PPSU

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

B. TECH. (CHEMICAL ENGINEERING)

SYLLABUS BOOK

AY 2023-24

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: 2023-24

Authored by: P P Savani University

CONTENT

FIRST YEAR B. TECH.

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

TEACHING & EXAMINATION SCHEME FOR B. TECH. BATCH : 2023 (CHEMICAL ENGINEERING)

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 OR 2	SESH1110	Calculus	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SESH1120	Linear Algebra	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SEME1110	Hardware Workshop	ME	0	4	0	4	4	0	0	100	0	0	0	100
	SECE1110	Software Workshop	CE	0	4	0	4	2	0	0	100	0	0	0	100
	SEIT1110	Cyberspace Awareness	IT	2	0	0	2	2	40	60	0	0	0	0	100
	SEIT1120	Competitive Quantitative Aptitude	IT	2	0	0	2	2	40	60	0	0	0	0	100
	SECE1120	Joy of Programming	CE	3	2	0	5	4	40	60	40	60	0	0	200
	SESH1130	Conceptual Experimental Physics	SH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH1110	Fundamental Chemistry & Environmental Science	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SEME1120	Fundamentals of Technical Drawing	ME	0	4	0	4	4	0	0	40	60	0	0	100
	SECV1110	Core Engineering Concepts	CV	3	2	0	5	4	40	60	40	60	0	0	200
	CFLS2130	Intermediate Communicative English	CFLS	2	2	0	4	3	100	00	100	0	0	0	200
	CLSC2070	Essentials of Entrepreneurship	CFLS/SLM	2	0	0	2	2	100	0	0	0	0	0	100
						Total	**52**	**45**							**2000**

Group 1	SESH1110	Calculus	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SEME1110	Hardware Workshop	ME	0	4	0	4	4	0	0	100	0	0	0	100
	SEIT1110	Cyberspace Awareness	IT	2	0	0	2	2	40	60	0	0	0	0	100
	SESH1130	Conceptual Experimental Physics	SH	3	2	0	5	4	40	60	40	60	0	0	200
	SEME1120	Fundamentals of Technical Drawing	ME	0	4	0	4	4	0	0	40	60	0	0	100
	SECE1120	Joy of Programming	CE	3	2	0	5	4	40	60	40	60	0	0	200
	CFLS2130	Intermediate Communicative English	CFLS	2	2	0	4	3	100	0	100	0	0	0	200
						Total	**29**	**26**							**1100**
Group 2	SESH1120	Linear Algebra	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SECE1110	Software Workshop	CE	0	4	0	4	2	0	0	100	0	0	0	100
	SEIT1120	Competitive Quantitative Aptitude	IT	2	0	0	2	2	40	60	0	0	0	0	100
	SECH1110	Fundamental Chemistry & Environmental Science	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECV1110	Core Engineering Concepts	CV	3	2	0	5	4	40	60	40	60	0	0	200
	CLSC2070	Essentials of Entrepreneurship	CFLS/SLM	2	0	0	2	2	100	0	0	0	0	0	100
						Total	**23**	**19**							**900**

P P Savani University

School of Engineering

Department of Science and Humanities

Course Code: SESH1110

Course Name: Calculus

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	
3	0	2	5	40	60	0	0	100	0	200

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 convergence or divergence of any infinite series and power series for learning advanced Engineering Mathematics.
- acquire knowledge of partial differentiation and ability to work with applications to advanced Engineering Mathematics.
- application of concavity of graph and find out points of inflection.

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.	9	20
2.	**Sequence and Series-I** Convergence and Divergence, Comparison Test, Integral Test, Ratio Test, Root Test, Alternating Series, Absolute and Conditional Convergence.	9	20
3.	**Sequence and Series-II** Power series, Taylor and Macluarin series, Indeterminate forms and L'Hospitals Rule.	5	10
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Partial Derivatives** Function of several variables, Partial differentiation, Applications, Chain rule, Linear approximations, Maxima and Minima, Euler's theorem, Lagrange multiplier.	11	30
2.	**Curve tracing**	11	20

	Tracing of Cartesian Curves, Polar Coordinates, Polar and Parametric Form of Standard Curves, Areas and Length in Polar co-ordinates		

List of Tutorials:

Sr. No.	Name of Tutorial	Hours
1.	Calculus-1	4
2.	Calculus-2	4
3.	Calculus-3	2
4.	Sequence and Series-1	4
5.	Sequence and Series-2	2
6.	Sequence and Series-3	2
7.	Partial Derivatives-1	4
8.	Partial Derivatives-2	2
9.	Curve tracing-1	4
10.	Curve tracing-2	2

Text Book:

Title	Author(s)	Publication
Thomas' Calculus	George B. Thomas, Maurice D. Weir and Joel Hass	Pearson
Elementary linear Algebra	Howard Anton and Chrish Rorres	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	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
- Continuous Evaluation consists of self-performance assignment to 20 marks.
- Internal Viva consists of 30 marks.

Course Outcome(s):

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

SESH1110	CALCULUS
CO 1	Recall the concepts of limit, continuity and differentiability for analysing mathematical problems.
CO 2	Analyze the series for its convergence and divergence to solve real world problems.
CO 3	Evaluate various limit problems using L' Hospital's rule.
CO 4	Identify the ordinary differentials and partial differentials and solve the maximum and minimum value of function.
CO 5	Construct the graphs for function with intervals and identify more application for function.

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, 5
2	Sequence and Series – I	1, 2, 3, 4, 6
3	Sequence and Series – II	1, 2, 3, 4, 6
4	Partial Derivatives	1, 2, 3, 4, 5
5	Curve tracing	1, 2, 3, 4, 5, 6

P P Savani University
School of Engineering

Department of Science and Humanities

Course Code: SESH1120
Course Name: Linear Algebra
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	
3	0	2	5	40	60	0	0	100	0	200

CE: Continuous Evaluation, ESE: End Semester Exam

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

- analyse and solve system of linear equations and understand characteristics of Matrices.
- 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.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**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.	12	30
2.	**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.	11	20
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Linear Transformation** Introduction of Linear Transformation, Kernal and Range, Rank and Nullity, Inverse of Linear Transformation, Rank Nullity Theorem, Composition of Linear Maps.	9	20
2.	**Inner Product Space** Inner Product, Angle and Orthogonality, Orthogonal projection, Gram-Schmidt process and QR Decomposition, Least square decomposition.	8	20

3.	**Beta and Gamma function** Improper Integrals, Convergence, Properties of Beta and Gamma Function, Duplication Formula (without proof)	5	10

List of Tutorial:

Sr. No.	Name of Tutorial	Hours
1.	Matrix Algebra-1	4
2.	Matrix Algebra-2	2
3.	Vector Space-1	4
4.	Vector Space-2	2
5.	Linear Transformation-1	4
6.	Linear Transformation-2	2
7.	Inner Product Space-1	4
8.	Inner Product Space-2	2
9.	Beta and Gamma function-1	4
10.	Beta and Gamma function-2	2

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 Chrish Rorres	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 50 marks.
- Continuous Evaluation consists of self-performance assignment to 20 marks.
- Internal Viva consists of 30 marks.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SESH1120	LINEAR ALGEBRA & CALCULUS
CO 1	Evaluate linear system using matrices and the knowledge of eigenvalues and eigenvectors for matrix diagonalization
CO 2	Determine the basis and dimension of vector spaces and subspaces.
CO 3	Discuss the matrix representation of a linear transformation given bases of the relevant vector space.
CO 4	Apply vectors, inner products, and linear transformations to real world situations.
CO 5	Classify gamma, beta functions & their relation which is helpful to evaluate some definite integral arising in various branch of engineering.

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	Matrix Algebra	1, 2, 3, 4, 5, 6
2	Vector Space	1, 2, 3, 4, 6
3	Linear Transformation	1, 2, 3, 4, 6
4	Inner Product Space	1, 2, 3, 4, 5, 6
5	Beta and Gamma Function	1, 2, 3, 4, 5

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1110
Course Name: Hardware 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	
00	04	00	04	00	00	100	00	00	00	100

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.

Course Content:

Module No.	Contents	Weightage in %
1.	**Introduction:** Introduction to Various Shops / Sections and Workshop Layouts, Safety Norms to be Followed in a Workshop. **Fitting Shop:** Introduction of Fitting Shop; Safety; Making a Job as per Drawing including Marking and other Performing Operations. **Carpentry and Drilling Shop:** Introduction of Carpentry Shop; Preparation of Job as per Drawing including Marking and other Performing Operations. **Introduction to Machine Tools:** Introduction and Demonstration of various Machine Tools like Lathe, Drilling, Grinding, Hack Saw Cutting etc. **Introduction to Welding & Plumbing:** Introduction and Demonstration of Welding process. Introduction and Demonstration of Plumbing Shop.	25%
2.	**Introduction to Computer Hardware** Computer hardware structure, Identify and understand hardware components: CPU, Motherboard, RAM, HDD, SSD, Keyboard, Ports, Mouse, Monitor, Printer, UPS/SMPS, etc. **Hardware Maintenance and Troubleshooting** Assembling and disassembling a PC, connectors and cables, BIOS setup, Disk management, Device manager, Task manager, Network	25%

	management, Backup/recovery disk.	
3.	**Electrical and Electronic Skill:** Use of Multimeter. Soldering of electrical circuits having discrete components (R, L, C & diode) and ICs on PCB, connections on Breadboard	25%
4.	**Logic Gates:** Digital Electronics, Symbol and truth table of Logic gates (OR, AND, NOT, NAND, NOR and EX-OR gate), De morgan's theorem. **Cathode Ray Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & Use of CRO for the measurement of voltage (dc or ac frequency, time period. Special features of dual trace, Digital storage Oscilloscope: Block diagram and principle of working.	25%

