Syllabus Book

B. Tech.
(Chemical Engineering)

P P Savani University

School of Engineering

Effective From: 2021-22

Authored by: P P Savani University

CONTENT

FIRST YEAR B. TECH.

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

TEACHING & EXAMINATION SCHEME FOR B. TECH. CHEMICAL ENGINEERING PROGRAMME AY:2021-22

Sem	Course Code	Course Title	Offered By	Teaching Scheme					Examination Scheme						
				Contact Hours				Credit	Theory		Practical		Tutorial		Total
				Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
1	SESH1070	Fundamentals of Mathematics	SH	2	0	2	4	4	40	60	0	0	50	0	150
	SEME1010	Engineering Graphics	ME	3	4	0	7	5	40	60	40	60	0	0	200
	SEME1020	Engineering Workshop	ME	0	2	0	2	1	0	0	50	0	0	0	50
	SESH1230	Fundamentals of Chemistry & Chemical Engineering	SH	3	2	0	5	4	40	60	20	30	0	0	150
	SEHV1010	Universal Human Values-I	SH	2	0	0	2	2	100	0	0	0	0	0	100
						Total	**20**	**16**							**650**
2	SESH1080	Linear Algebra & Calculus	SH	3	0	2	5	5	40	60	0	0	50	0	150
	SESH1240	Electrical & Electronics Workshop	ME	0	2	0	2	1	0	0	50	0	0	0	50
	SECV1040	Basics of Civil & Mechanical Engineering	CV	4	2	0	6	5	40	60	20	30	0	0	150
	SECV1080	Mechanics of Solids	CV	4	2	0	6	5	40	60	20	30	0	0	150
	SECE1010	Basics of Computer & Programming	CE	3	2	0	5	4	40	60	20	30	0	0	150
	CFLS1010	Linguistic Proficiency	CFLS	2	0	0	2	**2**	40	60	0	0	0	0	100
						Total	**26**	**22**							**750**

P P Savani University
School of Engineering

Department of Applied Science and Humanities

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

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme(Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
2	0	2	4	40	60	-	-	50	0	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Calculus** Limits, Continuity, Types of Discontinuity, Successive Differentiation, Rolle's Theorem, LMVT, CMVT, Maxima and Minima.	8	28
2.	**Sequence and Series-I** Convergence and Divergence, Comparison Test, Integral Test, Ratio Test, Root Test, Alternating Series, Absolute and Conditional Convergence.	6	20
Section II			
Module No.	Content	Hours	Weightage in %

1.	**Sequence and Series-II** Power series, Taylor and Macluarin series, Indeterminate forms and L'Hospitals Rule.	6	20
2.	**Matrix Algebra** Elementary Row and Column operations, Inverse of matrix, Rank of matrix, System of Linear Equations, Characteristic Equation, Eigen values and Eigen vector, Diagonalization, Cayley Hamilton Theorem, Orthogonal Transformation	10	32

List of Tutorials:

Sr. No.	Name of Tutorial	Hours
1.	Calculus-1	2
2.	Calculus-2	2
3.	Integration	2
4	Sequence and Series-1	2
5.	Sequence and Series-2	2
6.	Sequence and Series-3	2
7.	Matrix Algebra-1	2
8.	Matrix Algebra-2	2
9.	Matrix Algebra-3	2
10.	Matrix Algebra-4	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 For First Year	T Veerarajan	Tata Mc Graw Hill

Engineering Mathematics-1 (Calculus)	H. K. Dass and Dr. Rama Verma	S. Chand

Course Evaluation:

Theory:

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

Tutorial:

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

Course Outcome(s):

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

- make use of concepts of limit, continuity and differentiability for analysing mathematical
  problems.
- use concepts of Limit, Derivatives and Integrals.
- examine series for its convergence and divergence.
- solve linear system using matrices.

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1010
Course Name: Engineering Graphics
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	04	00	05	40	60	40	60	00	00	200

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

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

List of Practical:

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

Text Book(s):

Title	Author(s)	Publication

A Text Book of Engineering Graphics	P J Shah	S. Chand & Company Ltd., New Delhi
Engineering Drawing	N D Bhatt	Charotar Publishing House, Anand

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Practical:

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

Course Outcome(s):

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

- know and understand “Drawing is a language of Engineers.”
- interpret general assembly technical drawing.
- create traditions and the strategies for Engineering Drawing.
- evaluate basic and intermediate geometry.
- apply the knowledge of principles of projections.
- develop their hallucination/imagination skills.
- enhance their technical communication skill in the form of talkative drawings.

P P Savani University
School of Engineering

Department of Mechanical Engineering

Course Code: SEME1020
Course Name: Engineering Workshop
Prerequisite Course(s): -

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
0	2	0	1	0	0	50	0	0	0	50

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction:** Introduction to Various Shops / Sections and Workshop Layouts, Safety Norms to be Followed in a Workshop.	-	-
2.	**Fitting Shop:** Introduction of Fitting Shop; Safety; Making a Job as per Drawing including Marking and other Performing Operations.	-	-
3.	**Carpentry and Drilling Shop:** Introduction of Carpentry Shop; Preparation of Job as per Drawing including Marking and other Performing Operations.	-	-

4.	**Sheet Metal Shop:** Introduction of Sheet Metal Shop; Preparation of Job as per Drawing including Marking and other Performing Operations	-	-
5.	**Smithy Shop:** Introduction of Sheet Metal Shop; Preparation of Job as per Drawing including Marking and other Performing Operations	-	-
6.	**Introduction to Machine Tools:** Introduction and Demonstration of various Machine Tools like Lathe, Drilling, Grinding, Hack Saw Cutting etc.	-	-
7.	**Introduction to Welding & Plumbing:** Introduction and Demonstration of Welding process. Introduction and Demonstration of Plumbing Shop.	-	-

List of Practical:

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

Text Book(s):

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

Reference Book(s):

Title	Author(s)	Publication
Workshop Technology Vol. I	W.A.J. Chapman	Edward Donald Publication
Workshop Practices	H S Bawa	Tata McGraw-Hill

Basic Machine Shop Practice Vol. I, II	Tejwani V.K	Tata McGraw-Hill

Web Material Link(s):

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

Course Evaluation:

Practical:

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

Course Outcome(s):

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

- use various measuring instruments.
- know the importance of safety norms required in workshop.
- understand the application of various tools required for different operation.
- understand how to manufacture product from given raw material.
- know the use of machine tools, hand tools and power tools.

