Valves, Selection Criteria of Valves for various systems.	05	10
4.	**Pumps** Types of Pumps, NPSH Requirement, Pump Location, Pump Piping, Pump Piping Support, Process Control and Instrumentation Diagram, Control System Design for Process Auxiliaries.	5	15

Section II – Process Utilities in Allied Industries			
Module No.	Content	Hours	Weightage in %
1.	**Process Utilities** Process Water: Sources of Water, Hard and Soft water, Requisites of Industrial Water and its Uses, Methods of Water Treatment, Chemical Softening, Demineralization, Resins Used for Water Softening, Water for Boiler, Cooling Purposes, cooling towers, Drinking and Process Water Treatment.	08	15
2.	**Steam** Steam Generation and its Application in Chemical Process Plants, Distribution and Utilization, Steam Economy, Condensate Utilization, Steam Traps and their Characteristics, Selection and Application, Waste Heat Utilization.	08	15
3.	**Compressors and Vacuum Pumps** Types of Compressors and Vacuum Pumps and their Performance Characteristics, Methods of Vacuum Development and their Limitations, Materials Handling Under Vacuum, Lubrication and Oil Removal in Compressors and Pumps, Instrument Air.	04	15
4.	**Refrigeration System** Refrigeration and Chilling Systems, Oil Heating Systems, Nitrogen Systems.	02	5

Text Book(s):

Title	Author/s	Publication
Process Plant layout and Piping Design	Roger Hunt and Ed Bausbacher	PTR Prentice-Hall Inc
Process utility systems	Jack Broughton	Institution of Chem. Engineers, U.K.

Reference Book(s):

Chemical Engineering Plant Design	F.C. Vibrandt and C.E. Dryden	McGraw Hill, Fifth Edition
Plant design and Economics for Chemical Engineers	M.S. Peters and Timmerhaus	Mc Graw Hill 3rd Edition

Web Material Link(s):

- https://nptel.ac.in/syllabus/105102089/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- learn about the overall knowledge about the process plant.
- understand the importance of process auxiliaries and utilities in process industries.
- learn the conceptual design of chemical process plant.
- build a bridge between theoretical and practical concepts used for process auxiliaries and utilities in any process industry.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3530
Course Name: Air Pollution & Control
Prerequisite Course(s): -

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand various effects of air pollution.
- impart the knowledge on air pollution.
- analyze causes and effects of air pollution.
- familiarize with strategic planning for control of air pollution.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Air Pollution** Definition of Air Pollution - Sources and Classification of Air Pollutants-Effects of Air Pollution-Global Effects-Air Quality Emission Standards-Sampling of Pollutants in Ambient Air-Stack Sampling.	6	15
2.	**Meteorology and Air Pollution** Factors influencing Air Pollution, Wind Rose, Mixing Depths, Lapse Rates and Dispersion, Atmospheric Stability, Plume rise and Dispersion, Prediction of Air Quality, Box Model, Gaussian model, Dispersion Coefficient, Application of Tall Chimney for Pollutant Dispersion.	6	15
3.	**Control of Particulate Pollutants** Properties of Particulate Pollution, Particle Size Distribution, Control Mechanism, Dust Removal Equipment, Design and Operation of Settling Chambers, Cyclones, Wet Dust Rubbers, Fabric Filters and ESP.	6	10
4.	**Control of Gaseous Pollutant** Process and Equipment for the Removal of Gaseous Pollutants by Chemical Methods – Design and Operation of Absorption and Adsorption Equipment, Combustion and Condensation equipment.	5	10

Section II			
Module	Content	Hours	Weightage in %
1.	**Control Of Air Pollution** Zoning and Site Selection-Other Management Controls, API Legislation, Automobile Pollution and Control-Emission Standards.	7	15
2.	**Urban Air Pollution** Sectoral Analysis, Trends in Major Cities of India and Government initiatives.	4	10
3.	**Introduction to indoor air pollution**	4	10
4.	**Global effects of air pollution** Green House Effects, Acid Rain and Ozone Layer Depletion, International Agreements for Mitigating Global Air Pollution Effects.	7	15

