PPSU

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

B. TECH. (CHEMICAL ENGINEERING)

SYLLABUS BOOK

AY 2022-23

INSTITUTE VISION
To emerge as an Institute of Excellence by imparting value-based education aided with Research,Innovation and Entrepreneurial skills.

INSTITUTE MISSION	
1.	To impart the holistic engineering education of highest quality & prepare socially responsible professionals with entrepreneurial skills.
2.	To prepare value-aided engineering professionals to meet up global industry requirements by imparting cutting edge professional education.
3.	To inculcate the attitude of research and innovation among the stake holders through experiential and project-based teaching-learning pedagogy.
4.	To acquire global talent pool by providing world class amenities for teaching, learning & research.

Graduates will demonstrate ability to:

PEO No	PROGRAMME EDUCATIONAL OBJECTIVES
PEO 1	Solve real-world engineering problems, design and develop innovative and cost-effective solutions exhibiting engineering skills/fundamentals to cater needs of society.
PEO 2	Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting comprehensive competitiveness.
PEO 3	Exhibit professional ethics & values, effective communication, teamwork, multidisciplinary approach, and ability to relate engineering issues to broader societal framework.

PO No	PROGRAMME OUTCOMES
PO 1	Engineering knowledge: Apply knowledge of engineering fundamentals, science, mathematics & engineering specialization for the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate and analyze complex engineering problems leading to substantial conclusions using basic principles of mathematics, science and engineering.
PO 3	Design/development of solutions: Develop solutions for complex engineering problems and design system components or processes meeting specified needs having due consideration for the safety and societal & environmental considerations.
PO 4	Conduct investigations of complex problems: Use research-based knowledge & methods like design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid & viable conclusions.
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools for prediction and modeling of complex engineering activities with an understanding of the limitations.
PO 6	The engineer and society: Apply cognitive learning by the contextual knowledge to assess societal, health, safety, legal and cultural issues and following responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge & skill needed for sustainable development.
PO 8	Values & Ethics: Apply basic moral values & ethical principles and pledge to professional ethics/norms and responsibilities of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual/as a team member or as a leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects in multidisciplinary environments.
PO 12	Life-long learning: Recognize the need, do necessary preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO No	PROGRAMME SPECIFIC OUTCOMES (PSO) CHEMICAL ENGINEERING
PSO 1	Acquire and apply industry centric skills in the field of Chemical Engineering for the benefit of society.
PSO 2	Develop an attitude to accept global challenges and apply Chemical Engineering knowledge for solving engineering problems related to core and interdisciplinary fields.
PSO 3	Demonstrate and develop the appropriate solutions of the complex level of Chemical Engineering design-based problems to meet the specified needs and overall sustainability of the processes, considering the necessary approaches of safety, health hazards, societal and environmental factors.

Credit Guidelines (General)			
Component	**Hour/Week**	**Credit**	**Total Hours/Semester**
Theory	1	1	15
Practical	2	1	30
Tutorial	1	1	15
Note: In specific cases; extra credits can be granted for specific/important subjects.			

CO-PO Mapping Guidelines		
Mapping Level	**% age Mapping**	**Indicator**
0 / -	0	No Mapping
1	0-33	Low Level (Slightly Mapped)
2	33-66	Medium Level (Moderately Mapped)
3	>66	High Level (Strongly Mapped)

Syllabus Book

B. Tech.
(Chemical Engineering)

P P Savani University

School of Engineering

Effective From: 2022-23

Authored by: P P Savani University

CONTENT

FIRST YEAR B.TECH.

P P SAVANI UNIVERSITY															
SCHOOL OF ENGINEERING															
TEACHING & EXAMINATION SCHEME FOR B. TECH. CHEMICAL ENGINEERING PROGRAMME AY:2022-23															
Sem	**Course Code**	**Course Title**	**Offered By**	**Teaching Scheme**					**Examination Scheme**						
				Contact Hours				**Credit**	**Theory**		**Practical**		**Tutorial**		**Total**
				Theory	**Practical**	**Tutorial**	**Total**		**CE**	**ESE**	**CE**	**ESE**	**CE**	**ESE**	
1	SESH1070	Fundamentals of Mathematics	SH	2	0	2	4	4	40	60	0	0	50	0	150
	SEME1010	Engineering Graphics	ME	3	4	0	7	5	40	60	40	60	0	0	200
	SEME1020	Engineering Workshop	ME	0	2	0	2	1	0	0	50	0	0	0	50
	SESH1230	Fundamentals of Chemistry & Chemical Engineering	SH	3	2	0	5	4	40	60	20	30	0	0	150
	SEHV1010	Universal Human Values-I	SH	2	0	0	2	0	100	0	0	0	0	0	100
						Total	**20**	**14**							**650**
2	SESH1080	Linear Algebra & Calculus	SH	3	0	2	5	5	40	60	0	0	50	0	150
	SESH1240	Electrical & Electronics Workshop	ME	0	2	0	2	1	0	0	50	0	0	0	50
	SECV1040	Basics of Civil & Mechanical Engineering	CV	4	2	0	6	5	40	60	20	30	0	0	150
	SECV1080	Mechanics of Solids	CV	4	2	0	6	5	40	60	20	30	0	0	150
	SECE1010	Basics of Computer & Programming	CE	3	2	0	5	4	40	60	20	30	0	0	150
	CFLS1010	Linguistic Proficiency	CFLS	2	0	0	2	**2**	40	60	0	0	0	0	100
						Total	**26**	**22**							**750**

P P Savani University
School of Engineering

Department of Applied Science and Humanities

Course Code: SESH1070
Course Name: Fundamentals of Mathematics
Prerequisite Course(s): Algebra, Geometry, Trigonometry & Pre-Calculus till 12th Standard level

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

- summarize concept of calculus to enhance ability of analysing mathematical problems.
- acquire knowledge and ability to work with differentiation and integration for applications of mathematical techniques in engineering.
- develop the tool of power series for learning advanced Engineering Mathematics.
- analyse and solve system of linear equations and understand characteristics of Matrices.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Calculus** Limits, Continuity, Types of Discontinuity, Successive Differentiation, Rolle's Theorem, LMVT, CMVT, Maxima and Minima.	08	28
2.	**Sequence and Series-I** Convergence and Divergence, Comparison Test, Integral Test, Ratio Test, Root Test, Alternating Series, Absolute and Conditional Convergence.	07	22
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
3.	**Sequence and Series-II** Power series, Taylor and Macluarin series, Indeterminate forms and L'Hospitals Rule.	06	20
4.	**Matrix Algebra** Elementary Row and Column operations, Inverse of matrix, Rank of matrix, System of Linear Equations, Characteristic Equation, Eigen values and Eigen vector, Diagonalization, Cayley Hamilton Theorem, Orthogonal Transformation	09	30
TOTAL		30	100

List of Tutorials:

Sr. No.	Name of Tutorials	Hours
1.	Calculus-1	04
2.	Calculus-2	02
3.	Integration	04
4	Sequence and Series-1	04
5.	Sequence and Series-2	04
6.	Sequence and Series-3	02
7.	Matrix Algebra-1	04
8.	Matrix Algebra-2	02
9.	Matrix Algebra-3	02
10.	Matrix Algebra-4	02
TOTAL		30

Text Book:

Title	Author(s)	Publication
Thomas' Calculus	George B. Thomas, Maurice D. Weir and Joel Hass	Pearson
Elementary linear Algebra	Howard Anton and ChrishRorres	Wiley

Reference Book:

Title	Author(s)	Publication
Advanced Engineering Mathematics	E Kreyszig	John Wiley and Sons
A textbook of Engineering Mathematics	N P Bali and Manish Goyal	Laxmi
Higher Engineering Mathematics	B S Grewal	Khanna
Engineering Mathematics For First Year	T Veerarajan	Tata Mc Graw Hill
Engineering Mathematics-1 (Calculus)	H. K. Dass and Dr. Rama Verma	S. Chand

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same 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 50 marks

Course Outcome(s):

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

SESH1070	FUNDAMENTALS OF MATHEMATICS
CO 1	To recall the concepts of limit, continuity and differentiability for analysing mathematical problems.
CO 2	Explain concepts of limit, derivatives and integrals.
CO 3	Analyze the series for its convergence and divergence to solve real world problems.
CO 4	Evaluate linear system using matrices.
CO 5	Adapt the knowledge of eigenvalues and eigenvectors for matrix diagonalization

Mapping of CO With PO

SESH1070	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	1	1								1
CO 2	3	2	1									1
CO 3	3	2	1	1								
CO 4	3	2	1									1
CO 5	3	3	1		1							1

Mapping of CO with PSO

SESH1070	PSO1	PSO2	PSO3
CO 1	3		
CO 2	1	1	
CO 3	1	2	
CO 4	2	1	
CO 5	2	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Calculus	1, 2, 3, 4
2	Sequence and Series-I	1, 2, 3, 4
3	Sequence and Series-II	1, 2, 3, 4
4	Matrix Algebra	1, 2, 3, 4

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1010
Course Name: Engineering Graphics
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	04	--	05	40	60	40	60	--	--	200

CE: Continuous Evaluation, ESE: End Semester Exam

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

- know conventions and the methods of engineering drawing.
- interpret engineering drawings using fundamental technical mathematics.
- construct basic and intermediate geometry.
- improve their visualization skills so that they can apply these skills in developing new products.
- improve their technical communication skill in the form of communicative drawings.
- comprehend the theory of projection.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction:** Importance of the Course; Use of Drawing Instruments and accessories; BIS – SP – 46; Lettering, Dimensioning and Lines; Representative Fraction; Types of Scales (Plain and Diagonal Scales); Construction of Polygons.	03	05
2.	**Engineering Curves:** Classification and Application of Engineering Curves; Construction of Conics, Cycloidal Curves, Involutes and Spiral along with Normal and Tangent to each.	06	15
3.	**Principles of Projections:** Types of Projections; Introduction of Principle Planes of Projections. **Projection of Points & Line:** Projection of Pointsin all four Quadrants; Projection of Lines with its inclination to one Referral Plane & two Referral Planes. **Projection of Plane:** Projection of Planes (Circular and Polygonal) with	14	30

	inclination to one Referral Plane and two Referral Planes; Concept of Auxiliary Projection Method.		
Section II			
Module No.	Content	Hours	Weightage in %
4.	**Projection and Section of Solids:** **Projection of solids:** Polyhedral, Prisms, Pyramids, Cylinder, Cone, Auxiliary Projection Method, One View, Two View and Three View Drawings. Missing View, Rules for Selection of Views; Sectional View, Section Plane Perpendicular to the HP & VP and other Various Positions, True Shape of Sections.	08	14
5.	**Orthographic Projection:** Types of Projections: Principle of First and Third Angle Projection -Applications & Difference; Projection from Pictorial view of Object, View from Front, Top and Sides; Full Section View.	07	18
6.	**Isometric Projections and Isometric Drawing:** Isometric Scale, Conversion of Orthographic views into Isometric Projection, Isometric View or Drawing.	07	18
TOTAL		45	100

List of Practical:

Sr. No.	**Name of Practical**	**Hours**
1.	Introduction sheet (dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil, lettering)	08
2.	Plane scale and diagonal scale	04
3.	Engineering curves	08
4.	Projection of Points & Lines	06
5.	Projection of Planes	08
6.	Projection of solid & Section of solid	10
7.	Orthographic projection	08
8.	Isometric projection	08
TOTAL		60

Text Book(s):

Title	**Author(s)**	**Publication**
A Text Book of Engineering Graphics	P J Shah	S. Chand & Company Ltd., New Delhi
Engineering Drawing	N D Bhatt	Charotar Publishing House, Anand

Reference Book(s):

Title	Author(s)	Publication
Engineering Drawing	P.S.Gill	S. K. Kataria& sons, Delhi
Engineering Drawing	B. Agrawal & C M Agrawal	Tata McGraw Hill, New Delhi
Engineering Drawing made Easy	K. Venugopal	Wiley Eastern Ltd

Web Material Link(s):

- http://nptel.ac.in/courses/105104148/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

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

Course Outcome(s):

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

SEME1010	ENGINEERING GRAPHICS
CO 1	Learn and understand the bis standards, conventions and methods of engineering drawing.
CO 2	Explore the different methods to draw various engineering curves and its applications.
CO 3	Construct basic and intermediate geometry and comprehend the theory of projection.
CO 4	Improve visualization skills and apply it to develop a new product.

Mapping of CO With PO

SEME1010	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	1			2				3		1
CO 2	1	1	1		1					3		1
CO 3	1	1	1		1					3		1
CO 4	1	1	2		1					3		1

Mapping of CO with PSO

SEME1010	PSO1	PSO2	PSO3
CO 1	1	0	0
CO 2	2	1	1
CO 3	2	1	1
CO 4	2	1	1
CO 5	1	0	0

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1,2,6
2	Engineering Curves	2,6
3	Principles of Projections	1,2,3,4
4	Orthographic Projections	2,4,5
5	Isometric Projection	2,4,5
6	Projection & Section of Solids	2,3,4,6

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1020
Course Name: Engineering Workshop
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	
--	02	--	01	--	--	50	--	--	--	50

CE: Continuous Evaluation, ESE: End Semester Exam

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

- learn about the safety measures required to be taken while using working in workshop.
- learn about how to select the appropriate tools required for specific operation.
- learn about different manufacturing technique for production out of the given raw material.
- understand applications of machine tools, hand tools, power tools and welding process.

List of Practical:

Sr. No	**Name of Practical**	**Hours**
1.	Introduction and Demonstration of Safety Norms. Different Measuring Instruments.	02
2.	To Perform a Job of Fitting Shop.	06
3.	To Perform a Job of Carpentry Shop.	06
4.	To Perform a Job of Sheet Metal Shop.	06
5.	To Perform a Job of Black Smithy Shop.	04
6.	Introduction and Demonstration of Grinding & Hacksaw Cutting Machine.	02
7.	Introduction and Demonstration of Plumbing Shop & Welding Process.	04
TOTAL		30

Text Book(s):

Title	**Author(s)**	**Publication**
Elements of Workshop Technology Vol. I	Hajra Chaudhary S. K	Media promoters & Publishers
Workshop Technology Vol. I and II	Raghuvanshi B.S.	Dhanpat Rai & Sons

Reference Book(s):

Title	**Author(s)**	**Publication**
Workshop Technology Vol. I	W.A.J. Chapman	Edward Donald Publication

Workshop Practices	H S Bawa	Tata McGraw-Hill
Basic Machine Shop Practice Vol. I, II	TejwaniV.K	Tata McGraw-Hill

Web Material Link(s):

- http://nptel.ac.in/course.php

Course Evaluation:

Practical:

- Continuous Evaluation Consist of Performance of Practical which will be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 30 Marks.
- Internal Viva consists of 20 Marks.

Course Outcome(s):

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

SEME1020	**ENGINEERING WORKSHOP**
CO 1	Understand the various measuring instruments.
CO 2	Understand the safety norms required in the workshop.
CO 3	Understand the application of various tools required for different operations.
CO 4	Remember the process of manufacture from a given raw material.
CO 5	Explain various manufacturing processes in machine shop.

Mapping of CO With PO

SEME1020	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2					2			2		1	2
CO 2						3		3	3		1	3
CO 3	2					2			1		1	3
CO 4	2								3		2	3
CO 5	2								3		2	3

Mapping of CO with PSO

SEME1020	PSO1	PSO2	PSO3
CO 1	2	3	2
CO 2	0	0	0
CO 3	2	3	2
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Practical No.	Content	RBT Level
1	Introduction	1,2,4
2	Fitting Shop.	1,2,3
3	Carpentry and Drilling Shop	1,2,3
4	Sheet Metal Shop.	2,3,4
5	Smithy Shop.	2,3,4
6	Introduction to Machine Tools	2,3,4
7	Introduction to Welding & Plumbing	2,3,4

P P Savani University
School of Engineering

Department of Science & Humanities

Course Code: SESH1230
Course Name: Fundamentals of Chemistry & Chemical 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	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective of the Course:
To help learners to

- present sound knowledge of chemistry fundamentals, enriching students to understand the role of Chemistry in the field of science and engineering.
- inculcate habit of scientific reasoning to do the task rationally.
- give an introduction of chemical engineering & various unit operations to make aware the students about the role of chemical engineer in various chemical industries.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Chemical Bonding and Structure of Molecules** **General terms**: Chemical bond, valence, valence electrons, Bonding and Nonbonding electrons, Lewis symbols, Octet rule. **Ionic bond**: Definition, Condition for formation of ionic bond, Factors governing formation of ionic bond, examples (NaCl, $MgCl_2$, CaO, Al_2O_3), Characteristics of ionic compounds. **Covalent bond:** Definition, conditions for covalent bond formation, examples [(single covalent bond: H_2, Cl_2, H_2O, NH_3, CH_4) (multiple covalent bond: O_2, N_2, CO_2)], General characteristics of covalent compounds, valence bond approach, formation of H_2 molecule, Concept of hybridization, Hybridization and shape of molecules, Shape of water, ammonia, PCL_5 and SF_6, Limitations of Valence bond theory, VSEPR theory, Fajan's rules. **Co-ordinate covalent bond:** Definitions, examples (NH_4^+, H_3O^+, BF_4^-, CH_3NO_2, SO_3, $AlCl_3$, SO_4^{-2}, O_3 and CO. **Hydrogen bonding:** Definition, conditions for H-bond formation, examples (HF, H_2O, NH_3, 2-nitrophenol), Types of H-bonds, Characteristics of H-bonded compounds.	08	20

	Metallic bond: Definition, The Electron sea model, explanation to the physical characteristics of metal based on the electron sea model.		
2.	**Electrochemistry** Introduction, Arrhenius ionic theory, De-bye Huckel theory of strong electrolytes, activity and activity co-efficient, Conductivity of electrolytes, Kohlrausch's law of independent migration of ions, Ostwald's dilution law, Acids and bases, Concept of pH and pOH, Buffer solutions, Solubility product, common-ion effect, hydrolysis of salts, conductometric titration, transport number.	07	10
3.	**Water Technology and Colloids** Introduction, Source of water, Impurities of water, Hard and Soft water, Degree of hardness, Scale and Sludge formation in boiler, Boiler Corrosion, Caustic Embrittlement, Priming and Forming, Softening of water, Potable Water, Break point of chlorination, Desalination of Brackish Water. Lyophilic and Lyophobic colloids, Characteristics of lyophilic and lyophobic sols, preparation of sols, Dispersion methods, Aggregation methods, Purification of sols, Dialysis, optical properties of sols: Tyndall effect.	08	20
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Introduction to Unit Operation** Systematic analysis to chemical process, flow sheet symbols for various operations, Forms of Energy, Overall balances, Mass balance and Momentum Balance, total energy balance, Introduction to modes of heat transfer, Introduction to the concepts of mass transfer, Numerical	08	20
5.	**Introduction to Reaction Kinetics** Introduction to types of reaction, reaction rate, order of reaction, reaction mechanism, Numerical	08	20
6.	**Thermodynamics** Introduction & basic concepts, Equilibrium, Laws of Thermodynamics, Heat Reservior& Heat Engines, Energy Balances.	06	10
TOTAL		45	100

List of Practical:

Sr. No	**Name of Practical**	**Hours**
1.	Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.	02
2.	Demonstration: Preparation of solutions of different concentrations	04
3.	Determination of alkalinity in the given water sample.	02

4.	Determination of temporary and permanent hardness in water sample using EDTA as standard solution.	04
5.	Conduct metric titration of strong acid vs. strong base.	02
6.	Determination of critical micelle concentration of a surfactant using conductometry.	04
7.	Determination of concentration of unknown solution spectrophotometrically.	02
8.	Determining the strength of ferrous ammonium sulfate with the help of $K_2Cr_2O_7$.	04
9.	Determination of dissociation constant of strong acid by pH metric method.	02
10.	Determination of cloud point of a surfactant in the presence of salts.	04
TOTAL		**30**

Text Book:

Title	**Author/s**	**Publication**
Engineering Chemistry (16th Edition)	P.C. Jain and Monika Jain	DhanpatRai publishing company
Introduction to Chemical Engineering	W. Badger	Tata McGraw Hill Education
A textbook of Chemical Engineering Thermodynamics	K. V. Narayan	PHI Learning Pvt. Ltd.
An Introduction to Chemical Engineering Kinetics and Reactor Design	Charles Hill	Wiley India

Reference Book:

Title	**Author/s**	**Publication**
Textbook of Engineering Chemistry (4th Edition)	R. Gopalan, D. Venkappaya, S. Nagarajan	Vikas Publishing house Ltd.
A textbook of Chemical technology (Volume-1)	G. N. Pandey	Vikas Publishing house Ltd.
Essentials of Physical Chemistry	A.Bahl, B.S. Bahl and G.D. Tuli	S. Chand Publishing
Concise Inorganic Chemistry	J.D. Lee	Wiley India
Organic Reaction Mechanisms	V. K. Ahluwalia, R. K. Parashar	Norasa Publishing House
Organic Chemistry (6th edition)	Robert Thornnton Morrison Robert Neilson Boyd	Pearson Education
Introduction to Chemical Engineering.	L. B. Andersen & L. A. Wenzel	McGraw Hill Kogakusha Company Ltd

Web Material Links:

- https://books.google.co.in/books?id=Z3033BGuMBEC&printsec=frontcover&dq=engineering+chemistry+ebook&hl=en&sa=X&ved=0ahUKEwj9xoiNv3UAhVEL48KHYg7Ak0Q6AEIITAA#v=onepage&q&f=false

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consist of performance based on practical which should be evaluated out of 10 marks each in the next turn and average of the same will be converted to 10 marks.
- Internal viva component carries 10 marks of evaluation.
- Practical performance/quiz/drawing/test consists of 15 marks evaluation during end semester exam.
- Viva/Oral performance consists of 15 marks evaluation during end semester examination.

Course Outcome(s):

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

SESH1230	**FUNDAMENTALS OF CHEMISTRY & CHEMICAL ENGINEERING**
CO 1	Understand the relevance of fundamentals and applications of chemical sciences and chemistry in the field of engineering
CO 2	Apply the knowledge of thermodynamics in studying different chemical systems.
CO 3	Apply the knowledge of colloids, metals and alloys, their types and their properties
CO 4	Understand the basics of electrochemistry and its application in chemical engineering
CO 5	Impart an introduction of chemical engineering to get the awareness about the role of chemical engineer in various chemical industries

Mapping of CO With PO

SESH1230	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1											1
CO 2	2											
CO 3	1											
CO 4	1											
CO 5	1	1										1

Mapping of CO with PSO

SESH1230	PSO1	PSO2	PSO3
CO 1	1		
CO 2	1		
CO 3	1		
CO 4	1		
CO 5	1		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Chemical Bonding and structure of molecules general terms	1, 2
2	Electrochemistry	1, 2
3	Water Technology and Colloids	1, 2, 3, 5
4	Introduction to unit operation	1, 2, 6
5	Introduction to Reaction kinetics	1, 2, 5, 6
6	Thermodynamics	1, 2, 3

P P Savani University
School of Engineering

Department of Applied Science and Humanities

Course Code: SESH1080
Course Name: Linear Algebra & Calculus
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	--	02	05	40	60	--	--	50	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- learn about and work with vector space, linear transformation and inner product space.
- apply concepts of linear algebra for solving science and engineering problems.
- introduce the concept of improper integral and Beta-Gamma Function.
- develop the tool of Fourier series for learning advanced Engineering Mathematics.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Vector Space** Concept of vector space, Subspace, Linear Combination, Linear Dependence and Independence, Span, Basis and Dimension, Row Space, Column Space and Null Space, Rank and Nullity.	09	20
2.	**Linear Transformation** Introduction of Linear Transformation, Kernal and Range, Rank and Nullity, Inverse of Linear Transformation, Rank Nullity Theorem, Composition of Linear Maps, Matrix associated with linear map.	07	15
3.	**Inner Product Space** Inner Product, Angle and Orthogonality, Orthogonal projection, Gram- Schmidt process and QR Decomposition, Least square decomposition, Change of basis.	07	15
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Beta and Gamma function** Improper Integrals, Convergence, Properties of Beta and Gamma Function, Duplication Formula (without proof)	06	14
5.	**Fourier Series**	08	18

	Periodic Function, Euler Formula, Arbitrary Period, Even and Odd function, Half Range Expansion, Parseval's Theorem		
6.	**Curve tracing** Tracing of Cartesian Curves, Polar Coordinates, Polar and Parametric Form of Standard Curves, Areas and Length in Polar co-ordinates	08	18
TOTAL		45	100

List of Tutorial:

Sr. No.	**Name of Tutorials**	**Hours**
1.	Vector Space-1	04
2.	Vector Space-2	02
3.	Linear Transformation-1	04
4	Linear Transformation-2	02
5.	Inner Product-1	04
6.	Inner Product-2	02
7.	Beta and Gamma Function-1	04
8.	Beta and Gamma Function-2	02
9.	Curve tracing-1	04
10.	Curve tracing-2	02
TOTAL		30

Text Book(s):

Title	**Author/s**	**Publication**
Thomas' Calculus	George B. Thomas, Maurice D. Weir and Joel Hass	Pearson
Elementary Linear Algebra	Howard Anton and ChrishRorres	Wiley

Reference Book(s):

Title	**Author(s)**	**Publication**
Advanced Engineering Mathematics	E Kreyszig	John Wiley & Sons
A textbook of Engineering Mathematics	N P Bali and Manish Goyal	Laxmi
Higher Engineering Mathematics	B S Grewal	Khanna
Engineering Mathematics for First Year	T Veerarajan	Tata Mc Graw Hill
Engineering Mathematics-1 (Calculus)	H. K. Dass and Dr. Rama Verma	S. Chand

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests, each of 30 marks and 1 hour of duration and average of the same 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 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

SESH1080	**LINEAR ALGEBRA & CALCULUS**
CO 1	Determine the basis and dimension of vector spaces and subspaces.
CO 2	Discuss the matrix representations of a linear transformation given bases of the relevant vector space.
CO 3	Identify the ordinary differentials and partial differentials and solve the maximum and minimum value of function.
CO 4	Classify gamma, beta functions & their relation which is helpful to evaluate some definite integral arising in various branch of engineering.
CO 5	Construct the graphs for function with intervals and identify more application for function.