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Introduction and Demonstration of Safety Norms. Different Measuring Instruments. Introduction and Demonstration of Machine Shop. To Perform a Job of Fitting Shop.	12
2.	To Perform a Job of Carpentry Shop. Introduction and Demonstration of Plumbing Shop & Welding Process.	15
3.	(I)Identify computer hardware layout and components (II)Perform assembling and disassembling of PC	08
4.	Configure BIOS, disk, network and other hardware management	05
5.	Understanding the electronic components and study of Shouldering and Desoldering of electronic components on PCB Board.	04
6.	Understanding the connection on Breadboard and study of Alternate Flashing LED Lights using Breadboard.	06
7.	Verify the truth table of Logic gates and De morgan's theorem on IC trainer board.	04
8.	Study of Cathode Ray Oscilloscope.	06

Text Book(s):

Title	Author(s)	Publication
Elements of Workshop Technology	S K Hajra Choudhury	Media Promoters & Publishers
A text book in Electrical Technology	B L Theraja	S Chand and Co

Reference Book(s):

Title	Author(s)	Publication
Basic Electronics: A text lab manual	P.B. Zbar, A.P. Malvino, M.A. Miller	Mc-Graw Hill.
Digital Electronics	Subrata Ghoshal	Cengage Learning

Course Evaluation:

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 30 Marks.
- Faculty evaluation consists of 10 marks as per the guidelines provided by the Course Coordinator
- Internal Viva consists of 30 Marks.
- Practical performance/quiz/drawing/test will consist of 30 Marks.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME1110	**HARDWARE WORKSHOP**
CO 1	Apply the application of mechanical workshop such as fitting, drilling and carpentry. Understand various tools of mechanical workshop and understand its applications.
CO 2	Identify and inspect hardware components and interpret latest development of the field.
CO 3	Make students capable of analysing and solving the varieties of problems coming up in the electrical measurements and also enable the students to design as well as trouble shoots the circuits and networks through hands-on mode.
CO 4	Develop skill to build, and troubleshoot digital circuits.

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, Fitting Shop, Carpentry Shop and Drilling Shop, Introduction to Machine Tools, Welding and Plumbing	2,3,4,6
2	Introduction to Computer Hardware, Hardware Maintenance and Troubleshooting	1,2,3,4,5,6
3	Understand and designing of Electrical circuit	2,3,5
4	Cathode ray oscilloscope and Digital Electronics	1,2,3,5

P P Savani University

School of Engineering

Department of Computer Engineering

Course Code: SECE1110

Course Name: Software 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	
00	04	00	02	00	00	100	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Provide a comprehensive knowledge of overall basic computer software tools and technology.
- Providing hands-on experience related to basic software installation, usage of Operating systems, and various essential software utilities.

Course Content:

Section I		
Module No.	Content	Weightage in %
1.	**Software Fundamentals** Introduction to Software, Types of software, Applications of software, Web based software, Understand Software specific requirements, Installation of Software	10
2.	**Operating System** Introduction of OS, Functions of Operating System, Types of OS, Installation of Windows and Linux OS, Linux architecture, Role of Device Drivers in OS, Shell scripting, Command structure, and general-purpose utility.	25
3.	**DOS Commands** Getting Started with DOS, Introduction to Command Prompt, System Files and Command, Creating directories, Traversing through directories, Deleting directories, Viewing Files within a directory.	15
Section II		
Module No.	Content	Weightage in %
1.	**Application Software** Introduction to Application Software, Types of Application Software, Installation of Application Software, Logo Designing, Creating Flowcharts and diagrams, Introduction To Google Apps.	10

2.	**Data Analysis using Application Software** Introduction to Spreadsheets, Spreadsheet Functions to Organize Data, Introduction to Filtering, Pivot Tables, and Charts, VlookUp and HlookUp in Spreadsheets.	15
3.	**Website Creation** Creating a website using Google Sites, Creating Web Pages, Working with Images, Working with Documents on Web Pages. Introduction to Wordpress, Installing Web Server and Wordpress, Creating Web pages in Wordpress.	25

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Study of Different Software.	2
2.	Installation of any 2 software with required plugins and libraries.	4
3.	Study of Different Operating Systems.	2
4.	Creation of Bootable Pen drive.	2
5.	Installation of Windows OS.	2
6.	Installation of Linux OS using VMWare.	2
7.	Study of Basic commands of Linux/UNIX.	4
8.	Study of Basic commands of DOS.	4
9.	Design logo using Canva.	2
10.	Draw a Flowchart to find maximum of two numbers in either draw.io or Microsoft Visio or LucidChart.	2
11.	Study of different Google Apps.	4
12.	Create a Google Doc and Google sheet and share with 2 classmates.	2
13.	Demonstrate working of HlookUp and VlookUp in Excel.	2
14.	Create different types of charts in Excel.	4
15.	Demonstrate Data Analysis in Excel.	4
16.	Create a Google Website with minimum two pages showing your personal details.	4
17.	Demonstrate embedding of a youtube video and pdf document on a web page in google site.	4
18.	Demonstrate placing Map and hyperlinks on web page in Google Site.	4
19.	Create a wordpress site and create minimum three web pages and menu to navigate between the pages.	4
20.	Demonstrate the use of Accordian in wordpress.	2

Text Book(s):

Title	Author/s	Publication
Fundamentals Of Computers, 2nd Edition	Reema Thareja	Oxford University Press
Excel 2019 Bible	Michael Alexander, Richard Kusleika, John Walkenbach	Wiley

Reference Book(s):

Title	Author/s	Publication
UNIX : Concepts and Applications | 4th Edition	Sumitabha Das	McGraw Hill Education

Web Material Link(s):

- https://sites.google.com/site/willkimbley/google-apps-tutorials
- https://www.cs.upc.edu/~robert/teaching/foninf/doshelp.html
- https://www.javatpoint.com/software-engineering
- https://www.wikihow.com/Create-a-Website-Using-Google-Sites
- https://www.wpbeginner.com/guides/

Course Evaluation:

Practical:

- Continuous Evaluation consists of performance of practical, which should be evaluated out of 10 marks per each practical and average of the same will be converted to 10 marks.
- Internal viva consists of 20 marks.
- Practical performance/quiz/test consists of 30 marks during Internal practical Exam.
- Mini Project performance consists of 40 marks during End Semester Exam.

Course Outcome(s):

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

SECE1110	**Software Workshop**
CO 1	Understand the types of computer software with their requirements and how to use as per the need.
CO 2	Install different Operating Systems and learn commands used in the OS.
CO 3	Get familiar with the application software and different applications of application software
CO4	Achieve some useful information from data through analysis and represent it with different views like charts, graphs etc.
CO 5	Learn the designing and development of website to have a global communication.

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	Software Fundamentals	1,2
2	Operating System	1,2,3,6
3	Disk Operating System	2,3
4	Application Software	2,3,4,5
5	Data Analysis using Application Software	3,4,5,6
6	Website Creation	2,3,6

P P Savani University
School of Engineering
Department of Information Technology

Course Code: SEIT1110
Course Name: Cyberspace Awareness
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
2	0	0	2	40	60	00	00	0	0	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to,

- understand governance, regulatory, legal, economic, environmental, social, and ethical context of cyber security.
- equip students with the technical knowledge and skills needed to protect and defined against cyber threats.
- help students to protect the one's data, systems, and networks from malicious attacks and cyber threats.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Cyber space** Cyber space, Cyber Crime and its Types, Overview of Cyber Security, Cyber Attacks in History, Internet Governance, Hacking and its Types, Cracking, Overview of System and Web Vulnerability, OWASP	06	20
2.	**Cyber Threats** Various Cyber Threats, Malware, Phishing, Password Attacks, DOS attack, Man in the Middle, Drive by download, Malvertising, Rogue Software, Cyber Warfare and its conflicts, Cyber Terrorism, Case studies	09	30
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Cyber security Practices** Cyber Security Practices and dos and don'ts, Data Privacy and Security, Security Controls, Overview of social media and its security, E-Commerce, Digital payments and its security, Tools and technology for cyber security, Platform to report and combat cyber crime, Case studies	05	15

2.	**Cyberspace and the Law** Cyber Security Regulations, Cyber Law, need for a Comprehensive Cyber Security Policy, Need for an International convention on Cyber space, Contemporary crime, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards, The INDIAN Cyberspace, Indian IT Act 2000, Indian IT Act 2008, Case studies	06	15
3.	**Cyber Forensics** Introduction to Cyber Forensics, Handling Preliminary analysis, Investigating Investigations, Controlling an Investigation, Legal Policies, Case studies	04	20

Text Book(s):

Title	Author/s	Publication
Cybersecurity for Beginners	Raef Meeuwisse	Cyber Simplicity Ltd

Reference Book(s):

Title	Author/s	Publication
Cyber Security	Nina Godbole, Sunit Belapure	Wiley India, New Delhi
The Indian Cyber Law	Suresh T. Vishwanathan;	Bharat Law House 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.

Course Outcome(s):

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

SEIT1110	Cyberspace Awareness
CO 1	Understand Concepts of Cyber space.
CO 2	Analyze the Concepts of Cyber Threats.
CO 3	Elaborate the overview of social media and understanding cybercrimes.
CO 4	Identify cyber laws and cyber acts in India.
CO 5	Explore different case studies based on cyber-Forensics.