Text Book(s):

Title	Author/s	Publication
Air pollution	Wark and Warner	Harper & Row, New York.
Air Pollution	M.N.Rao and H.V.N.Rao	McGraw Hill Education
Air pollution	Prof. K.V.S.G. Muralikrishna	Kaushal Publications – Kakinada

Reference Book(s):

An introduction to Air Pollution	R.K. Trivedy and P.K. Goel	B.S. Publications

Web Material Link(s):

- https://nptel.ac.in/syllabus/105102089/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- understand the Sources of Air pollutants and its classification.
- demonstrate the ability to design and operation of control units.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3540
Course Name: Polymer Science & Technology
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- get knowledge of polymers, polymerization techniques and behavior in polymers.
- explore various types of thermoplastics, thermosetting and elastomers.
- Familiarize with various polymer processing techniques for polymers, rubbers and fibers.
- get knowledge on various testing methods and characterization of polymers.
- get knowledge on specialty polymers.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Polymers** Polymers, Polymerization, History of polymers, Pioneers in Polymer Science, Chemistry of Polymerization –Addition, Condensation, Coordination Polymerization –Mechanism and Kinetics, Degree of Polymerization, Polymerization Conditions (Bulk, Solution, Precipitation, Suspension, Emulsion, Interfacial), Crystallinity– Polymer Single Crystals, Spherulite Sand Glass Transition Temperature(tg).	07	15
2.	**Thermoplastics, Thermosetting and Elastomers** Thermoplastic Polymers – Poly-Olefins – Vinyl Polymers – Polystyrene, PMMA - Pan, Thermoplastic Polymers – Teflon – Polyamides – Polycarbonates and their Applications, Thermosetting Polymers – Phenolic Resins –Polyesters – Epoxies – Polyurethanes and their Applications, Elastomers- Natural rubber – Isoprene Rubber, Synthetic Rubbers - Butadiene Rubber- Butyl Rubber- Styrene Butadiene Rubber, Chloroprene Rubber- Nitrile Rubber - Silicone Rubber.	10	25

3.	**Polymer Processing** Processing of Thermoplastics and Thermosetting plastics – Compounding and Processing Aids, Compression Moulding - Injection Moulding – Extrusion Moulding, Blow Moulding, Rotational Moulding, Transfer Moulding, Processing of Rubbers – Vulcanization, Mastication – Calendaring, Reaction Injection Moulding – Solution Casting – SMC and DMC, Fiber Spinning and Drawing.	06	10
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Testing & Characterization of Polymers** Polymer Characterization Tests - Melt Flow Index, Capillary Rheometer Test, Viscosity Test, GPC, Thermal Analysis Techniques – DSC, TGA and TMA, Morphology - SEM, TEM, XRD, Mechanical Properties- Tensile Test, Impact Test, Hardness, Electrical properties –Di-Electric Strength & Di-Electric Constant, Thermal Properties-HDT, Vicat.	12	30
2.	**Specialty Polymers** Poly-Electrolytes and Ionomers, Conducting Polymers –Electro-Luminescent Polymers, High temperature Polymers and Polymer Blends, Polymer Composites and Nano-Composites, Interpenetrating Polymer Networks, Liquid Crystalline Polymers, Biomedical Polymers.	10	20

Text Book(s):

Title	Author/s	Publication
Polymer Science	V R Gowariker, Vasant R. Gowariker, N V Viswanathan, JayadevSreedhar	New Age International, 2nd Edition
Polymer Science and Technology	Joel R.Fried	PHI, Eastern Economy Edition, 2nd Edition

Reference Book(s):

Text book of Polymer Science	Billmeyer F. W.	3rd edn., Wiley, Singapore, 1984
Speciality Polymers	R.W. Dyson	Chapman and Hall, New York, 1987
Handbook of Plastics Testing Technology	Vishu Shah	Wiley international publication

Web Material Link(s):