Mapping of CO With PO

SESH1080	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1										
CO 2	1											
CO 3	2	1										
CO 4	1	1										
CO 5	1											

Mapping of CO with PSO

SESH1080	PSO1	PSO2	PSO3
CO 1			
CO 2			
CO 3	1		
CO 4			
CO 5			

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Vector Space	1, 2, 3, 4
2	Linear Transformation	1, 2, 3, 4
3	Inner product space	1, 2, 3, 4
4	Partial Derivatives	1, 2, 4, 5
5	Beta and Gamma Function	1, 2, 4, 5
6	Curve Tracing	1, 2, 4, 5, 6

P P Savani University
School of Engineering

Department of Applied sciences & Humanities

Course Code: SESH1240
Course Name: Electrical & Electronics Workshop
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	
--	02	--	01	--	--	50	--	--	--	50

CE: Continuous Evaluation, ESE: End Semester Exam

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

- identify basic fundamental electronic components in circuits.
- learn to use common electronic component on breadboard.
- understand components of instruments, terminology and applications.

List of Practical:

Sr No	Name of Practical	Hours
1	Understanding of electronic component with specification.	02
2	Understanding of Galvanometer, Voltmeter, Ammeter, Wattmeter and Multimeter	02
3	Understanding of breadboard connections	02
4	Drawing and wiring of basic circuits on breadboard	02
5	Verification of Ohm's law	02
6	Half wave, full wave using centre tap transformer and full wave bridge rectifier	03
7	Kirchhoff's laws (KVL, KCL).	03
8	Faraday's laws of Electromagnetic Induction and Electricity Lab	04
9	LDR characteristics	02
10	Study of CRO, measurement of amplitude (voltage) & time period (frequency)	04
11	PCB designing	04
TOTAL		30

Text Book:

Title	Author/s	Publication
Electronic Principles	Albert Malvino and David J Bates	Mc Graw Hill (7th Edition)

Reference Book:

Title	Author/s	Publication
Electronic Devices	Thomas L. Floyd	Pearson (7th Edition)

Electronic Devices and Circuits	David A. Bell	Oxford Press (5th Edition)
Integrated Electronics	Jacob Millman, Christos	Tata McGraw Hill (2nd Edition)

Course Evaluation:

Practical:

- Continuous Evaluation Consist of Performance of Practical which should be evaluated out of 10 for each practical in the next turn and average of the same will be converted to 30 Marks.
- Internal viva consists of 30 marks.

Course Outcome(s):

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

SESH1240	**ELECTRICAL & ELECTRONICS WORKSHOP**
CO 1	Identify the ability to design various electronic circuit on a bread board.
CO 2	Recognize the basic electronic devices and components in a circuit connection.
CO 3	Identify the ability to design a pcb.
CO 4	Define the practical side of basic physics laws.

Mapping of CO With PO

SESH1240	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	2	3	3	2	2		3			3
CO 2	2	3	2	3	3	2	2		3			3
CO 3	2	3	3	3	3	2	2		3			3
CO 4	2	3	2	3	3	2	2		3			3

Mapping of CO with PSO

SESH1240	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	3	2	
CO 3	3	2	
CO 4	3	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Practical No.	**Content**	**RBT Level**
1	Electronic Components	1,2,3,4
2	Electronic Devices	1,2,3,4
3	Understanding of Breadboard	1,2,4,5,6
4	Wiring of Breadboard	1,2,4,5,6
5	Ohm’s Law	1,2,3,4
6	Rectifiers	1,2,3,5,6
7	KCL & KVL	1,2,3,4,6
8	LDR	1,2,3,6

9	Electricity Lab	1,2,3,4
10	CRO	1,2,4,5
11	PCB	1,2,6

P P Savani University
School of Engineering

Department of Civil Engineering

Course Code: SECV1040
Course Name: Basics of Civil & Mechanical 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	
04	02	--	05	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- study the fundamentals of mechanical systems.
- study and appreciate significance of mechanical engineering in different fields of engineering.
- carry out simple land survey and recent trends in civil engineering.
- understand components of building, building terminology and construction materials.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Civil Engineering: An Overview** Introduction, Branches, Scope, Impact, Role of Civil Engineer, Unit of Measurement, Unit Conversion (Length, Area, Volume)	03	04
2.	**Introduction to Surveying and Levelling:** Introduction, Fundamental Principles, Classification **Linear Measurement:** Instrument Used, Chaining on Plane Ground, Offset, Ranging **Angular Measurement:** Instrument Used, Meridian, Bearing, Local Attraction **Levelling:** Instrument Used, Basic Terminologies, Types of Levelling, Method of Levelling **Modern Tools:** Introduction to Theodolite, Total Station, GPS	07	12
3.	**Building Materials and Construction:** Introduction (Types and Properties) to Construction Materials Like Stone, Bricks, Cement, Sand, Aggregates, Concrete, Steel. Classification of Buildings, Types of Loads Acting on Buildings, Building Components and their Functions, Types of Foundation and Importance, Symbols Used in Electrical Layout, Symbols Used for Water Supply, Plumbing and	10	14

	Sanitation		
4.	**Construction Equipment:** Types of Equipment- Functions, Uses. Hauling Equipment- Truck, Dumper, Trailer. Hoisting Equipment- Pulley, Crane, Jack, Winch, Sheave Block, Fork Truck. Pneumatic Equipment- Compressor. Conveying Equipment- Package, Screw, Flight/scrap, Bucket, Belt Conveyor. Drill, Tractor, Ripper, Rim Pull, Dredger, Drag Line, Power Shovel, JCB, HOE.	04	08
5.	**Recent Trends in Civil Engineering:** Mass Transportation, Rapid Transportation, Smart City, Sky Scarper, Dams, Rain Water Harvesting, Batch Mix Plant, Ready Mix Concrete Plant, Green Building, Earth Quake Resisting Building, Smart Material	06	12
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**Basic Concepts of Thermodynamics:** Prime Movers - Meaning and Classification; the Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific Heat Capacity, Internal Energy, Specific Volume; Thermodynamic Systems, All Laws of Thermodynamics	04	08
7.	**Fuels and Energy:** Fuels Classification: Solid, Liquid and Gaseous; their Application, Energy Classification: Conventional and Non-Conventional Energy Sources, Introduction and Applications of Energy Sources like Fossil Fuels, Solar, Wind, and Bio-Fuels, LPG, CNG, Calorific Value	04	08
8.	**Basics of I.C Engines:** Construction and Working of 2 Stroke & 4 Stroke Petrol and Diesel Engines, Difference Between 2-Stroke - 4 Stroke Engine & Petrol-Diesel Engine, Efficiency of I. C. Engines	12	18
9.	**Power Transmission Elements:** Construction and Applications of Couplings, Clutches and Brakes, Difference Between Clutch and Coupling, Types of Belt Drive and Gear Drive	10	16
TOTAL		60	100

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Unit conversation Exercise and Chart preparation of building components	02
2.	Linear measurements	02
3.	Angular measurements	02
4.	Determine R. L of given point by Dumpy level. (Without Change Point)	02
5.	Determine R. L of given point by Dumpy level. (With Change Point)	02

6.	Presentation on various topics as in module about recent trends	04
7.	To understand construction and working of various types of boilers	04
8.	To understand construction and working of mountings	04
9.	To understand construction and working of accessories	04
10.	To understand construction and working 2 –stroke & 4 –stroke Petrol Engines	02
11.	To understand construction and working 2 –stroke & 4 –stroke Diesel Engines	02
TOTAL		30

Text Book(s):

Title	**Author(s)**	**Publication**
Elements of Mechanical Engineering	S. B. Mathur, S. Domkundwar	DhanpatRai& Sons Publications
Elements of Mechanical Engineering	Sadhu Singh	S. Chand Publications
Elements of Civil Engineering	Anurag A. Kandya	Charotar Publication
Surveying Vol. I & II	Dr. B. C. Punamia	Laxmi Publication

Reference Book(s):

Title	**Author(s)**	**Publication**
Thermal Engineering	R. K. Rajput	Laxmi Publications
Basic Mechanical Engineering	T.S. Rajan	Wiley Eastern Ltd., 1996.
Surveying and Levelling	N. N. Basak	Tata McGraw Hill
Surveying Vol. I	S. K. Duggal	Tata McGraw Hill
Surveying and Levelling	R. Subramanian	Oxford University
Building Construction and Construction Material	G. S. Birdie and T. D. Ahuja	DhanpatRai Publishing
Engineering Material	S.C. Rangwala	Charotar Publication

Web Material Link(s):

- http://nptel.ac.in/course.php
- http://nptel.ac.in/courses/105107157/
- http://nptel.ac.in/courses/105101087/
- http://nptel.ac.in/courses/105107121/
- http://nptel.ac.in/courses/105104100/

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist 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 performance of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECV1040	**BASICS OF CIVIL & MECHANICAL ENGINEERING**
CO 1	Apply the principles of basic mechanical engineering.
CO 2	Comprehend the importance of mechanical engineering equipments like ic engine and power transmission elements.
CO 3	Understand different structural loads, components , materials and equipments used in the construction of a building.
CO 4	Adapt various methods of area plotting and marking before starting the construction activity.

Mapping of CO With PO

SECV1040	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	1	3	2	2						3
CO 2	2	3	1	3	2	2						3
CO 3	1	3	1	3	2	2						3
CO 4	1	3	1	3	2	2						3

Mapping of CO with PSO

SECV1040	PSO1	PSO2	PSO3
CO 1	2	2	2
CO 2	2	2	2
CO 3	3	2	2
CO 4	3	2	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Civil Engineering: An Overview	1, 2, 3, 4
2	Introduction to Surveying and Levelling	1, 2, 3, 4
3	Building Materials and Construction	1, 2, 3, 4
4	Construction Equipment	1, 2, 4, 5
5	Recent Trends in Civil Engineering	1, 2, 4, 5
6	Basic Concepts of Thermodynamics	1, 2, 4, 5, 6
7	Fuels and Energy	2,3,4
8	Basics of Steam Generators	3,4,5
9	Basics of I.C Engines	2,3,4
10	Power Transmission Elements	1, 2, 3, 4

P P Savani University
School of Engineering

Department of Civil Engineering

Course Code: SECV1080
Course Name: Mechanics of Solids
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	--	05	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand different types of forces, systematic evaluation of effect of these forces, behavior of rigid and deformable bodies subjected to various types of forces at the state of rest or motion of the particles.
- understand the stresses developed under the application of force.
- understand the physical and mechanical properties of materials.
- understand behaviour of structural element under the influence of various loads.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction:** Definition of Rigid Body, Deformable Body, Scalar and Vector Quantities, Fundamental Principles of Mechanics: Principle of Transmissibility, Principle of Superposition, Law of Parallelogram of Forces.	08	10
2.	**Fundamental of Static:** Force, Types of Forces, Characteristics of a Force, System of Forces, Composition and Resolution of Forces. **Concurrent Forces:** Resultant of Coplanar Concurrent Force System by Analytical Method, Law of Triangle of Forces, Law of Polygon of Forces, Equilibrium Conditions for Coplanar Concurrent Forces. **Non-Concurrent Forces:** Moments & Couples, Characteristics of Moment And Couple, Varignon's Theorem, Resultant of Non-Concurrent Forces by Analytical Method, Equilibrium Conditions of Coplanar Non-Concurrent Force System.	12	15
3.	**Centroid and Centre of Gravity:** Centroid of Lines, Plane Areas and Volumes, Examples Related	05	12

	to Centroid of Composite Geometry, Pappus –Guldinus Theorems.		
4.	**Moment of Inertia:** Parallel and Perpendicular Axis Theorems, Polar Moment of Inertia, Radius of Gyration of Areas, Examples related to moment of Inertia of Composite geometry.	05	13
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**Mechanical Properties of Materials:** Introduction, Classification of Materials, Properties Related to Axial, Bending, and Torsional & Shear Loading, Toughness, Hardness, Ductility, Brittleness. Proof stress, Factor of Safety, Working Stress, Load Factor.	02*	10
6.	**Simple Stress and Strain:** Definition of Stress and Strain, Tensile & Compressive Stresses: Shear and Complementary Shear Strains, Linear, Shear, Lateral, Thermal and Volumetric. Hooke's Law, Stresses and Strain in bars of Varying, Tapering & Composite Section, Principle of Superposition. Elastic Constant, Relation between Elastic Constants.	15	20
7.	**Shear Force and Bending Moment:** Introduction, Types of Loads, Supports and Beams, Shear Force, Bending Moment, Sign Conventions for Shear Force & Bending Moment. Statically Determinate Beam, Support Reactions, SFD and BMD for Concentrated Load and Uniformly Distributed Load, Uniformly Varying Load, Point of Contra-flexure.	15	20
TOTAL		60	100

*(To be covered during lab hours)

List of Practical (Any Ten):

Sr. No	Name of Practical	Hours
1.	Equilibrium of coplanar concurrent forces	02
2.	To verify the law of parallelogram of forces	02
3.	To verify the law of polygon of forces	02
4.	To verify the Lami's theorem	02
5.	Equilibrium of parallel force system – simply supported beam	02
6.	Tensile test on Ductile materials.	02
7.	Compression test on Ductile materials	02
8.	Compression test on Brittle Materials	02
9.	Determination of hardness of metals (Brinell/ Rockwell hardness test)	02
10.	Determination of impact of metals (Izod/ Charpy impact test)	02
11.	Tutorial on concurrent & Non-concurrent forces	04

12.	Tutorials on C. G & MI	02
13.	Tutorials on SFD & BMD	04
TOTAL		30

Text Book(s):

Title	Author(s)	Publication
Applied Mechanics	S. B. Junnarkar& H. J. Shah	Charotar Publication
Strength of Materials (SI Units)	R S Khurmi, N Khurmi	S. Chand & Company Pvt. Ltd.

Reference Book(s):

Title	Author(s)	Publication
Engineering Mechanics,	Meriam and Karaige,	Wiley-India
Engineering Mechanics: Statics and Dynamics	S Rajsekaran	Vikas Publication
Engineering Mechanics of Solids	Popov E.P	Prentice Hall of India
Strength of Materials (SI Units)	Er. R . K. Rajput	S. Chand & Company Pvt. Ltd.
Mechanics of Structure-Vol.I	Dr. H.J. Shah & S. B. Junarkar	Charotar Publishing House Pvt. Ltd.
Strength of materials	R. Subramanian	Oxford Publications
Strength of materials	S. Ramamrutham	DhanpatRai Publishing Company
Strength of Materials (SI Units)	Er. R . K. Rajput	S. Chand & Company Pvt. Ltd.

Web Material Link(s):

- http://nptel.ac.in/courses/122104014/
- http://nptel.ac.in/courses/112103108/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination will consist of 60 marks.

Practical:

- Continuous Evaluation consists of performance of practical which should 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 consists of 15 marks during End Semester Exam.
- Viva/Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECV1080	**MECHANICS OF SOLIDS**
CO 1	Conceptualization of the basic principles of dynamics, equilibrium, static reactions, and internal forces in statically determined beams.
CO 2	Application of principles of statics to determine c.g and m.i of a different geometrical shape.
CO 3	Problem formulation of mechanical elements and analyze the deformation behavior for different types of loads.
CO 4	Understand the different types of stresses and strains developed in the member subjected to axial, bending, shear & torsional effects.

Mapping of CO With PO

SECV1080	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1										
CO 2	2	1	1									
CO 3	2	1										
CO 4	2	1		1	1							

Mapping of CO with PSO

SECV1040	PSO1	PSO2	PSO3
CO 1	3		
CO 2	3		
CO 3	3		
CO 4	2		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1, 2
2	Fundamental of Static	2,3,4
3	Centroid and Centre of Gravity	2,4,5
4	Moment of Inertia	3. 4. 5.
5	Mechanical Properties of Materials	1, 2, 5, 6
6	Simple Stress and Strain	2,4,5
7	Shear Force and Bending Moment	3, 4, 5, 6

P P Savani University
School of Engineering

Department of Computer Engineering

Course Code: SECE1010
Course Name: Basics of Computer and 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	
03	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand basic components of computer system.
- identify appropriate approach to computational problems.
- develop logic building and problem-solving skill.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction to Computer and its Architecture:** Introduction and Characteristics, Generation, Classification, Applications, Central Processing Unit, Communication between Various Units, Processor Speed, Various Input and Output Devices.	03	10
2.	**Memory and Operating Systems:** Introduction to Memory, Memory Hierarchy, Primary Memory and its Type, Secondary Memory, Classification of Secondary Memory, Various Secondary Storage Devices and their Functioning, their Merits and Demerits, Evolution of Operating System, Types and Functions of Operating Systems,	06	15
3.	**Recent Advances in Computer:** Introduction to Emerging Areas like Artificial Intelligence, IoT tools, Data Science, Sensors, 3D Printing, Automization in the field of Civil, Mechanical and Chemical.	05	10
4.	**Computer Programming Language:** Introduction to different types of Programming Languages, Flowcharts and Algorithms. Introduction to C Programming Language, Features of C, Structure of C	08	15

	Program, Development of Program, Types of Errors, Debugging and Tracing Execution of Program.		
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**Constants, Variables and data Types:** Character Set, C tokens, Keyword, Constants and Variables, Data Types - Declaration and Initialization, User define type Declarations Typedef, Enum, Basic Input and Output Operations, Symbolic Constants	05	10
6.	**Operators and Expression and Managing I/O operations**: Introduction to Operators and its Types, Evaluation of Expressions, Precedence of Arithmetic Operators, Type Conversions in Expressions, Operator Precedence and Associativity. Managing Input and Output, Reading a Character, Writing a Character, Formatted Input, Formatted Output.	07	16
7.	**Conditional statement and branching:** Decision Making & Branching: Decision Making with If & If ... Else Statements, If - Else Statements (Nested Ladder), The Switch & go - to Statements, The Ternary (?:) Operator Looping: The While Statement, The Break Statement & The Do. While Loop, The FOR Loop, Jump Within Loops - Programs.	06	12
8.	**Arrays and Strings:** Introduction to Array, One Dimensional Array, Two Dimensional Arrays, Declaring and Initializing String Variables, Arithmetic Operations on Characters, Putting Strings Together, Comparison of Two Strings, Basic String Handling Functions	05	12
TOTAL		45	100

List of Practical:

Sr. No	**Name of Practical**	**Hours**
1.	Introduction to Basic Command	04
2.	Word Processing, Spreadsheets and Presentation Exercises	06
3.	Introduction to Octave Environment	04
4.	Implementation in C for conditional statement and branching Implementation of if, if...else, nested if...else and switch statements Implementation of while loop, do...while loop and for loop	06
5.	Implementation of 1-D and 2-D array	06
6.	Implementation of in-built string functions, application programs of array and strings	04
TOTAL		30

 # Use of different libraries will be covered in Practical Assignments.

Text Book(s):

Title	Author(s)	Publication
Programming in ANSI C	E. Balagurusamy	Tata McGraw Hill
Introduction to Computer Science	ITL Education Solutions Limited	Pearson Education

Reference Book(s):

Title	Author(s)	Publication
Programming in C	Ashok Kamthane	Pearson
Let Us C	Yashavant P. Kanetkar	Tata McGraw Hill
Introduction to C Programming	Reema Thareja	Oxford Higher Education
Programming with C	Byron Gottfried	Tata McGraw Hill

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consists of the performance of practical, which will be evaluated out of 10 per each practical. At the end of the semester, the average of the entire practical will be converted to 10 marks.
- Internal viva consists of 10 marks.
- Practical performance/quiz/test consists of 15 marks during End Semester Examination.
- Viva/Oral performance consists of 15 marks during End Semester Examination.

Course Outcome(s):

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

SECE1010	BASICS OF COMPUTER & PROGRAMMING
CO 1	Observe the different types of operating systems and its functionalities.
CO 2	Explore new emerging area in computer field.
CO 3	Apply basic principles of imperative and structural programming to solve complex problems.
CO 4	Classify the types of errors occur while running the program.