Level of 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 Cyber space	1
2	Cyber Threats	1,2
3	Cyber security Practices	1,2,3

4	Cyberspace and the Law	1,2
5	Cyber Forensics	1,23

P P Savani University

School of Engineering

Department of Computer Engineering

Course Code: SEIT1120

Course Name: Competitive Quantitative Aptitude

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	00	00	02	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

- This course is designed to suit the need of the outgoing students and to acquaint them with frequently asked patterns in quantitative aptitude and logical reasoning during various examinations and campus interviews.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Quantitative Ability (Basic Mathematics)** Number Systems, LCM and HCF, Decimal Fractions, Simplification, Square Roots and Cube Roots, Average, Problems on Ages, Surds & Indices, Percentages, Problems on Numbers, Quadratic Equations	5	15
2.	**Quantitative Ability (Applied & Engineering Mathematics)- Part I** Logarithm, Permutation and Combinations, Probability, Profit and Loss, Simple and Compound Interest,	5	35
3.	**Quantitative Ability (Applied & Engineering Mathematics) -Part II** Time, Speed and Distance, Time & Work, Ratio and Proportion, Mixtures and Allegation	5	20
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Data Interpretation** Data Interpretation, Tables, Column Graphs, Bar Graphs, Line Charts, Pie Chart, Venn Diagrams1	6	20

2.	**Logical Reasoning (Deductive Reasoning)** Analogy, Blood Relation, Directional Sense, Number and Letter Series, Coding – Decoding, Calendars, Clocks, Seating Arrangement, Syllogism	6	20
3.	**Mensuration & Trigonometry** Two-dimensional (2D) and Three-dimensional (3D) Mensuration, Degree and Radian Measures, Trigonometric Ratios, Complementary Angles, Height and Distance, Standard Identities, Area, Inequalities	3	10

Text Book(s):

Title	Author/s	Publication
Quantitative aptitude for Competitive examination	R S Agarwal	S. Chand
A Modern Approach to Verbal & Non-Verbal Reasoning	R S Agarwal	S. Chand

Reference Book(s):

Title	Author/s	Publication
Analytical and Logical reasoning	Sijwali B S	arihant

Web Material Link(s):

- https://prepinsta.com/
- https://www.indiabix.com/
- https://www.javatpoint.com/

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 be able to

SEIT1120	Competitive Quantitative Aptitude
CO 1	Understand the basic concepts of quantitative ability
CO 2	Understand the basic concepts of logical reasoning Skills
CO 3	Acquire satisfactory competency in use of reasoning
CO4	Solve campus placements aptitude papers covering Quantitative Ability, Logical Reasoning Ability
CO 5	Compete in various competitive exams like CAT, CMAT, GATE, GRE, GATE, UPSC, GPSC etc

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	Quantitative Ability (Basic Mathematics)	1, 3, 5
2	Quantitative Ability (Applied & Engineering Mathematics)	1, 2, 3, 5
3	Data Interpretation	2, 3, 6
4	Logical Reasoning (Deductive Reasoning)	2, 4, 5
5	Mensuration & Trigonometry	1, 3, 5

P P Savani University
School of Engineering
Department of Computer Engineering

Course Code: SECE1120

Course Name: Joy of 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	00	04	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:
To help learners to
- identify appropriate approach to computational problems.
- develop logic building and problem-solving skills.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Motivation of Programming:** Use of Programming, Importance of Programming, Discussion of different Case Study	5	14
2.	**Welcome to Programming:** Introduction of Programming, Flow Charts and Algorithms, Debugging, Tracing the execution of the Program, Watching Variables Values in Memory, Character Set, Keyword and Identifiers, Constants and Variables, Data Types - Declaration and Initialization, Basic Input, and Output Operations, Symbolic Constants, Overflow and Underflow of Data.	9	18
3.	**Conditional Statements and Looping Statements:** Decision Making & Branching: Decision Making with If and If - else Statements, Nesting of If-else Statements, The Switch and go-to statements. Looping: The while Statement, The Break Statement &The Do While loop, The FOR loop, Jump within loops - Programs.	9	18
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Collection of Data:** Introduction, One-dimensional Arrays, Two-dimensional Arrays, Concept of Multidimensional Arrays, Declaring and Initializing String Variables, Arithmetic Operations on Characters, Putting Strings Together, Comparison of Two Strings, String Handling Functions, Dictionary, List, Tuples and Sets.	10	20
2.	**Functions** Introduction to Functions, defining a Function, Calling a Function, Types of Functions, Function Arguments, Anonymous Functions,	6	15

	Global and Local Variables, Recursion		
3.	**Building Desktop Application** Exploring the Tkinter Library in Python, Creating basic Desktop application using Tkinter	6	15

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Working with basic elements of C languages (different input functions, different output functions, different data types, and different operators).	2
2.	Working with control structures (if statement, if-else statement, nested if-else statement, switch statement, break statement, goto statement).	2
3.	Working with array and strings in C.	4
4.	Introduction to Python (Introduction to IDLE, different data types, Input Output in Python, Operators, Operator precedence).	2
5.	Implementation of Dictionaries, Sets, Tuples and Lists and its various methods in Python.	6
6.	Working with functions in C/Python.	2
7.	Working with recursive function in C/Python.	2
8.	Building desktop application of your own calculator in Python.	4
9.	Case Study: a. Sorting : Arrange the books b. Searching : Find in seconds c. Recursion : Tower of Hanoi	6

 # 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
Python Programming: A modular approach	Sheetal Taneja, Naveen Kumar	Pearson

Reference Book(s):

Title	Author(s)	Publication
Programming in C	Ashok Kamthane	Pearson
Python Cookbook	David Ascher, Alex Martelli Oreilly	O Reilly Media

Web Material Link(s):

- https://www.tutorialspoint.com/cprogramming/index.htm
- https://www.w3schools.com/c/
- https://www.tutorialspoint.com/python/
- https://www.w3schools.com/python/

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.

Practical:

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

Course Outcomes:

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

SECE1120	**JOY OF PROGRAMMING**
CO 1	Immediately analyze the syntax and semantics of the computer languages and apply it in programs.
CO 2	Implement computing solutions using logic building and problem-solving skills of a given programming language.
CO 3	Interpret the fundamental language syntax, semantics and fluent in the use of python or any computer language control flow statements.
CO 4	Determine the methods to create and manipulate programs by utilizing the data structures like lists, dictionaries, tuples and sets with emphasis on Python.

Level of Revised Bloom's Taxonomy in Assessment:

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

Module No	**Content**	**RBT Level**
1.	Motivation of Programming	1, 2, 4
2.	Welcome to Programming	1, 2, 3
3.	Conditional Statements and Looping Statements	1, 2, 3
4.	Collection of Data	1, 2, 3
5.	Functions	2, 3, 4, 6
6.	Building Desktop Application	2, 3, 4, 6

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH1110
Course Name: Fundamental Chemistry & Environmental Science
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	00	04	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

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

- Understand the basic concepts of chemistry, including atoms, molecules, and chemical processes.
- Apply the scientific method to examine chemical phenomena, including the design and execution of experiments, data analysis, and evidence-based conclusion drawing.
- Evaluate the causes and consequences of environmental problems and propose solutions based on scientific evidence.
- Integrate knowledge from multiple disciplines to analyze environmental problems and propose effective solutions.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Chemistry** Overview of the scientific method and chemistry as a science, Basic concepts of matter, including atoms, molecules, and the periodic table, Introduction to chemical bonding and intermolecular forces, Basic principles of chemical reactions, including stoichiometry and reaction types	6	15
2.	**Chemical Thermodynamics and Kinetics** Introduction to thermodynamics and the laws of thermodynamics, Energy and enthalpy changes in chemical reactions, Introduction to chemical kinetics and reaction rates, Factors affecting reaction rates, including temperature, concentration, and catalysts	6	15
3.	**Properties of Matter and Solutions** Physical properties of matter, including states of matter and phase changes, Solutions and their properties, including solubility and colligative properties, Introduction to acids and bases and their properties, Chemical equilibrium and the equilibrium constant	5	10
4.	**Organic Chemistry** Introduction to organic chemistry and the basics of carbon chemistry,	6	10

	Functional groups and their properties, Nomenclature and isomerism in organic compounds, Introduction to organic reactions and Mechanisms		

Section II			
Module	Content	Hours	Weightage in %
1.	**Introduction to Environment** Definition, principles and scope of Environmental Science, Impacts of development on Environment, Environmental Degradation, The interdisciplinary nature of environmental science, Concept of 4R's	06	10
2.	**Environmental Pollution** a) Water Pollution: Introduction – Water Quality Standards, Sources of Water Pollution, Classification of water pollutants, Effects of water pollutants. b) Air Pollution: Composition of air, Structure of atmosphere, Ambient Air Quality Standards, Classification of air pollutants, Sources of common air pollutants like PM, SO_2, NO_X, Auto exhaust, Effects of common air pollutants c) Noise Pollution: Introduction, Sound and Noise, Noise measurements, Causes and Effects. d) Solid Waste: Generation and management e) Bio-medical Waste: Generation and management f) E-waste: Generation and management	08	20
3.	**Social Issues and Environment** Sustainable Development, Equitable use of Resources for sustainable lifestyle and it's benefits, Water conservation, Climate Change, Global Warming and Green House Effect, Acid Rain, Depletion of Ozone layer, Carbon Footprint	08	20

List of Practical:

Sr. No	Name of Practical	Hours
1.	Acid-base titration adding a base of known concentration to an acid of unknown concentration until the reaction is complete, and the concentration of the acid is determined.	02
2.	Determination of the boiling point of a liquid heating a sample of a liquid and observing the temperature at which it boils.	02
3.	Determination of the density of a liquid weighing a known volume of a liquid and calculating its density.	04
4.	Determination of the pH of a solution using a pH meter to measure the acidity or basicity of a solution.	04
5.	Flame test: burning a sample of a substance and observing the color of the flame to identify the presence of certain elements.	04
6.	Preparation of a salt reacting an acid and a base to form a salt and observing the reaction products.	02
7.	Testing of soil acidity	02

8.	Studying the effect of temperature on the solubility of a solid in water at different temperatures to see how temperature affects solubility.	02
9.	Studying the properties of acids and bases: Students can test the properties of different acids and bases (e.g., pH, conductivity) and compare their properties.	04
10.	Investigating the reaction between an acid and a metal and measure the amount of gas produced.	04

Text Book(s):

Title	Author/s	Publication
Textbook of Environmental Chemistry and Pollution Control	Dr. S. S. Dara, Dr. D.D. Mishra	S Chand & Co Ltd
Environmental Studies	Benny Joseph	Mc.Graw hill education Pvt. Ltd.
Environmental Studies	Dr. S.K. Dhameja	S.K. Kataria & Sons

Reference Book(s):

Title	Author/s	Publication
Engineering Chemistry	Jain & Jain	Dhanpat Rai Publishing company
Environmental Studies (From crisis to cure)	R. Rajagopalan	OXFORD university press

Web Material Link(s):

https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_ENS_LECTURE_NOTES_2.pdf

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 20 marks.
- Internal Viva consists of 20 marks.
- Practical performance/quiz/drawing/test of 30 marks during End Semester Exam.
- Viva/Oral presentation consists of 30 marks during End Semester Exam.