P P Savani University
School of Engineering

Department of Science & Humanities

Course Code: SESH1230
Course Name: Fundamentals of Chemistry & Chemical Engineering
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	2	0	4	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objective of the Course:
To help learners to

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Chemical Bonding and Structure of Molecules** **General terms**: Chemical bond, valence, valence electrons, Bonding and Nonbonding electrons, Lewis symbols, Octet rule. **Ionic bond**: Definition, Condition for formation of ionic bond, Factors governing formation of ionic bond, examples (NaCl, $MgCl_2$, CaO, Al_2O_3), Characteristics of ionic compounds. **Covalent bond:** Definition, conditions for covalent bond formation, examples [(single covalent bond: H_2, Cl_2, H_2O, NH_3, CH_4) (multiple covalent bond: O_2, N_2, CO_2)], General characteristics of covalent compounds, valence bond approach, formation of H_2 molecule, Concept of hybridization, Hybridization and shape of	08	20

	molecules, Shape of water, ammonia, PCL_5 and SF_6, Limitations of Valence bond theory, VSEPR theory, Fajan's rules. **Co-ordinate covalent bond:** Definitions, examples (NH_4^+, H_3O^+, BF_4^-, CH_3NO_2, SO_3, $AlCl_3$, SO_4^{-2}, O_3 and CO. **Hydrogen bonding:** Definition, conditions for H-bond formation, examples (HF, H_2O, NH_3, 2-nitrophenol), Types of H-bonds, Characteristics of H-bonded compounds. **Metallic bond:** Definition, The Electron sea model, explanation to the physical characteristics of metal based on the electron sea model.		
2.	**Electrochemistry** Introduction, Arrhenius ionic theory, De-bye Huckel theory of strong electrolytes, activity and activity co-efficient, Conductivity of electrolytes, Kohlrausch's law of independent migration of ions, Ostwald's dilution law, Acids and bases, Concept of pH and pOH, Buffer solutions, Solubility product, common-ion effect, hydrolysis of salts, conductometric titration, transport number.	06	10
3.	**Water Technology and Colloids** Introduction, Source of water, Impurities of water, Hard and Soft water, Degree of hardness, Scale and Sludge formation in boiler, Boiler Corrosion, Caustic Embrittlement, Priming and Forming, Softening of water, Potable Water, Break point of chlorination, Desalination of Brackish Water. Lyophilic and Lyophobic colloids, Characteristics of lyophilic and lyophobic sols, preparation of sols, Dispersion methods, Aggregation methods, Purification of sols, Dialysis, optical properties of sols: Tyndall effect.	08	20
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Introduction to Unit Operation** Systematic analysis to chemical process, flow sheet symbols for various operations, Forms of Energy, Overall balances, Mass balance and Momentum Balance, total energy balance, Introduction to modes of heat transfer, Introduction to the concepts of mass transfer, Numerical	08	20

2.	**Introduction to Reaction Kinetics** Introduction to types of reaction, reaction rate, order of reaction, reaction mechanism, Numerical	08	20
3.	**Thermodynamics** Introduction & basic concepts, Equilibrium, Laws of Thermodynamics, Heat Reservior & Heat Engines, Energy Balances.	07	10

List of Practical/Tutorial:

Sr. No	Name of Practical	Hours
1.	Introduction to chemistry laboratory – Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Quantitative analysis etc.	2
2.	Demonstration: Preparation of solutions of different concentrations	4
3.	Determination of alkalinity in the given water sample.	2
4.	Determination of temporary and permanent hardness in water sample using EDTA as standard solution.	4
5.	Conduct metric titration of strong acid vs. strong base.	2
6.	Determination of critical micelle concentration of a surfactant using conductometry.	4
7.	Determination of concentration of unknown solution spectrophotometrically.	2
8.	Determining the strength of ferrous ammonium sulfate with the help of $K_2Cr_2O_7$.	4
9.	Determination of dissociation constant of strong acid by pH metric method.	2
10.	Determination of cloud point of a surfactant in the presence of salts.	4
	Total	**30**

Text Book:

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

Reference Book:

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

Web Material Links:

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

Course Evaluation:

Theory:

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

Practical:

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

Course Outcome(s):

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

- understand the relevance of fundamentals and applications of chemical sciences and chemistry in the field of engineering.
- apply the knowledge of thermodynamics in studying different chemical systems.
- apply the knowledge of Colloids, metals and alloys, their types and their properties.
- have sound knowledge on Electrochemistry.
- give an introduction of chemical engineering to make aware the students about the role of chemical engineer in various chemical industries.
- acquire knowledge on unit processes and unit operations, and to train how to apply mass balance and energy balance on them.

P P Savani University
School of Engineering

Department of Applied Science and Humanities

Course Code: SESH1080
Course Name: Linear Algebra & Calculus
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	0	2	5	40	60	-	-	50	0	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Vector Space** Concept of vector space, Subspace, Linear Combination, Linear Dependence and Independence, Span, Basis and Dimension, Row Space, Column Space and Null Space, Rank and Nullity.	9	20
2.	**Linear Transformation** Introduction of Linear Transformation, Kernal and Range, Rank and Nullity, Inverse of Linear Transformation, Rank Nullity Theorem, Composition of Linear Maps, Matrix associated with linear map.	7	15
3.	**Inner Product Space** Inner Product, Angle and Orthogonality, Orthogonal projection, Gram- Schmidt process and QR Decomposition, Least square decomposition, Change of basis.	7	15

Section II			
Module No.	Content	Hours	Weightage in %
1.	**Beta and Gamma function** Improper Integrals, Convergence, Properties of Beta and Gamma Function, Duplication Formula (without proof)	6	14
2.	**Fourier Series** Periodic Function, Euler Formula, Arbitrary Period, Even and Odd function, Half Range Expansion, Parseval's Theorem	8	18
3.	**Curve tracing** Tracing of Cartesian Curves, Polar Coordinates, Polar and Parametric Form of Standard Curves, Areas and Length in Polar co-ordinates	8	18

List of Tutorial:

Sr. No.	Name of Tutorial	Hours
1.	Vector Space-1	4
2.	Vector Space-2	2
3.	Linear Transformation-1	2
4	Linear Transformation-2	2
5.	Inner Product-1	2
6.	Inner Product-2	2
7.	Beta and Gamma Function-1	2
8.	Beta and Gamma Function-2	2
9.	Curve tracing-1	2
10.	Curve tracing-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 30 marks.
- MCQ based examination consists of 10 marks.
- Internal Viva consists of 10 marks.