Mapping of CO With PO

SECE1010	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		1										
CO 2		1		2	1						2	
CO 3		3	2	1								
CO 4		1	1	1								

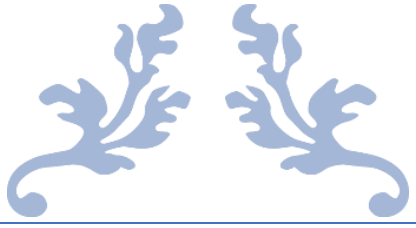
Mapping of CO with PSO

SECE1010	PSO1	PSO2	PSO3
CO 1	3	3	1
CO 2	3	1	3
CO 3	3	3	1
CO 4	1	3	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Computer and its Architecture	1,2
2	Memory and Operating Systems	1,3
3	Recent Advances in Computer	1,2
4	Computer Programming Language	2,3,4
5	Constants, Variables and data Types	3,4,5,6
6	Operators and Expression and Managing I/O operations	2,3,4
7	Conditional statement and branching	1,4,5,6
8	Arrays and Strings	2,4,5



SECOND YEAR B.TECH

P P SAVANI UNIVERSITY														
SCHOOL OF ENGINEERING														
TEACHING & EXAMINATION SCHEME FOR B.TECH. SECOND YEAR CHEMICAL ENGINEERING PROGRAMME AY:2019-20														
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**	
3	SESH2031	Differential Methods for Chemical Engineers	3	0	2	5	5	40	60	00	00	50	00	150
	SECH2010	Chemical Process Calculation	3	0	1	4	4	40	60	00	00	50	00	150
	SECH2020	Mechanical Operations	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2030	Unit Processes in Organic Synthesis	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2040	Chemical Engineering Materials and Metallurgy	2	0	0	2	2	40	60	00	00	00	00	100
	CFLS1020	Global Communication Skills	2	0	0	2	**2**	40	60	0	0	0	0	100
	SECH2910	Industrial Exposure	2			0	2	00	00	100	00	00	00	100
		Total				**23**	**23**							**900**
4	SESH2022	Numerical & Statistical Analysis	3	0	2	5	5	40	60	00	00	50	00	150
	SECH2050	Fluid Flow Operations	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2061	Physical, Inorganic & Analytical Chemistry	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2070	Chemical Engineering Thermodynamics-I	3	0	2	5	5	40	60	00	00	50	00	150
	SECH2080	Mass Transfer Operations – I	3	2	0	5	4	40	60	20	30	00	00	150
	CFLS3010	Foreign Language-I	2	0	0	2	2	40	60	0	0	0	0	100
	SEPD3040	Integrated Personality Development Course-I	2	0	0	2	1	100	0	0	0	0	0	100
		Total				**29**	**25**							**950**

P P Savani University
School of Engineering

Department of Science & Humanities

Course Code: SESH2031
Course Name: Differential Methods for Chemical Engineers
Prerequisite Course(s): SESH1010-Elementary Mathematics for Engineers

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	05	40	60	--	--	50	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- learn orientation of calculus and its applications in solving engineering problems including differential equations.
- learn introduction of Partial Differential Equations with methods of its solutions.
- learn applications of Integral Transforms for solving linear differential equations.
- learn introduction of Periodic functions and Fourier series with their applications for solving ODEs.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Ordinary Differential Equation** First order ODEs, Formation of differential equations, Solution of differential equation, Solution of equations in separable form, Exact first order ODEs, Linear first order ODEs, Bernoulli Equation, ODEs of Second and Higher order, Homogeneous linear ODEs, Linear Dependence and Independence of Solutions, Homogeneous linear ODEs with constant coefficients, Differential Operators Nonhomogeneous ODEs, Undetermined Coefficients, Variation of Parameters.	10	22
2.	**Partial Differential Equation** Formation of First and Second order equations, Solution of First order equations, Linear and Non-liner equations of first, Higher order equations with constant coefficients, Complementary function, Particular Integrals.	07	15
3.	**Integral Transform-A** Laplace Transform, Linearity, First Shifting Theorem, Existence Theorem, Transforms of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Dirac's Delta function,	06	13

	Laplace Transformation of Periodic function, Inverse Laplace transform, Convolution		
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Integral Transform-B** Introduction of Z transform, Linearity property, Damping rule, Basic theory of Z transform, Inverse Z-transform, Convolutions theorems, Application to Difference Equations	09	21
5.	**Fourier Series** Periodic function, Euler Formula, Arbitrary Period, Even and Odd function, Half-Range Expansions, Applications to ODEs.	06	14
6.	**Fourier Integral and Transformation** Representation by Fourier Integral, Fourier Cosine Integral, Fourier Sine Integral, Fourier Cosine Transform and Sine Transform, Linearity, Fourier Transform of Derivatives.	07	15
TOTAL		45	100

List of Tutorials:

Sr. No.	**Name of Tutorial**	**Hours**
1.	Ordinary Differential Equation-1	02
2.	Ordinary Differential Equation-2	02
3.	Ordinary Differential Equation-3	04
4.	Partial Differential Equation-1	02
5.	Partial Differential Equation-2	04
6.	Laplace Transform	02
7.	z-Transform-1	02
8.	z-Transform-2	02
9.	z-Transform-3	04
10.	Fourier Series-1	02
11.	Fourier Series-2	02
12.	Fourier Integral and Transformation	02
TOTAL		30

Text Book(s):

Title	**Author/s**	**Publication**
Advanced Engineering Mathematics	Erwin Kreyszig	Wiley India Pvt. Ltd.

Reference Book(s):

Title	**Author/s**	**Publication**
Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers
Advanced Engineering Mathematics	R. K. Jain, S.R.K. Iyengar	Narosa Publishing House Pvt. Ltd.
Differential Equations for Dummies	Steven Holzner	Wiley India Pvt. Ltd.
Higher Engineering Mathematics	H.K. Dass, Er. Rajnish Verma	S. Chand & Company Pvt. Ltd.

Web Material Link(s):

1) http://nptel.ac.in/courses/111105035/
2) http://nptel.ac.in/courses/111106100/
3) http://nptel.ac.in/courses/111105093/
4) http://nptel.ac.in/courses/111108081/

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 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

SESH2031	**DIFFERENTIAL METHODS FOR CHEMICAL ENGINEERS**
CO1	Describe 1st and 2nd order odes and pdes.
CO2	Classify differential equations and evaluate linear and non linear partial differential equations.
CO3	Apply laplace transform as a tool which are used to evaluate differential equation and fourier integral representation.
CO4	Evaluate the solution of difference equation by using z transform.
CO5	Examine the various tests of power series and fourier series for learning engineering.

Mapping of CO with PO

SESH2031	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	1								1
CO 2	3	1	1	1								1
CO 3	3	1	1	1								1
CO 4	3	1	1	1								1
CO 5	3	1	1	1								1

Mapping of CO with PSO

SESH2031	PSO1	PSO2	PSO3
CO 1	2	1	
CO 2	2	1	
CO 3	2	1	
CO 4	2	1	

CO 5	2	1	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Ordinary Differential Equation	1, 2, 3, 5
2	Partial Differential Equation	1, 2, 4, 5
3	Laplace Transform	1, 2, 4, 5
4	Z-transform	1, 2, 4
5	Fourier Series	1, 2, 3, 5
6	Fourier Integral and Transformation	1, 2, 3, 4

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2010
Course Name: Chemical Process Calculations
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	--	01	04	40	60	--	--	50	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- know the conventions and the methods of chemical process.
- develop the basic acumen for the Chemical Engineering and its calculations.
- know how to carry out various process calculations.
- improve their analytical skills for various chemical processes.
- improve their technical ability in the form of numerical analysis of chemical problems.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction:** Chemical Engineering and Chemical Industry, Steady state and unsteady state processes, Unit Operations, Unit Processes and Process Flow Diagrams.	02	03
2.	**Graphics and Basics of Chemical Processes:** Graphical methods of curve fittings, Method of least squares, Solution of cubic equations by trial and error method, Conversion of units, Dimensional analysis, Properties of gas, liquid and solid, Equations of state.	03	07
3.	**Basic Calculations:** State properties: Molecular weight, Compositions, Density, Vapor pressure etc for gas, liquid and solid systems, Thermal properties: Heat capacity, Sensible heat, Latent heat, Heat of reaction, Heat of solution, Enthalpy calculations etc. for gas, liquid and solid systems, Techniques of problem Solution: Analytical, Graphical and Numerical, Gas laws and phase equilibria, Humidity, Saturation and Crystallization.	09	20
4.	**Material Balances:** Materials balance: Concepts of limiting and excess reactants,	09	20

	Batch, Stage-wise, Continuous and recycle operations, Material balance of systems involving mixing, extraction, distillation, crystallization, chemical reaction and recycle processes, Material balance equations based on conservation principle, Material balances for non-reactive processes (Unit Operations), Material balances for reactive processes.		
Section II			
Module No	**Content**	**Hours**	**Weightage in %**
5.	**Vapour pressure:** Vapour pressure plots, Vapour pressure of immiscible liquids and vapour pressure of solutions; Humidity and saturation humidity chart, Super saturation, Distribution of a solute between immiscible and partially miscible liquids, Solubility of gases.	03	05
6.	**Thermo physics and Energy Balances:** Energy balances for closed and open systems based on energy conservation principle, Energy balances for non-reactive processes (Unit Operations), Energy balances for reactive processes, Coupled material and energy balances for single unit process, Heats of formation, combustion, reaction, solution, dilution, Effect of temperature on heat of reaction, Energy balance of systems without and with chemical reactions, Heat capacity calculations, Enthalpy changes of reactions, dissolution and laws of thermochemistry, Effect of pressure and temperature on heat of reactions.	12	25
7.	**Multiple Unit Processes:** Introduction to processes with multiple Units; Material balances on processes with recycle, Purge, and bypass, Introduction to DOF analysis and solution strategy for multi-unit process, Degrees of freedom in steady-state processes, Simultaneous material and energy balance problems using flow sheeting codes, Unsteady state material and energy balances.	07	20
	TOTAL	45	100

List of Tutorials:

Sr No	Name of Tutorials	Hours
1.	Tutorial – 1 – basics to Unit operations and Unit Conversion	01
2.	Tutorial – 2- Method of least squares	01
3.	Tutorial – 3- Dimensional analysis	01
4.	Tutorial – 4- Material Balances	01
5.	Tutorial – 5- Material Balances	02
6.	Tutorial – 6- Material Balances	02
7.	Tutorial – 7- Material Balances	01

8.	Tutorial – 8 - Material balances for non-reactive processes	01
9.	Tutorial – 9- Material balances for non-reactive processes	01
10.	Tutorial – 10 - Material balances for non-reactive processes	01
11.	Tutorial – 11 - Unsteady state material and energy balances	02
12.	Tutorial – 12 - Unsteady state material and energy balances	01
TOTAL		15

Text Book(s):

Title	Author/s	Publication
Stoichiometry	Bhatt, B.I. and Vora, S.M.	Tata McGraw-Hill Publishing Co., New Delhi.
Chemical Process Principles Part-I	Hougen, O.A., Watson. K.M. and Ragatz, R.A.	John Wiley & Sons, (CBS Publishers & Distributor, New Delhi).

Reference Book(s):

Title	Author/s	Publication
Basic Principles and Calculation in Chemical Engineering	Himmelblau, D.M.	Prentice Hall, Inc.
Introduction to Chemical Engineering	S K Ghoshal, S K Sanyal and S Dutta	Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
Conservation of Mass and Energy	Whitwell J.C. &Jone R.K.	McGraw-Hill, Singapore, 1973

Web Material Link(s):

- http://nptel.ac.in/courses/103103039/23

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 should be evaluated out of 10 Marks for each tutorial and average of the same will be converted to 30 marks.
- Numerical Test consists of 10 marks.
- Internal Viva consists of 10 marks.

Course Outcome(s):

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

SECH2010	CHEMICAL PROCESS CALCULATIONS
CO 1	Apply the concept of dimension and unit conversion to check dimensional consistency of balanced equations and understand the specific terms used in process calculation.
CO 2	Compute material balance problems on distillation, absorption, etc without chemical reactions.

CO 3	Compute material balance problems on batch and continuous process with chemical reactions.
CO 4	Solve energy balance problems on heat exchanger, evaporator, etc of various unit processes.
CO 5	Solve problems related to ideal and real gas and liquid solutions.

Mapping of CO with PO

SECH2010	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1										1
CO 2		1			1				1	1		1
CO 3				1					1	1		1
CO 4			1		1					1		1
CO 5	2	1		1	1					1		1

Mapping of CO with PSO

SECH2010	PSO1	PSO2	PSO3
CO 1		1	
CO 2	1	1	
CO 3		1	
CO 4	1	1	
CO 5	1	1	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1,2,5
2	Graphics and Basics of Chemical Processes	1,2,3,4,5
3	Basic Calculations	3,4,5
4	Material Balances	3,4,5
5	Vapour pressure	1,2,3,4,5
6	Thermo physics and Energy Balances	3,4,5
7	Multiple Unit Processes	3,4,5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2020
Course Name: Mechanical 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	
03	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand many basic principles of Chemical Engineering operations such as Size Reduction, Filtration, Sedimentation, Mixing and Agitation etc. and their mathematical co-relation.
- understand basic principles of particle preparation and their characterization.
- study various methods for storage of solids and conveyors available for their transportation.
- understand the performance of different equipment for separation of solids and size reduction

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Properties of particulate solid** Introduction to particle technology, Characterization of solid particles, particle size measurement techniques, Mixed particles, specific surface of mixture, Particle population.	02	05
2.	**Size reduction and enlargement** Types of equipment and their studies, Principles of comminution, Laws of crushing and grinding, Closed and open circuit grinding, power requirements, Energy and power required for comminution, Industrial processes for particle size enlargement, size enlargement equipment comminution, Broad classification, Primary breaking operations, Intermediate crushing by crushers, cone, roll and impact crushers, Ball and fumbling mills—fine grinding, Determination of power consumption.	10	20
3.	**Properties of masses of solids** Storage of solids: Angle of repose, bulk storage, storage in bins and silos.	02	08

4.	**Conveying of solids** Codes for characterization of solids, screw conveyers, belt conveyers, bucket elevators, pneumatic conveying of solids, Design of conveyor belts, Mechanical and pneumatic conveying equipment and power consumption.	03	07
5.	**Screening - equipment and efficiency** Screen analysis, Method of reporting screen analysis, Capacity and effectiveness of screens, Screen analysis, sizing curves, industrial sizing, screening revolving and vibrating screens, Screen efficiency and capacity, Classification: Laws, wet and dry methods, Types of classifiers—stationary, mechanical, centrifugal and hydraulic.	05	10
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**Filtration** Flow through porous media, Theories of filtration - Principles of filtration, constant rate and constant pressure filtration, Optimum cycle, compressible cakes and filter aids, constant pressure, constant rate filtration, compressible and incompressible cakes, cake resistance, filter media resistance, filter media, filter aids, filtration equipment (batch, continuous), selection criteria, washing of filter cakes, filtration by continuous vacuum and pressure filters.	06	15
7.	**Gravity setting and sedimentation** Gravity clarifiers, sorting clarifiers, Batch sedimentation, rate of sedimentation, Thickening process and sedimentation, Design of thickeners and clarifiers free and hindered setting, Centrifugal sedimentation: Principles of centrifugal sedimentation, Solid gas separation, liquid solid separation, Centrifugation.	05	10
8.	**Mixing** Mixing equipment and characteristics, power consumption and efficiency, mixing of powders and pastes: Mixers for cohesive and non-cohesive solids, Mixing Index Agitation and mixing of liquids: Basic stirred tank design, Types of impellers, flow patterns, power consumption and scale up.	06	10
9.	**Separators** Cyclones and electrostatic precipitator, Flotation, Thickeners,	06	15

	Flotation, Physico-chemical principles, Chemistry of flotation reagents and their functions, Flotation processes, Froth flotation machines, Concentration of copper, lead and zinc ores by flotation, Flotation of non-sulphide ores of copper and lead, dolomite, fluorspar, gypsum, phosphates, manganese, silica, sillimanite, graphite and coal, Electrical and magnetic concentration, Electrostatic and magnetic separations, dry and wet type separators.		
TOTAL		45	100

List of Practical:

Sr No	Name of Practical	Hours
13.	Determination of particle size by sieve analysis.	02
14.	Determination of the optimum speed and critical speed of a ball mill.	02
15.	Measurement of different bulk properties of powder samples.	02
16.	To study powder compaction behaviour using different powder compaction models.	02
17.	Study of particle size reduction by Roll crusher and Jaw crusher	04
18.	Characterization of powder flow ability by Angle of Repose.	04
19.	Obtaining the collection efficiency of cyclone	02
20.	Obtaining settling rates of slurry as function of solid concentration	02
21.	Power consumption in Agitated vessels	02
22.	Study of froth flotation process	02
23.	Study of Plate and Frame filter place	04
24.	Study of Centrifugation process	02
TOTAL		30

Text Book(s):

Title	Author/s	Publication
Unit Operations of Chemical Engineering	W L McCabe and J C Smith	McGraw-Hill International
Principles of Mineral Dressing	A M Gaudin	Tata McGraw-Hill Publishing Co. Ltd., New Delhi
Elements of Ore Dressing	A F Taggart	John Wiley and Sons, New York

Reference Book(s):

Title	Author/s	Publication
Chemical Engineering Vol.- II, 6th Ed.	J.M. Coulson & J.F. Richardson	Elsevier, 2003 or Pergamon Press
Unit Operations	G.G. Brown Ed.	John Wiley & Sons, 1950
Transport Processes and Separation Process Principles' 4th Ed,	C.G. Geankopolis	Prentice Hall India, 2003

Web Material Link(s):
http://nptel.ac.in/syllabus/103107091

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 of various topics consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH2020	**MECHANICAL OPERATIONS**
CO 1	Apply and distinguish fluid particle systems and equipment.
CO 2	Select suitable size reduction equipment for solid solid separation method and conveying system.
CO 3	Describe and analyze agitation and mixing and their equipment.
CO 4	Classify solid liquid gas separation equipment. liquid gas separation equipment.

Mapping of CO with PO

SECH2020	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2	2	1		1			1	1	
CO 2	3	2	2	2	1		1			1	1	
CO 3	2	2	2	2	1		1			1	1	
CO 4	2	2	2	2	1		1			1	1	

Mapping of CO with PSO

SECH2020	PSO1	PSO2	PSO3
CO 1	2	2	
CO 2	2	2	
CO 3	2	2	
CO 4	2	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Solid Properties	1
2	Size Reduction	1,2,3,4
3	Particulate properties	1,2,4
4	Conveying of Solids	1,3,4
5	Screening	2,4,5
6	Filtration	2,4,5
7	Gravity settling	2,4,5
8	Mixing	2,4,5
9	Separators	2,4,5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2030
Course Name: Unit Processes in Organic Synthesis
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	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- develop an acumen for various chemical processes used in industries
- develop a mindset for various organic synthesis
- develop an acumen for design and development of process flow diagrams (PFDs) for various chemical processes

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction** Definition and importance of unit processes in chemical engineering, Concept of unit operation and unit processes and their role in systematizing the cognitive structure of chemical industries, Classification of unit processes, Chemical process kinetics and Factors affecting, Symbols used in Chem. Engineering, Process flow diagram, Introduction to thermochemistry	04	09
2.	**Nitration** Introduction to nitration reactions, Nitrating agents, Aromatic Nitration, Kinetics and mechanism of aromatic nitration, Nitration of paraffinic hydrocarbon, Thermodynamics of nitration, Process equipment for technical nitration - schimid and Biazznitrator, Mixed acid for nitration, D.V.S. value and nitric reaction, Comparison of batch Vs. Cont. nitration, Mfg. of Nitrobenzene, Dinitrobenzene, O-and P-Chloronitrobenzene, tri nitrotoluene.	05	12
3.	**Amination by reduction** Introduction to Amination reactions, Various methods of reductions and factors affecting it, Iron and acid (Bechamp)	05	11

	reduction, Batch and continuous process for manufacture of Aniline from Nitrobenzene, Continuous process for manufacturing of Aniline from nitrobenzene using catalytic fluidized bed reactor.		
4.	**Hydrogenation** Definition and scope of hydrogenation, Hydrogen: production and properties, Gas catalytic hydrogenation and hydrogenlysis, Kinetics and thermodynamics of hydrogenation reactions, General principles concerning hydrogenation catalysts, Industrial hydrogenation of fat & oil, Production of methanol from CO_2& H_2. Hydrogen production technologies and petroleum fractions.	03	07
5.	**Oxidation** Definition and Types of oxidative reactions, Oxidizing agents, Liquid phase oxidation with oxidizing compounds, Liquid-phase oxidation with oxygen, Oxidation of toluene with MnO2. Manufacturing of Acetaldehyde from Acetic acid and Manufacturing of Acetic acid from Ethanol; Vapor phase oxidation of Methanol, Benzene and Naphthalene, Apparatus and its M/s. for oxidation reactions.	05	11
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**Esterification and Hydrolysis** Definition and scope of Esterification, Esterification by organic acids and by carboxylic acid derivatives, Esters by addition to unsaturated systems and inorganic acids, Definition and scope of hydrolysis, Hydrolyzing agents, Materials susceptible to hydrolysis, Kinetics, thermodynamics, and mechanism of hydrolysis, Equipment for hydrolysis with technical operations.	03	06
7.	**Halogenation** Definition and scope of halogenation reactions, Thermodynamics and kinetics of halogenation reactions Halogenating agents, Industrial halogenation with types of equipment, Manufacturing of Chlorobenzene, Benzene hexa-chloride and vinyl chloride from Ethylene and Acetylene.	05	09
8.	**Sulfonation and sulfation** Definition and scope of sulfonation and sulfation, Chemical and physical factors in sulfonation and sulfation, Thedesulfonation reaction, Use of SO_3, SO_2, H_2SO_4 as sulfonating and sulfating agents and their applications, Mfg. of Benzene sulfonates, Sulfation of Dimethyl Ether and Lauryl Alcohol.	04	10
9.	**Amination by ammonolysis** Definition & types of reactions, Aminating agents, Physical and Chemical factors affecting it. Catalyst used in ammonolysis,	04	08

	Kinetics and Thermodynamics of ammonolysis Mfg. of Aniline from chlorobenzene and Nitroaniline from Dichloro Nitro Aniline.		
10.	**Hydrolysis** Definition and types of hydrolysis, Hydrolyzing agents, Kinetics, thermodynamics, and mechanism of hydrolysis, Industrial Hydrolysis of fat, hydrolysis of carbohydrates, starch to dextrose, Manufacturing of ethanol from ethylene (shell process) Mfg. of phenol from benzene sulfonic.	05	09
11.	**Polymerization** Introduction & chemistry of polymerization reactions, classifications of polymers methods of polymerization.	02	08
TOTAL		45	100

List of Practical:

Sr No	Name of Practical	Hours
1.	Preparation of Urea-formaldehyde Resin	02
2.	Synthesis of Phenol-formaldehyde Resin	02
3.	Manufacturing of m-dinitrobenzene from Nitrobenzene	04
4.	Determination of amount of benzoic acid in given sample	04
5.	Residual Chlorine in water	02
6.	Estimation of phenol by bromination	04
7.	Determination of Ascorbic acid in a given sample	04
8.	Determination of amount of acid neutralize capacity by given antacid sample	02
9.	Preparation of Azo dye	02
10.	Determination of oil absorption value of given pigment sample	04
TOTAL		30

Text Book(s):

Title	Author/s	Publication
Unit Processing of Organic Synthesis, 5th edition	Groggins P. H.	Tata-McGraw Hill, New Delhi, 2001
Shreve's Chemical Process Industries, 5th Edition	Austin G. T	McGraw-Hill Pub., 1994.
Unit Processes in Organic Chemical Industries	Desikan, P and Sivakumar, T.C.	Chemical Engineering Education Development Centre, IIT Madras, 1982.

Reference Book(s):

Title	Author/s	Publication
Dryden's Outlines of Chemical Tech. 2nd Ed.	Gopalarao. M. & Sitting M.	East-West Pub., New Delhi, 1997.
Elementary Principles of Chemical Processes3rd ed.	Felder R.M., Rousseau R.W.	John Wiley, New York, 2000.
Riggel's Handbook of Industrial Chemistry	Kent J.A.	Van Nostrant Reinhold, 1974.

Web Material Link(s):

- http://nptel.ac.in/courses/103107082/3

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 should 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 the completion of the course, the student will able to

SECH2030	**UNIT PROCESSES IN ORGANIC SYNTHESIS**
CO 1	Describe unit operations and unit processes in chemical process industry.
CO 2	Discover fundamental structure of organic molecules and their synthesis processes.
CO 3	Describe and analyze chemical reactions such as nitration, amination and sulfonation in inorganic chemical industry.
CO 4	Distinguish and analyze chemical reactions such as nitration, amination and sulfonation in inorganic chemical industry.
CO 5	Distinguish and analyze chemical reactions such as hydration, polymerization and esterification in organic chemical industry.