Course Outcome(s):

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

SECH1110	Fundamental Chemistry & Environmental Science
CO 1	Develop a fundamental understanding of the principles and concepts of chemistry, including atomic structure, chemical reactions, and chemical bonding.
CO 2	Demonstrate an ability to apply chemical knowledge to real-world problems, such as calculating reaction yields and predicting chemical properties.
CO 3	Identify the types of pollution in society along with their sources.
CO 4	Realize the global environmental issues.

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 Chemistry	2,1
2	Chemical Thermodynamics and Kinetics	4, 5
3	Properties of Matter and Solutions	1,2
4	Organic Chemistry	4,5
5	Introduction to Environment	1,2
6	Environmental Pollution	1,2,3
7	Social Issues and Environment	1,2,3

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1120
Course Name: Fundamentals of Technical Drawing

Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
00	04	00	04	00	00	40	60	00	00	100

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.
- Basic knowledge of computer-aided drawing using AutoCAD.

Course Content:

Section I			
Module No.	Contents	Lab 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, Spiral, and Normal & Tangent to each curve.	12	15%
3.	**Projections of points, lines & planes:** Types of Projections; Introduction of Principle Planes of Projections; Projection of Points in all four Quadrants; Projection of Lines inclined to one Referral Plane & two Referral Planes. True length and inclination with reference plane; Projection of Planes (Circular and Polygonal) with inclination to one Referral Plane and two Referral Planes; Concept of Auxiliary Projection Method.	15	30%

Section II			
Module No.	Content	Hours	Weightage in %
1.	**Orthographic Projection and Isometric Projections** 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. Isometric Scale, Conversion of Orthographic views into Isometric Projection, Isometric View, or Drawing of simple objects.	18	30%
2.	**Residential Building Planning:** Introduction to buildings, Classification of buildings, Principles of building planning, Principles of architecture composition, Detail drawing, Line Plan, plan, elevation, section, Preparing working drawing of residential building.	06	10%
3.	**Computer-Aided Drawing:** Introduction to AutoCAD, Basic commands for 2D drawing (Line, Circle, Polyline, Rectangle, Hatch, Fillet, Chamfer, Trim, Extend, Offset, Dim style, etc.)	06	10%

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Introduction sheet (dimensioning methods, different types of lines,construction of various polygons, dividing the line and angle into parts, use of stencil, lettering), plane scale and diagonal scale	03
2.	Engineering curves	12
3.	Projection of points, lines & planes	15
4.	Orthographic projection	10
5.	Isometric projection	10
6.	Residential building drawing (Line plan, Plan, Elevation, Section, Schedule opening)	04
7.	Computer-Aided Drawing	06

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
Building Planning, Designing and Scheduling	Gurucharan Singh	Standard Book

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
Building Drawing	M. G. Shah, C.M. Kale, S.Y. Patki	Tata McGraw Hill

Web Material Link(s):

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

Course Evaluation:

Practical:

- Continuous evaluation consists of performance of practical/tutorial which will be evaluated out of 20 marks for each practical/tutorial and average of the same will be converted to 20 marks.
- Internal viva consists of 20 marks.
- Practical test will consist of 30 marks and viva will consist of 30 marks during end semester exam.

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SEME1120	FUNDAMENTALS OF TECHNICAL DRAWING
CO 1	Apply BIS standards of building planning and conventions while drawing Lines, printing Letters, and showing dimensions.
CO 2	Explore the various methods to draw various engineering curves and their applications.
CO 3	Classify the orthographic projection systems concerning the observer, object, and reference planes.
CO 4	Develop 3D Isometric views in relation to 2D orthographic views.
CO 5	Software application in engineering drawing.

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	Projection of Points, Line & Plane	1, 2, 3, 4
4	Orthographic Projection	2, 5, 4
5	Isometric Projections and Isometric Drawing	2, 5, 4
6	Computer-Aided Drawing	2,3,6

P P Savani University

School of Engineering

Department of Civil Engineering

Course Code: SECV1110

Course Name: Core Engineering Concepts.

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	00	04	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- Study the basic fundamentals of construction planning and material.
- Study significance of mechanical engineering systems in different fields of engineering.
- Study the basic concepts of electrical and electronics engineering.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Basics of Construction material and techniques** Common materials used in construction, Aggregate, Sand, Cement, Bricks, Timber, Steel, Paints. Bonds in brick masonry techniques, Foam works, Curing, Compaction of concrete, Water proofing, Fire safety norms and requirement.	08	18
2.	**Building planning and Bye laws** Building by laws as per national building code, building by laws as per local authority, standards for residential, public, commercial, industrial and institutional buildings planning, planning of earth quake resistance building, overview of RERA and ODPS, Green building and LEED certification, general layout, maps and plan used at construction site.	08	18
3.	**Basic Electricity Principles** Concept of Charge, Potential Difference and Current, Resistor, capacitor, Inductor, Ohm's law, effect of Temperature on resistance, temperature coefficient, Series and parallel combinations of Resistors and capacitors, Lenz and Faraday's laws for electromagnetic induction, AC Electricity and DC Electricity. **Electrical Wiring:** Different types of conductors and cables. Basics of wiring-Star and delta connection. Voltage drop and losses across cables and conductors.	07	14

Section II			
Module No.	Content	Hours	Weightage in %
1.	**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.	08	18
2.	**Power Transmission Elements:** Construction and Applications of Couplings, Clutches and Brakes, Difference Between Clutch and Coupling, Types of Belt Drive and Gear Drive	08	18
3.	**DC Circuits and AC Circuits** DC Circuits: Introduction of Electrical circuit elements (prerequisites), voltage and current sources, Kirchoff's current and voltage laws, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits. AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, Phasor representation of AC quantities, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Series and parallel resonance. Three phase balanced circuits, voltage and current relations in star and delta connections, Power measurement in three phase circuits.	06	14
4.	**Basics of Steam Generators:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox Boiler, Functioning of Different Mountings and Accessories	LAB	08

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Preparation of drawing sheet showing various bonds.	04
2.	Preparation of Basic plan of Construction site.	04
3.	Preparation sketch of various building component.	04
4.	Verify the series and parallel connections of resistors and capacitors.	04
5.	To understand construction and working of various types of boilers.	04
6.	To understand construction and working of mountings and accessories.	04
7.	To verify the Kirchoff's current and voltage laws and Network theorems.	02
8.	To understand construction and working 2 –stroke & 4 –stroke Petrol engines.	02
9.	To understand construction and working 2 –stroke & 4 –stroke Diesel engines.	02

Text Book(s):

Title	Author(s)	Publication
Elements of Mechanical Engineering	Sadhu Singh	S. Chand Publications
Building construction	Dr. B C Punamia	Laxmi Publication

A text book in Electrical Technology	B L Theraja -	S Chand & Co.
Basic Electrical Engineering	D. C. Kulshreshtha	McGraw Hill, 2009

Reference Book(s):

Title	Author(s)	Publication
Basic Mechanical Engineering	T.S. Rajan	Wiley Eastern Ltd., 1996.
Town Planning	G. K. Hiraskar	Dhanpatrai Publications
Basic Electrical Engineering	Nagsarkar and Sukhija,	Oxford University Press

Web Material Link(s):

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

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

Course Outcome(s):

After the completion of the course, the following course outcomes will be able to:

SECV1110	Core Engineering Concepts
CO 1	Understand basic properties of various construction materials.
CO 2	Understand the general rules and regulation of building planning.
CO3	Apply the principles of basic mechanical engineering.
C04	Comprehend the importance of mechanical engineering equipments like IC engine and power transmission elements.
CO5	Understand working of various instruments and equipments used for the measurement of various electrical engineering parameters like voltage, current, power, phase etc in industry as well as in power generation, transmission and distribution sectors.
CO6	Apply fundamental electrical laws and circuit theorems to electrical circuits.

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	Basics of Construction material and techniques	1, 2, 3
2	Building planning and Bye laws	1, 2
3	Basic Electricity Principles	1,2,3
4	Power Transmission Elements	1, 2
5	Basics of I.C Engines	2
6	DC Circuits and AC Circuits	2,3,4
7	Basics of Steam Generators	1, 2

P P Savani University

School of Engineering

Course Code: CLSC2180

Course Name: Essentials of Entrepreneurship

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	00	00	2	100	00	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- To understand the basics of entrepreneurship and its traits
- To analyze the theory and models of entrepreneurships
- To evaluate different types and dimensions of entrepreneurship

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Entrepreneurship** Definition of Entrepreneurship, Entrepreneurship as a career choice, Benefits and Myths of Entrepreneurship, Characteristics, Qualities and Skills of an Entrepreneur, Model Traits of Entrepreneurs	07	30
2.	**Dimensions of Entrepreneurship** Entrepreneurship Theories, Intrapreneurship, Benefits of intrapreneurship, Difference between Entrepreneurs and Intrapreneurs Institutes for Entrepreneurship Development, sStartup Failures, Startup Success Stories	08	20

Section II			
Module No.	Content	Hours	Weightage in %
1.	**Women Entrepreneurship** Women Entrepreneurship Meaning, Factors that influence women Entrepreneurship, Barriers to Women Entrepreneurship, Qualities of Women Entrepreneurs, Success stories of Women Entrepreneurs Lijjat Papad Case study, Jassuben Pizza Case study	08	30
2.	**Social Entrepreneurship and emerging trends** Social Entrepreneurship, Functions of Social Entrepreneurship, Difference between Entrepreneurship and Social Entrepreneurship How does an NGO run?, Case Study on Social Entrepreneurship,	07	20

	Emerging trends in Entrepreneurship		

Text Book(s):