Course Outcome(s):

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

- understand the concepts of Vector Space, Linear Transformation and inner product
- space.
- evaluate functions like Gamma, Beta functions & their relation which is helpful to evaluate some definite integral arising in various branch of engineering.
- understand the concept of Fourier series.

P P Savani University
School of Engineering

Department of Applied sciences & Humanities

Course Code: SESH1240
Course Name: Electrical & Electronics Workshop
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
0	2	0	1	0	0	50	0	0	0	50

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

List of Practical:

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

Text Book:

Title	Author/s	Publication

Electronic Principles	Albert Malvino and David J Bates	Mc Graw Hill(7th Edition)

Reference Book:

Title	**Author/s**	**Publication**
Electronic Devices	Thomas L. Floyd	Pearson (7th Edition)
Electronic Devices and Circuits	David A. Bell	Oxford Press (5th Edition)
Integrated Electronics	Jacob Millman, Christos	Tata McGraw Hill (2nd Edition)

Course Evaluation:

Practical:

- Continuous Evaluation Consist of Performance of Practical which should be evaluated out of 10 for each practical in the next turn and average of the same will be converted to 20 Marks.
- Internal viva consists of 20 marks.

Course Outcome(s):

- After completion of the course, the students will be able to design elementary combinational and sequential circuits.

P P Savani University
School of Engineering

Department of Civil Engineering

Course Code: SECV1040
Course Name: Basics of Civil & Mechanical Engineering
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	2	0	5	40	60	20	30	0	0	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

	Concrete, Steel. Classification of Buildings, Types of Loads Acting on Buildings, Building Components and their Functions, Types of Foundation and Importance, Symbols Used in Electrical Layout, Symbols Used for Water Supply, Plumbing and Sanitation		
4.	**Construction Equipment:** Types of Equipment- Functions, Uses. Hauling Equipment-Truck, Dumper, Trailer. Hoisting Equipment- Pulley, Crane, Jack, Winch, Sheave Block, Fork Truck. Pneumatic Equipment-Compressor. Conveying Equipment- Package, Screw, Flight/scrap, Bucket, Belt Conveyor. Drill, Tractor, Ripper, Rim Pull, Dredger, Drag Line, Power Shovel, JCB, HOE.	04	08
5.	**Recent Trends in Civil Engineering:** Mass Transportation, Rapid Transportation, Smart City, Sky Scarper, Dams, Rain Water Harvesting, Batch Mix Plant, Ready Mix Concrete Plant, Green Building, Earth Quake Resisting Building, Smart Material	06	12
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Basic Concepts of Thermodynamics:** Prime Movers - Meaning and Classification; the Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific Heat Capacity, Internal Energy, Specific Volume; Thermodynamic Systems, All Laws of Thermodynamics	04	06
2.	**Fuels and Energy:** Fuels Classification: Solid, Liquid and Gaseous; their Application, Energy Classification: Conventional and Non-Conventional Energy Sources, Introduction and Applications of Energy Sources like Fossil Fuels, Solar, Wind, and Bio-Fuels, LPG, CNG, Calorific Value	04	06
3.	**Basics of Steam Generators:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox Boiler, Functioning of Different Mountings and Accessories	LAB	12
4.	**Basics of I.C Engines:** Construction and Working of 2 Stroke & 4 Stroke Petrol and Diesel Engines, Difference Between 2-Stroke - 4 Stroke Engine & Petrol-Diesel Engine, Efficiency of I. C. Engines	12	14
5.	**Power Transmission Elements:** Construction and Applications of Couplings, Clutches and Brakes, Difference Between Clutch and Coupling, Types of Belt Drive and Gear Drive	10	12

List of Practical:

Sr. No.	Name of Practical	Hours
1.	Unit conversation Exercise and Chart preparation of building components	02
2.	Linear measurements	02
3.	Angular measurements	02
4.	Determine R. L of given point by Dumpy level. (Without Change Point)	02
5.	Determine R. L of given point by Dumpy level. (With Change Point)	02
6.	Presentation on various topics as in module about recent trends	04
7.	To understand construction and working of various types of boilers	04
8.	To understand construction and working of mountings	04
9.	To understand construction and working of accessories	04
10.	To understand construction and working 2 –stroke & 4 –stroke Petrol Engines	02
11.	To understand construction and working 2 –stroke & 4 –stroke Diesel Engines	02

Text Book(s):

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Practical:

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

Course Outcome(s):

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

- know the principles and working of basic mechanical systems.
- comprehend importance of mechanical engineering in various fields of engineering.
- know about different civil engineering fields with an overview of building material, building construction and recent developments in civil engineering.

P P Savani University
School of Engineering

Department of Civil Engineering

Course Code: SECV1080
Course Name: Mechanics of Solids
Prerequisite Course(s): -

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
4	2	0	5	40	60	20	30	0	0	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction:** Definition of Rigid Body, Deformable Body, Scalar and Vector Quantities, Fundamental Principles of Mechanics: Principle of Transmissibility, Principle of Superposition, Law of Parallelogram of Forces.	8	10
2.	**Fundamental of Static:** Force, Types of Forces, Characteristics of a Force, System of Forces, Composition and Resolution of Forces. **Concurrent Forces:** Resultant of Coplanar Concurrent Force System by Analytical Method, Law of Triangle of Forces, Law of Polygon of Forces, Equilibrium Conditions for Coplanar Concurrent Forces.	12	15