Mapping of CO with PO

SECH2030	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1					2						
CO 2	1					2						
CO 3						2						
CO 4						3						
CO 5						3						

Mapping of CO with PSO

SECH2030	PSO1	PSO2	PSO3
CO 1	3		
CO 2	3		
CO 3	3		
CO 4	3		
CO 5	3		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1,2
2	Nitration	1,2,4
3	Amination by Reduction	1,2,4
4	Hydrogenation	1,2
5	Oxidation	1,2
6	Esterification and Hydrolysis	1,2,4
7	Halogenation	1,2
8	Sulfonation & Sulfaction	1,2,4
9	Amination by Ammonolysis	1,2,4
10	Hydrolysis	1,2
11	Polymerization	1,2

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2040
Course Name: Chemical Engineering Materials & Metallurgy
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	
02	--	--	02	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

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

- identify the different chemicals and related materials and their properties.
- understand the microstructures, crystallography, defects, and phase diagrams of different materials.
- help the students to understand the process involved in chemical and mechanical testing of materials under certain conditions.
- make them aware about the advancements in the area of materials used in chemical and allied industries.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction to Engineering Materials** Classification of engineering materials, Engineering requirements from materials, Basics of crystals and their correlated properties, Factors that govern material selection for engineering applications, Micro and macro examination.	02	07
2.	**Structure and Imperfections in Crystals** Introduction, Unit cells and their lattice structure, coordination number, crystal structure of metals, Atomic packing factor, Crystallographic planes and directions, Polymorphism and Allotropy, Diffusion in solids, Imperfection in crystals and their types.	03	03
3.	**Properties of Materials** Mechanical, Electrical and magnetic properties of materials, Selection of material like SS, Ti/Zr alloy and design for corrosion control, Factors determining the choice of materials of construction in chemical industries.	02	05

4.	**Ferrous metals and its Alloys** Iron and their alloys - Aluminium, copper, Zinc, lead, Nickel and their alloys with reference to the application in chemical industries. Phase Diagrams and Phase Transformation, TTT and CCT Diagrams. Iron-Iron Carbide and Iron-carbon diagrams, Overview of different types of irons - Wrought iron Pig iron, Cast iron, White Cast Iron, Grey Cast Iron, Malleable Cast Iron and their properties and characteristics, deformation of metals, Types of steel like Chromium, Manganese, Molybdenum and Manganese steels.	03	15
5.	**Metals: their behaviours and properties** Solidification of metals and an alloy, Nucleation and Growth, Solidification defects, Effects of Structure on Mechanical Properties, Methods to control the grain structure resulting from solidification, Cooling curve of pure metal and alloy, Deformation in polycrystalline materials, Mechanical testing of materials (destructive & non-destructive) testing methods.	03	12
6.	**Heat Treatment and Surface hardening processes** Annealing and its types, Normalizing, Aus-tempering, Mar-tempering, Quenching and Temper heat treatment, Hardenability, Applications of above processes for the industrial practices, Flame and induction hardening, Carburizing, Nitriding and Carbonitriding, Applications of above processes for the industrial practices.	02	08
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
7.	**Polymers, Ceramics, and Composites:** Methods of fabrication of materials like timber, plastics, rubber, fibres and other polymeric materials, Ceramics, Ceramic Matrix, Crystalline and non-crystalline ceramic systems, Properties of ceramic materials, Glass and refractories, Cement refractories, Alumina, Zirconia, Silicon Carbide, Sialons, Reaction Bonded Silicon Nitride, Processing Composite materials, Fibre reinforced plastic (FRP), Organic materials like wood, plastics, and rubber, Advanced materials like Biomaterials and composites with special reference to the applications in chemical Industries, Polymers - Definition, Classification & characteristics, Types of polymerization, Polymer processing, Smart polymer, Advanced polymer Conductive polymer, bio-route prepared nano polymer, Blended polymer, self-cleaning polymer surfaces.	04	15
8.	**Membrane Materials and modules**	03	10

	Membrane and their types, Membrane Materials, Modules and their types, method of preparation of various membranes, Industrial applications.		
9.	**Applications of advance materials in chemical Engineering** Colloidal Materials and Their Industrial Applications, Surfactants, Mixed surfactants, Micelles, Vesicles, Micelles, Reverse micelles, Emulsions, Macroemulsions, foams, Thin Films, microbial polymers**,** green solvents, Industrial enzymes, Protein as Enzymes, Gels and Smart Hydrogels like Hydrogel, Core and shell hydrogel, shell and core hydrogel, green hydrogel, stimuli responsiveness hydrogel.	05	15
10.	**Nano materials** Metal and Semiconductor Nano materials, Quantum Dots, Wells and Wires, Molecule to bulk transitions, Bucky balls and Carbon Nano tubes, Nano composite, Molecular machines, Nanofactories, Nanocatalysts, Nanocomposites, Bio-analytical tools, Nano/micro arrays, Nano devices, lab-on-a-chip etc.	03	10
TOTAL		30	100

Text Book(s):

Title	Author/s	Publication
Materials Science and Metallurgy	O. P. Khanna	Dhanpatrai Publication
Chemical Engineering Materials	Rumford F.	Constable and Company Limited, 2nd Edition, 1987
Membrane Separation Processes	Kaushik Nath	PHI Pvt. Ltd., 2008
Principles of Colloid and Surface Chemistry, 3rd Edn.	Hiemenz, P. C., and R. Rajgopalan	Marcel Dekker, NY, 1997.
Nano chemistry A chemical approach to nanomaterials	Ozin G. A, Andre C. Arsenault	Royal society of chemistry, UK,2005.

Reference Book(s):

Title	Author/s	Publication
Callister's Material Science and Engineering	R. Balasubramanian	Wiley India
Chemical Engineering Materials	Chaudhry H.	Indian Book Distributing Company, 2nd Edition, Delhi, 1982

Web Material Link(s):

- http://nptel.ac.in/downloads/113106032/

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 the completion of the course, the student will able to

SECH2040	**CHEMICAL ENGINEERING MATERIALS & METALLEURGY**
CO 1	Enable understanding of crystal structure of various materials.
CO 2	Analyze microstructures, crystallography and defects of different chemical engineering materials and metals
CO 3	Classify the metallurgy of ferrous and non ferrous metals and alloys.
CO 4	Define the basics of polymers and composite material.

Mapping of CO with PO

SECH2040	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1			3			3			1		
CO 2	1			1			3			3		
CO 3	1			2						3		
CO 4	1			1								

Mapping of CO with PSO

SECH2040	PSO1	PSO2	PSO3
CO 1	3	3	2
CO 2	3	3	3
CO 3			
CO 4			

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Engineering Materials	1,2
2	Structure and Imperfections in Crystals	2,3
3	Properties of Materials	4
4	Metals: their behaviours and properties	2,3,4
5	Heat Treatment and Surface hardening processes	2,3,4
6	Powder Metallurgy	2,5
7	Polymers, Ceramics, and Composites	1,2,3
8	Membrane Materials and modules	1,2
9	Applications of advance materials in chemical Engineering	3,5,6
10	Nano materials	3,5,6

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2910
Course Name: Industrial Exposure
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	
--	--	--	02	--	--	100	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective of the Course:

To help learners to

- get exposed to the industrial spectrum.
- learn the mechanisms of industry/ workplace.
- be aware about work culture and policies of industries.

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
TOTAL		**100**

Course Outcome(s):

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

SECH2910	INDUSTRIAL EXPOSURE
CO 1	Construct company profile by compiling brief history, management structure, products/services offered, key achievements and market performance for the company visited during internship.
CO 2	Determine the challenges and future potential for his/her internship organization in particular and the sector in general.
CO 3	Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.
CO 4	Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship

	organization.
CO 5	Analyze the functioning of internship organization and recommend changes for improvement in processes.

Mapping of CO with PO

SECH2910	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	2	3	3	3	3	3					3
CO 2	1	2	3	3	3	3	3				3	3
CO 3	1	2	3	3	3	3	3				3	
CO 4	1	1					3				3	3
CO 5	1	1	2	3	3	3	3					3

Mapping of CO with PSO

SECH2910	PSO1	PSO2	PSO3
CO 1			
CO 2	3	3	3
CO 3	3	3	3
CO 4			
CO 5		3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Selection of Companies	1,2,3,4
2	Company Information collection	1,2,3,4
3	Report Writing	1,2,3,4
4	Presentation & Question-Answer	1,2,3,4

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 Science & Humanities

Course Code: SESH2022
Course Name: Numerical & Statistical Analysis
Prerequisite Course(s): SESH1020-Linear Algebra & Vector Calculus
SESH2031-Differential Methods for Chemical Engineers

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	05	40	60	--	--	50	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- provide the knowledge of numerical analysis & statistical methods to the students.
- mentally prepare the students to identify and formulate the engineering problem and obtain their solution.
- inculcate the analytical skill of the students to apply the Numerical & Statistical techniques to the problems of respective field.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Complex Variables** Complex numbers with operators and geometric representation, Analytic function, Derivative of complex function, Cauchy-Riemann equation, Trigonometric and Hyperbolic functions, Complex Integration, Conformal Mapping, Linear functional transformations, Cauchy's Integral, Calculation of residue	10	20
2.	**Numerical Solutions of Linear and Non-linear Equations** Errors and Their computations, General error formula, Bisection Method, Iteration Method, Newton-Raphson Method, Solution of system of non-linear equation, Solution of linear system, Gauss Elimination	6	13
3.	**Numerical Differentiation and Integration** Interpolation, Finite Differences, Error in numerical differentiation, Cubic Splines Method, Differentiation Formulae, Numerical solution of ODEs, Picard's Method, Euler's Method, Runge-Kutta Method, Numerical Integration, Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule,	7	17

	Euler-Maclaurin Formulae		
Section II			
Module	**Content**	**Hours**	**Weightage in %**
4.	**Basics of Statistics** Elements, Variables, Observations, Quantitative and Qualitative data, Corss-sectional and Time series data, Frequency distribution, Dot plot, Histogram, Cumulative distribution, Measure of location, Mean, Median, Mode, Percentile, Quartile, Measure of variability, Range, Interquartile Range, Variance, Standard Deviation, Coefficient of Variation, Regression Analysis, Regression line and regression coefficient, Karl Pearson's method	07	15
5.	**Probability Distribution** Introduction, Conditional probability, Independent events, independent experiments, Theorem of total probability and Bayes' theorem, Probability distribution, Binomial distribution, Poisson distribution, Uniform distribution, Normal distribution.	08	18
6.	**Testing of Hypothesis** Introduction, Sampling, Tests of significance for parametric test, Null Hypothesis, Type 1 and Type 2 errors, Level of significance, Chi-square test, Student's t-test, Seducer's f-test	07	17
	TOTAL	45	100

List of Tutorials:

Sr. No.	**Name of Tutorials**	**Hours**
1.	Complex Variables-1	04
2.	Complex Variables-2	02
3.	Numerical Solutions of Linear and Non-linear Equations-1	02
4.	Numerical Solutions of Linear and Non-linear Equations-2	04
5.	Numerical Differentiation and Integration-1	02
6.	Numerical Differentiation and Integration-2	02
7.	Basics of Statistics-1	02
8.	Basics of Statistics-2	04
9.	Probability-1	02
10.	Probability-2	02
11.	Testing of Hypothesis-1	02
12.	Testing of Hypothesis-2	02
TOTAL		30

Text Book(s):

Title	**Author/s**	**Publication**
Advanced Engineering Mathematics	Erwin Kreyszig	Wiley India Pvt. Ltd. New Delhi.
Probability and Statistics for Engineers	Richard A. Johnson	Pearson India Education

	Irwin Miller, John Freund	Services Pvt. Ltd., Noida.

Reference Book(s):

Title	Author/s	Publication
Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers, New Delhi
Advanced Engineering Mathematics	R. K. Jain, S. R. K. Iyengar	Narosa Publishing House, New Delhi.
Introductory Methods of Numerical Analysis	S. S. Sastry	PHI Learning Pvt. Ltd., New Delhi.

Web Material Link(s):

- http://nptel.ac.in/courses/111106094/
- http://nptel.ac.in/courses/111106084/
- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111101003/
- http://nptel.ac.in/courses/111105090/

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 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

Course Outcome(s):

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

SESH2022	NUMERICAL & STATISTICAL ANALYSIS
CO 1	Derive numerical solution of linear and nonlinear system of equation.
CO 2	Apply probability in decision making, artificial intelligence, machine learning etc.
CO 3	Construct different statistical methods to collect, compare, interpret & evaluate data.
CO 4	Acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration.

Mapping of CO with PO

SESH2022	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	2	3	3	2	2		3			3
CO 2	2	3	2	3	3	2	2		3			3
CO 3	2	3	3	3	3	2	2		3			3
CO 4	2	3	2	3	3	2	2		3			3

Mapping of CO with PSO

SESH2022	PSO1	PSO2	PSO3
CO 1		2	
CO 2		2	
CO 3		2	
CO 4		2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Complex Variables	1, 2, 3, 4, 6
2	Numerical Solutions of Linear and Non-linear Equations	1, 2, 3, 5
3	Numerical Differentiation and Integration	1, 2, 3, 5
4	Basics of Statistics	1, 2, 3, 4, 5
5	Probability Distribution	1, 2, 3, 4, 5
6	Testing of Hypothesis	1, 2, 3, 5, 6

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2050
Course Name: Fluid Flow 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	
03	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- get the introductory idea and explanation of basic fundamentals of Fluid Flow Operations which is used in the applications of chemical engineering, Porous media movement, Aerodynamics, hydraulics, Marine Engineering, Gas dynamics etc.
- learn Fluid Properties.
- understand the importance of flow measurement and its applications in Industries and to obtain the loss of flow in a flow system.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Properties of fluids and concept of pressure** Definitions of Unit operations, Basic concepts of fluids and its application, Properties of fluids (Density, Viscosity, Surface Tension, Compressibility, Capillary, Vapour Pressure, Bulk Modulus, Cavitation, Classification of Fluids), Unit Conversion, Dimensional analysis, Dimensional homogeneity, Dimensionless equations, Raleigh and Buckingham π theorem, Common π groups, Non Dimensional Numbers, Similarities – Geometrical, Kinematics and Dynamic.	03	05
2.	**Fluid statics & its application** Nature of fluids: Incompressible and compressible fluids, Pressure concepts, Force and Pressure, Pascal's law of Pressure at a point, Pressure measurement by Manometers – U tube, Inclined U tube and Differential, Centre of Pressure, Hydrostatic equilibrium in gravitational and centrifugal field, Hydrostatic forces on surface – Vertical, Horizontal and Inclined, Forces on curved Surfaces, Buoyancy and Buoyant Force, Centre of Buoyancy and Meta Centre, Determination of	04	10

	Metacentric Height, Stability of Floating and Submerged Body, Position of metacentre relative to Centre of buoyancy. Manometers, Inclined manometer, Continuous gravity and centrifugal decanter.		
3.	**Boundary layers & its applications** Concept of Boundary Layer, Boundary layer Thickness, Momentum Thickness, Displacement Thickness, Drag and Lift, Separation of Boundary layer, Streamlined and Bluffed Bodies.	03	05
4.	**Momentum Balance and their Applications** Kinematics of fluid flow, Types of flow, Steady and Unsteady Flow, Potential flow, One – two and three Dimensional Flow, Uniform and Non Uniform Flow, Rotational and Irrotational Flow, Stream Lines and Stream Function, Velocity Potential Function, Relation between stream and velocity potential function, Flow nets, Continuity Equation for 2D and 3D flow in Cartesian co-ordinates system , Laminar flow, Reynolds number, Newtonian and non-Newtonian fluids, Velocity gradient and Rate of shear, Expression for co-efficient of friction – DracyWeishbach Equation, Moody's Diagram resistance for smooth and rough pipes, Viscosity of gases and liquids, Turbulent flow, Nature of turbulence, Eddy viscosity, Eddy diffusivity of momentum, Flow in boundary layers, Laminar and turbulent flow in boundary layers, Boundary layer formation in straight tube and flat plates, Boundary layer thickness, Boundary layer separation and wake formation.	04	10
5.	**Basic fluid equations &fluid dynamics** Stream line and stream tubes, Average velocity, Mass velocity, Momentum balance, Bernoulli's equation without friction & its applications, Correction of Bernoulli's equation for fluid friction, Pump work in Bernoulli's equation. Newton's law of motion, Euler's Equation and its applications, Momentum Equation, Pitot Tube, Determination of volumetric flow with pitot tube, Principle of Venturimeter, Pipe Orifice and Rotameter.	03	05
6.	**Flow of incompressible fluids through ducts and its applications in conduits and thin layers** Flow of incompressible fluids in pipes, Friction factor, Laminar flow of Newtonian and non-Newtonian fluids, Turbulent flow in pipes and closed channels, Effect of roughness, Friction factor chart, Drag reduction in turbulent flow Friction factor in flow through channels of noncircular cross section, Friction from changes in velocity or direction, Effect of fittings and valves, Major and Minor Losses in Pipes, Hydraulic Gradient line and Total energy line, Equivalent Pipes, Pipes in series and parallel, Siphon, Power transmission through pipe, Moody's Diagram, Practical use of velocity heads in design,	06	15

	Minimization expansion and contraction losses. Flow through Open Channel: Specific Energy and Specific Force, Critical Flow, Hydraulic Jump, Measurement of Discharge in open Channels.		
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
7.	**Flow of compressible fluids and its applications** Introduction to compressible flow, flow through pipes and nozzles, Fans, Blowers ejectors and compressors; Continuity equations, Velocity of sound, Stagnation temperature, Processes of compressible flow.	05	10
8.	**Flow of Fluids through Solids** Form drag - skin drag - Drag co-efficient. Flow around solids and packed beds. Friction factor for packed beds. Ergun's Equation - Motion of particles through fluids - Motion under gravitational and centrifugal fields - Terminal settling velocity. Fluidisation - Mechanism, types, general properties – applications	05	10
9.	**Transportation and Metering** Transportation of fluids, Pipes, pipe standards, fittings, pipe joints, valves and their constructional features, Fluid moving machinery: Positive displacement and centrifugal pumps, centrifugal pump theory, concept of NPSH, pump performance and characteristics, Measurement of fluid flow: Orifice meter, venturi meter, pitot tube, rotameter, weirs and notches Wet gas meter and dry gas meter, Area meters; Head meters; Mass flow meter; Hot-wire anemometer, Hot wire and hot film anemometers.	06	15
10.	**Applications of fluid mechanics** Pipe, fitting and valves, pumps, compressor, blowers and fans, Flow past immersed bodies: Drag, Drag coefficients, Flow through beds of solids, Particle motion, Terminal velocity, Hindered settling, Settling and rise of bubbles and drops, Fluidization, Special cases of Single and two phase flow through packed beds, two-phase gas liquid flow in pipes, Essentials of gas solid flows. Introduction to computational fluid dynamics (CFD).	06	15
TOTAL		45	100

List of Practical:

Sr No	Name of Practical	Hours
1.	Determine metacentric height of floating body.	02
2.	Measurement of pressure using different types of manometers.	04
3.	Determine Co-efficient of Discharge by venturimeter, Orificemeter and Rotameter.	04

4.	Verification of Bernoulli's apparatus.	02
5.	Measurement of velocity of flow using Pitot tube.	02
6.	Measurement of Friction factor for Different pipes & annulus.	02
7.	Measurement of viscosity using Redwood Viscometer.	02
8.	Determine discharge through triangular/trapezoidal / rectangular notch.	02
9.	Determine different flow patterns by Reynolds's apparatus.	02
10.	Measurement of lift and drag of aerofoil.	02
11.	Measurement of static pressure distribution around aerofoil using wind tunnel.	02
12.	Experiment on viscosity by stoke's law	02
13.	Experiments on characteristics of centrifugal pumps	02
TOTAL		30

Text Book(s):

Title	**Author/s**	**Publication**
Textbook of Fluid Mechanics and Hydraulic Machines	R. K. Bansal	Laxmi Publications
Introduction to Fluid Mechanics and Fluid Machines	S.K. Som& G Biswas.	Tata McGraw Hill Publication
Unit Operations of Chemical Engineering	McCabe W.L., Smith J.C., Harriott P.	McGraw Hill

Reference Book(s):

Title	**Author/s**	**Publication**
Fluid Mechanics	Frank M. White	Tata McGraw Hill Publication
Fluid Mechanics	R.K. Rajput	Schand Publication
Fluid Mechanics for Chemical Engineers	De Nevers N	McGraw-Hill

Web Material Link(s):

- http://nptel.ac.in/courses/112105171/1

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 should 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 of various topics consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH2050	FLUID FLOW OPERATIONS
CO 1	Describe fundamentals of fluids and its types.
CO 2	Analyze various flow problems and flow characteristics for various flow conditions.
CO 3	Demonstrate working of different flowmeters.
CO 4	Analyze major and minor frictional losses in different pipes fittings.
CO 5	Describe and observe different pumps and their performance.

Mapping of CO with PO

SECH2050	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	1							2		1
CO 2	2	1	1									
CO 3	1	1	1									
CO 4	1	1										
CO 5		1		1								

Mapping of CO with PSO

SECH2050	PSO1	PSO2	PSO3
CO 1	1		
CO 2	1	1	1
CO 3	2	1	
CO 4		3	
CO 5		1	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Basic Concept and Fluid statics & its application	1,2
2	Boundary layers & its applications	2,4
3	Kinematics of fluid flow	2,3,4
4	Basic fluid equations & fluid dynamics	1,2
5	Flow of compressible fluids and its applications	1,2,4,5
6	Flow of Fluids through Solids	2,3,4
7	Transportation	3,4,5
8	Flow of incompressible fluids through ducts and its applications in conduits and thin layers	1,2,6
9	Basic fluid equations &fluid dynamics	2,4,5
10	Boundary layers & its applications	2,3,4,5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2061
Course Name: Physical Inorganic and Analytical Chemistry
Prerequisite Course(s): 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	
03	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- provide the basic knowledge of physical, inorganic and analytical chemistry to students in the context of industrial need to make a good foundation in Chemistry which will help to the students in their self-development and to cope up with industries need.
- understand the basics of different chemistry
- make them aware about various analytical techniques used for the analysis of chemical substances
- use physical chemistry and its theoretical principles and experimental techniques to investigate the chemical transformations and Physical changes accompanying them.
- make them aware about the inorganic chemistry and its qualitative analysis.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Properties of Liquid and preparation of solution** Define the terms: Solute, Solvent and Solution, Different standards of solutions like Primary standards and Secondary standards, Definition and different methods of expressing concentration, Definition of the Surface tension, Parachor, Refractive index, Molar refraction, Specific refraction, Viscosity.	02	04
2.	**Electro analytical techniques for analysis** Basic concepts, Standard reduction potentials, Measurement of overall redox reaction tendency, Introduction to Potentiometry, Electrodes (Reference electrode, Saturated calomel reference electrode, indicator electrode, pH electrode), potentiometric titration, Karl Fischer titration (End point detection, The coulometric method)	06	14
3.	**Phase Rule**	03	07

	Introduction, Phase Rule and its merits and demerits, Phase diagrams of single component systems (H_2O and Sulphur), two component systems involving eutectic systems (Pb-Ag, Sn-Mg), Applications.		
4.	**Nuclear Chemistry** Basic terms and concepts, Types of nuclear reactions, Nuclear fission and fusion, nuclear reactors, radiation measurements (Detectors- Gas ionization detectors- principle, Ion chambers- proportional counter, G.M. Counter-scintillation detector- principle, features, Inorganic & organic scintillators, solid state detectors), disposal of nuclear waste.	05	11
5.	**Emerging Trends in Green Chemistry** Introduction to Green Chemistry, Twelve principles of Green Chemistry with examples, Designing a Green Synthesis, Example of green synthesis (adipic acid, catechol, Methyl Methacrylate).	02	04
6.	**Microscopy Techniques** Principles, Instrumentation, Analysis of images/artifacts, Applications, AFM (Atomic force microscopy), SEM (Scanning electron microscope), TEM (Transmission electron microscopy), FTIR.	04	10
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
7.	**Corrosion and its Control** Introduction and theories of corrosion, Dry corrosion (chemical), Wet corrosion (electrochemical), Bio corrosion, Mechanism of corrosion, Factors influencing corrosion (ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature), Corrosion control and prevention methods, corrosion inhibitors, cathodic and anodic protection and Electroplating. Protective coatings, chemical principles involved, boiler corrosion, inter granular corrosions.	07	17
8.	**Instrumental Methods Of Chemical Analysis: Spectroscopic methods** Basic concepts, Instrumentation, Interpretation of data and relevant applications, Ultraviolet spectroscopy (UV), Infrared spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Mass Spectrometry.	06	13
9.	**Thermal methods of analysis** TGA, DTA, DSC (Principle, Instrumentation, Quantitative aspects of curves and/or Interpretation of curves, Applications)	05	10
10.	**Separation Techniques** Principle, Instrumentation, selection of column and its	05	10

	specifications, applications and Limitations, Planar Chromatography (Paper chromatography, Thin Layer Chromatography), Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC)		
TOTAL		45	100

List of Practical:

Sr. No.	**Name of Practical**	**Hours**
1.	To determine the strength of the given Hydrochloric acid by Sodium hydroxide conduct metrically.	04
2.	To synthesize Chrome Alum.	04
3.	To determine λmax and concentration of unknown solution of KMnO4 in 2N H2SO4 using Colorimeter.	04
4.	Determine the amount of Ba^{2+} as $BaSO_4$ in a salt solution.	04
5.	To investigate the reaction between $K_2S_2O_8$ and KI.	04
6.	Conductometric titration of strong acid vs. strong base.	04
7.	Determination of dissociation constant of weak acid by pH metric method.	04
8.	Determination of cloud point of a surfactant in the presence of salts.	02
TOTAL		30

Text Book(s):

Title	**Author/s**	**Publication**
Text Book of Engineering Chemistry	Chawla S.	DhanpatRai& Co. Pvt. Ltd., Delhi, 2003.
Engineering Chemistry	Sharma B. K.	Krishna Prakashan Media (P) Ltd, Meerut.,2001
Instrumental Methods of Chemical Analysis	Ewing G. W.	Tata-McGraw Hill., New Delhi, 2001.
Basis Concept of Analytical Chemistry	Khopkar S. M.	New Age International Publishers, 1998.
A Text Book of Quantitative Chemical Analysis	Vogel A. I.	ELBS UK, 5th Edition, 1996.
A Text Book of Polymer Science	Billmeyer F. W.	Wiley Interscience, New York, 3rd ed., 1984.