Title	Author/s	Publication
Entrepreneurship Business and Management	Dr. R C Bhatia	Sultan Chand and Sons

Reference Book(s):

Title	Author/s	Publication
Entrepreneurship	Trehan A	Dremtech

Web Material Link(s):

- https://www.startupindia.gov.in
- https://ediindia.ac.in
- https://www.ediindia.org

Theory:

- Continuous Evaluation consists of one test of 20 marks, 10 marks assignment, 10 marks presentation, 10 marks class participation and behavior.
- One live project of 50 marks

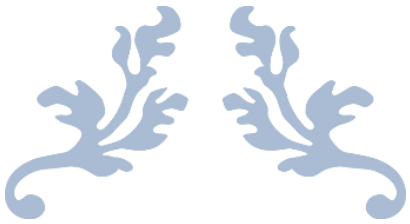
Course Outcome(s):

CLSC2070	Essentials of Entrepreneurship
CO 1	Students will be able to think of startup ideas
CO 2	Students will be able to apply the model of entrepreneurship practically
CO 3	Students will be able to further analyze other dimensions of Entrepreneurship

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 Entrepreneurship	1, 2, 3, 4, 5
2	Dimensions of Entrepreneurship	1, 2, 3, 4, 5
3	Women Entrepreneurship	1, 2, 3, 4, 6
4	Emerging Trends and Social Entrepreneurship	1, 2, 3, 4, 6



SECOND YEAR B.TECH

P P SAVANI UNIVERSITY														
SCHOOL OF ENGINEERING														
TEACHING & EXAMINATION SCHEME FOR SECOND YEAR B.TECH. PROGRAMME AY: 2023-24														
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**	
3	SESH2110	Differential Methods & Complex Variable	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SECH2210	Chemical Process Calculations	CH	2	0	2	4	4	40	60	0	0	100	0	200
	SECH2220	Mechanical Operations	CH	2	2	0	4	3	40	60	40	60	0	0	200
	SECH2230	Fluid Flow Operations	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH2240	Materials Science and Technology	CH	2	0	0	2	2	40	60	0	0	0	0	100
	CFLS2140	Upper Intermediate Communicative English	CFLS	2	0	0	2	2	100	0	0	0	0	0	100
	CLSC2020	IPDC-I	CLSC	2	0	0	2	2	100	0	0	0	0	0	100
						Total	**24**	**22**							**1100**
4	SESH2120	Numerical Methods & Statistics	SH	3	0	2	5	5	40	60	0	0	100	0	200
	SECH2250	Heat Transfer Operations	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH2260	General Chemical Technology	CH	2	2	0	4	3	40	60	40	60	0	0	200
	SECH2270	Chemical Engineering Thermodynamics-I	CH	2	0	2	4	4	40	60	0	0	100	0	200
	SECH2280	Mass Transfer Operations-I	CH	3	2	0	5	4	40	60	40	60	0	0	200
	CLSC2030	IPDC-II	CLSC	2	0	0	2	2	100	0	0	0	0	0	100
						Total	**25**	**22**							**1100**

P P Savani University
School of Engineering

Department of Science & Humanities

Course Code: SESH2110
Course Name: Differential Methods & Complex Variable
Prerequisite Course(s): SESH1110- Calculus

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	-	-	100	-	200

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 Laplace Transforms for solving ODEs.
- learn introduction of Periodic functions and Fourier series with their applications for solving ODEs.
- Represent complex numbers algebraically and geometrically.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	Ordinary Differential Equation First order ODEs, Formation of differential equations, Exact, linear and Bernoulli's equations, Ordinary differential equations of higher orders, Homogeneous Linear ODEs of Higher Order, Homogeneous Linear ODEs with Constant Coefficients, Euler–Cauchy Equations Differential Operators Nonhomogeneous ODEs, Variation of Parameters.	10	20
2.	Partial Differential Equation Formation of First and Second order equations, Solution of First order Linear and Non-liner equations, Higher order equations with constant coefficients, Complementary function, Particular Integrals, Initial and boundary conditions, Modeling and solution of the Heat, Wave and Laplace equations.	08	17
3.	Laplace Transform Laplace Transform, Linearity, First Shifting Theorem, Existence Theorem, Transforms of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Laplace Transformation of Periodic function, Inverse Laplace transform, Convolution, Systems of ODEs	07	13
Section II			

Module No.	Content	Hours	Weightage in %
1.	Fourier Series Fourier Series of $2n$ periodic functions, Euler Formula, Arbitrary Period, Even and Odd function, Half-Range Expansions.	07	14
2.	Complex Variables Complex Variable – Differentiation, Complex number, polar form of complex number, Cauchy-Riemann equations, analytic functions, harmonic functions, Mobius transformations and their properties.	08	21
3.	Complex Variable - Integration Representation by Fourier Integral, Cauchy's integral theorem and formula, Taylor and Laurent series.	05	15

List of Tutorials:

Sr. No.	Name of Tutorial	Hours
1.	Ordinary Differential Equation-1	2
2.	Ordinary Differential Equation-2	2
3.	Ordinary Differential Equation-3	2
4.	Partial Differential Equation-1	2
5.	Partial Differential Equation-2	4
6.	Laplace Transform-1	4
7.	Laplace Transform-2	2
8.	Fourier Series-1	2
9.	Fourier Series-2	2
10.	Complex Variables -1	2
11.	Complex Variables -2	2
12.	Complex Variables -3	4

Text Book(s):

Title	Author/s	Publication
Advanced Engineering Mathematics	Erwin Kreyszig	Wiley India Pvt. Ltd.
Complex Variables and Applications,	J. W. Brown and R. V. Churchill	McGraw Hill.

Reference Book(s):

Title	Author/s	Publication
Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers
A first course in complex analysis with applications	Dennis G. Zill, Patrick D. Shanahan	Jones and Bartlett Publishers Inc.
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):

- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111106100/
- http://nptel.ac.in/courses/111105093/
- http://nptel.ac.in/courses/111108081/
- http://nptel.ac.in/courses/111/103/111103070/

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

SESH2110	**DIFFERENTIAL METHODS & COMPLEX VARIABLE**
CO1	Describe 1st and 2nd order odes and pde's.
CO2	Classify differential equations and evaluate linear and nonlinear partial differential equations.
CO3	Apply Laplace transform as a tool which are used to evaluate differential equation.
CO4	Examine the various tests of power series and Fourier series for learning engineering.
CO5	Demonstrate understanding of the basic concepts underlying complex analysis to evaluate definite integrals and infinite series.

Mapping of CO with PO

SESH2110	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	1	1								1
CO 2	1	1	1									1
CO 3	2	1	1	1								1
CO 4	2	1	1									1
CO 5	2	2	1	1								1

Mapping of CO with PSO

SECV2110	PSO1	PSO2	PSO3
CO 1	2	1	
CO 2	1	1	
CO 3	1	1	
CO 4	2		
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	Fourier Series	1, 2, 3, 5
5	Complex Variables	1, 2, 3, 4, 5
6	Complex Integration	1, 2, 3, 4, 5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2210
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	
02	--	02	04	40	60	--	--	100	--	200

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.	05	20
4.	**Material Balances:** Materials balance: Concepts of limiting and excess reactants, Batch, Stage-wise, Continuous and recycle operations, Material balance of	05	20

	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.		
Secti on 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.	07	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.	05	20
	TOTAL	30	100

List of Tutorials:

Sr No	Name of Tutorials	Hours
1.	Tutorial – 1 – basics to Unit operations and Unit Conversion	02
2.	Tutorial – 2- Method of least squares	02
3.	Tutorial – 3- Dimensional analysis	02
4.	Tutorial – 4- Material Balances	02
5.	Tutorial – 5- Material Balances	02
6.	Tutorial – 6- Material Balances	02
7.	Tutorial – 7- Material Balances	02
8.	Tutorial – 8 - Material balances for non-reactive processes	02
9.	Tutorial – 9- Material balances for non-reactive processes	02
10.	Tutorial – 10 - Material balances for non-reactive processes	02
11.	Tutorial – 11 - Unsteady state material and energy balances	02
12.	Tutorial – 12 - Unsteady state material and energy balances	02
TOTAL		30

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

SECH2210	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

SECH2210	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

SECH2210	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: SECH2220
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	
02	02	--	03	40	60	40	60	--	--	200

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.	07	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	02	07

	and power consumption.		
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.	02	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.	03	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.	04	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.	04	10
9.	**Separators** Cyclones and electrostatic precipitator, Flotation, Thickeners, 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.	04	15
TOTAL		30	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	02

	models.	
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

SECH2220	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

SECH2220	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

SECH2220	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: SECH2230
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	40	60	--	--	200

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 Metacentric Height, Stability of Floating and Submerged Body, Position of metacentre relative to Centre of	04	10

	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, Minimization expansion and contraction losses. Flow through Open Channel: Specific Energy and Specific Force, Critical Flow, Hydraulic Jump, Measurement of Discharge in open Channels.	06	15
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's:

- 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

SECH2230	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

SECH2230	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

SECH2230	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: SECH2240
Course Name: Materials Science and 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	
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	03	15

	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.		
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** Membrane and their types, Membrane Materials, Modules and their types, method of preparation of various membranes, Industrial applications.	03	10
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	05	15

	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.		
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

SECH2240	**Materials Science and Technology**
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

SECH2240	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

SECH2240	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 Science & Humanities

Course Code: SESH2120
Course Name: Numerical Method & Statistics
Prerequisite Course(s): SESH2110- Differential Methods and Complex Variable