	Non-Concurrent Forces: Moments & Couples, Characteristics of Moment And Couple, Varignon's Theorem, Resultant of Non-Concurrent Forces by Analytical Method, Equilibrium Conditions of Coplanar Non-Concurrent Force System.		
3.	**Centroid and Centre of Gravity:** Centroid of Lines, Plane Areas and Volumes, Examples Related to Centroid of Composite Geometry, Pappus – Guldinus Theorems.	5	12
4.	**Moment of Inertia:** Parallel and Perpendicular Axis Theorems, Polar Moment of Inertia, Radius of Gyration of Areas, Examples related to moment of Inertia of Composite geometry.	5	13
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Mechanical Properties of Materials:** Introduction, Classification of Materials, Properties Related to Axial, Bending, and Torsional & Shear Loading, Toughness, Hardness, Ductility, Brittleness. Proof stress, Factor of Safety, Working Stress, Load Factor.	2*	10
2.	**Simple Stress and Strain:** Definition of Stress and Strain, Tensile & Compressive Stresses: Shear and Complementary Shear Strains, Linear, Shear, Lateral, Thermal and Volumetric. Hooke's Law, Stresses and Strain in bars of Varying, Tapering & Composite Section, Principle of Superposition. Elastic Constant, Relation between Elastic Constants.	15	20
3.	**Shear Force and Bending Moment:** Introduction, Types of Loads, Supports and Beams, Shear Force, Bending Moment, Sign Conventions for Shear Force & Bending Moment. Statically Determinate Beam, Support Reactions, SFD and BMD for Concentrated Load and Uniformly Distributed Load, Uniformly Varying Load, Point of Contra-flexure.	15	20

*(To be covered during lab hours)

List of Practical (Any Ten):

Sr. No	Name of Practical	Hours
1.	Equilibrium of coplanar concurrent forces	02

2.	To verify the law of parallelogram of forces	02
3.	To verify the law of polygon of forces	02
4.	To verify the Lami's theorem	02
5.	Equilibrium of parallel force system – simply supported beam	02
6.	Tensile test on Ductile materials.	02
7.	Compression test on Ductile materials	02
8.	Compression test on Brittle Materials	02
9.	Determination of hardness of metals (Brinell/ Rockwell hardness test)	02
10.	Determination of impact of metals (Izod/ Charpy impact test)	02
11.	Tutorial on concurrent & Non-concurrent forces	04
12.	Tutorials on C. G & MI	02
13.	Tutorials on SFD & BMD	04

Text Book(s):

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Practical:

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

Course Outcome(s):

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

- understand fundamental principles of mechanics, equilibrium, statics reactions and internal forces in statically determinate beams.
- apply principles of statics for determine C.G and M.I of a different geometrical shape and Understand basics of friction and its importance.
- critically analyze problem and solve the problem related to mechanical elements and analyze the deformation behavior for different types of loads.
- understand the different types of stresses and strains developed in the member subjected to axial, bending, shear & torsional effects.
- understand the physical properties of materials.

P P Savani University
School of Engineering

Department of Computer Engineering

Course Code: SECE1010
Course Name: Basics of Computer and Programming
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/ Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
3	2	0	4	40	60	20	30	0	0	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

4.	**Computer Programming Language:** Introduction to different types of Programming Languages, Flowcharts and Algorithms. Introduction to C Programming Language, Features of C, Structure of C Program, Development of Program, Types of Errors, Debugging and Tracing Execution of Program.	08	15
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Constants, Variables and data Types:** Character Set, C tokens, Keyword, Constants and Variables, Data Types - Declaration and Initialization, User define type Declarations Typedef, Enum, Basic Input and Output Operations, Symbolic Constants	05	10
2.	**Operators and Expression and Managing I/O operations**: Introduction to Operators and its Types, Evaluation of Expressions, Precedence of Arithmetic Operators, Type Conversions in Expressions, Operator Precedence and Associativity. Managing Input and Output, Reading a Character, Writing a Character, Formatted Input, Formatted Output.	07	16
3.	**Conditional statement and branching:** Decision Making & Branching: Decision Making with If & If ... Else Statements, If - Else Statements (Nested Ladder), The Switch & go - to Statements, The Ternary (?:) Operator Looping: The While Statement, The Break Statement & The Do. While Loop, The FOR Loop, Jump Within Loops - Programs.	06	12
4.	**Arrays and Strings:** Introduction to Array, One Dimensional Array, Two Dimensional Arrays, Declaring and Initializing String Variables, Arithmetic Operations on Characters, Putting Strings Together, Comparison of Two Strings, Basic String Handling Functions	05	12

List of Practical:

Sr. No	Name of Practical	Hours
1.	Introduction to Basic Command	04
2.	Word Processing, Spreadsheets and Presentation Exercises	06
3.	Introduction to Octave Environment	04

4.	Implementation in C for conditional statement and branching Implementation of if, if...else, nested if...else and switch statements Implementation of while loop, do...while loop and for loop	06
5.	Implementation of 1-D and 2-D array	06
6.	Implementation of in built string functions, application programs of array and strings	04

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

Text Book(s):

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

Reference Book(s):

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

Course Evaluation:

Theory:

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

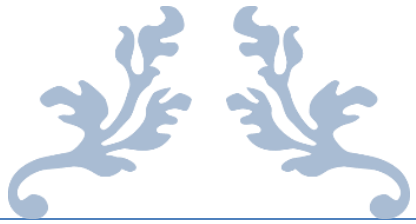
Practical:

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

Course Outcomes:

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

- explore new emerging areas of the field.
- apply programming fundamentals to solve real time problems.



SECOND YEAR B. TECH.

P P SAVANI UNIVERSITY

SCHOOL OF ENGINEERING

TEACHING & EXAMINATION SCHEME FOR B.TECH. SECOND YEAR CHEMICAL ENGINEERING PROGRAMME

Sem	Course Code	Course Name	Teaching Scheme					Examination Scheme						
			Contact Hours				Credit	Theory		Practical		Tutorial		Total
			Theory	Practical	Tutorial	Total		CE	ESE	CE	ESE	CE	ESE	
3	SESH2031	Differential Methods for Chemical Engineers	3	0	2	5	5	40	60	00	00	50	00	150
	SECH2010	Chemical Process Calculation	3	0	1	4	4	40	60	00	00	50	00	150
	SECH2020	Mechanical Operations	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2030	Unit Processes in Organic Synthesis	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2040	Chemical Engineering Materials and Metallurgy	2	0	0	2	2	40	60	00	00	00	00	100
	CFLS1020	Global Communication Skills	2	0	0	2	2	40	60	00	00	00	00	100
	SECH2910	Industrial Exposure	2			0	2	00	00	100	00	00	00	100
		Total				**23**	**23**							**900**
4	SESH2022	Numerical & Statistical Analysis	3	0	2	5	5	40	60	00	00	50	00	150
	SECH2050	Fluid Flow Operations	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2061	Physical, Inorganic & Analytical Chemistry	3	2	0	5	4	40	60	20	30	00	00	150
	SECH2070	Chemical Engineering Thermodynamics-I	3	0	2	5	5	40	60	00	00	50	00	150
	SECH2080	Mass Transfer Operations – I	3	2	0	5	4	40	60	20	30	00	00	150
	SEPD3040	Integrated Personality Development Course-I	2	0	0	2	1	100	0	0	0	0	0	100
	CFLS3010	Foreign Language-I	2	0	0	2	2	40	60	0	0	0	0	100
		Total				**29**	**25**							**950**