Reference Book(s):

Title	**Author/s**	**Publication**
Analytical Chemistry for Technicians (4^{th} edition)	John Kenkel	CRC Press, Taylor & Francis Group
Corrosion Engineering Principles and Practice	Pierre R. Roberge	The McGraw-Hill Companies
New-Trends-in-Green-Chemistry	V. K. Ahluwalia, M.Kidwai	Kluwer Academic Publishers, Boston Dordrecht London & Anamaya Publishers, New Delhi
Atomic Force Microscopy	Peter Eaton	Oxford University Press

Fundamentals of Atomic Force Microscopy	Ronald G. Reifenberger	World Scientific Publishing Co
Principles and Practice of Modern Chromatographic Methods	Robards K., Jackson P., Haddad P A.	Elsevier Academic Press
Fundamentals of Analytical Chemistry	Douglas A. S., Donald M. W., Holler H. J., Crouch H. R.	Brooks Cole; 9thedition
Introduction to Spectroscopy	Donal L. P., Gary M. L., George S. K. , James A. V.	Brooks Cole

Web Material Link(s):
http://nptel.ac.in/courses/105104148/

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 should 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 the completion of the course, the student will able to

SECH2061	**PHYSICAL, INORGANIC & ANALYTICAL CHEMISTRY**
CO 1	Describe the basics of different chemistries used in chemical industries.
CO 2	Assess the theoretical and practical knowledge about modern analytical techniques and its quantitative analysis.
CO 3	Predict and apply the analytical tools used in research laboratories.
CO 4	Evaluate fundamentals of electrochemistry and recognize the electrochemical processes.
CO 5	Identify and define various types of nuclear changes or processes including fission, fusion and decay reactions.

Mapping of CO with PO

SECH2061	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	1	1		3				2		3
CO 2	3	3	2	3		3				1		3
CO 3	3	3	3	3	3	3				1		3

CO 4	3	3	2	2	3	3				3		3
CO 5	3	3		2	3	3				3		3

Mapping of CO with PSO

SECH2061	PSO1	PSO2	PSO3
CO 1	3		1
CO 2	3		2
CO 3	3		3
CO 4	3		3
CO 5	3		3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Properties of Liquid and preparation of solution	1,2
2	Electro analytical techniques for analysis	1,3
3	Phase Rule	2,5
4	Nuclear Chemistry	1,2,3
5	Emerging Trends in Green Chemistry	1,2,5
6	Microscopy Techniques	2,5
7	Corrosion and its Control	2,3,4
8	Instrumental Methods Of Chemical Analysis: Spectroscopic methods	4,5
9	Thermal methods of analysis	2,4,5
10	Separation Techniques	2,4,5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2070
Course Name: Chemical Engineering Thermodynamics-I
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	--	02	05	40	60	--	--	50	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help the 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.	**Introduction to the laws of Thermodynamics:** Concept of Equilibrium, Entropy & Gibbs Free Energy, Laws of Thermodynamics (Open and Closed Systems) and Equations of Change (dU, dH, dA, dG).	07	10
2.	**Properties of pure fluids:** PVT behavior including EOS for mixtures; Fugacity estimation/ calculations based on PVT behavior, Heat effects accompanying chemical Reactions. Phase equilibrium criteria and VLE calculations for different pressure ranges including flash calculations.	07	15
3.	**Estimation of VLE data:** Fugacity, Fugacity Coefficient, Activity, Activity Coefficient, Activity coefficient calculation from experimental VLE data and data reduction, applications of Gibbs-Duhem relation for calculations of and consistency check for VLE data.	05	10
4.	**Phase Diagrams in Thermodynamics:** Phase diagrams for miscible, partially miscible and immiscible liquid mixtures, introduction to LLE and VLE calculations.	04	15
	Section II		
Module	**Content**	**Hours**	**Weightage**

No.			in %
5.	**Thermodynamic Properties of Solutions:** Introduction to fugacity and activity, Activity Coefficients- Partial molar properties- miscible system, immiscible system, Chemical potential as a partial molar property-Lewis randall rule-Roults and Henry's law-Gibbs Duhem Equation Mathematical relation among thermodynamic functions, Maxwell's relations, Interrelation between H, S, U, G, C_p, C_v, properties of single- and two-phase system. Types of thermodynamic diagrams. Partially immiscible system, testing of vapor-liquid equilibrium data, Van Laar equation. Margules equation, Redlich-Kister equation, P-X-Y, T-X-Y, & X-Y Diagram, vapor-liquid equilibrium of ideal and non-ideal solution	16	30
6.	**Refrigeration and liquefaction:** Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump, Liquefaction processes.	06	20
TOTAL		45	100

List of Tutorials:

Sr No	Name of Tutorials	Hours
1.	Tutorial – 1 (Entropy & Gibbs Free Energy) Calculation	02
2.	Tutorial – 2 (Fugacity estimation) Calculation	04
3.	Tutorial – 3 (Phase equilibrium criteria) Calculation	04
4.	Tutorial – 4 (Fugacity Coefficient) Calculation	04
5.	Tutorial – 5 (Activity Coefficient) Calculation	02
6.	Tutorial – 6 (Henry's law-Gibbs Duhem Equation) Calculation	02
7.	Tutorial – 7 (Maxwell's relations) Calculation	04
8.	Tutorial – 8 (Carnot refrigerator) Calculation	04
9.	Tutorial – 9 (Vapour compression cycle) Calculation	02
10.	Tutorial – 10 (Absorption refrigeration) Calculation	02
TOTAL		30

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	B.F. Dodge	McGraw Hill, New York, 1971.

Thermodynamics		
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).

Web Material Links:

- http://nptel.ac.in/courses/103106070/

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 should 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 of various topics consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH2070	**CHEMICAL ENGINEERING THERMODYNAMICS-I**
CO 1	Relate the terminology associated with engineering thermodynamics.
CO 2	Evaluate changes in different thermodynamic properties for pure fluids using eos.
CO 3	Correlate experimental vle data of pure component and ideal mixtures with suitable equations.
CO 4	Calculate feasibility of reaction, heat of reaction, extent of reaction & equilibrium composition.
CO 5	Construct to devise a technically feasible refrigerator for wide applications.

Mapping of CO with PO

SECH2070	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1				2					1	
CO 2	2					2						
CO 3	2	1				2					2	
CO 4	3	1				2					2	
CO 5	2	1				2						

Mapping of CO with PSO

SECH2070	PSO1	PSO2	PSO3
CO 1			
CO 2		1	
CO 3		2	
CO 4		2	
CO 5		1	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to the laws of Thermodynamics	1,2
2	Properties of pure fluids	2,3
3	Estimation of VLE data	3,4,5
4	Phase Diagrams in Thermodynamics	4
5	Thermodynamic Properties of Solutions	4,5,6
6	Refrigeration and liquefaction	5,6

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2080
Course Name: Mass Transfer Operations - I
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	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- learn the concept of diffusion in gas, liquid & solid.
- understand the basics of inter-phase mass transfer.
- learn application of gas-liquid operation and simultaneous heat and mass transfer operations.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction** Introduction to Mass Transfer Operation, Classification of mass transfer	02	05
2.	**Diffusion** Introduction**,** Molecular diffusion, Flux, Models of diffusion, Fick's law, Molecular and eddy diffusion, Molecular diffusion in gases, Steady state molecular diffusion in a binary mixture through constant area - fluids at rest and laminar condition and for gases, A diffusing in non-diffusing B, equimolar counter current diffusion for gases, A diffusing in non-diffusing B, equimolar counter current diffusion for liquids, Diffusion in solids, Some special types of diffusion in solids.	10	20
3.	**Mass Transfer Coefficients and Analogy Equations** Introduction, Types of mass transfer coefficients, Dimensionless groups in mass transfer, Analogy between momentum, heat and mass transfer, Mass transfer coefficients for simple geometrical shapes.	06	15
4.	**Interphase Mass Transfer** Introduction, Theories of interphase mass transfer – two film, penetration, surface renewal and boundary layer theory.	04	10

Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**Humidification and dehumidification** Introduction, Terminologies used, Adiabatic saturation temperature, Wet-bulb temperature, Operation involving gas-liquid contact, Water cooling, Adiabatic Humidification – Cooling, Cooling range and approach, Nonadiabatic operations – evaporative cooling, Equipment for air-water contact, some accessories and operational features of cooling tower.	09	15
6.	**Drying** Introduction, Drying Equilibria, Some important terminologies, Mechanism and Theory of drying, Drying rate curve- Constant Rate period, Cross circulation, falling rate and through circulation, Continuous drying, Rate of batch drying – Cross circulation and through circulation, Rate of continuous drying, Batch driers – direct and indirect driers, Continuous driers – direct and indirect driers, selection of driers.	07	20
7.	**Crystallization** Introduction, Solid Liquid equilibria, Solubility data, Supersaturation, Material and energy balance, Crystallization process, Method of nucleation, Crystal growth, Mier's supersaturation theory, Fractional crystallization, crystallization and precipitation, Caking of crystals , Crystallization equipment, Working principle of crystallizers like agitated batch, Swenson-walker, Circulating liquor and magma, Melt crystallization – Suspension based and progressive freezing, Purification, Reactive crystallization.	07	15
TOTAL		45	100

List of Practical:

Sr No	Name of Practical	Hours
1.	Solid In Air Diffusion (Vaporization Of Naphthalene Balls)	02
2.	To determine the rate of drying for rotary dryer for different air flow rates & different air inlet temperatures.	04
3.	Mass Transfer With/Without Chemical Reaction (Solid-Liquid System – Dissolution Of Benzoic Acid In Aqueous NaOH Solution)	04
4.	To calculate the mass transfer coefficient in the Humidification and Dehumidification column.	04
5.	To perform Spray Drying.	02
6.	Vapour In Air Diffusion - To determine the diffusion coefficient of an organic vapor (i.e. CCl_4) in air.	02
7.	To study mass transfer operation in water cooling tower for different flow & thermos dynamic conditions.	04
8.	Liquid – Liquid Diffusion - To study the effect of temperature on the diffusion coefficient.	04

9.	Natural Draft Tray Dryer - To perform drying test on solids & heat and mass transfer analysis of a drying process.	02
10.	To study Swenson Walker crystallizer.	02
TOTAL		30

Text Book(s):

Title	Author/s	Publication
Mass Transfer – Principles and Operations	A.P. Sinha and Parameshwar De	PHI Learning Private Limited, New delhi
Mass Transfer concepts	K Ashokan	Universities Press
Unit Operations of Chemical Engineering	W L McCabe and J C Smith.	McGraw-Hill International
Mass Transfer Operations	Trebal, R.E.	McGraw-Hill, Inc.

Reference Book(s):

Title	Author/s	Publication
Chemical Engineering Vol.- II, 6th Ed.	J.M. Coulson & J.F. Richardson	Elsevier, 2003 or Pergamon Press.
Unit Operations	G.G. Brown Ed.	John Wiley & Sons, 1950
Transport Processes and Separation Process Principles' 4th Ed	C.G. Geankopolis	Prentice Hall India, 2003.

Web Material Link(s):

- https://nptel.ac.in/courses/103103035/

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/Tutorial:

- 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 the completion of the course, the student will able to

SECH2080	MASS TRANSFER OPERATIONS - I
CO 1	Identify and demonstrate different mass transfer mechanism such diffusion.
CO 2	Explain and describe different mass transfer theories and analogies.

CO 3	Classify industrial dryers &crytallizers.
CO 4	Apply the knowledge of humidification & dehumidification to solve industrial problem in drying &crystalliation.

Mapping of CO with PO

SECH2080	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	1	1								1
CO 2	3	2	1									1
CO 3	3	2	1	1								
CO 4	3	2	1									1

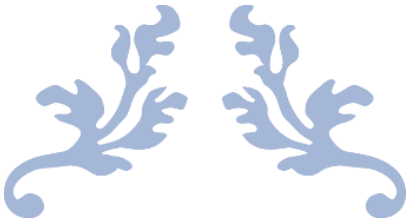
Mapping of CO with PSO

SECH2080	PSO1	PSO2	PSO3
CO 1	1		
CO 2	1	1	
CO 3	1	2	
CO 4	1		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	2,3
2	Diffusion	1,2
3	Mass Transfer Coefficients and Analogy Equations	2,3,4
4	Interphase Mass Transfer	4,5
5	Humidification and dehumidification	4,5
6	Drying	2,3,4
7	Crystallization	2,3,4



THIRD YEAR B.TECH

P P SAVANI UNIVERSITY															
SCHOOL OF ENGINEERING															
TEACHING & EXAMINATION SCHEME FOR B. TECH. CHEMICAL ENGINEERING PROGRAMME AY:2019-20															
Sem	**Course Code**	**Course Title**	**Offered By**	**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	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH3021	Mass Transfer Operations-II	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH3030	Instrumentation & Process Control	CH	4	2	0	6	5	40	60	20	30	0	0	150
	SECH3041	Chemical Engineering Thermodynamics-II	CH	3	0	1	4	4	40	60	0	0	50	0	150
	SEPD3030	Foreign Language	SEPD	2	0	0	2	0	100	0	0	0	0	0	100
	SEPD3010	Professional Communication & Soft Skills	SEPD	1	2	0	3	2	0	0	50	50	0	0	100
	SECH3910	Summer Training	CH	4			0	4	0	0	100	0	0	0	100
		Elective -I	CH	3	0	0	3	3	40	60	0	0	0	0	150
						Total	**29**	**27**							**1000**
6	SECH3052	Chemical Reaction Kinetics-I	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH3062	Process Equipment & Design-I	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH4030	Petroleum Studies	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH3080	Industrial Safety & Hazard Analysis	CH	2	0	0	2	2	40	60	0	0	0	0	100
	SEME4021	Renewable Energy Sources & Systems	ME	3	2	0	5	4	40	60	20	30	0	0	150
	SEPD3020	Corporate Grooming & Etiquette	SEPD	1	2	0	3	2	0	0	50	50	0	0	100
	SEPD3030	Foreign Language	SEPD	2	0	0	2	2	2	2	40	60	0	0	0
		Elective -II	CH	3	0	0	3	3	40	60	00	00	0	0	100
						Total	**30**	**25**							**1000**

Elective Courses																
Offered from Sem.	Course Code	Course Name	Offered By	Teaching Scheme					Examination Scheme							
				Contact Hours				Credit	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	

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	
03	02	--	04	40	60	20	30	--	--	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.	04	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.	06	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.	06	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.	04	10
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**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.	06	10
7.	**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

8.	**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	06	20
9.	**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.	04	10
	TOTAL	45	100

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
TOTAL		30

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 the completion of the course, the student will able to

SECH3010	HEAT TRANSFER OPERATION
CO 1	Describe and classify different heat transfer process and its mode.
CO 2	Able to solve conduction, convection and radiation problems.
CO 3	Describe industrial applications and regimes involved in boiling and condensation.
CO 4	Predict extend of heat flow by radiation through grey, white and real surfaces.
CO 5	Categorize different types of evaporators with performance evaluation and to analyze material and energy balance for single and multi-effect systems.

Mapping of CO with PO

SECH3010	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	1						2	2		2
CO 2	3	2	3						2	2		3
CO 3	2	2	1						2	3		2
CO 4	2	2	1						2	2		3
CO 5	2	2	1						2	3		3

Mapping of CO with PSO

SECH3010	PSO1	PSO2	PSO3
CO 1	3	3	
CO 2	2	2	3
CO 3	2	1	1
CO 4	3		1
CO 5	3	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1,2
2	Conduction: One Dimensional	2,3
3	Convective Heat Transfer: One Dimensional	1,3,5
4	Forced Convective Heat Transfer	2,3,5
5	Heat Transfer by Natural Convection	1,3
6	Heat Transfer in Boiling and Condensation	1,3,5
7	Radiation Heat Transfer	3,4,5
8	Heat Exchangers	3,4,5
9	Evaporators	2,3,4,5

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	
03	02	--	04	40	60	20	30	--	--	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.	08	20
2.	**Liquid - Liquid Extraction** Liquid-liquid Extraction and their Industrial applications, Mixture Rule, Ternary Diagram, Extraction systems Effect of	06	15

	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.		
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.	09	15
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**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.	06	15
5.	**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
6.	**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
TOTAL		45	100

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
TOTAL		30

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	NiraliPrakashan

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 the completion of the course, the student will able to

SECH3021	MASS TRANSFER OPERATIONS - II
CO 1	Apply equilibrium data for design of distillation columns.
CO 2	Classify industrial extraction process for liquid liquid& liquid solid (leaching process).
CO 3	Classify and describe the concept and operation of various types of gas liquid contactors and absorption process.
CO 4	Analyze the concept of solid fluid interaction and adsorption process.

Mapping of CO with PO

SECH3021	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2	2	1		1			1	1	
CO 2	3	2	2	2	1		1			1	1	
CO 3	2	2	2	2	1		1			1	1	
CO 4	2	2	2	2	1		1			1	1	

Mapping of CO with PSO

SECH3021	PSO1	PSO2	PSO3
CO 1	2	2	
CO 2	2	2	
CO 3	2	2	
CO 4	2	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Distillation	2,3,4
2	Extracction L-L	2,3,4
3	Absorption	2,3,4
4	GasLiquid Contactors	2,3,4
5	Adsorption	2,3,5
6	Extracction (Leaching)	2,3,4

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3090
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	
03	02	--	04	40	60	20	30	--	--	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	**Content**	**Hours**	**Weightage in %**
1.	**Introduction to process control** Process control system, Variable physical element of process control system, Modelling of a process.	05	05
2.	**Laplace Transforms** Properties of Laplace transforms, Solution of linear differential equation using Laplace transform techniques, Dynamic behaviour of systems, Transfer functions	05	10
3.	**Dynamic behaviour of chemical processes** Analysis of first order system with different forcing functions, Analysis of second & higher order system, Components of feedback control system.	07	20
4.	**Modes of control action** Controllers and final control elements, closed loop transfer function and block diagram algebra, characteristic equation.	06	15
Section II			

Module	Content	Hours	Weightage in %
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.	06	15
6.	**Piping & Instrumentation (P&I) diagram** Symbols, P&I Diagram of reactors, Distillation column, Shell & tube heat exchanger etc.	04	10
7.	**Introduction of Process Measurement** Elements of instruments, Parts of instruments, Static and dynamic characteristics.	04	10
8.	**Measuring devices for flow, temperature, pressure and level.**	08	15
	TOTAL	45	100

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
	TOTAL	30

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	NiraliPrakashan
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 of 30 marks each and 1 hour of duration and average of the same will be converted to 30 marks.
- Faculty Evaluation consists of 10 marks as per the guidelines provided by Course Coordinator.
- End Semester Examination consists of 60 marks.

Practical:

- Continuous Evaluation consist of performance of Practical which should 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 the completion of the course, the student will able to

SECH3090	**INSTRUMENTATION & PROCESS CONTROL**
CO 1	Summarize information about common instruments on the chemical process systems as well as the operating principles.
CO 2	Develop conceptual understanding of the mathematical modelling and transfer functions of open loop control systems to study their responses.
CO 3	Analyze how to develop closed loop block diagram.
CO 4	Explain the use of block diagram and the mathematical basis for the design of control systems.
CO 5	Measure steadiness of the control system with time and frequency domain analysis techniques.

Mapping of CO with PO

SECH3090	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1										
CO 2		1										
CO 3				1								
CO 4				1								
CO 5				1								

Mapping of CO with PSO

SECH3090	PSO1	PSO2	PSO3
CO 1	1	0	1
CO 2		1	
CO 3	1		1
CO 4		1	

CO 5	1		1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to process control	1,2
2	Laplas Transforms	1,2,5
3	Dynamic behavior of chemical processes	1,5
4	Modes of control action	1,2
5	Stability Criterion	1,2,5
6	Piping & Instrumentation (P&I) diagram	1,4
7	Introduction of Process Measurement	1,2
8	Measuring devices for flow, temperature, pressure and level.	1,2

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3101
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	
03	--	01	04	40	60	--	--	50	--	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.	05	10
2.	**Gibbs-Duhem Equation** General form, Various forms of Gibbs-Duhem equation, Applications, Limitations, Property changes of mixing, Excess Properties.	06	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.	06	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.	06	10

Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**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,	06	18
6.	**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**.**	06	12
7.	**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.	06	15
8.	**Phase Equilibria** The Gamma / Phi Formulation of VLE, Equilibrium and stability, Liquid-liquid equilibrium, Solid- Liquid Equilibrium, Osmotic Equilibrium and Osmotic pressure	04	5
TOTAL		45	100

List of Tutorials:

Sr. No	Name of Tutorial	Hours
1.	Introduction to Instrumentation & Control Laboratory	02
2.	Calibration of pressure gauge	02
3.	Dynamics of thermometer	02
4.	Dynamics of thermal system	02
5.	Dynamics of evacuation system	02
6.	Dynamics of liquid level system	02

7.	Control of liquid level system	02
8.	Dynamics & control of heat exchanger	01
TOTAL		15

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 the completion of the course, the student will able to

SECH3101	CHEMICAL ENGINEERING THERMODYNAMICS-II
CO 1	Coorelate the conditions of equilibrium for multiphase systems.
CO 2	Apply thermodynamic principles to understand fugacity, partial molar properties, chemical potential, and
CO 3	Comprehend knowledge of vapor pressure for single component multiphase systems.

CO 4	Anlayze models for excess gibbs free energy in non ideal mixtures.
CO 5	Perform calculations for vapor liquid equilibrium system.

Mapping of CO with PO

SECH3101	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2									
CO 2	2	2	1	3								2
CO 3	1	1	1									
CO 4	1	1	1									
CO 5	1	2	1									

Mapping of CO with PSO

SECH3101	PSO1	PSO2	PSO3
CO 1		1	1
CO 2			1
CO 3			1
CO 4			1
CO 5			2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Thermodynamic Properties of Pure Substances	1,2
2	Gibbs-Duhem Equation	2,3
3	Criteria of Phase Equilibrium	4
4	Activity Coefficient	1,4
5	Solution Thermodynamics	1,4
6	Liquid Phase Properties	2,4
7	Chemical Reaction Equilibrium	2,3,6
8	Phase Equilibria	5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3910
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	
-	-	-	04	--	--	100	--	--	--	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
TOTAL		**100**

Course Outcome(s):
After the completion of the course, the student will able to

SECH3910	SUMMER TRAINING
CO 1	Construct company profile by compiling brief history, management structure, products/services offered, key achievements and market performance for the company visited during internship.
CO 2	Determine the challenges and future potential for his/her internship organization in particular and the sector in general.
CO 3	Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.
CO 4	Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship

	organization.
CO 5	Analyze the functioning of internship organization and recommend changes for improvement in processes.

Mapping of CO with PO

SECH3910	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1		1	2								2
CO 2	1	3	1	1		3				1	2	1
CO 3	1			2	3	3	2		1		2	1
CO 4	1			1	3	3	1		1	2	2	1
CO 5	1			2		3	3					1

Mapping of CO with PSO

SECH3910	PSO1	PSO2	PSO3
CO 1		2	
CO 2	3	2	2
CO 3	3	2	
CO 4	3	2	2
CO 5	3	3	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Selection of Companies	1,2,3,4
2	Company Information collection	1,2,3,4
3	Report Writing	1,2,3,4
4	Presentation & Question-Answer	1,2,3,4

Report Writing Guidelines

A. Report Format:

15. 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.

16. Project Certification Form

[The form should be duly filled signed by the supervisors.]

17. 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.]

18. Table of Contents/Index with page numbering
19. List of Tables, Figures, Schemes
20. Summary/abstract of the report.
21. Introduction/Objectives of the identified problem
22. Data Analysis and Finding of Solution
23. Application of the identified solution
24. Future Scope of enhancement of the Project and Conclusion
25. "Learning during Project Work", i.e. "Experience of Journey during Project Duration"
26. References(must)
27. Bibliography
28. 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	
03	02	--	04	40	60	20	30	--	--	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.	04	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.	06	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**		20

	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.	07	
Section II			
Module	**Content**	**Hours**	**Weightage in %**
5.	**Design of industrial reactors** Optimum reactor size, plug flow/mixed flow reactors in series and parallel, recycle reactor.	07	15
6.	**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.	07	15
7.	**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
	TOTAL	45	100

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
TOTAL		30

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

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 the completion of the course, the student will able to

SECH3052	CHEMICAL REACTION KINETICS-I
CO 1	Classify the concept of reactor design for chemical process industries.
CO 2	Analyze kinetics and rate law based on experimental data obtained from the laboratory.
CO 3	Perform calculations on plug, mixed, and batch reactors for homogeneous and heterogeneous reactions.
CO 4	Develop skills to choose, design and scale the right kind of reactor for a given reaction.