- https://nptel.ac.in/courses/113105028/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the students will be able to

- elaborate on step-growth and chain polymerization with respect to mechanism and kinetics.
- elaborate on the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both.
- distinguish between absolute and relative methods for molecular weight determination.
- describe the flow properties of polymer melts and solutions.
- interpret experimental data and determine parameters such as polymerization rates and copolymer composition.
- estimate the solubility of a given polymer in various solvents and blends.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3550
Course Name: Computational Methods in Chemical Engineering (MATLAB programming)
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
2	2	0	3	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- perform an error analysis for various numerical methods.
- derive appropriate numerical methods to solve non-linear algebraic and transcendental equations and linear system of equations.
- develop appropriate numerical methods to approximate a function.
- provide appropriate numerical methods to calculate a definite integral and to evaluate a derivative at a value.
- develop appropriate numerical methods to solve an ordinary differential equation.
- understand the various techniques to solve Partial differential equations.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to MATLAB Programming** Basics of MATLAB programming, Array operations in MATLAB, Array operations in MATLAB, working with files: Scripts and Functions, Plotting and program output	05	12
2.	**Approximations and Errors** Defining errors and precision in numerical methods, Truncation and round-off errors, Error propagation, Global and local truncation errors	04	18
3.	**Numerical Differentiation and Integration** Numerical Differentiation in single variable, Numerical differentiation: Higher derivatives, Differentiation in multiple variables, Newton-Cotes integration formulae, Multi-step application of Trapezoidal rule, MATLAB functions for integration	06	20

Section II			
Module No.	Content	Hours	Weightage in %
1.	**Linear Equations** Linear algebra in MATLAB, Gauss Elimination, LU decomposition and partial pivoting, Iterative methods: Gauss Siedel, Special Matrices: Tri-diagonal matrix algorithm	08	25
2.	**Nonlinear Equations** Nonlinear equations in single variable, MATLAB function fzero in single variable, Fixed-point iteration in single variable, Newton-Raphson in single variable, MATLAB function fsolve in single and multiple variables, Newton-Raphson in multiple variables	07	25

List of Practical:

Sr. No	List of Experiments	Hours
1.	Introduction to MATLAB	02
2.	Plotting with MATLAB	02
3.	Scripts & functions	02
4.	Matrix generation	02
5.	MATLAB programming and debugging	02
6.	Array Operations	04
7.	Solving linear equations	04
8.	M-file scripts	02
9.	M-file functions and input to script file	02
10.	The "if...end" structure	02
11.	The "for...end" loop	02
12.	The "while...end" loop	02
13.	Relational and logical operators	02

Text Book(s):

Title	Author/s	Publication
Applied Numerical Analysis using MATLAB	L. V. Fausett	Pearson Education
Numerical Methods for Engineers - 5th Edition	S. C. Chapra & R. P. Kanale	McGraw-Hill

Reference Book(s):

Title	Author/s	Publication
Textbook on Computational Methods	B. R. GT Kochav	Nirali Prakashan
Numerical Methods for Scientific & Engineering Computation	M. K Jain, S. R. K. Lyenger	Wiley Eastern Ltd.

Web Material Link(s):

- https://nptel.ac.in/syllabus/103106118/

Course Evaluation:

Practical

- Continuous Evaluation consists of Performance of Practical to be evaluated out of 10 marks for each practical and average of the same will be converted to 30 marks.
- Internal Viva consists of 20 marks.
- Practical performance/quiz/drawing/test/submission of 30 marks during End Semester Exam.
- Viva/Oral performance of 20 marks during End Semester Exam.