P P Savani University
School of Engineering

Department of Science & Humanities

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

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	02	05	40	60	00	00	50	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

	Laplace Transform, Linearity, First Shifting Theorem, Existence Theorem, Transforms of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Dirac's Delta function, Laplace Transformation of Periodic function, Inverse Laplace transform, Convolution		
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Integral Transform-B** Introduction of Z transform, Linearity property, Damping rule, Basic theory of Z transform, Inverse Z-transform, Convolutions theorems, Application to Difference Equations	09	21
2.	**Fourier Series** Periodic function, Euler Formula, Arbitrary Period, Even and Odd function, Half-Range Expansions, Applications to ODEs.	06	14
3.	**Fourier Integral and Transformation** Representation by Fourier Integral, Fourier Cosine Integral, Fourier Sine Integral, Fourier Cosine Transform and Sine Transform, Linearity, Fourier Transform of Derivatives.	07	15

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	4
4.	Partial Differential Equation-1	2
5.	Partial Differential Equation-2	4
6.	Laplace Transform	2
7.	z-Transform-1	2
8.	z-Transform-2	2
9.	z-Transform-3	4
10.	Fourier Series-1	2
11.	Fourier Series-2	2
12.	Fourier Integral and Transformation	2

Text Book(s):

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

Reference Book(s):

Title	Author/s	Publication
Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers
Advanced Engineering Mathematics	R. K. Jain, S.R.K. Iyengar	Narosa Publishing House Pvt. Ltd.

Differential Equations for Dummies	Steven Holzner	Wiley India Pvt. Ltd.
Higher Engineering Mathematics	H.K. Dass, Er. Rajnish Verma	S. Chand & Company Pvt. Ltd.

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Tutorial:

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

Course Outcome(s):

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

- grasp the respective 1^{st} and 2^{nd} order ODE and PDE.
- analyze engineering problems (growth, decay, flow, spring and series/parallel electronic circuits) using 1^{st} and 2^{nd} order ODE.
- classify differential equations and solve linear and non-linear partial differential equations.
- understand concepts, formulas, and problem-solving procedures to thoroughly investigate relevant real-world problems.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2010
Course Name: Chemical Process Calculations
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	01	04	40	60	00	00	50	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

	Analytical, Graphical and Numerical, Gas laws and phase equilibria, Humidity, Saturation and Crystallization.		
4.	**Material Balances:** Materials balance: Concepts of limiting and excess reactants, Batch, Stage-wise, Continuous and recycle operations, Material balance of systems involving mixing, extraction, distillation, crystallization, chemical reaction and recycle processes, Material balance equations based on conservation principle, Material balances for non-reactive processes (Unit Operations), Material balances for reactive processes.	10	20
Section II			
Module No	Content	Hours	Weightage in %
1.	**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.	02	05
2.	**Thermo physics and Energy Balances:** Energy balances for closed and open systems based on energy conservation principle, Energy balances for non-reactive processes (Unit Operations), Energy balances for reactive processes, Coupled material and energy balances for single unit process, Heats of formation, combustion, reaction, solution, dilution, Effect of temperature on heat of reaction, Energy balance of systems without and with chemical reactions, Heat capacity calculations, Enthalpy changes of reactions, dissolution and laws of thermochemistry, Effect of pressure and temperature on heat of reactions.	12	25
3.	**Multiple Unit Processes:** Introduction to processes with multiple Units; Material balances on processes with recycle, Purge, and bypass, Introduction to DOF analysis and solution strategy for multi-unit process, Degrees of freedom in steady-state processes, Simultaneous material and energy balance problems using flow sheeting codes, Unsteady state material and energy balances.	07	20

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

- know and understand the basics of Chemical Engineering calculations.
- interpret the data for Chemical Engineering process scenarios.
- apply the knowledge of the principles of Chemical Engineering reactions.
- enhance their technical skills in the form of numerical analysis.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2020
Course Name: Mechanical Operations
Prerequisite Course(s): --

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Properties of particulate solid** Introduction to particle technology, Characterization of solid particles, particle size measurement techniques, Mixed particles, specific surface of mixture, Particle population.	02	05
2.	**Size reduction and enlargement** Types of equipment and their studies, Principles of comminution, Laws of crushing and grinding, Closed and open circuit grinding, power requirements, Energy and power required for comminution, Industrial processes for particle size enlargement, size enlargement equipment comminution, Broad classification, Primary breaking operations, Intermediate crushing by crushers, cone, roll and	10	20