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	-	-	100	00	200

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.	**Approximations and Errors:** Errors and Their computations, General error formula. **Solution of Algebraic and Transcendental Equations:** Bracketing Methods (Bisection, Secant, Method of False Position), Convergence of Iterative Methods, Newton-Raphson Method, Newton-Raphson Method	7	17
2.	**Numerical Solutions of Linear Equations** Gauss-Seidel Method Iteration Method, Jacobi's Method, Gauss-Seidel Method, Eigen Value Problem.	6	13
3.	**Numerical Differentiation and Integration** Finite Differences: Forward, Backward and Divided Differences Table, Newton's Forward, Backward and Divided Differences Interpolation Formula, Interpolation Polynomials, Lagrange Interpolation Formula Interpolation, Numerical Integration, Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule.	10	20
Section II			
Module	Content	Hours	Weightage in %
1.	**Numerical Methods for ODEs**: Taylor's Series and Euler's Method, Modifications and Improvements in Euler's Method, Runge-Kutta 2nd	7	16

	Order & 4th Order Methods, Milne's Predictor-Corrector Methods, Boundary Value Problems.		
2.	**Basics of Statistics** Elements, Variables, Observations, Quantitative and Qualitative data, Cross-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 line and regression coefficient, Karl Pearson's method	7	16
3.	**Probability Distribution** Introduction, Conditional probability, Independent events, independent experiments, Bayes' theorem, Probability distribution, Binomial distribution, Poisson distribution, Normal distribution.	8	18

List of Tutorials:

Sr. No.	Name of Tutorial	Hours
1.	Approximations and Errors	2
2.	Solution of Algebraic and Transcendental Equations	4
3.	Numerical Solutions of Linear Equations	2
4.	Numerical Differentiation and Integration-1	2
5.	Numerical Differentiation and Integration-2	2
6.	Ordinary Differential Equations-1	2
7.	Ordinary Differential Equations-2	4
8.	Basics of Statistics-1	4
9.	Basics of Statistics-2	2
10.	Probability-1	4
11.	Probability-2	2

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 Irwin Miller, John Freund	Pearson India Education Services Pvt. Ltd., Noida.

Reference Book(s):

Title	Author/s	Publication
Numerical Methods in Engineering & Science	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.
Statistics for Business and Economics	David R. Anderson, Dennis J. Sweeney,	Cengage Learning

	Thomas A.Williams	

Web Material Link(s):

- http://nptel.ac.in/courses/111106094/
- http://nptel.ac.in/courses/111105035/
- http://nptel.ac.in/courses/111101003/
- http://nptel.ac.in/courses/111105090/
- http://nptel.ac.in/courses/111107105/
- http://nptel.ac.in/courses/110107114

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

SESH2120	**NUMERICAL METHODS & STATISTICS**
CO 1	Derive numerical solution of linear and nonlinear system of equation.
CO 2	Acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration.
CO 3	Compare variety of numerical methods for solving ordinary differential Equation.
CO 4	Construct different statistical methods to collect, compare, interpret & evaluate data.
CO 5	Apply probability in decision making, artificial intelligence, machine learning etc.

Mapping of CO with PO

SESH2120	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1	1	1								1
CO 2	2	1	1	2								1
CO 3	2	2	1	1								1
CO 4	2	1	1	1								1
CO 5												

Mapping of CO with PSO

SESH2120	PSO1	PSO2	PSO3
CO 1		2	
CO 2		2	
CO 3		2	
CO 4		2	

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	Solution of Algebraic and Transcendental Equations	1, 2, 3, 4, 6
2	Numerical Solutions of Linear Equations	1, 2, 3, 5
3	Numerical Differentiation and Integration	1, 2, 3, 5
4	Numerical Methods for ODEs	1, 2, 3, 5, 6
5	Basics of Statistics	1, 2, 3, 4, 5
6	Probability Distribution	1, 2, 3, 4, 5

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2250
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	40	60	--	--	200

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	06	10

	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.		
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

SECH2250	**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

SECH2250	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

SECH2250	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: SECH2260
Course Name: General Chemical 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	
02	02	--	03	40	60	40	60	--	--	200

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Fuel and Energy** Classification of Fuel, Various Types of Coal, Coal as Chemical Feed Stock, Coal Carbonization and Coke Oven Plant, Gasifiers, Gasification of Coal, Petro coke And Biomass.	03	10
2.	**Chlor-Alkali Industry** Production of Common Salt, Caustic Soda, Chlorine, Hydrochloric Acid and Soda Ash.	03	10
3.	**Pulp and Paper Industries** Raw Materials, Pulping Processes, Stock Preparation and Paper Making, Chemical Recovery from Black Liquor.	03	10
4.	**Pesticides Industries** Processes for Manufacturing of Insecticides, Fungicides and Herbicides.	02	05
5.	**Polymer and Synthetic Fibre Industries** Introduction to Polymerization, Commodity Polymers, Rayon, Polyester, Polyamide, Acrylic Fibre and Nylons.	04	15
Section II			
Module No.	Content	Hours	Weightage in %

6.	**Petrochemicals and Petro Industries** Origin, Occurrence and Characteristics of Crude Oil, Crude Oil Distillation and Secondary Processing, Manufacturing Processes of Formaldehyde, Acetaldehyde, Acetic acid, Acetic Anhydride, Maleic Anhydride, Nitrobenzene, Ethylene Oxide, Ethylene Glycol.	03	10
7.	**Industrial Gases** Technology Options of Producing Producer Gas, Syn gas, Pyro gas, Nitrogen, Oxygen and Carbon dioxide.	02	10
8.	**Oil, Fat, Soap and Detergent Industries** Vegetable Oil Extraction Method using Mechanical and Solvent Extraction Process, Hydrogenation of oil, Introduction to Soap and Detergent, Soap Making and Recovery of Glycerine, Synthetic Detergent and Linear Alkyl Benzene.	03	10
9.	**Fermentation Industry** Introduction to Sugar, Fermentation Industry and Manufacture of Alcohol, Ethanol as Biofuel and Chemical Feed Stock.	02	05
10.	**Cement & Glass Manufacturing Industries** Lime Stone Beneficiation and Manufacturing of Cement, Types of Cement, Manufacturing of Glass, Types of Glass.	02	05
11.	**Sulphur, Phosphorus and Nitrogen Industries** Origin and Extraction of Sulphur, Production Routes of Suphuric Acid and Oleum, Manufacturing of Phosphorus, Phosphoric Acid and Phosphatic Fertilizers, Manufacturing of Ammonia, Nitric Acid, Nitrogenous and Mixed Fertilizers.	02	10
	TOTAL	30	100

List of Practical:

Sr. No	Name of Practical	Hours
1.	To check the hardness of given water sample.	02
2.	To determine the loss on igniting the cement sample.	01
3.	To determine the total silica in the given sample.	02
4.	To determine the amount of potassium in the given sample of fertilizer.	04
5.	To determine the total insoluble residue in the cement sample.	04
6.	To determine % available chlorine in bleaching powder.	04
7.	To determine the amount of calcium in the given sample of fertilizer volumetrically	04
8.	Determine the acid value of the given sample of oil.	04
9.	Preparation of detergent.	01
10.	Preparation of Boric acid by acidified solution of Borax ($Na_2B_4O_7$).	02
11.	Preparation of CaCl2 from HCl and lime (CaCO3).	02
	TOTAL	30

Text Book(s):

Title	Author/s	Publication
Dryden's Outlines of Chemical Technology - 3rd Edition	Gopala Rao. M. and Marshall Sittig	East-West Press, New Delhi, 2008

Shreve's Chemical Process Industries	George. T Austin	McGraw-Hill International Editions, Singapore, 1984

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Practical:

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

Course Outcome(s):

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

SECH2260	General Chemical Technology
CO 1	Recall fundamental principles of chemical engineering involved in process technology, including material balances, energy balances, and unit operations.
CO 2	Demonstrate comprehension of the interplay between different unit operations in chemical processes, and analyze how changes in operating conditions impact process performance and product quality.
CO 3	Apply theoretical knowledge to solve practical problems encountered in chemical process industries, such as optimizing reactor design, troubleshooting equipment failures, and ensuring compliance with safety regulations.
CO 4	Analyze complex chemical processes by breaking them down into component unit operations, evaluating the efficiency of each step, and identifying potential areas for improvement or optimization.
CO 5	Critically assess the sustainability and environmental impact of chemical processes, considering factors such as energy consumption, waste generation, and raw material utilization, and propose strategies for minimizing adverse effects while maximizing

	efficiency and profitability.

Mapping of CO with PO

SECH2260	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

SECH2260	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	Fuel and Energy	1,2
2	Chlor-Alkali Industry	1,2,5,6
3	Pulp and Paper Industries	1,2,5,6
4	Pesticides Industries	1,2,5,6
5	Polymer and Synthetic Fibre Industries	1,2,6
6	Petrochemicals and Petro Industries	1,2,5,6
7	Industrial Gases	1,2,5,6
8	Oil, Fat, Soap and Detergent Industries	1,2,5,6
9	Fermentation Industry	1,2,6
10	Cement & Glass Manufacturing Industries	1,2,5,6
11	Sulphur, Phosphorus and Nitrogen Industries	1,2,5,6

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2270
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	
02	--	02	04	40	60	--	--	100	--	200

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).	04	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.	03	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.	03	15
	Section II		
Module No.	**Content**	**Hours**	**Weightage in %**
5.	**Thermodynamic Properties of Solutions:** Introduction to fugacity and activity, Activity Coefficients-Partial	09	30

	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		
6.	**Refrigeration and liquefaction:** Carnot refrigerator, Vapour compression cycle, Absorption refrigeration, Choice of refrigerant, Heat pump, Liquefaction processes.	06	20
TOTAL		30	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 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).