Course Outcome(s):

After completion of the course, the student will be able to

- perform an error analysis for a given numerical method.
- solve a linear system of equations and non-linear algebraic or transcendental equation using an appropriate numerical method.
- approximate a function using an appropriate numerical method.
- understand the basics of MATLAB and implement it in solving complex chemical engineering problems.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3560
Course Name: Environmental issues, Waste Management & EIA
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand the fundamentals of EM and ecosystem.
- understand various Environmental policies, legislations and international treaties.
- know concept of environmental impact assessment (EIA) and the preparation of EIA report.
- learn methodology and Processes of environmental auditing.
- understand life cycle assessment (LCA) and various EM system standards.
- decide environmental design and economics.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Environmental Management** Principles of Environmental Management, Ecosystem concept, Environmental concerns in India, Policy and Legal Aspects of EM.	05	10
2.	**Environmental Policies** Introduction to Environmental policies**,** Environmental Laws and Legislations, Environmental Legislation in India.	06	10
3.	**Environmental Impact Assessment (EIA)** Introduction, Impact Prediction, Evaluation and Mitigation, Forecasting Environmental Changes, Strategic Environmental Assessment (SEA), Environmental Clearance Procedure in India.	06	15
4.	**EIA Documentation and Processes** EIA Monitoring and Auditing, Environmental Auditing, Elements of Audit Process, Waste Audit and Pollution Prevention Assessments.	05	15

Section II			
Module No.	Content	Hours	Weightage in %
1.	**EA in Industrial Projects** Liability Audits and Site Assessment, Auditing of EM, Life Cycle Assessment (LCA), Stages in LCA of a Product, Procedures for LCA, Different Applications of LCA.	07	20
2.	**Environmental Management System (EMS)** Environmental Management System Standards, EMS Standards: ISO 14000, Implementation of EMS Conforming to ISO 14001, Environmental management techniques, Application of Remote Sensing and GIS in EM.	05	10
3.	**Ecosystem and Environmental Design** Ecosystem approach to risk assessment, Environmental Design, ED for Manufactured Products, ED for Buildings, ED for Developmental Planning.	04	10
4.	**Environmental Economics** Environmental Economics, Economics and the Environment, Environmental Valuation, Economics of Natural Resource, Environmental and Regional Economics, Ecological Economics.	07	10

Text Book(s):

Title	Authors	Publication
Environmental Management	Vijay Kulkarni and Ramachandra T.V.	Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore

Reference Book(s):

Title	Author/s	Publication
Management of Municipal Solid Waste	Ramachandra T.V.	Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore
Soil and Groundwater Pollution from Agricultural Activities	Ramachandra T.V.	Commonwealth Of Learning, Canada and Indian Institute of Science, Bangalore

Web Material Link(s):

- www.ces.iisc.ernet.in/energy
- www.wgbis.ces.iisc.ernet.in
- www.ces.iisc.ernet.in/biodiversity
- www.astra.iisc.ernet.in

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- understand environmental management approaches in India and internationally.
- analyses environmental management in relation to the major principles of sustainable development.
- translate generic concepts and methods into critical reviews of contemporary, real-world environmental management practices.
- critically assess theoretical and conceptual issues relating to environmental management utilizing dialectical analysis approaches.
- present synthesized and critically evaluated information in oral and written forms.
- work effectively to create environmental management analysis outputs of professional quality, both independently and within team environments.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3570
Course Name: Fundamentals to Dyes and Pigment
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- study the New Functional dyes & Recent Trends in Dyes Technology in chemical industries.
- provides fundamental knowledge of new functional Dyes which is applicable in chemical industries.
- study the basic Technology applied in various types of pigments in chemical industries.
- provides fundamental knowledge of various types of pigments and how to carry out manufacturing & applications of these pigments in chemical industries.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Technology of Fibers** Classification of coloring matters according to their application to the fibers, Physical and chemical structures of fibers and dyes in relation to dyeing, Interaction between dye molecules and the fibers, dyeing of different dyestuffs onto various natural textile fibers, Dye-fiber bonds and parameters affecting them.	05	10
2.	**Physicochemical Properties of Dye-Fiber Systems** Thermodynamics and Kinetics of dyeing process, Affinity of dyes towards the fibers, Adsorption isotherms, Equilibrium adsorption and factors influencing the same, Saturation value, Diffusion coefficient, Glass transition temperature and its effect on dyeability, Electro-kinetic properties of dye-fiber systems.	08	15
3.	**New Techniques in Dyeing** Compatibility of dyes in mixtures, Dyeing of fiber blends and shade matching, Important properties of dyestuffs and their evaluation, Evaluation of fastness properties of dyed materials and their acceptability limits, Novel dyeing techniques.	05	15