	impact crushers, Ball and fumbling mills—fine grinding, Determination of power consumption.		
3.	**Properties of masses of solids** Storage of solids: Angle of repose, bulk storage, storage in bins and silos.	02	08
4.	**Conveying of solids** Codes for characterization of solids, screw conveyers, belt conveyers, bucket elevators, pneumatic conveying of solids, Design of conveyor belts, Mechanical and pneumatic conveying equipment and power consumption.	03	07
5.	**Screening - equipment and efficiency** Screen analysis, Method of reporting screen analysis, Capacity and effectiveness of screens, Screen analysis, sizing curves, industrial sizing, screening revolving and vibrating screens, Screen efficiency and capacity, Classification: Laws, wet and dry methods, Types of classifiers—stationary, mechanical, centrifugal and hydraulic.	05	10
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Filtration** Flow through porous media, Theories of filtration - Principles of filtration, constant rate and constant pressure filtration, Optimum cycle, compressible cakes and filter aids, constant pressure, constant rate filtration, compressible and incompressible cakes, cake resistance, filter media resistance, filter media, filter aids, filtration equipment (batch, continuous), selection criteria, washing of filter cakes, filtration by continuous vacuum and pressure filters.	06	15
2.	**Gravity setting and sedimentation** Gravity clarifiers, sorting clarifiers, Batch sedimentation, rate of sedimentation, Thickening process and sedimentation, Design of thickeners and clarifiers free and hindered setting, Centrifugal sedimentation: Principles of centrifugal sedimentation, Solid gas separation, liquid solid separation, Centrifugation.	05	10
3.	**Mixing** Mixing equipment and characteristics, power consumption and efficiency, mixing of powders and pastes: Mixers for cohesive and non-cohesive solids, Mixing Index Agitation and mixing of liquids: Basic stirred tank design, Types of impellers, flow patterns, power consumption and scale up.	06	10
4.	**Separators**	06	15

	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.		

List of Practical:

Sr No	Name of Practical	Hours
1.	Determination of particle size by sieve analysis.	02
2.	Determination of the optimum speed and critical speed of a ball mill.	02
3.	Measurement of different bulk properties of powder samples.	02
4.	To study powder compaction behavior using different powder compaction models.	02
5.	Study of particle size reduction by Roll crusher and Jaw crusher	04
6.	Characterization of powder flow ability by Angle of Repose.	04
7.	Obtaining the collection efficiency of cyclone	02
8.	Obtaining settling rates of slurry as function of solid concentration	02
9.	Power consumption in Agitated vessels	02
10.	Study of froth flotation process	02
11.	Study of Plate and Frame filter place	04
12.	Study of Centrifugation process	02

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

- understand the basic principles of particles preparation and their characterization.
- have an understanding of solid storage and their conveying in chemical process industries.
- have an understanding of design of sedimentation tanks and other solid fluid separation equipment.
- have knowledge about different size reducing equipment and power requirements during size reduction.
- develop an ability to design chemical engineering processes while including economic safety, environment and ethical consideration.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2030
Course Name: Unit Processes in Organic Synthesis
Prerequisite Course(s): --

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** Definition and importance of unit processes in chemical engineering, Concept of unit operation and unit processes and their role in systematizing the cognitive structure of chemical industries, Classification of unit processes, Chemical process kinetics and Factors affecting, Symbols used in Chem. Engineering, Process flow diagram, Introduction to thermochemistry	04	09
2.	**Nitration** Introduction to nitration reactions, Nitrating agents, Aromatic Nitration, Kinetics and mechanism of aromatic nitration, Nitration of paraffinic hydrocarbon, Thermodynamics of nitration, Process equipment for technical nitration - schimid and Biazz nitrator, Mixed acid for nitration, D.V.S. value and nitric reaction, Comparison of batch Vs. Cont. nitration, Mfg. of Nitrobenzene,	05	12

	Dinitrobenzene, O-and P-Chloronitrobenzene, tri nitrotoluene.		
3.	**Amination by reduction** Introduction to Amination reactions, Various methods of reductions and factors affecting it, Iron and acid (Bechamp) reduction, Batch and continuous process for manufacture of Aniline from Nitrobenzene, Continuous process for manufacturing of Aniline from nitrobenzene using catalytic fluidized bed reactor.	05	11
4.	**Hydrogenation** Definition and scope of hydrogenation, Hydrogen: production and properties, Gas catalytic hydrogenation and hydrogenlysis, Kinetics and thermodynamics of hydrogenation reactions, General principles concerning hydrogenation catalysts, Industrial hydrogenation of fat & oil, Production of methanol from CO_2 & H_2. Hydrogen production technologies and petroleum fractions.	03	07
5.	**Oxidation** Definition and Types of oxidative reactions, Oxidizing agents, Liquid phase oxidation with oxidizing compounds, Liquid-phase oxidation with oxygen, Oxidation of toluene with MnO2. Manufacturing of Acetaldehyde from Acetic acid and Manufacturing of Acetic acid from Ethanol; Vapor phase oxidation of Methanol, Benzene and Naphthalene, Apparatus and its M/s. for oxidation reactions.	05	11
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Esterification and Hydrolysis** Definition and scope of Esterification, Esterification by organic acids and by carboxylic acid derivatives, Esters by addition to unsaturated systems and inorganic acids, Definition and scope of hydrolysis, Hydrolyzing agents, Materials susceptible to hydrolysis, Kinetics, thermodynamics, and mechanism of hydrolysis, Equipment for hydrolysis with technical operations.	03	06
2.	**Halogenation** Definition and scope of halogenation reactions, Thermodynamics and kinetics of halogenation reactions Halogenating agents, Industrial halogenation with types of equipment, Manufacturing of Chlorobenzene, Benzene hexa-chloride and vinyl chloride from Ethylene and Acetylene.	05	09
3.	**Sulfonation and sulfation**	04	10

	Definition and scope of sulfonation and sulfation, Chemical and physical factors in sulfonation and sulfation, The desulfonation reaction, Use of SO_3, SO_2, H_2SO_4 as sulfonating and sulfating agents and their applications, Mfg. of Benzene sulfonates, Sulfation of Dimethyl Ether and Lauryl Alcohol.		
4.	**Amination by ammonolysis** Definition & types of reactions, Aminating agents, Physical and Chemical factors affecting it. Catalyst used in ammonolysis, Kinetics and Thermodynamics of ammonolysis Mfg. of Aniline from chlorobenzene and Nitroaniline from Dichloro Nitro Aniline.	04	08
5.	**Hydrolysis** Definition and types of hydrolysis, Hydrolyzing agents, Kinetics, thermodynamics, and mechanism of hydrolysis, Industrial Hydrolysis of fat, hydrolysis of carbohydrates, starch to dextrose, Manufacturing of ethanol from ethylene (shell process) Mfg. of phenol from benzene sulfonic.	05	09
6.	**Polymerization** Introduction & chemistry of polymerization reactions, classifications of polymers methods of polymerization.	02	08

List of Practical:

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

Text Book(s):

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

Reference Book(s):

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

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Practical:

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

Course Outcome(s):

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

- build a basic knowledge of the Fundamental structure of organic molecules and their manufacturing process.
- understand and explain the reactions in organic synthesis.
- correlate the same as per their utility in field of Chemical Engineering.
- understand the various Unit Processes and learn about the chemistry and organic compound.