Mapping of CO with PO

SECH3052	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2	2	1		1			1	1	
CO 2	2	2	1	2	1		1			1	1	
CO 3	1	2	1	2	1		1			1	1	
CO 4	2	2	2	2	1		1			1	1	

Mapping of CO with PSO

SECH3052	PSO1	PSO2	PSO3
CO 1	2	3	3
CO 2	2	3	3

CO 3	2	3	3
CO 4	2	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Fundamentals of Reaction Engineering	2,3
2	Rate Laws, Kinetics and Mechanisms of Homogeneous and Heterogeneous Reactions	2,3,5
3	Analysis of Rate Data	4,5,6
4	Introduction to Reactor Design	1,2,4
5	Design of industrial reactors	2,5,6
6	Design of reactors for single and parallel reaction	5,6
7	Residence time distributions	1,2,4,6

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	
03	02	--	04	40	60	20	30	--	--	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.	08	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	08	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.	07	10
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**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
5.	**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.	12	25
TOTAL		45	100

Drawing of Process Equipment:

Sr. No	Process Equipment	Hours
1.	Flow sheeting, pressure vessel, and enclosures	02
2.	Flanges, nozzles and supports	04
3.	Agitated vessel and basket centrifuge	04
4.	Gravity thickener	02
5.	Cyclone separator	02
6.	Heat exchangers	04
7.	Evaporators	02
8.	Crystallizer	04
9.	Distillation and absorber column	04
10.	Rotary dryer	02
TOTAL		30

Text Book(s):

Title	Author/s	Publication
Chemical Engineering - Volume 6, 3rdEdn	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	Wiley Eastern, 1968

	Young, E.M	
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 the completion of the course, the student will able to

SECH3062	PROCESS EQUIPMENT & DESIGN-I
CO 1	Classify different process equipments used in chemical process industry.
CO 2	Differentiate different supports used in process industries and apply strategies in selection of supports.
CO 3	Design special vessels and various parts of vessels.
CO 4	Design different kinds of heat exchanger and evaporator.
CO 5	Demonstrate procedures in designing of tray distillation columns including minimum reflux ratio, number of stages, feed stage, and column diameter.

Mapping of CO with PO

SECH3062	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	2	1					2	2		3
CO 2	2	2	2	3					2	3		2

CO 3	2	1	3	2					3	2		1
CO 4	3	3	3	1					3	3		2
CO 5	2	3	3	3					3	3		3

Mapping of CO with PSO

SECH3062	PSO1	PSO2	PSO3
CO 1	2	1	2
CO 2	3	3	3
CO 3	3	1	2
CO 4	2	2	1
CO 5	3	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Basic Consideration in Process Equipment Design	1,2
2	Enclosures, Flanges, Nozzles and Supports	1,2,5,6
3	Reaction/Agitated Vessels, Basket Centrifuge, Gravity Thickener and Cyclone Separator	1,2,5,6
4	Heat Exchangers, Evaporators and Crystallizers	1,2,5,6
5	Distillation Column, Absorption Column and Rotary Drier	1,2,6

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH4030
Course Name: Petroleum Studies
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	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- understand various chemical allied operations related to petroleum industries.
- know the wide field of chemical engineering in petrochemical.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Basic of Petroleum** Role of Crude oil in global economy, Present Scenario of Crude Oil Refinery, Importance, Occurrence, Origin(formation), Exploration, Composition, Classification and Evaluation of Crude oil, Crude Assay Analysis, Distillation Characteristics such as TBP, ASTM& EFV etc.	04	10
2.	**Properties of Crude and Petroleum Products** Various types of Average Boiling Points of Crude Oil & Petroleum Fractions, Types of Gases & their Composition, Types of Gasoline & it's Important Properties and tests such as ASTM Distillation, RVP, Octane Number, Oxidation Stability, Sulphur Content etc, Various Types of Naphtha and their Important Properties & Applications. Important Tests & Properties of Kerosene such as Flash& Fire Point, Smoke Point , Aniline Point etc., Types of Diesel & its Important Properties & Tests such as Pour Point, Diesel Index, Cetane Number etc. Heavy Fractions like Lube Oil, Bitumen, Asphalt etc & their Important Properties such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point etc.	06	10
3.	**Processing of Petroleum** Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude, Distillation of Petroleum &	04	10

	Types of Reflux, ADU & VDU, Topping Operations etc.		
4.	**Treatment Techniques** Physical Impurities found in Crude& their Removal, Sweetening Techniques, Production and Treatment of LPG & their Methods, Dehydration and Sweetening of Gases, Gasoline Treatment such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Treatment of kerosene, Various Methods of Treatment of Lubes such as Clay Treatment, Phenol Extraction, Furfural Extraction, Dewaxing etc.	04	10
5.	**Thermal & Catalytic Cracking** Necessity and Types of Cracking **Thermal Cracking** Mechanism of Thermal Cracking, Properties of Cracked Materials, Vis Breaking, Dubb's Two Coil Process, Delayed Coking, Naphtha Cracking, etc. **Catalytic Cracking** Advantage & Theory of Catalytic Cracking, Fixed bed, Moving Bed & Fluidized Bed Technology, FCC, Hydrocracking, Catalytic Reforming, Platforming, Continuous Catalyst Regeneration Reforming, Catalytic Polymerization, Catalytic Alkylation, Catalytic Isomerization, etc.	05	10
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**Petrochemicals and Petro Industries** Physical & Chemical Properties, Various Routes of Production, Manufacturing Processes, Flow Sheets, Thermodynamics & Kinetics Consideration & Major Engineering Problems for following Petrochemicals	05	10
7.	**C1 Petrochemicals** Petrochemicals Obtained from Methanol, Formaldehyde, Chloromethane etc.	04	10
8.	**C2 Petrochemicals** Petrochemicals obtained from Ethylene, Ethanolamine, Ethylene Dichloride, Vinyl Chloride, Ethylene Oxide etc.	05	10
9.	**C3 &Aromatic Petrochemicals** Petrochemicals Obtained from Propylene, ACN, Isopropanol, Cunene, BTX Separation, Phenol, Styrene, Phthalic Anhydride etc.	04	10
10.	**Polymers** PVC, LDPE, LLDPE, HDPE, Polypropylene, Polypropylene Co-polymers, Polystyrene, SBR, Polyesters etc.	04	10
TOTAL		45	100

List of Practical:

Sr. No	Name of Practical	Hours
1.	Determination of Aniline point of the given oil sample	02
2.	Determination of the flash & fire point of a given sample of oil by Pensky – Martin apparatus	04
3.	Determination of distillation characteristics of gasoline using A.S.T.M distillation	04
4.	Determination of viscosity of given sample of heavy oil saybolt viscometer	04
5.	Determination of viscosity of given sample of heavy oil redwood viscometer	04
6.	Determination of percentage carbon residue of petroleum product by conradson carbon residue.	04
7.	Determination of softening point of given bituminous material	04
8.	Determination of the flash point of a given sample of oil by Able's apparatus	04
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Modern Petroleum Refining Processes	B. K. Bhaskar Rao	Oxford and IBH 2007
Dryden's Outlines of Chemical technology, 3rd Edition	M Gopal Rao	East-West press Pvt. Ltd, Delhi

Reference Book(s):

Title	Author/s	Publication
Petroleum Refinery Engineering	W. L. Nelson	McGraw Hill, Newyork, 1958.
The Chemistry and technology of Petroleum	Speight, J. G.	5th Edition, M. Dekker, 1991

Web Material Link(s):

- https://nptel.ac.in/courses/103/102/103102022/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration.
- 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 should be evaluated out of 10 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 performance of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH4030	PETROLEUM STUDIES
CO 1	Identify compositions of crude oil.
CO 2	Illustrate knowledge about preprocessing and basic separation processes of crude oil.
CO 3	Classify different types of methods for enhancement of refinery products.
CO 4	Interpret various purification processes of crude oil.
CO 5	Generalize manufacturing processes & applications of widely used petrochemicals.

Mapping of CO with PO

SECH4030	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1					1	2	1				1	
CO 2	1											
CO 3	1				1		2				1	
CO 4	1										1	
CO 5	2				1		1				1	

Mapping of CO with PSO

SECH4030	PSO1	PSO2	PSO3
CO 1		1	2
CO 2		1	
CO 3			1
CO 4			1
CO 5		2	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Basic of Petroleum	1,2
2	Properties of Crude and Petroleum Products	2,3
3	Processing of Petroleum	3,4,5
4	Treatment Techniques	2,3,4
5	Thermal & Catalytic Cracking	2,5
6	Petrochemicals and Petro Industries	1,2,5
7	C1 Petrochemicals	2,5,6
8	C2 Petrochemicals	2,5,6
9	C3 &Aromatic Petrochemicals	2,5,6
10	Polymers	1,2,5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3080
Course Name: Industrial Safety & Hazard Analysis
Prerequisite Course: - Nil

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	--	--	02	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:
To help learners to

- critically understand the importance of safety in process industries.
- assess and identify the potential hazards in process industries.
- identify and evaluate the causes of accident in a chemical industry.

Course Content:

Section I			
Module	**Content**	**Hours**	**Weightage in %**
1.	**Introduction to Safety in Chemical process Industries** Need for Development of Safety Consciousness in Chemical Industries- Hazard-Risk-Danger-Accident, Promotion of industrial safety, Extreme operating conditions, toxic chemicals, Safe handling, Psychological attitude towards safety.	05	15
2.	**Safety Programs in Industries** Importance of Safety Programs in industries, Elements of Safety Program, Effective Realization, Economic and Social Benefits from Safety Program, Effective Communication Training at various levels of Production and Operation, Accidents identification and prevention.	05	15
3.	**Potential Hazards in Chemical Process Industries** Chemical and Physical job Safety Analysis, High pressure and Temperature Operation, Dangerous and Toxic Chemicals, Routes of entry, Effects of toxicants and its elimination, Toxic release and dispersion models, Radio Active materials, Safe Handling and Operation of materials and Machinery, Periodic inspection and replacement.	05	20
Section II			

Module	Content	Hours	Weightage in %
4.	**Risk Assessment** Quantitative risk assessment, Rapid and comprehensive risk analysis, Risk due to Radiation, Explosion due to over pressure, Plant layout Personnel Safety and Protective Equipment, Occupational health and safety.	04	10
5.	**Hazard Identification** Introduction to Hazard identification - Overall risk and hazard analysis, Emergency planning - On site &off site emergency planning, Risk management, ISO 14000, Safety audits, Checklist, What if analysis – Vulnerability models - Event tree analysis - Fault tree analysis.	04	15
6.	**HAZOP** HAZOP study - case studies, Pumping system, Reactor-mass transfer system, Hazard Identification and Assessment, Involvement of Human factors and Errors- Hazard Quantifications, Disaster management, Occupational and Industrial Health Hazards, Safety Systems.	04	15
7.	**Case studies** Dominos effect, Worst case scenario, Fire, Accidents, Chemical release, Explosion, Petroleum, Commercial, Natural disasters, EMS models case studies.	03	10
	TOTAL	30	100

Text Book(s):

Title	Author/s	Publication
Hazard Analysis Techniques for System Safety	Ericson C.A	2nd edition. Wiley, USA, 2015.
Industrial Safety and Environment	Gupta A.	2nd edition. Laxmi Publications, India, 2015

Reference Book(s):

Title	Author/s	Publication
Guidelines for process hazards analysis, hazards identification & risk analysis	Hyatt, N.	1st edition. CRC Press, USA, 2003.

Web Material Links:

https://nptel.ac.in/courses/110/105/110105094/ (Lecture Series by Prof. Jhareswar Maiti, Department of Mechanical Engineering, IIT Kharagpur)

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 30 marks and 1 hour of duration.

- Submission of Power point presentation which is to be presented by the students in a group of 3 students and it carried 10 marks of evaluation.
- End semester examination will consist of 60 marks.

Course Outcome(s):

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

SECH3080	**INDUSTRIAL SAFETY & HAZARD ANALYSIS**
CO 1	Identify and analyse various types of hazards present in the chemicals processing and testing methodology followed by monitoring and controlling them.
CO 2	Identify the methods of hazard identification and preventive measures.
CO 3	Evaluate the safety performance of an organization from accident records.
CO 4	Identify onsite and offsite emergency plans.

Mapping of CO with PO

SECH3080	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1		1								
CO 2	1	1	1			2						
CO 3		1	1		1	3	2	1		2		2
CO 4		1	1					3	2	2		

Mapping of CO with PSO

SECH3080	PSO1	PSO2	PSO3
CO 1			
CO 2			2
CO 3	1		3
CO 4	1		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Safety in Chemical process Industries	1,4
2	Safety Programs in Industries	2,5
3	Potential Hazards in Chemical Process Industries	2,4
4	Risk Assessment	2,4,5,6
5	Hazard Identification	2,4,5,6
6	HAZOP	2,4,5
7	Case studies	6

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME4021
Course Name: Renewable Energy Sources & 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	--	04	40	60	20	30	--	--	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. **Solar Applications** Conversion of Solar Energy into Heat, Solar thermal collectors,	19	40

	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 %**
3.	**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
4.	**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
5.	**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
TOTAL		45	100

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 considering different water depth and day-night performance and calculation of payback period.	04
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
	TOTAL	30

Text Book(s):

Title	**Author/s**	**Publication**
Solar Energy-Fundamentals, Design, Modelling and Applications.	G. N. Tiwari	Narosa Publishers
Non-conventional energy resources.	ShobhNath 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 the completion of the course, the student will able to

SEME4021	RENEWABLE ENERGY SOURCES & SYSTEMS
CO1	Analyze the present scenario of conventional and non-conventional energy in India.
CO2	Estimate the application of solar energy to developed different solar based devices in use.
CO3	Understand basics of wind energy and its use for power generation.
CO4	Relate the generation of biogas through different biogas plant and gasifier.
CO5	Recognize the basics of ocean, geothermal, tidal & wave energy-based power plants.

Mapping of CO with PO

SEME4021	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		2	2	2	3	3	3	1	3	3		3
CO 2	2	2	3	3	3	3	3	1	3	3		3
CO 3	1	3	3	3	3	3	3	1	3	3		3
CO 4		3	3	2	3	3	3	1	3	3		3
CO 5		3	1	2	3	3	3	1	3	3		3

Mapping of CO with PSO

SEME4021	PSO1	PSO2	PSO3
CO 1	3	3	1
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Renewable Energy Scenario	1,2,3
2	Solar Energy, Solar Power generation, Solar Applications	1,2,3,4,5,6
3	Wind Energy, Wind Power Conversion	1,2,3,4
4	Bio energy, Biogas Generation,	1,2,3,4
5	Geothermal energy, Ocean Energy	1,2,3

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	
03	--	--	03	40	60	--	--	--	--	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 %
4.	**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
5.	**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
6.	**Semisolids Formulation** Semisolid Formulation with Special Reference to Penetration Enhancers, Emulgels, Semisolids based on Liposomes, Niosomes.	04	10
7.	**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
TOTAL		45	100

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-Juuim	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 the completion of the course, the student will able to

SECH3510	**PHARMA TECHNOLOGY – API & FORMULATION**
CO 1	Identify basic unit processes and unit operations involved in pharma industry.
CO 2	Relate the different equipment with usage and applications.
CO 3	Differentiate api and formulation in the pharmaceutical industries
CO 4	Apply knowledge of basic science in dosage and formulation to enhance the plant efficiency.

Mapping of CO with PO

SECH3510	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1								1		
CO 2	1	1		1						2		1
CO 3	1	1	1	2						2		1
CO 4	1	1		1						2		1

Mapping of CO with PSO

SECH3510	PSO1	PSO2	PSO3
CO 1	1		
CO 2	1		
CO 3		1	1
CO 4		1	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Basic Pharmaceutical and Fine Chemical Industry	1,2
2	Unit Processes involved in Pharma Industry	1,2
3	Unit Operations involved in Pharma Industry	1,2
4	Solid Formulation	1,2
5	Liquid Formulation	1,2
6	Semisolids Formulation	1,2
7	Inhalation Aerosols	1,2

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	--	--	03	40	60	--	--	--	--	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	05	15

	Piping, Pump Piping Support, Process Control and Instrumentation Diagram, Control System Design for Process Auxiliaries.		
Section II – Process Utilities in Allied Industries			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**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
6.	**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
7.	**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
8.	**Refrigeration System** Refrigeration and Chilling Systems, Oil Heating Systems, Nitrogen Systems.	02	05
TOTAL		**45**	**100**

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 the completion of the course, the student will able to

SECH3520	**PROCESS AUXILIARIES & UTILITIES IN ALLIED INDUSTRIES**
CO 1	Describe overall knowledge about the process plant.
CO 2	Analyse the importance of process auxiliaries and utilities in process industries.
CO 3	Apply the conceptual design of chemical process plant.
CO 4	Build a bridge between theoretical and practical concepts used for process auxiliaries and utilities in any process industry.

Mapping of CO with PO

SECH3520	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1							2					
CO 2												
CO 3							2					1
CO 4												

Mapping of CO with PSO

SECH3520	PSO1	PSO2	PSO3
CO 1	3	2	3
CO 2	3	1	2
CO 3	3	2	2
CO 4	3		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Process Auxiliaries	1,2,3,4
2	Piping Design	1,2,3,4,5,6
3	Valves	1,2,3,4
4	Pumps	1,2,3,4
5	Process Utilities	1,2,3,4
6	Steam	1,3,4,5
7	Compressors and Vacuum Pumps	1,2,3,4,5
8	Refrigeration System	1,2,4

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	--	--	03	40	60	--	--	--	--	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.	06	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.	06	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.	06	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	05	10

	equipment.		
Section II			
Module	**Content**	**Hours**	**Weightage in %**
5.	**Control Of Air Pollution** Zoning and Site Selection-Other Management Controls, API Legislation, Automobile Pollution and Control-Emission Standards.	07	15
6.	**Urban Air Pollution** Sectoral Analysis, Trends in Major Cities of India and Government initiatives.	04	10
7.	**Introduction to indoor air pollution**	04	10
8.	**Global effects of air pollution** Green House Effects, Acid Rain and Ozone Layer Depletion, International Agreements for Mitigating Global Air Pollution Effects.	07	15
TOTAL		**45**	**100**

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 the completion of the course, the student will able to

SECH3530	**AIR POLLUTION & CONTROL**
CO 1	Design various air pollution control equipment and evaluate its use.
CO 2	Classify and identify the sources of air pollutants and predict the effects of air pollutant on human health and environment.
CO 3	Analyze the air quality and relate with air pollution regulation.
CO 4	Apply and relate the significance of various air pollution dispersion models.

Mapping of CO with PO

SECH3530	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	1	1								
CO 2	1	1	1	1			2	3		1	1	
CO 3						2				1		
CO 4		1	1	1								

Mapping of CO with PSO

SECH3530	PSO1	PSO2	PSO3
CO 1	2		
CO 2	1	1	1
CO 3			
CO 4			

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Air Pollution	1, 2
2	Meteorology and Air Pollution	1,2,3,6
3	Control of Particulate Pollutants	2, 4
4	Control of Gaseous Pollutant	2, 4
5	Control Of Air Pollution	1,2,5
6	Urban Air Pollution	1,2
7	Introduction to indoor air pollution	1,2
8	Global effects of air pollution	1,2

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	--	--	03	40	60	--	--	--	--	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 –	06	10

	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.		
Section II			
Module No.	Content	Hours	Weightage in %
4.	**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
5.	**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
TOTAL		**45**	**100**

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 the completion of the course, the student will able to

SECH3540	**POLYMER SCIENCE & TECHNOLOGY**
CO 1	Elaborate on step growth and chain polymerization with respect to mechanism and kinetics.
CO 2	Elaborate on the differences between crystalline melting temperature and glass transition temperature, as well as the effect of kinetics on both.
CO 3	Distinguish between absolute and relative methods for molecular weight determination.
CO 4	Interpret experimental data and determine parameters such as polymerization rates and copolymer composition.
CO 5	Estimate the solubility of a given polymer in various solvents and blends.

Mapping of CO with PO

SECH3540	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1					2	3	1	2		2
CO 2	2	1				3	3	3	1	3		2
CO 3	2	2				2	3		3	2		3
CO 4	2	2				2	1	1	2	3		2
CO 5	2	2				2	3	3	2	3	1	3

Mapping of CO with PSO

SECH3540	PSO1	PSO2	PSO3
CO 1	3	2	1
CO 2	3	3	3
CO 3	3	1	3
CO 4	3	2	2
CO 5	3	2	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Polymers	1,2
2	Thermoplastics, Thermosetting and Elastomers	1,2
3	Polymer Processing	1,2,4
4	Testing & Characterization of Polymers	1,2,4
5	Specialty Polymers	1,2

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	
02	02	--	03	40	60	20	30	--	--	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 %
4.	**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
5.	**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
TOTAL		**30**	**100**

List of Practical:

Sr. No	List of Practical	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
TOTAL		30

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	NiraliPrakashan
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 the completion of the course, the student will able to

SECH3550	**COMPUTATIONAL METHODS IN CHEMICAL ENGINEERING (SCI-LAB/ OCTAVE/ MATLAB)**
CO 1	Perform an error analysis for a given numerical method.
CO 2	Solve a linear system of equations and non linear algebraic or transcendental equation using an appropriate numerical method.
CO 3	Calculate a function using an appropriate numerical method.
CO 4	Predict the basics of matlab and implement it in solving complex chemical engineering problems.

Mapping of CO with PO

SECH3550	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2	2	1		1			1	1	
CO 2	3	2	2	2	1		1			1	1	
CO 3	2	2	2	2	1		1			1	1	
CO 4	2	2	2	2	1		1			1	1	

Mapping of CO with PSO

SECH3550	PSO1	PSO2	PSO3
CO 1	3	2	
CO 2	3	2	
CO 3	3	2	
CO 4	3	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to MATLAB Programming	1,2,3,
2	Approximations and Errors	2,3,4,5,
3	Numerical Differentiation and Integration	3,4,5
4	Linear Equations	1,2,3,4,5,6
5	Nonlinear Equations	1,2,3,4,5,6

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	--	--	03	40	60	--	--	--	--	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 %**
5.	**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
6.	**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
7.	**Ecosystem and Environmental Design** Ecosystem approach to risk assessment, Environmental Design, ED for Manufactured Products, ED for Buildings, ED for Developmental Planning.	04	10
8.	**Environmental Economics** Environmental Economics, Economics and the Environment, Environmental Valuation, Economics of Natural Resource, Environmental and Regional Economics, Ecological Economics.	07	10
TOTAL		**45**	**100**

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 the completion of the course, the student will able to

SECH3560	**ENVIRONMENTAL ISSUES, WASTE MANAGEMENT & EIA**
CO 1	Identify the objectives, scope and concept of ems in process industries.
CO 2	Summarize the importance of environmental attributes.
CO 3	Illustrate the necessity of public participation in eia studies.
CO 4	Identify impacts for various developmental projects.

Mapping of CO with PO

SECH3560	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1					2	2		3			
CO 2							1		2		2	
CO 3									2		1	
CO 4	1								1		2	

Mapping of CO with PSO

SECH3560	PSO1	PSO2	PSO3
CO 1	1		2
CO 2	3		3
CO 3	1		1
CO 4	2		2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Environmental Management	1,2
2	Environmental Policies	1,2
3	Environmental Impact Assessment (EIA)	1,2
4	EIA Documentation and Processes	1,2
5	EA in Industrial Projects	1,2
6	Environmental Management System (EMS)	1,2
7	Ecosystem and Environmental Design	1,2
8	Environmental Economics	1,2

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	--	--	03	40	60	--	--	--	--	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 %**
5.	**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
6.	**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
7.	**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
8.	**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
TOTAL		45	100

Text Book(s):

Title	**Author/s**	**Publication**
Handbook of Synthetic Dyes and Pigments	K. M. Shah	Multitech Publishing Company, Bombay
Technology of Dyeing	ShenaiV.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 the completion of the course, the student will able to

SECH3570	**FUNDAMENTALS TO DYES & PIGMENT (ELECTIVE-II)**
CO 1	Classify the basics of dyes and their types.
CO 2	Formulate the thermodynamic and kinetic properties of dye fibre systems
CO 3	Anlayze the knowledge of pigments technology and classification, types & manufacturing of pigments in pigments industries.
CO 4	Categorize the application of dyes and pigments to different fibre systems and their respective methods.