4.	**Method of Dyeing & Dyeing Machineries** Batch type, semi continuous and continuous type dyeing machinery for all forms of fibers.	04	10
	Section II		
Module No.	Content	Hours	Weightage in %
1.	**Pigments** Definitions of pigment, extenders, dyes, pigment dyestuffs, toner and lakes, Classification of inorganic and organic pigments with examples, Additive and Subtractive colour mixing.	05	10
2.	**General Methods of Processing and Synthesis of Organic and Inorganic Pigments** Crushing and Grinding, Vaporization, Co Precipitation, Filtration, Drying, Flushing, Calcinations/Roasting, Vapor phase oxidation etc., A brief study of coal tar distillation and the role of distillation products in the manufacture of synthetic dyes: bases and precipitants used in the color striking, toners and lake formation.	06	15
3.	**Extenders or Filler Pigments** Sources, manufacture, properties and uses of carbonates, sulphates and other extender pigments like Calcium carbonate, hydrated aluminum oxide, aluminum silicates/ china clays, Magnesium silicate/ talc.	06	15
4.	**Manufacture, Properties and Applications of Black, Blue and Green Pigments** Channel blacks, Furnace blacks, Lampblacks, Acetylene blacks, Graphite, black iron oxide, Jet ness of black, Chrome green, pigment green B, Ultramarine blue, Prussian blue, Phthalocyanines: Copper phthalocyanines, phthalocyanine green.	06	10

Text Book(s):

Title	Author/s	Publication
Handbook of Synthetic Dyes and Pigments	K. M. Shah	Multitech Publishing Company, Bombay
Technology of Dyeing	Shenai V.A	Sevak Publication, Bombay
A manual of Dyeing : For use of Practical Dyers, Manufactures, Students and all interested in art of dyeing	E.Knecht, C. Rawson, R.Loewenthal	Charles Griffin and Company Ltd., London
Industrial Inorganic Pigments	G. Buxbaum (Ed.)	Completely Revised Edition, 1998, ISBN 3-527-28878-3

Reference Book(s):

Dyeing and Printing	Cockett S.R., Hilton K.A.	Leonard Hill Books Ltd., London
Encyclopedia of Textile Finishing	Rouette Hans-Karl	Springer-Verlag, Berlin

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- get an introductory knowledge of Pigments Technology and classification, types & manufacturing of pigments.
- apply this knowledge in Pigments industries.
- build a bridge between theoretical and practical concept used in industry.
- get an introductory knowledge of New Functional dyes & Recent Trends in Dyes Technology.
- apply this knowledge in Dyes industries.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3580
Course Name: Processing in Agrochemical, Food Industries & Biochemical Engineering
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	00	03	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to

- understand various synthesis process of pesticides and insecticides.
- understand the important processes in food industry.
- develop understanding about biochemistry and bio chemical processes.
- develop understanding about application of engineering principles in biochemical.

Course Content:

Section I			
Module No.	Content – Agrochemical and Food industries	Hours	Weightage in %
1.	**Pesticides and Insecticides Synthesis** History of pesticides and insecticides, Development of Pesticides and insecticides, Brief introduction to classes of pesticides and insecticides (Chemical class, targets), structures, chemical names, physical and chemical properties, synthesis, degradation, metabolism, formulations, mode of action, uses, toxicity (acute and chronic toxicity in mammals, birds, aquatic species etc.), methods of analysis.	06	10
2.	**Important Parameters of Pesticides Formulations Affecting Quality of Pesticides –** particle size, bulk density, flowability, electrostatic charge, sorptivity, compatibility, and their effects on stability, rainfastness and shelf life of formulation, Rheological properties	03	10
3.	**Tests for Quality Control** A brief introduction on Specifications of Pesticide technical and formulations (WHO/FAO/BIS) Methods of analysis of Physical properties of formulations- Suspensibility, Wettability, Emulsion stability, wet sieve test, acidity, alkalinity, moisture content, Flash Point, Specific gravity, Persistent foaming, water runoff test, dry sieve test etc. and their significance during field application.	05	10