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

SECH2270	**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

SECH2270	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

SECH2270	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: SECH2280
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	40	60	--	--	200

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	**Content**	**Hours**	**Weightage**

No.			in %
5.	**Humidification and dehumidification** Introduction, Terminologies used, Adiabatic saturationtemperature, 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

SECH2280	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

SECH2280	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

SECH2280	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. BATCH: 2023 (CHEMICAL ENGINEERING)

Sem	Course Code	Course Title	Course Category	Offered by	Teaching Scheme					Examination Scheme						
					Contact Hours				Credit	Theory		Practical		Tutorial		Total
					Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
5	SECH3211	Mass Transfer Operations-II	Major/Core	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH3220	Instrumentation & Process Control	Major/Core	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH3231	Chemical Engineering Thermodynamics-II	Major/Core	CH	2	0	2	4	4	40	60	0	0	100	0	200
	SECH3240	Fuels and Combustion	Major/Core	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3250	Cleaner Technologies in Chemical Process Industries	Major/Core	CH	2	0	0	2	2	40	60	0	0	0	0	100
		Elective -I	Minor	CH	3	0	0	3	3	40	60	0	0	0	0	100
		Language Training Elective Course	AEC	CFLS	3	0	0	3	3	100	0	0	0	0	0	100
		Life Skill Elective Course-I	VAC	CLSC	2	0	0	2	2	100	0	0	0	0	0	100
	SECH3920	Summer Training	Minor	CH	0	4	0	0	4	0	0	100	0	0	0	100
							Total	**27**	**29**							**1200**
6	SECH3260	Chemical Reaction Kinetics-I	Major/Core	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH3270	Process Equipment Design and Drawing	Major/Core	CH	2	0	2	4	4	40	60	0	0	100	0	200
	SECH3280	Petroleum Studies	Major/Core	CH	3	2	0	5	4	40	60	40	60	0	0	200
	SECH3290	Process Plant Safety Health and Hygiene	Major/Core	CH	2	0	0	2	2	40	60	0	0	0	0	100
		Elective -II	Minor	CH	3	0	0	3	3	40	60	0	0	0	0	100
	TNPC3010	Corporate Grooming & Etiquette	SEC	TNPC	3	0	0	3	3	100	0	0	0	0	0	100
	SECH3490	MOOC Course / University Elective	SEC		3	0	0	3	3	100	0	0	0	0	0	100
		Life Skill Elective Course-II	VAC	CLSC	2	0	0	2	2	100	0	0	0	0	0	100
							Total	**27**	**25**							**1100**

Elective Courses															
Offered from Sem.	Course Code	Course Name	Offered By	Teaching Scheme				Credit	Examination Scheme						Total
				Contact Hours					Theory		Practical		Tutorial		
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
5	SECH3610	Corrosion and Electrochemical Engineering	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3620	Sustainability, Green Chemistry and Engineering	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3630	Waste to Energy Conversation	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3640	Polymer Engineering	CH	3	0	0	3	3	40	60	0	0	0	0	100
6	SECH3650	Design of Experiments	CH	2	2	0	4	3	40	60	20	30	0	0	100
	SECH3660	Chemical Engineering Plant Design and Economics	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3670	New Separation Techniques	CH	3	0	0	3	3	40	60	0	0	0	0	100
	SECH3680	Chemical Process Development and Design	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: SECH3211
Course Name: Mass Transfer Operations - II
Prerequisite Course(s): SECH2080-Mass Transfer operations -I

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	--	05	40	60	40	60	--	--	200

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	08	20

	Savarit method, Azeotropic distillation, Extractive Distillation, Numerical.		
2.	**Liquid - Liquid Extraction** Liquid-liquid Extraction and their Industrial applications, Mixture Rule, Ternary Diagram, Extraction systems Effect of Temperature and Pressure Plotting the Binodal Curve, Solvent Selection Criteria, Cross and Counter current Extraction, Multistage Counter current Extraction with and without Reflux, ΔR point, Equipment for Extraction, Numerical.	10	15
3.	**Gas Absorption** Gas Absorption, Equilibrium solubility, Ideal and Non ideal solutions, Solvent Selection Criteria, Material Balance Counter Current Operations, Continuous Contact equipment, HETP, HTU, NTU, Absorption with chemical reactions, Gas Liquid Contacting equipment, Mechanical Mixing, Agitators, Tray towers and its internals, Coning ,Weeping, Loading and Flooding, Types of Trays e.g. Bubble cap, Sieve tray etc., Tray diameter, Spacing, Flow Pattern, Venturi Scrubbers, Packed tower, Types of packings and selection criteria, Numerical.	12	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.	10	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,	10	25

	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.		
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.	10	10
	TOTAL	60	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	Nirali Prakashan

Reference Book(s):

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

Engg.	Harriott	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

SECH3211	**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

SECH3211	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	2	2		1		1			1		
CO 2	3		2	2	3	2	1	2		1	1	2
CO 3		2		2			1	3	1		1	
CO 4	2	2	2	2	1		1		2	1	1	

Mapping of CO with PSO

SECH3211	PSO1	PSO2	PSO3
CO 1	2	1	1
CO 2		2	
CO 3	3	2	1
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	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: SECH3220
Course Name: Instrumentation & Process Control
Prerequisite Course (/s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
04	02	--	05	40	60	40	60	--	--	200

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.	07	05
2.	**Laplace Transforms** Properties of Laplace transforms, Solution of linear differential equation using Laplace transform techniques, Dynamic behaviour of systems, Transfer functions	08	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.	08	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.	10	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.**	10	15
	TOTAL	60	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.	Wiley, NewYork

	and Mellichamp, D.A.	
Process Instrumentation And Control	A. P. Kulkarni	Nirali Prakashan
Industrial Instrumentation & Control	S. K. Singh	Tata McGraw-Hill Education.

Web Material Link(s):

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

Course Evaluation:

Theory:

- Continuous Evaluation consists of two tests 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

SECH3220	**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

SECH3220	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1		2				2		1		2
CO 2		1				1						
CO 3			2	1	2		1			1	1	
CO 4					1							
CO 5	3	2		1	1				1		3	2

Mapping of CO with PSO

SECH3220	PSO1	PSO2	PSO3
CO 1	1		1
CO 2	2	1	2

CO 3	1		1
CO 4		1	
CO 5	1	3	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: SECH3231
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	
02	--	02	04	40	60	--	--	100	--	200

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.	07	10
2.	**Gibbs-Duhem Equation** General form, Various forms of Gibbs-Duhem equation, Applications, Limitations, Property changes of mixing, Excess Properties.	07	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.	08	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.	08	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,	08	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**.**	07	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.	08	15
8.	**Phase Equilibria** The Gamma / Phi Formulation of VLE, Equilibrium and stability, Liquid-liquid equilibrium, Solid- Liquid Equilibrium, Osmotic Equilibrium and Osmotic pressure	07	5
	TOTAL	60	100

List of Tutorials:

Sr. No	Name of Tutorial	Hours

1.	Introduction to Instrumentation & Control Laboratory	04
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	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 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

SECH3231	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

SECH3231	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	1	2				2		1	1		
CO 2	2	2		3	2			1	1			2
CO 3	1		1		1	1			1		1	
CO 4		1	1				2					3
CO 5	1	2	1		1			3	2			

Mapping of CO with PSO

SECH3231	PSO1	PSO2	PSO3
CO 1	1	1	1
CO 2			2
CO 3		3	1
CO 4	3	3	
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: SECH3920
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**

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

Course Outcome(s):

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

SECH3920	**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

SECH3920	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

SECH3920	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

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3240
Course Name: Fuels and Combustion
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	
03	--	--	03	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:
To help learners to

- Understand Fuel Properties and Classification
- Apply Combustion Chemistry Principles
- Assess Combustion Technologies
- Evaluate Environmental Impact and Mitigation

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	Introduction to Fuels Classification, Properties, Calorific Value, Proximate & Ultimate Analysis of Coal	04	10
2.	Solid Fuels Coal: Types, Carbonization, Biomass Fuels, Coke Manufacturing	06	10
3.	Liquid Fuels Petroleum Refining, Cracking, Reforming, Synthetic Fuels	04	10
4.	Gaseous Fuels Natural Gas, LPG, Producer Gas, Water Gas, Biogas	04	10
Section II			
Module No.	Content	Hours	Weightage in %
5.	Combustion Chemistry Stoichiometry, Heat of Combustion, Air-Fuel Ratio	05	10
6.	Combustion Technologies	04	10

	Types of Flames, Burners, Furnaces, Ignition Phenomena		
7.	Environmental Pollution from Combustion Emissions (CO, NOx, SOx, Particulates), Pollution Control Strategies	05	10
8.	Alternative Fuels and Energy Efficiency Biodiesel, Hydrogen, Fuel Cells, Energy Conservation Techniques	04	10
	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

SECH3240	**Fuels and Combustion**
CO 1	Understand the classification and properties of various fuels.
CO 2	Analyze combustion reactions and energy efficiency.
CO 3	Assess the environmental effects of fuel combustion.
CO 4	Learn techniques for emission control and energy conservation.

Mapping of CO with PO

SECH3240	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	1	2	1			1	2		2	2		
CO 2			1	2	1					3		
CO 3	2		1				2	1		3	1	1
CO 4		2		2	3						1	1

Mapping of CO with PSO

SECH3240	PSO1	PSO2	PSO3
CO 1		2	3
CO 2	3	1	2
CO 3	3	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	Introduction to Fuels and Their Properties	1,2,3,4
2	Solid Fuels: Coal, Biomass, and Coke	1,2,3,4,5,6
3	Liquid Fuels: Petroleum, Cracking, and Reforming	1,2,3,4
4	Gaseous Fuels: Natural Gas, LPG, and Biogas	1,2,3,4
5	Combustion Chemistry and Stoichiometry	1,2,3,4
6	Combustion Technologies: Burners and Furnaces	1,3,4,5
7	Environmental Pollution from Fuel Combustion	1,2,3,4,5
8	Alternative Fuels and Energy Efficiency	1,2,4

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH3250
Course Name: Cleaner Technologies in Chemical Process Industries
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

- Understand Principles of Cleaner Production
- Apply Process Optimization Strategies
- Analyze Pollution Control Technologies
- Evaluate Regulatory Compliance and Case Studies

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	Introduction to Cleaner ProductionPrinciples, Sustainable Development, Circular Economy, Life Cycle Assessment	04	10
2.	Green Chemistry Principles 12 Principles, Green Catalysis, Solvent Selection	06	10
3.	Process Optimization Energy Efficiency, Process Intensification, Sustainable Manufacturing	04	10
4.	Waste Minimization Strategies Source Reduction, Recycling, By-product Utilization	04	10
Section II			
Module No.	Content	Hours	Weightage in %
5.	Pollution Control Technologies Adsorption, Membrane Separation, Advanced Oxidation	05	10
6.	Zero Liquid Discharge (ZLD) Systems Water Management, Effluent Treatment, Reverse Osmosis	04	10

7.	Regulatory Framework and Compliance Environmental Laws, EIA, Industry Standards (ISO 14000, EPA)	05	10
8.	Industrial Case Studies Petrochemicals, Pharmaceuticals, Textiles, Agrochemicals	04	10
	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 completion of the course, the student will be able to

SECH3250	**CLEANER TECHNOLOGIES IN CHEMICAL PROCESS INDUSTRIES**
CO 1	Understand the principles of cleaner production and sustainable development.
CO 2	Apply green chemistry and waste minimization techniques.
CO 3	Analyze pollution control strategies in industries.
CO 4	Learn energy-efficient and eco-friendly process designs.