P P Savani University
School of Engineering

Chemical Engineering Materials & Metallurgy

Course Code: SECH2040
Course Name: Chemical Engineering Materials & Metallurgy
Prerequisite Course(s): --

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
02	00	00	02	40	60	00	00	00	00	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	10
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.	04	10
3.	**Ferrous metals and its Alloys**	06	15

	Iron and their alloys - Aluminium, copper, Zinc, lead, Nickel and their alloys with reference to the application in chemical industries. Phase Diagrams and Phase Transformation, TTT and CCT Diagrams. Iron-Iron Carbide and Iron-carbon diagrams, Overview of different types of irons - Wrought iron Pig iron, Cast iron, White Cast Iron, Grey Cast Iron, Malleable Cast Iron and their properties and characteristics, deformation of metals, Types of steel like Chromium, Manganese, Molybdenum and Manganese steels.		
4.	**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	15
Section II			
Module No.	Content	Hours	Weightage in %
1.	**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.	10	30
2.	**Nano materials** Nanomaterials Concept and classification, Nanostructured materials like nanorods, nano shells, nanotubes and nanofluids, synthesis methods for nanomaterials, Top down and bottom approach, various applications of nanomaterials like Environment, Food, Pharmaceutical, Electronic, Sports and Textile industries	05	20

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 completion of the course, the student will be able to

- interpret important chemical and mechanical properties and classification of engineering materials and metals.
- define different heat treatment process used in industrial applications.
- understand the different types of metals, alloys and chemical materials.
- analyze different microstructure, crystallography and defects of Chemical Engineering materials and metals.
- identify different destructive & non-destructive testing methods used in the practical field and their applications.
- understand the use powder metallurgy and their application to industries.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2910
Course Name: Industrial Exposure
Prerequisite Course(s): --

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objective of the Course:
To help learners to
- get exposed to the industrial spectrum.
- learn the mechanisms of industry/ workplace.
- be aware about work culture and policies of industries.

Outline of the Course:

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

Course Evaluation:

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

Course Outcome:
After completion of the course, the student will be able to
- get acquainted with the industrial scenario.
- be aware about his future prospects in the respective field.
- gain knowledge of work culture and industrial expectations.

Report Writing Guidelines

A. Report Format:

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

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

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

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

B. Guideline for Report Formatting:

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

P P Savani University
School of Engineering

Department of Science & Humanities

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

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	02	05	40	60	00	00	50	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

	Euler's Method, Runge-Kutta Method, Numerical Integration, Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule, Euler-Maclaurin Formulae		
Section II			
Module	Content	Hours	Weightage in %
1.	**Basics of Statistics** Elements, Variables, Observations, Quantitative and Qualitative data, Corss-sectional and Time series data, Frequency distribution, Dot plot, Histogram, Cumulative distribution, Measure of location, Mean, Median, Mode, Percentile, Quartile, Measure of variability, Range, Interquartile Range, Variance, Standard Deviation, Coefficient of Variation, Regression Analysis, Regression line and regression coefficient, Karl Pearson's method	7	15
2.	**Probability Distribution** Introduction, Conditional probability, Independent events, independent experiments, Theorem of total probability and Bayes' theorem, Probability distribution, Binomial distribution, Poisson distribution, Uniform distribution, Normal distribution.	8	18
3.	**Testing of Hypothesis** Introduction, Sampling, Tests of significance for parametric test, Null Hypothesis, Type 1 and Type 2 errors, Level of significance, Chi-square test, Student's t-test, Seducer's f-test	7	17

List of Tutorials:

Sr. No.	Name of Tutorial	Hours
1.	Complex Variables-1	4
2.	Complex Variables-2	2
3.	Numerical Solutions of Linear and Non-linear Equations-1	2
4.	Numerical Solutions of Linear and Non-linear Equations-2	4
5.	Numerical Differentiation and Integration-1	2
6.	Numerical Differentiation and Integration-2	2
7.	Basics of Statistics-1	2
8.	Basics of Statistics-2	4
9.	Probability-1	2
10.	Probability-2	2
11.	Testing of Hypothesis-1	2
12.	Testing of Hypothesis-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
Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers, New Delhi
Advanced Engineering Mathematics	R. K. Jain, S. R. K. Iyengar	Narosa Publishing House, New Delhi.
Introductory Methods of Numerical Analysis	S. S. Sastry	PHI Learning Pvt. Ltd., New Delhi.

Web Material Link(s):

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

Course Evaluation:

Theory:

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

Tutorial:

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

Course Outcome(s):

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

- derive numerical solution of linear and non-linear system of equation.
- acquire knowledge of finite differences, interpolation, numerical differentiation and numerical integration.
- select appropriate method to collect data and construct, compare, interpret and evaluate data by different statistical methods.
- apply concept of probability in decision making, artificial intelligence, machine learning etc.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2050
Course Name: Fluid Flow Operations
Prerequisite Course(s): --

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Basic Concept and Fluid statics & its application** Scope and Applications of fluid flow, Properties of fluids such as Density, viscosity, surface tension, capillarity effect, vapour pressure. **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 Metacenters, Determination of Metacentric Height, Stability of Floating and Submerged	08	15

	Body, Position of metacenter relative to Centre of buoyancy. Manometers, Inclined manometer, Continuous gravity and centrifugal decanter.		
2.	**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	04	10
3.	**Kinematics of fluid flow** Types of fluid flow namely steady and unsteady, Uniform and non- uniform, laminar and turbulent, compressible and incompressible internal and external, one, two-dimensional flow. Newton's Law of Viscosity, Rheological behavior of fluid, capillary viscometer.	04	10
4.	**Basic fluid equations & fluid dynamics** Bernoulli's equation Euler's Equation, Modified Bernoulli's equation. Major and Minor losses, Equivalent length, flow through pipe in series, parallel, pipe network Application Venturimeter: Horizontal and inclined, Orifice meter, Pitot tube Notches and Weirs: Introduction, classification, Derivation for V – notch, Rectangular notch	06	15
Section II			
Module No.	Content	Hours	Weightage in %
1.	**Flow of compressible fluids and its applications** Introduction to compressible flow, flow through pipes, Pipe fitting. Valves, nozzles, Fans, Blowers ejectors and compressors; Continuity equations, Velocity of sound, Stagnation temperature, Processes of compressible flow.	07	15
2.	**Flow of Fluids through Solids** Form drag - skin drag - Drag coefficient. 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. Fluidization - Mechanism, types, general properties – applications	08	15
3.	**Transportation** Classification and types, Centrifugal pumps – Construction and working, Power required, Definitions of heads and efficiency, NPSH, Priming, Cavitations, characteristic curves. Specific speed, minimum speed.	08	20

	Reciprocating Pump: Classifications and working. Power Consumption in Agitation: Power curves, Power No., types of impellers. Introduction to Compressors, Fans and Blowers. Types of Valves: Globe valves, Gate valves, butterfly valves and non – Return valves.		