4.	**Introduction to Food industries** General aspects of food industry, world food demand and Indian scenario, constituents of food, quality and nutritive aspects, Food additives, standards, deteriorative factors and their control, preliminary processing methods, conversion and preservation operation.	04	10
5.	**Energy Engineering, Process calculation and Packaging** Fuel Utilization, Process Controls in Food Processing, Systems for Heating and Cooling Food Products, Thermal Properties of Foods, Preservation by heat and cold dehydration, concentration, frying, irradiation, microwave heating, sterilization and pasteurization, treatment and disposal of food processing wastes, Food Protection, Product Containment, Innovations in Food Packaging, Food Packaging and Product Shelf-life.	05	10
Section II			
Module No.	Content – Biochemical Engineering	Hours	Weightage in %
1.	**Introduction to Biochemical Engineering** History, Background, Interdisciplinary approach, Integrated bioprocess, Unit operations in bioprocess.	01	02
2.	**Microbial Growth Kinetics** Cell growth in Batch Culture, Continuous culture – multistage system, Phases of cell growth in batch cultures, Monod model, Factors affecting microbial growth, Maintenance energy, environmental factors affecting microbial growth, heat generation by microbial growth, Cell growth and product formation, Elemental balances, Degrees of reduction of substrate and biomass available, electron balances, Yield coefficient of biomass and product formation, Maintenance coefficients, Energetic analysis of microbial growth and product formation, oxygen consumption	08	18
3.	**Enzyme kinetics:** Enzyme and its Classification, Mechanisms of enzyme action–concept of active site, Estimation of Michelis-Menten parameters, Inhibiter–types of inhibition mechanism, Enzyme Immobilization – types, Enzyme deactivation: mechanisms and manifestations of protein denaturation, Deactivation models and kinetics, Enzyme used in current and developing industry	07	15
4.	**Bioreactors** Basic principle of Bioreactor, Design and Operation of Biochemical reactors - Fluidized bed, Regime analysis of Biochemical reactors processes, Correlations for oxygen transfer, Scale-up criteria for bioreactors based on oxygen transfer and power consumption, Measurement of physical and chemical parameters in bioreactors, Separation, isolation and purification of Biomolecule.	06	15

Text Book(s):

Title	Author/s	Publication
Pesticide Synthesis Handbook	Thomas A. Unger	Prochrom Industrias Quimicas S/A Elsevier, 1996.
Chemistry of Insecticides and Fungicides	U. S. Shree Ramulu	Oxford & IBH Pub., 2nd, 1995
Biochemical Engineering Fundamentals	J. E. Bailey and D. F. Ollis	McGraw Hill, New York, 1986.
Biochemical Engineering	H. W. Blanch and D. S. Clark	Marcel Dekker, Inc., New York, 1996.

Reference Book(s):

The Agrochemical Handbook	Hartley, D., Kidd, H	Royal Society, England, 1984.
Biochemical Reaction Engineering in Chemical Engineering, Vol. III, 3rd Edn.	R.Lovitt and M.Jones Edited by J. F. Richardson and Peacock	Pergamon, London, 1994.

Web Material Link(s):

- http://nptel.ac.in/courses/103105054/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration, which will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the course coordinator.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

After completion of the course, the student will be able to

- conceive, design, and operate food processes, equipment, and plants for efficient food production with minimal impact on the environment.
- learn to apply engineering principles and concepts to handling, storing, processing, packaging, and distributing food and related products.
- provide an understanding of the chemical, biochemical, microbiological, and physical characteristics of foods.
- analyses the kinetics of cell growth and product formation in area of bio chemical.
- understand models of bioprocesses and design downstream processes involved in product recovery.