Mapping of CO with PO

SECH3250	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

SECH3250	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 Cleaner Production and Sustainability	1,4
2	Green Chemistry and Eco-friendly Solvents	2,5
3	Process Optimization and Energy Efficiency	2,4
4	Waste Minimization and Resource Recovery	2,4,5,6
5	Advanced Pollution Control Technologies	2,4,5,6
6	Zero Liquid Discharge (ZLD) and Water Management	2,4,5
7	Environmental Regulations and Compliance	6
8	Industrial Case Studies on Cleaner Technologies	4,6

P P Savani University
School of Engineering
Department of Chemical Engineering

Course Code: SECH3260
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	40	60	--	--	200

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.	07	10
2.	**Rate Laws, Kinetics and Mechanisms of Homogeneous and Heterogeneous Reactions** Kinetic models for non-elementary reactions, Testing kinetic models, Temperature dependent term of rate equations from Arrhenius theory and comparison with collision and transition state theory, Activation energy and temperature dependency, Predictability of reaction rate from theory.	08	10
3.	**Analysis of Rate Data** Integral and differential methods for analyzing kinetic data, interpretation of constant volume reactor, zero,	08	10

	first, second and third order reactions, half life period, irreversible reaction in parallel and series, catalytic reaction, auto catalytic reaction, reversible reactions.		
4.	**Introduction to Reactor Design** Interpretation of variable volume batch reactions for zero, first and second order reactions, design equation for batch, continuous stirred tank, plug flow reactors for isothermal reaction.	07	20
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.	10	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.	10	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.	10	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

SECH3260	**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

SECH3260	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		1	2			1	3			1	
CO 3	1	2			1		1		1	1	1	2
CO 4	2	2	2	2	1	1	1			1	1	

Mapping of CO with PSO

SECH3260	PSO1	PSO2	PSO3
CO 1	2	3	3
CO 2	1	3	2
CO 3			3
CO 4	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	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: SECH3270
Course Name: Process Equipment Design and drawing
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	
02	02	--	04	40	60	40	60	100	--	200

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		30	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, 3rd Edn	Sinnott. R.K, Coulson & Richardson's	Butterworth Heinemann, New Delhi, 1999
Chemical Engineers Handbook - Perry's, 7th Edn	Perry. R.H., et al.	McGraw Hill, NewYork, 1997
Process Equipment Design	Bownell, L.E., and Young, E.M	Wiley Eastern, 1968

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Tutorial:

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

Course Outcome(s):

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

SECH3270	PROCESS EQUIPMENT DESIGN AND DRAWING
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

SECH3270	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

SECH3270	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: SECH3280
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	40	60	--	--	200

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 %
5.	**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
6.	**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
7.	**Processing of Petroleum**	04	10

	Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude, Distillation of Petroleum & Types of Reflux, ADU & VDU, Topping Operations etc.		
8.	**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
9.	**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

SECH3280	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

SECH3280	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1				1	1	2	1				1	
CO 2	1							1				
CO 3	1	2			1		2	3			1	2
CO 4	1	1									1	2
CO 5	2		3		1		1		1		1	3

Mapping of CO with PSO

SECH3280	PSO1	PSO2	PSO3
CO 1		1	2
CO 2	2	1	
CO 3	3		1
CO 4			1
CO 5	1	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: SECH3290
Course Name: Process Plant Safety Health and Hygiene
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	05	20

	models, Radio Active materials, Safe Handling and Operation of materials and Machinery, Periodic inspection and replacement.		
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. JhareswarMaiti, 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 completion of the course, the student will be able to

SECH3290	**Process Plant Safety Health and Hygiene**
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

SECH3290	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

SECH3290	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 Chemical Engineering

Course Code: SECH3650
Course Name: Design of Experiments
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	--	--	03	40	60			--	--	100

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**

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:

- 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

SECH3650	DESIGN OF EXPERIMENTS
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

SECH3650	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

SECH3650	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	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: SECH3620
Course Name: Sustainability, Green Chemistry and 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 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

SECH3620	**SUSTAINABILITY, GREEN CHEMISTRY AND ENGINEERING**
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

SECH3620	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

SECH3620	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: SECH3660
Course Name: Chemical Engineering Plant Design and Economics industries Prerequisite Course(s): --

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

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

Course Content:

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

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

Text Book(s):

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Course Outcome(s):

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

SECH3660	CHEMICAL ENGINEERING PLANT DESIGN AND ECONOMICS
CO 1	Describe overall knowledge about the process plant.
CO 2	Anlayze 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

SECH3660	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

SECH3660	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	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: SECH3680
Course Name: Chemical Process Development and Design
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	00	00	03	40	60		0	00	00	100

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 %

1.	**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,	10	20
	Determination of Power Required for Agitation, Shaft Diameter, Blade Thickness, Etc.		
2.	**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
3.	**Supports** Different Types of Supports, Mechanical Design of Bracket Support, Skirt, Support & Saddle Support, Numerical	05	12

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 (7th Edition)	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 following course outcomes will be able to

SECH3680	CHEMICAL PROCESS DEVELOPMENT AND DESIGN
CO 1	Anlayze 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

SECH3680	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

SECH3680	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	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

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH3670
Course Name: New Separation Techniques Prerequisite Course(s):
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Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

- 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 No.	Content	Hours	Weightage in %
1.	**Membrane Gas Separation**	07	20
	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		
2.	**Pervaporation** Mass Transfer and Thermodynamics Aspects of Pervaporation, Temperature Drop at Membrane Interface	05	10
3.	**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
4.	**Membrane Reactor** Membrane Bioreactor, Membrane Distillation	04	10

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 be able to

SECH3670	NEW SEPARATION TECHNIQUES
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

SECH3670	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

SECH3670	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	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: SECH3640
Course Name: Polymer 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	
3	0	0	3	40	60	0	0	0	0	100

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
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	10	25
	Strategies, Powder Processing Area (PPA) – Conditions, Validation and Cleaning processes.		

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

Text Book(s):

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

Reference Book(s):

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

Course Evaluation:

Theory:

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

coordinator.

- End Semester Examination consists of 60 marks.

Course Outcome(s):

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

SECH3640	POLYMER ENGINEERING
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

SECH3640	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

SECH3640	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	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: SECH3630
Course Name: Waste to Energy Conversation
Prerequisite Course(s):

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

4.	**EIA Documentation and Processes** EIA Monitoring and Auditing, Environmental Auditing, Elements of Audit Process, Waste Audit and Pollution Prevention Assessments.	05	15

Section II

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

Text Book(s):

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Course Outcome(s):

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

SECH3630	WASTE TO ENERGY CONVERSATION
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

SECH3630	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

SECH3630	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	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: SECH3610
Course Name: Corrosion and Electrochemical Engineering
Prerequisite Course(s):

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objective(s) of the Course:

To help learners to

- understand 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.	**Introduction to Corrosion** Definition and significance of corrosion, Types and forms of corrosion: dry and wet corrosion, atmospheric, galvanic, pitting, crevice, intergranular, stress corrosion cracking. Thermodynamics and kinetics of corrosion reactions. Electrochemical cells, EMF series, and Pourbaix diagrams..	05	10
2.	**Electrochemical Fundamentals** Faraday's laws of electrolysis, Electrode potential, Nernst equation, Electrochemical cells, Polarization – types and effects, Butler-Volmer equation, Tafel plots, corrosion current, mixed potential theory, Electrochemical measurement techniques.	06	10
3.	**Corrosion Control Methods – I** Cathodic and anodic protection: principles, design and applications. Use of sacrificial anodes, impressed current systems, coatings – organic and inorganic. Corrosion inhibitors: types, selection and applications.	06	15

4.	**Corrosion Testing and Monitoring** Laboratory and field testing techniques – weight loss, potentiostatic and galvanostatic techniques, electrochemical impedance spectroscopy (EIS), corrosion probes, real-time monitoring, evaluation of corrosion rate.	05	15
Section II			
Module No.	Content	Hours	Weightage in %
1.	**High-Temperature and Microbiological Corrosion** Oxidation, carburization, sulfidation, hot corrosion mechanisms. Microbial-induced corrosion (MIC), sulfate-reducing bacteria, detection and control methods.	07	20
2.	**Corrosion in Specific Environments** Corrosion in soil, marine, high-temperature, and chemical plant environments. Corrosion in reinforced concrete and underground pipelines. Case studies from oil & gas, power plants, and chemical industries.	05	10
3.	**Electrochemical Engineering Applications** Principles and applications of electrochemical cells in industrial processes – electroplating, electrowinning, electrorefining, electroforming, batteries and fuel cells. Cell design, current distribution, and scale-up.	04	10
4.	**Corrosion in Material Selection and Design** Material selection criteria, corrosion-resistant materials: stainless steels, alloys, ceramics, composites. Designing for corrosion prevention. Economic impact and life cycle cost analysis.	07	10

Text Book(s):

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Course Outcome(s):

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

SECH3610	CORROSION AND ELECTROCHEMICAL ENGINEERING
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

SECH3610	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

SECH3610	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	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