Mapping of CO with PO

SECH3570	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1					2	1			1		1
CO 2		1										
CO 3	1											
CO 4						2				2		1

Mapping of CO with PSO

SECH3570	PSO1	PSO2	PSO3
CO 1	1		
CO 2			1
CO 3		1	
CO 4			1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Technology of Fibers	1,2,5
2	Physicochemical Properties of Dye-Fiber Systems	1,2,5
3	New Techniques in Dyeing	1,2,5
4	Method of Dyeing & Dyeing Machineries	1,2,5

5	Pigments	1,2,5
6	General Methods of Processing and Synthesis of Organic and Inorganic Pigments	1,2,5
7	Extenders or Filler Pigments	1,2,5
8	Manufacture, Properties and Applications of Black, Blue and Green Pigments	1,2,5

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	--	--	03	40	60	--	--	--	--	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,	05	10

	Persistent foaming, water runoff test, dry sieve test etc. and their significance during field application.		
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 %**
6.	**Introduction to Biochemical Engineering** History, Background, Interdisciplinary approach, Integrated bioprocess, Unit operations in bioprocess.	01	02
7.	**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
8.	**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
9.	**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	06	15

	transfer and power consumption, Measurement of physical and chemical parameters in bioreactors, Separation, isolation and purification of Biomolecule.		
TOTAL		45	100

Text Book(s):

Title	Author/s	Publication
Pesticide Synthesis Handbook	Thomas A. Unger	ProchromIndustriasQuimicas 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 the completion of the course, the student will able to

SECH3580	PROCESSING IN AGROCHEMICAL, FOOD INDUSTRIES & BIOCHEMICAL ENGINEERING
CO 1	Design and operate food processes, equipment, and plants for efficient food production with minimal impact on the environment.
CO 2	Apply engineering principles and concepts to handling, storing, processing, packaging, and distributing food and related products.
CO 3	Formulate chemical, biochemical, microbiological, and physical characteristics of foods.
CO 4	Analyses the kinetics of cell growth and product formation in area of bio chemical.
CO 5	Differntiate models of bioprocesses and design downstream processes involved

	in product recovery.

Mapping of CO with PO

SECH3580	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2		1							2		1
CO 2	1									2		1
CO 3	2	1	1	1						2		1
CO 4	1	1		1						2		1
CO 5	2	1	1							2		1

Mapping of CO with PSO

SECH3580	PSO1	PSO2	PSO3
CO 1			1
CO 2	1		
CO 3	2	1	1
CO 4	1	1	
CO 5	3	1	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Pesticides and Insecticides Synthesis	1,2
2	Important Parameters of Pesticides Formulations Affecting Quality of Pesticides –	1,2
3	Tests for Quality Control	1,2
4	Introduction to Food industries	1,2
5	Energy Engineering, Process calculation and Packaging	1,2
6	Introduction to Biochemical Engineering	1,2
7	Microbial Growth Kinetics	1,2
8	Enzyme kinetics:	1,2
9	Bioreactors	1,2

FOURTH YEAR B. TECH

P P SAVANI UNIVERSITY															
SCHOOL OF ENGINEERING															
TEACHING & EXAMINATION SCHEME FOR B. TECH. CHEMICAL PROGRAMME AY:2019-20															
Sem	**Course Code**	**Course Title**	**Offered By**	**Teaching Scheme**					**Examination Scheme**						
				Contact Hours				**Credit**	**Theory**		**Practical**		**Tutorial**		**Total**
				Theory	**Practical**	**Tutorial**	**Total**		**CE**	**ESE**	**CE**	**ESE**	**CE**	**ESE**	
7	SECH4011	Process Equipment & Design-II	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH4021	Chemical Reaction Kinetics - II	CH	3	2	0	5	4	40	60	20	30	0	0	150
	SECH4041	Chemical Engineering Plant design, Economics & Industrial Management	CH	2	0	0	2	2	40	60	0	0	0	0	100
	SECH4050	Modelling, Simulation & CAD in Chemical Engineering	CH	2	2	0	4	3	40	60	20	30	0	0	150
	SECH4062	Transport Phenomena	CH	2	0	2	4	4	40	60	0	0	50	0	150
	SEPD4010	Creativity, Problem Solving & Innovation	SEPD	3	0	0	3	3	100	00	0	0	0	0	100
	SECH4910	Project/Summer Training	CH	4			0	4	0	0	100	0	0	0	200
		Elective -III	CH	3	0	0	3	3	40	60	0	0	0	0	100
						Total	**26**	**27**							**1000**
8	SECH4920	Project/Training	CH	24			24	24	0	0	200	300	0	0	500
						Total	**24**	**24**							**500**

P P SAVANI UNIVERSITY															
SCHOOL OF ENGINEERING															
TEACHING & EXAMINATION SCHEME FOR FOURTH YEAR B.TECH. CHEMICAL ENGINEERING PROGRAMME (ELECTIVE COURSES)															
Sem	**Course Code**	**Department Elective Course Title**	**Offered By**	**Teaching Scheme**					**Examination Scheme**						
				Contact Hours				**Credit**	**Theory**		**Practical**		**Tutorial**		**Total**
				Theory	**Practical**	**Tutorial**	**Total**		**CE**	**ESE**	**CE**	**ESE**	**CE**	**ESE**	
7	SECH4510	Chemical System Modelling	CH	03	00	00	03	03	40	60	00	00	00	00	100
	SECH4520	Quality Control & Quality Assurance – Instrumentation & Validation Process	CH	03	00	00	03	03	40	60	00	00	00	00	100
	SECH4530	Membrane Technology	CH	03	00	00	03	03	40	60	00	00	00	00	100
	SECH4540	Industrial Health & Safety Engineering	CH	03	00	00	03	03	40	60	00	00	00	00	100

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School of Engineering

Department of Chemical Engineering

Course Code: SECH4011
Course Name: Process Equipment & Design-II
Prerequisite Course(s): SECH3062 - Process Equipment & Design-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	
03	02	--	04	40	60	20	30	--	--	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.	**Introduction to Chemical Engineering Design** Process Design, Mechanical aspects of process equipment design, General design procedure, Equipment classifications, Design codes and standards (IS, ASTM and BS).	02	05
2.	**Process Design of Piping, Fluid Moving Devices and Flow meters** Introduction, Process Design of Piping, Npsha&Npshr, Power Required by Pump, Evaluation of Centrifugal Pump Performance When Handling Viscous Liquids, Power Required in Fan, Blower and Adiabatic Compressor, Flow Meters, Process Design of Orifice Meter, Rotameter Etc.	10	20
3.	**Process Design of Extractor** Industrial Applications of Liquid-Liquid Extraction, Choice of Solvent, Process Design of Counter Current Multistage Extractor, Selection Criteria among Different Types of Extractor, Process Design of Mixer-Settler Type Extractor & Packed Tower Type Extractor, Guidelines for the Design of Other Types of Extractors	10	25

Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Mechanical design of Reaction Vessel** Mechanical Design of Shell, Head, Jacket, Coil, Agitator, Nozzle, Body Flange, Etc., Different Types of Agitators &their Selection Criteria, Different Types of Agitator Shaft Sealing System &their Selection Criteria, Different Types of Power Transmission System, Determination of Power Required for Agitation, Shaft Diameter, Blade Thickness, Etc.	10	20
5.	**Mechanical design of Storage Tan** Classification of Storage Tank as Per Is-803, Capacity of Storage Tank, Its Diameter & Height, Design of Shell and Bottom Plate for Storage Tank, Design of Self Supported Conical Roof, Design of Structured Supported Conical Roof as Per Api 620, Selection of Column, Girders and Rafters, Roof Curb Angel, Floating Roof	08	18
6.	**Supports** Different Types of Supports, Mechanical Design of Bracket Support, Skirt, Support & Saddle Support, Numerical	05	12
	TOTAL	45	100
TOTAL		45	100

List of Practical:

Sr. No	Name of Practical	Hours
1.	Flow sheeting of piping	0202
2.	Flow sheeting of pumps	0202
3.	Flow sheeting of compressor	0202
4.	Flow sheeting of flow meters	0202
5.	Flow sheeting of extractor	0204
6.	Flow sheeting of agitated vessel	02
7.	Flow sheeting of different types of agitator	0404
8.	Flow sheeting of different types of extractors	0404
9.	Flow sheeting of storage tank	0202
10.	Flow sheeting of bracket support	0202
11.	Flow sheeting of skirt support	0202
12.	Flow sheeting of saddle support	0202
	TOTAL	30
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Chemical Engineering - Volume 6 (3rd Edition)	Sinnott. R.K, Coulson & Richardson's	Butterworth Heinemann, New Delhi, 1999
Chemical Engineers Handbook - Perry's(7thEdition)	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 (1st Edition)	S B Thakore and B I Bhatt	Tata McGraw Hill, 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	Maidargi, Suresh C.	Maidargi, Suresh C.
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.

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 consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH4011	PROCESS EQUIPMENT & DESIGN-II
CO 1	Analyze the pumping power required in different pipe fittings and flow meters.
CO 2	Design of column/support, etc for extractor.
CO 3	Estimate reactor and storage sizings used for industrial applications.
CO 4	Classify different supports used in process industry.

Mapping of CO with PO

SECH4011	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1										
CO 2	1	1		1			1	1				
CO 3	2		1	1						1	1	
CO 4	2	1	1		1							1

Mapping of CO with PSO

SECH4011	PSO1	PSO2	PSO3
CO 1	1	1	
CO 2	1		
CO 3	1		
CO 4			1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Chemical Engineering Design	1,2
2	Process Design of Piping, Fluid Moving Devices and Flow meters	1,2,4,6
3	Process Design of Extractor	1,2,4,6
4	Mechanical design of Reaction Vessel	1,2,4,6
5	Mechanical design of Storage Tan	1,2,4,6
6	Supports	1,2,4,6

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Department of Chemical Engineering

Course Code: SECH4021
Course Name: Chemical Reaction kinetics - II
Prerequisite Course(s): SECH3052 - Chemical Reaction Kinetics – 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	
03	02	--	04	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- comprehend residence time distributions, and how they can be used to characterize anddesign non-ideal reactors.
- understand the preparation of catalysis, solid-catalyzed reactions and heterogeneous reaction and its application in various chemical industries.
- kinetics and design of reactors for non-catalytic fluid-fluid and fluid-particle reactions.
- to know the basic operational principle of advance reactors and it's used in allied chemical industries.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Non-Ideal Flow** Basics of non-ideal flow, Residence time distribution, stimulus response techniques, The E, F and C Curves, their interrelationship, conversion in non-ideal flow reactors, Dispersion model, Chemical Reaction and dispersion, Intensity of fluid mixing. Tanks in series model, Deviation from plug flow, Models for real stirred tanks.	05	15
2.	**Heterogeneous Reactions: Introduction** Rate steps involved in heterogeneous systems, Overall rate expression for linear and non-linear process, contacting patterns for two-phase systems.	06	10
3.	**Fluid-Fluid Systems** Rate equation, rate equation for straight mass transfer, kinetic regimes of mass transfer and chemical reaction, rate equation for mass transfer and chemical reactions, film conversion parameter, fluid-fluid reactor design.	07	15
4.	**Fluid-Particle Systems**	05	10

	Fluid partial reaction kinetics, selection of a model, Shrinking Core Model for unchanging and changing size spherical partials, Diffusion through gas film and through ash layer controlling, Chemical reaction controlling, shrinking core model, its limitations, Determination of rate controlling step.		
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**Catalysis** Catalysts, Physical properties of catalyst, surface area, void volume,solid density, pore volume distribution, Classification and preparation of catalyst, catalyst promoters. Catalyst inhibitors, Catalyst poisons, Nature and Mechanism of Catalytic reactions.	08	20
6.	**Solid-Catalysed Reactions: Kinetics** Adsorption isotherms and rates of adsorption and desorption. Kinetic regimes, rate equations for surface kinetics, Pore diffusion, determining rate controlling step, experimental methods for finding rates, product distribution in multiple reactions.	06	15
7.	**Introduction to Catalytic Reactor** Packed bed catalytic reactors, fluidized bed reactors, trickle beds, slurry reactors. Kinetics of Bio-Reaction, Monod Equation, Design of Bioreactors, Reactions in Solids – Reactors for Solid Reactions, CVD Reactors, Monolithic Reactors, Gauze Reactors	08	15
	TOTAL	45	100
TOTAL		45	100

List of Practical

Sr. No	**Name of Practical**	**Hours**
1.	RTD study in Tubular reactor	02
2.	RTD study in CSTR reactor	04
3.	RTD study in Packed bed reactor	04
4.	RTD study in PFTR	04
5.	Kinetics study in Batch enzyme reactor	04
6.	Heterogeneous reaction kinetics study in catalytic reactor	04
7.	Heterogeneous reaction kinetics study in catalytic fluidized bed reactor	04
8.	Kinetics study in Annular UV photo reactor.	04
	TOTAL	30
TOTAL		30

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
Chemical and Catalytic Reaction Engineering	J. J. Carberry	McGraw Hill, New York, 1976.
Elements of Chemical Reaction Engineering	H. Scott Fogler	3rd Edition, John Wiley & Sons (Asia) pvt. Ltd.

Web Material Link(s):

- https://nptel.ac.in/courses/103/108/103108097/
- https://nptel.ac.in/courses/103/101/103101141/
- https://nptel.ac.in/courses/103/102/103102012/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration.
- 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 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 performance of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH4021	CHEMICAL REACTION KINETICS - II
CO 1	Demonstrate basics of non-ideality.
CO 2	Design alternatives to carry out reactions in real reactors.
CO 3	Assess the progressive conversion model and shrinking core model for explaining the fluid particle reaction.
CO 4	Illustrate the principles and mechanism involved in heterogeneous catalysis and analyze the data of heterogeneous catalytic reactions.
CO 5	Identify the rate controlling mechanisms in heterogeneous catalysis and their rate determinations.

Mapping of CO with PO

SECH4021	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2	2	1		1			1	1	
CO 2	3	2	2	2	1		1			1	1	
CO 3	2	2	2	2	1		1			1	1	
CO 4	2	2	2	2	1		1			1	1	
CO 5	2	1	2	2	1		1			1	1	

Mapping of CO with PSO

SECH4021	PSO1	PSO2	PSO3
CO 1	2	2	
CO 2	2	2	
CO 3	2	2	
CO 4	2	2	
CO 5	2	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Non-Ideal Flow	1,2
2	Heterogeneous Reactions: Introduction	1,2
3	Fluid-Fluid Systems	1,2,4
4	Fluid-Particle Systems	1,2,4
5	Catalysis	1,2
6	Solid-Catalysed Reactions: Kinetics	1,2,4
7	Introduction to Catalytic Reactor	1,2

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School of Engineering
Department of Chemical Engineering

Course Code: SECH4062
Course Name: Transport Phenomena
Prerequisite Course(s): SECH3010- Heat Transfer Operations
SECH2050- Fluid Flow 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	
02	--	02	04	40	60	--	--	50	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- learn momentum, Heat and Mass Transfer are three basic transport processes in chemical engineering.
- understand mathematical modeling and analogical aspects of chemical process systems where these transport processes occur simultaneously.
- understand transport Phenomena also focuses on typical situations and thereby its complete understanding on axial as well as radial profiles.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Analogies in Momentum, Heat and Mass Transfer** Introduction, Reynolds Analogy, Prandtl Taylor Analogy, Van Karman Analogy, Martinelli Analogy, Chilton Analogy	04	15
2.	**Principles of Momentum & Overall Balances** Newtonian and Non-Newtonian Fluid Models, Classification of Fluids on the Basis of Rheology, General Molecular Transport Equation for Momentum Transfer, Review of Shell Balance Method and Equations of Changes for Fluid Flow Problems, Time Derivatives	06	20
3.	Equations of Changes for Isothermal, Non-Isothermal, and Multi Component Mixtures. Velocity, Temperature, and Concentration Distributions with more than one Independent Variable; Boundary Layer Theory	05	15
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Turbulent transport** Laminar-turbulent transition; Basic characteristic features of	04	10

	turbulent flow; Time smoothed equation of changes; Eddy viscosity, thermal conductivity and diffusivity; Distribution of velocity, temperature, and concentration in turbulent flows.		
5.	**Principles of Heat Transfer** Application of Shell balance and Equations of changes for temperature distributions in heat flow problems Heat conduction with various heat sources, Heat conduction with cooling fins, Temperature distribution for fully developed viscous flow, Heat transfer for non-Newtonian fluids, Unsteady state heat transfer in various geometries, Partial freezing model, Chilling & Freezing of biological materials, Heat transfer with phase change.	05	20
6.	**Principles of Mass Transfer** Application of Shell balance method and Equations of changes for mass transfer problems, Diffusivity, mass and molar transport by convection, Concentration distributions for isothermal and non-isothermal mixtures, Multi component systems with more than one independent variable and in turbulent flow convective mass transfer and correlation, inter phase mass transfer, Diffusion with chemical reaction, Transport across selectively permeable membrane and porous media.	06	20
	TOTAL	30	100
	TOTAL	30	100

List of Tutorials:

Sr. No	Name of Practical	Hours
1.	Tutorial – 1 (Momentum Transfer)	02
2.	Tutorial – 2 (Momentum Transfer)	04
3.	Tutorial – 3 (Momentum Transfer)	04
4.	Tutorial – 4 (Fluid Transfer)	04
5.	Tutorial – 5 (Fluid Transfer)	04
6.	Tutorial – 6 (Fluid Transfer)	04
7.	Tutorial – 7 (Heat Transfer)	04
8.	Tutorial – 8 (Heat Transfer)	04
	TOTAL	30
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Transport Phenomena	Bird R.B., Stewart W.E., Lightfoot E. N.	John Wiley & Sons, 2002.
Fundamentals of Momentum, Heat and Mass transfer	Welty, J.R., Wicks, C.W., Wilson, R.E. and Rorrer, G.	John Wiley & Sons.

Reference Book(s):

Title	Author/s	Publication
Momentum Heat and Mass Transfer in Cintiniua.	Slattery J.C.	McGraw-Hill
Advanced Transport Phenomena.	Slattery J.C.	Cambridge University Press

Web Material Link(s):

- https://nptel.ac.in/courses/103/106/103106159/
- https://nptel.ac.in/courses/103/102/103102024/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Submission of Power point presentation which is to be presented by the students in a group of 3 which carries 10 marks of evaluation.
- 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

SECH4062	TRANSPORT PHENOMENA
CO 1	Interpret overall balances for conservation of momentum, energy and mass.
CO 2	Recognize and apply analogies among momentum, heat and mass transfer.
CO 3	Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.
CO 4	Utilize information obtained from solutions of the balance equations to obtain engineering quantities of interest.

Mapping of CO with PO

SECH4062	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1								1		
CO 2	2	1	1									
CO 3		1		1	1							1
CO 4	1	1	1		1							

Mapping of CO with PSO

SECH4062	PSO1	PSO2	PSO3
CO 1			

CO 2	1	1	
CO 3			
CO 4	2		

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Analogies in Momentum, Heat and Mass Transfer	1,2,4,5
2	Principles of Momentum & Overall Balances	1,2,4,5
3	Equations of Changes	1,2,5
4	Turbulent transport	1,2,4
5	Principles of Heat Transfer	1,2,4,5
6	Principles of Mass Transfer	1,2,4,5

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Course Code: SECH4041
Course Name: Chemical Engineering Plant design, Economics & Industrial Management
Prerequisite Course(s): SECH3071 - Chemical Process Technology

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	--	--	02	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:
To help learners to

- deal with design aspect, selection of equipment, importance of utilities and auxiliaries for any process industries.
- deal with various cost involve in industrial processes, capital investments and investment returns.
- fill the gap between technical knowledge commercial sustainability of any plant by imparting brief description of any plant from top to bottom approach.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction** Basic Considerations in Chemical Engineering Plant Design, Optimization & Feasibility of Plant Design	02	05
2.	**Process Design Aspects** Selection of Process-Factors Affecting Process Selection. Types of Project Design, Importance of Laboratory Development Pilot Plant, Safety Factors, Types of Flow Diagrams	0404	15
3.	**Selection of Process Equipment** Standard Versus Special Equipment-Material of Construction for Process Equipment, Selection Criteria, and Specification Sheets	03	05
4.	**Process Auxiliaries and Process Utilities** Piping Design, Layout, and Supports for Piping Insulations. Pipe Fittings, Types of Valves, Selection of Valves, Process Control and Instrumentation Control System Design. Process Water, Boiler Feed Water, Water Treatment, Waste Treatment and Disposal, Disposal, Steam, Oil Heating System, Chilling Plant, Compressed Air and Vacuum	0304	15
5.	**Plant location and layout** Factors Affecting Plant Location, Factors in Planning Layouts, Principles of Plant Layout, Use of Scale Models	0402	10

Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**Cost Estimation** Cash Flow and Cumulative Cash Position for Industrial Operations, Factors Affecting Estimation of Investment and Production Cost, Breakeven Point and Its Significance, Total Capital Investment, Fixed and Working Capital Investment & Their Estimations, Type of Estimates, Cost Indexes, Method for Estimating Capital Investment	0303	10
7.	**Estimation of Total Product Cost** Estimation of Total Product Cost: Manufacturing Cost, General Expenses, Manufacturing Cost: Direct Production Cost, Fixed Charges, Plant Overhead Cost.	0202	10
8.	**Depreciation** Types of Depreciation, Method for Determining Depreciation: Straight Line Method, Decline Balance Method, Sum of the Year Digit Method, Shrinking Fund Method etc, Single Unit and Group Depreciation, Adjustment of Depreciation Account, Evaluation of Depreciation Methods	0403	10
9.	**Profitability, Alternative Investments and Replacement** Methods for Profitability Evaluation, Evaluation of Break Even Point, % Rate of Return, Practical Factors in Alternative Investment and Replacement Studies.	02	10
10.	**Project Management** Planning of Project Schedule by BAR CHART, Inventory Control Scheduling a Project using CPM/PERT Methods.	0203	10
	TOTAL	30	100
	TOTAL	30	100

Text Book(s):

Title	Author/s	Publication
Plant design and Economics for Chemical Engineers	M.S. Peters and Timmerhaus	McGraw Hill 3rd Edition
Chemical Engineering Plant Design	F.C. Vibrandt and C.E. Dryden	McGraw Hill 5th Edition

Reference Book(s):

Title	Author/s	Publication
Industrial Engineering and Management	O. P. Khanna	DhanpatRai& Sons, 1985 7th Edition

Web Material Link(s):

- https://nptel.ac.in/courses/103103039/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration.
- 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 the completion of the course, the students will able to:

SECH4041	**CHEMICAL ENGINEERING PLANT DESIGN, ECONOMICS & INDUSTRIAL MANAGEMENT**
CO 1	Predict economic analysis for process to calculate equipment cost, and profitability for process.
CO 2	Distinguish the special and standard equipments used in chemical process industries.
CO 3	Evaluate the project cost including capital investment, product cost, breakeven point, depreciation cost for equipment and the total project cost.
CO 4	Perform resource planning and project scheduling.
CO 5	Apply cpm and pert methods in effective project management

Mapping of CO with PO

SECH4041	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1			1								3	
CO 2		1	1								3	
CO 3	1										3	
CO 4		1	1						3		3	
CO 5			1		1						3	

Mapping of CO with PSO

SECH4041	PSO1	PSO2	PSO3
CO 1	2		
CO 2	1		
CO 3			1
CO 4			1
CO 5	3		2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1
2	Process Design Aspects	2,3,6
3	Selection of Process Equipment	4
4	Process Auxiliaries and Process Utilities	1,4
5	Plant location and layout	1,4
6	Cost Estimation	2,4
7	Estimation of Total Product Cost	2,3,6
8	Depreciation	1,4
9	Profitability, Alternative Investments and Replacement	1,2

10	Project Management	2,5

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Course Code: SECH4050
Course Name: Modelling, Simulation & CAD in Chemical 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	
02	02	--	03	40	60	20	30	--	--	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- understand the basic principles of process modelling & simulation.
- apply the concepts of modelling and simulation to develop models of chemical engineering systems.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Process Analysis and its Basic Principles** Description of Systems, Subsystems, Scientific Methods, System Parameters, Process Analysis and Simulation	04	10
2.	**Introduction to Simulation Tools**	03	8
3.	**Mathematical Models and their Classification** Models Based on Transport Phenomena Principles, Alternate Classification of Models, Population Balance, Stochastic, and Empirical Models, Unit Models	05	17
4.	**Models of Heat Transfer Equipment** Development of Detailed Mathematical Models of Evaporators, Use of Newton Raphson Method for Solving Evaporator Problems	03	15
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**Models of Separation Processes** Separation of Multi-Components Mixtures by Use of a Single Equilibrium Stage, Flash Calculation Under Isothermal and Adiabatic Conditions. Tridiagonal Formulation of Component Material Balances and Equilibrium Relationships for Distillation, Absorption and Extraction of Multi-Components. Thiele and Geddes Method, Plus θ-method and k_b method, models of Absorbers, Strippers and Extractors	07	25

6.	**Models of Reactors** Classification of Fixed Bed Reactor Models, One Dimensional and Two-Dimensional Fixed Bed Reactor Models, Fluidized Bed Reactor Models, Bioreactor Models	08	25
TOTAL		30	100

List of Practical:

Sr. No	Name of Practical	Hours
1.	Introduction to ASPEN Plus	02
2.	Thermodynamic model in ASPEN Plus	04
3.	Steady State simulation in ASPEN Plus	02
4.	Rigorous modelling Example-01	02
5.	Rigorous modelling Example-02	04
6.	Rigorous modelling Example-03	04
7.	Rigorous modelling Example-04	02
8.	Reactor Modelling Example -01	02
9.	Reactor Modelling Example -02	04
10.	Reactor Modelling Example -03	04
TOTAL		30

Text Book(s):

Title	Author/s	Publication
Process Plant Simulation	B. V. Babu	Oxford University Press

Reference Book(s):

Title	Author/s	Publication
Numerical methods for engineers	S. K. Gupta	New Age International Publishers Ltd., (1995)
Applied Mathematics and modelling for Chemical Engineers	R. G. Rice, D. D. Do	John Wiley & Sons (1995)
Transport Phenomena	R. B. Bird, W. E. Stewart, E. N. Lightfoot	John Wiley & Sons (2002)

Web Material Link(s):

- https://nptel.ac.in/courses/103/107/103107096/
- https://lecturenotes.in/notes/17696-note-for-simulation-and-modelling-sm-by-bohar-singh
- https://nptel.ac.in/courses/112107214/

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 consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

SECH4050	**MODELLING, SIMULATION & CAD IN CHEMICAL ENGINEERING**
CO 1	Apply basic principles of the cad software.
CO 2	Perform product and process design and underlying thermodynamic and physical principles.
CO 3	Calculate computer aided equipment design of various chemical equipment: evaporators, distillation columns, reactors, and adsorption columns.
CO 4	Design dynamic simulation of different systems.
CO 5	Simulate in various commercial design software and optimizers used in the field of chemical engineering.

Mapping of CO with PO

SECH4050	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2	2	1		1			1	1	
CO 2	3	2	2	2	1		1			1	1	
CO 3	2	2	2	2	1		1			1	1	
CO 4	2	2	2	2	1		1			1	1	
CO 5	2	1	2	2	1		1			1	1	

Mapping of CO with PSO

SECH4050	PSO1	PSO2	PSO3
CO 1	2	2	
CO 2	2	2	
CO 3	2	2	
CO 4	2	2	
CO 5	2	2	

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Process Analysis and its Basic Principles	1,2,3
2	Introduction to Simulation Tools	1,2,3
3	Mathematical Models and their Classification	2,3,4
4	Models of Heat Transfer Equipment	3,4,5
5	Models of Separation Processes	3,4,5
6	Models of Reactors	3,4,5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH4930
Course Name: Project/Summer Internship
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	
--	05	--	05	--	--	100		--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Outline of the Course:

Project

- The project will be aligned with the aims of the engineering programme and its areas of specialization and shall be based on the recent trends in technology.
- The student shall carry out a comprehensive project at relevant academic / R&D / industrial organization.
- The student is required to submit a project report based on the work carried out.

Training

- The aim of this course is to use the internship experience to enable students to develop their engineering skills and practices.
- The student will be placed in industry/organization for 12 to 18 weeks and assessed for academic credit.
- The students may select industry on their own or one which is offered by institute.
- Students are expected to experience a real-life engineering workplace and understand how their engineering and professional skills can be utilized in industry.
- The student is required to submit a project report based on the work carried out.

Course Outcome(s):

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

SECH4930	**PROJECT / SUMMER INTERNSHIP**
CO 1	Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
CO 2	Determine the challenges and future potential for his/her internship organization in particular and the sector in general.
CO 3	Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.
CO 4	Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization.
CO 5	Analyze the functioning of internship organization and recommend changes for improvement in processes.

Mapping of CO with PO

SECH4930	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	2	3	3	3	3	3	3	3	1	2
CO 2	2	3	2	3	3	3	3	3	3	3	1	2
CO 3	2	3	2	3	3	3	3	3	3	3	1	3
CO 4	2	3	2	3	3	3	3	3	3	3	1	2
CO 5	2	3	2	3	3	3	3	3	3	3	1	3

Mapping of CO with PSO

SECH4930	PSO1	PSO2	PSO3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Content	**RBT Level**
Project/Summer Internship	1,2,3,4,5

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH4940
Course Name: Project/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	
--	19	--	19	--	--	200	300	--	--	500

CE: Continuous Evaluation, ESE: End Semester Exam

Outline of the Course:

Project

- The project will be aligned with the aims of the engineering programme and its areas of specialization and shall be based on the recent trends in technology.
- The student shall carry out a comprehensive project at relevant academic / R&D / industrial organization.
- The student is required to submit a project report based on the work carried out.

Training

- The aim of this course is to use the internship experience to enable students to develop their engineering skills and practices.
- The student will be placed in industry/organization for 12 to 18 weeks and assessed for academic credit.
- The students may select industry on their own or one which is offered by institute.
- Students are expected to experience a real-life engineering workplace and understand how their engineering and professional skills can be utilized in industry.
- The student is required to submit a project report based on the work carried out.

Course Outcome(s):

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

SECH4940	**PROJECT / SUMMER INTERNSHIP**
CO 1	Apply fundamental and disciplinary concepts and methods in ways appropriate to their principal areas of study.
CO 2	Determine the challenges and future potential for his/her internship organization in particular and the sector in general.
CO 3	Test the theoretical learning in practical situations by accomplishing the tasks assigned during the internship period.
CO 4	Apply various soft skills such as time management, positive attitude and communication skills during performance of the tasks assigned in internship organization.
CO 5	Analyze the functioning of internship organization and recommend changes for

	improvement in processes.

Mapping of CO with PO

SECH4940	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	2	3	3	3	3	3	3	3	1	2
CO 2	2	3	2	3	3	3	3	3	3	3	1	2
CO 3	2	3	2	3	3	3	3	3	3	3	1	3
CO 4	2	3	2	3	3	3	3	3	3	3	1	2
CO 5	2	3	2	3	3	3	3	3	3	3	1	3

Mapping of CO with PSO

SECH4940	PSO1	PSO2	PSO3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Content	**RBT Level**
Project/Summer Internship	1,2,3,4,5

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH4510
Course Name: Chemical System Modelling
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	--	--	03	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

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

- give an overview of various methods of process modeling, different computational techniques for simulation.
- focus on the techniques, rather than specific applications so that the student can take up modeling and simulation challenges in his profession.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction to Process Modeling** Systematic Approach to Model Building, Classification of Models. Conservation Principles, Thermodynamic Principles of Process Systems	05	10
2.	**Models based on First Principle** Development of Steady State and Dynamic Lumped and Distributed Parameter Models Based on First Principles. Analysis of Ill-conditioned Systems. Models with Stiff Differential Equations.	08	20
3.	**Development of Grey Box Models** Empirical model building. Statistical model calibration and validation. Examples. Introduction to population balance models, multi-scale modeling.	09	20
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Solution Strategies for Lumped Parameter Models and Stiff Differential Equations** Solution Methods for Initial Value and Boundary Value Problems. Euler's Method. R-k Methods, Shooting Method, Finite Difference Methods – Predictor Corrector Methods.	10	20

5.	**Solution Strategies for Distributed Parameter Models** Solving parabolic, elliptic and hyperbolic partial differential equations. Introduction to finite element and finite volume methods.	10	20
6.	**Solving Problems using MATLAB**	03	10
TOTAL		45	100

Text Book(s):

Title	Author/s	Publication
Process Modeling, Simulation and Control for Chemical Engineers (2nd edition)	W.L. Luyben	McGraw Hill Book Co., New York (1990)

Reference Book(s):

Title	Author/s	Publication
Mathematical Methods in Chemical Engineering (2nd edition)	Jensen V.G., Jeffrey's G.V.	Academic Press, London(1978)
Computational Methods for Process Simulation (2nd edition)	W. F. Ramirez	Butterworths (1997)
Chemical Process Modelling and Computer Simulation (2nd edition)	Amiya K. Jana	Prentice Hall of India (2011)
Applied Numerical Analysis using MATLAB (2nd edition)	Laurene V. Fausett	Pearson (2009)

Web Material Link(s):

- https://nptel.ac.in/courses/103101142/
- https://lecturenotes.in/subject/383/simulation-and-modelling-sm

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration and the average of the same 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 the completion of the course, the students will able to:

SECH4510	CHEMICAL SYSTEM MODELLING
CO 1	Develop process models based on conservation principles and process data.
CO 2	Correlate computational techniques to solve process models.
CO 3	Apply simulation tools for real problem solving.
CO 4	Develop mathematical models for various chemical processes.

Mapping of CO with PO

SECH4510	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	3		3	3							3
CO 2	1	3		3	3							
CO 3	1	3		3	3							
CO 4	1	3		3	3						3	

Mapping of CO with PSO

SECH4510	PSO1	PSO2	PSO3
CO 1	1	3	2
CO 2			2
CO 3		2	2
CO 4		1	2

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction to Process Modeling	1,2
2	Models based on First Principle	1,2,3
3	Development of Grey Box Models	3,4,5
4	Solution Strategies for Lumped Parameter Models and Stiff Differential Equations	3,4,5
5	Solution Strategies for Distributed Parameter Models	2,3,4
6	Solving Problems using MATLAB	3,4,5

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Department of Chemical Engineering

Course Code: SECH4520
Course Name: Quality Control and Quality Assurance – Instrumentation and Validation Process
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	--	--	03	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- understand the importance of quality
- learn about ISO management systems
- know the tools for quality improvement
- analyze the issues in quality
- learn the importance of quality evaluation of pharmaceuticals
- understand the concept of stability testing of drug and drug substances
- practice statistical approaches for quality

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Introduction** Concept and evolution and Scopes of Quality Control and Quality Assurance, Good Laboratory Practice, GMP, Overview of ICHGuidelines - QSEM, with special emphasis on Q series guidelines.Good Laboratory Practices: Scope of GLP, Definitions, Quality AssuranceUnit, Protocol for Conduct of Non-Clinical Testing, Control on Animal House,Report Preparation and Documentation. CPCSEA Guidelines	07	14
2.	**Inspection Convention** cGMP Guidelines according to schedule M, USFDA (inclusive of CDER andCBER) Pharmaceutical Inspection Convention(PIC), WHO and EMEACovering: Organization and Personnel Responsibilities, Training, Hygiene andPersonal Records, Drug Industry Location, Design, Construction and Plant LayOut, Maintenance, Sanitation, Environmental Control, Utilities andMaintenance of Sterile Areas, Control of Contamination and GoodWarehousing Practice.	07	18
3.	**Quality Control**	08	18

	Analysis of Raw Materials, Finished Products, Packaging Materials, In ProcessQuality Control (IPQC), Developing Specification (Ich Q6 And Q3), PurchaseSpecifications and Maintenance of Stores for Raw Materials.In Process Quality Control and Finished Products Quality Control for FollowingDosage Forms in Pharma Industry according to Indian, US and British Pharmacopoeias: **Table**ts, Capsules, Ointments, Suppositories, Creams,Parenterals, Ophthalmic andSurgicalProducts (How to ReferPharmaCopoeias).		
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
4.	**Documentation** Documentation in Pharmaceutical Industry: Three tier documentation,Policy, Procedures and Work Instructions, and Records (Formats), BasicPrinciples- How to Maintain, Retention and Retrieval etc. Standard Operating Procedures (How to write), Master Batch Record, Batch Manufacturing Record, Quality Audit Plan and Reports. Specification and Test Procedures,Protocols and Reports. Distribution Records. Electronic Data Handling.Concepts of Controlled and Uncontrolled Documents. Submission documentsfor regulators DMFs, as Common Technical Document an ElectronicCommon Technical Documentation (CTD, eCTD). Concept of regulated andnon regulated markets.	12	25
5.	**Manufacturing Operations and Controls** Sanitation of ManufacturingPremises, Mix-Ups and Cross Contamination, Processing of Intermediates andBulk Products, Packaging Operations, IPQC, Release of Finished Product,Process Deviations, Charge-In of Components, Time Limitations on Production,Drug Product Inspection, Expiry Date Calculation, Calculation of Yields,Production Record Review, Change Control, Sterile Products, Aseptic ProcessControl, Packaging, Reprocessing, Salvaging, Handling of Waste and ScrapDisposal. Introduction, Scope and Importance of Intellectual Property Rights. Concept of Trade Mark, Copyright and Patents.	11	25
TOTAL		45	100

Text Book(s):

Title	**Author/s**	**Publication**
Quality Assurance Guide by organization of Pharmaceutical Procedures of India	D H Shah	3rdrevised edition, Volume I & II, Mumbai, 1996.
How to Practice GMP's	P P Sharma,	Vandana Publications, Agra, 1991.

Reference Book(s):

Title	**Author/s**	**Publication**
Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I & II, 2nd edition	--	WHO Publications, 1999
Good laboratory Practice Regulations –, Volume 38,	Allen F. Hirsch	Marcel Dekker Series,

		1989

Web Material Link(s):

- www.pharmaguide.com

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 Hour of duration and average of the same 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 the completion of the course, the students will able to:

SECH4520	**QUALITY CONTROL AND QUALITY ASSURANCE – INSTRUMENTATION AND VALIDATION PROCESS**
CO 1	Analyze importance of quality control and quality assrance roles in process industries.
CO 2	Discover about iso management systems and their applications for qc qa laboratories.
CO 3	Execute tools for quality improvement in the research and development field.
CO 4	Analyze issues in quality control and process.
CO 5	Predict quality evaluation of various products generated by chemical process industries.

Mapping of CO with PO

SECH4520	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2		2	1	2				3		1
CO 2			1			3				3		1
CO 3	2	2	1	3	1					3		1
CO 4	2	2	1	3	1					3		1
CO 5	2	2	1	3	1					3		1

Mapping of CO with PSO

SECH4520	PSO1	PSO2	PSO3
CO 1	3	1	1
CO 2	3	1	1
CO 3	3	1	1
CO 4	3	1	1
CO 5	3	1	1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Introduction	1,2
2	Inspection Convention	1,2
3	Quality Control	1,2

4	Documentation	1,2
5	Manufacturing Operations and Controls	1,2

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH4530
Course Name: Membrane 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	--	--	03	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

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

- enable to understand membrane-based separation problems by acquiring in-depth knowledge in the area of membrane separation mechanisms, transport models, membrane materials and modules.
- focus particularly on various applications of membrane science and technology.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Rate Governed and Equilibrium Membrane Separation Processes** Fundamentals, Types of Membranes, Modules, Flow Patterns, Preparation and Characterization of Membranes, Melt Pressing, Film Stretching, Sol-gel Peptization, Interfacial Polymerization etc. Measurement of Pore Size and Solute Rejection Properties	06	15
2.	**Reverse Osmosis** Design and Operating Parameters, Various Transport Models, Kedem-katchalsky Model, Spiegler-kedem Model, Solution-diffusion Model, Concentration Polarization and Flux Decline, Design of an RO module, Forward Osmosis	06	15
3.	**Nanofiltration** Transport Mechanism in NF Membranes, Parameters affecting the Performance of NF Membranes, Fouling Model, Determination of Various Resistances	06	10
4.	**Ultrafiltration** Factors Affecting Performance of Ultrafiltration, Resistance Model, Gel Polarization Model, Fouling and Flux Decline, Micellar-Enhanced Ultrafiltration, Affinity Ultrafiltration, Microfiltration Advances	05	10
Section II			
Module	**Content**	**Hours**	**Weightage**

No.			in %
5.	**Membrane Gas Separation** Membranes for Gas Separation, Fundamental Mechanism of Gas Transport, Knudsen Diffusion, Molecular Sieving, Solution Diffusion, Dual Sorption Model, Factors Affecting Gas Permeation, Complete Mixing Model, Solution of Equations, Equations for Multicomponent Mixtures, Cross - Flow Model, Countercurrent Model, Applications	07	20
6.	**Pervaporation** Mass Transfer and Thermodynamics Aspects of Pervaporation, Temperature Drop at Membrane Interface	05	10
7.	**Dialysis** Principle of Dialysis, Dialysis Systems, Mass Transfer in Dialysis, Modeling of Solute Transport in Hemodialyzer, Advantages of Diffusion Dialysis, Application of Diffusion Dialysis, Electrodialysis	06	10
8.	**Membrane Reactor** Membrane Bioreactor, Membrane Distillation	04	10
TOTAL		45	100

Text Book(s):

Title	Author/s	Publication
Membrane technology and applications	Baker, R.W.	2nd ed., John Wiley 2004
Membrane separation Processes	K Nath	Prentice Hall of India, New Delhi

Reference Book(s):

Title	Author/s	Publication
Basic Principles of Membrane Separation	Mudler J	(2nd Edition), Springer

Web Material Link(s):

https://nptel.ac.in/courses/103105121/

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same will be converted to 30 marks.
- Submission of power point presentation which is to be presented by the students in a group of 3 which carries 10 marks of evaluation.
- End Semester Examination consists of 60 marks.

Course Outcome(s):

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

SECH4530	MEMBRANE TECHNOLOGY
CO 1	Identify and describe the main unit operations associated with membrane technology.
CO 2	Describe the main industrial applications of membrane technology.
CO 3	Calculate mean flux, selectivity and membrane area for the different membrane processes.
CO 4	Employ membrane technology knowledge to discuss recent journal articles in the membrane field and compare the with similar separation processes.

Mapping of CO with PO

SECH4530	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2				2				2		2
CO 2	1	1				3	1			2		2
CO 3	3	2				2	3			2		2
CO 4	2	2				3	2			3		2

Mapping of CO with PSO

SECH4530	PSO1	PSO2	PSO3
CO 1	2	2	1
CO 2	2	1	2
CO 3	3	2	3
CO 4	1	3	3

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	Content	RBT Level
1	Rate Governed and Equilibrium Membrane Separation Processes	1,2,4
2	Reverse Osmosis	1,2
3	Nanofiltration	1,2
4	Ultrafiltration	1,2
5	Membrane Gas Separation	1,2
6	Pervaporation	1,2
7	Dialysis	1,2
8	Membrane Reactor	1,2

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH4540
Course Name: Industrial Health & Safety 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	--	--	03	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

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

- provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- understand the various hazards and prevention in commissioning stage of industry.
- recognize and identify the safe operation of equipment in process industry.
- plan and trained for emergency planning in a process industry.
- get fundamental knowledge on safe storage of chemicals.
- understand mathematical modeling and analogical aspects of chemical process systems where these transport processes occur simultaneously.
- transport Phenomena also focuses on typical situations and thereby its complete understanding on axial as well as radial profiles.

Course Content:

Section I			
Module No.	**Content**	**Hours**	**Weightage in %**
1.	**Hazard, Risk Issues, and Hazard Assessment** Introduction, Hazard assessment, Hazard operability studies (HAZOP, HAZAN), Fire triangle, OSHA standards	03	05
2.	**Safety in Process Design** Design Process, Conceptual Design and Detail Design, Assessment, Inherently Safer Design Chemical Reactor, Types, Batch Reactors, Reaction Hazard Evaluation, Assessment, Reactor Safety, Operating Conditions, Unit Operations and Equipment, Utilities	05	08
3.	**Safety in Pressure System Design** Pressure System, Pressure Vessel Design, Standards and Codes- Pipe Works and Valves - Heat Exchangers - Process Machinery- Over Pressure Protection, Pressure Relief Devices and Design, Fire Relief, Vacuum and Thermal Relief, Special Situations, Disposal- Flare and Vent Systems Failures In Pressure System.	06	17

4.	**Plant Commissioning** Commissioning Phases and Organization, Pre-Commissioning Documents, Process Commissioning, Commissioning Problems, Post Commissioning Documentation	04	10
5.	**Plant Inspection** Plant Inspection, Pressure Vessel, Pressure Piping System, Non-Destructive Testing, Pressure Testing, Leak Testing and Monitoring - Plant Monitoring, Performance Monitoring, Condition, Vibration, Corrosion, Acoustic Emission-Pipe Line Inspection	05	10
Section II			
Module No.	**Content**	**Hours**	**Weightage in %**
6.	**Plant Maintenance, Modification and Emergency Planning** Management of Maintenance, Hazards - Preparation for Maintenance, Isolation, Purging, Cleaning, Confined Spaces, Permit System - Maintenance Equipment - Hot Works - Tank Cleaning, Repair and Demolition - Online Repairs - Maintenance of Protective Devices - Modification of Plant, Problem-Controls of Modifications.	07	10
7.	**Storages and Transportation** General consideration, petroleum product storages, storage tanks and vessel- storages layout segregation, separating distance. LPG storages, pressure storages, layout, instrumentation, vaporizers, refrigerated storages-LNG Storages, Hydrogen Storages, Toxic Storages, Chlorine Storages, Ammonia Storages. Chemical Storages- Underground Storages- Loading and Unloading Facilities- Drum and Cylinder Storage- ware House, Storage Hazard Assessment of LPG and LNG Hazards during Transportation – Pipeline Transport.	07	20
8.	**Plant Operations** Application of Shell Balance Method and Equations of Changes for Mass Transfer Problems, Diffusivity, Mass and Molar Transport By Convection, Concentration Distributions for Isothermal and Non-Isothermal Mixtures, Multi-component Systems with more than one Independent Variable and in Turbulent Flow Convective Mass Transfer and Correlation, Inter Phase Mass Transfer, Diffusion with Chemical Reaction, Transport Across Selectively Permeable Membrane and Porous Media	08	20
TOTAL		45	100

Text Book(s):

Title	Author/s	Publication
Safety and Accident Prevention in Chemical Operations.	Fawcett, H.h. and Wood	Wiley inters, Second Edition.
High Risk Safety Technology.	Green, A.E.	John Wiley & Sons.

Reference Book(s):

Title	Author/s	Publication
Loss Prevention in Process Industries.	Lees, F.P	Butterworths and Company

Guidelines for Chemical Process Quantitative Risk Analysis	--	AICHE, 2000

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests each of 30 marks and 1 hour of duration and average of the same 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 the completion of the course, the students will able to:

SECH4540	**INDUSTRIAL HEALTH & SAFETY ENGINEERING**
CO 1	Analyze the effect of release of toxic substances in process industries.
CO 2	Anticipate the industrial laws, regulations and source models. used for prediction of health and safety measures.
CO 3	Apply the methods of prevention of fire and explosions by various fire fighting aids.
CO 4	Distinguish the relief and its sizing methods used for safety precaution.
CO 5	Evaluate the methods of hazard identification and preventive actions.

Mapping of CO with PO

SECH4540	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1				2	1		3	1	2	1	2	
CO 2	1			1	1			1	2	3	2	
CO 3				1				1	3	2	1	
CO 4				1	1				1	1	1	
CO 5				1						2		

Mapping of CO with PSO

SECH4540	PSO1	PSO2	PSO3
CO 1	3	0	3
CO 2			3
CO 3	3		1
CO 4			
CO 5			1

Level of Bloom's Revised Bloom's Taxonomy in Assessment

1: Remember	2: Understand	3: Apply
4: Analyze	5: Evaluate	6: Create

Module No	**Content**	**RBT Level**
1	Hazard, Risk Issues, and Hazard Assessment	1,2
2	Safety in Process Design	1,2
3	Safety in Pressure System Design	1,2
4	Plant Commissioning	1,2
5	Plant Inspection	1,2

6	Plant Maintenance, Modification and Emergency Planning	1,2
7	Storages and Transportation	1,2
8	Plant Operations	1,2

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