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

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/Tutorial:

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

- understand fundamentals of fluids.
- analyze various flow problems and flow characteristics.
- determine major and minor losses through different pipes.
- apply the concept of fluid mechanics to design various system.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2061
Course Name: Physical Inorganic and Analytical Chemistry
Prerequisite Course(s): SESH1220 – Chemistry

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

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

	electrode), potentiometric titration, Karl Fischer titration (End point detection, The coulometric method)		

3.	**Phase Rule** Introduction, Phase Rule and its merits and demerits, Phase diagrams of single component systems (H_2O and Sulphur), two component systems involving eutectic systems (Pb-Ag, Sn-Mg), Applications.	03	07
4.	**Nuclear Chemistry** Basic terms and concepts, Types of nuclear reactions, Nuclear fission and fusion, nuclear reactors, radiation measurements (Detectors- Gas ionization detectors- principle, Ion chambers- proportional counter, G.M. Counter- scintillation detector- principle, features, Inorganic & organic scintillators, solid state detectors), disposal of nuclear waste.	05	11
5.	**Emerging Trends in Green Chemistry** Introduction to Green Chemistry, Twelve principles of Green Chemistry with examples, Designing a Green Synthesis, Example of green synthesis (adipic acid, catechol, Methyl Methacrylate).	02	04
6.	**Microscopy Techniques** Principles, Instrumentation, Analysis of images/artifacts, Applications, AFM (Atomic force microscopy), SEM (Scanning electron microscope), TEM (Transmission electron microscopy), FTIR.	04	10
	Section II		
Module No.	Content	Hours	Weightage in %
1.	**Corrosion and its Control** Introduction and theories of corrosion, Dry corrosion (chemical), Wet corrosion (electrochemical), Bio corrosion, Mechanism of corrosion, Factors influencing corrosion (ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature), Corrosion control and prevention methods, corrosion inhibitors, cathodic and anodic protection and Electroplating. Protective coatings, chemical principles involved, boiler corrosion, inter granular corrosions.	07	17
2.	**Instrumental Methods Of Chemical Analysis: Spectroscopic methods** Basic concepts, Instrumentation, Interpretation of data and relevant applications, Ultraviolet spectroscopy (UV), Infrared spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Mass Spectrometry.	06	13

3.	**Thermal methods of analysis** TGA, DTA, DSC (Principle, Instrumentation, Quantitative aspects of curves and/or Interpretation of curves, Applications)	05	10
4.	**Separation Techniques** Principle, Instrumentation, selection of column and its specifications, applications and Limitations, Planar Chromatography (Paper chromatography, Thin Layer Chromatography), Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC)	05	10

List of Practical:

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

Text Book(s):

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

Reference Book(s):

Title	Author/s	Publication
Analytical Chemistry for Technicians (4^{th} edition)	John Kenkel	CRC Press, Taylor & Francis Group

Corrosion Engineering Principles and Practice	Pierre R. Roberge	The McGraw-Hill Companies
New-Trends-in-Green-Chemistry	V. K. Ahluwalia, M.Kidwai	Kluwer Academic Publishers, Boston Dordrecht London & Anamaya Publishers, New Delhi
Atomic Force Microscopy	Peter Eaton	Oxford University Press
Fundamentals of Atomic Force Microscopy	Ronald G. Reifenberger	World Scientific Publishing Co
Principles and Practice of Modern Chromatographic Methods	Robards K., Jackson P., Haddad P A.	Elsevier Academic Press
Fundamentals of Analytical Chemistry	Douglas A. S., Donald M. W., Holler H. J., Crouch H. R.	Brooks Cole; 9thedition
Introduction to Spectroscopy	Donal L. P., Gary M. L., George S. K. , James A. V.	Brooks Cole

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

Course Evaluation:
Theory:

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

Practical/Tutorial:

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

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

- familiarize him/herself with the basics of different chemistries used in chemical industries.
- have theoretical and practical knowledge about modern analytical techniques and its quantitative analysis.
- able to perform in industry for various analytical tools.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2070
Course Name: Chemical Engineering Thermodynamics - I
Prerequisite Course(s):

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
Theory	Practical	Tutorial	Credit	Theory		Practical		Tutorial		Total
				CE	ESE	CE	ESE	CE	ESE	
03	00	01	04	40	60	00	00	50	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

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

- Understand basic principles of chemical engineering thermodynamics and calculations.
- Examine and select specific data and solve energy transformation problems.
- Learn important applications of laws of chemical engineering thermodynamics in chemical engineering.

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction and first law of thermodynamics:** The scope of thermodynamics in chemical engineering, application and limitation of thermodynamics, Zeroth law of thermodynamics, Heat engine and heat pump, Joule's experiment, Internal energy, enthalpy, first law of thermodynamics, energy balance for closed system, state function, path function, equilibrium, the phase rule, reversible and irreversible process, Heat capacity, first law of thermodynamics for flow process	6	15
2.	**Volumetric Properties of Pure Fluids** PVT behavior of pure substances, volume expansivity, isothermal compressibility, Ideal and nonideal gases, Isothermal, isobaric, isochoric, adiabatic and polytropic processes for ideal gas, equation of state for real gases, Virial equation of state, Cubic equation of state and theorem of corresponding states, acentric factor, generalized correlation for gases and liquids.	10	20

3.	**Heat Effects** Sensible heat effects, Temperature dependence of the heat capacity, latent heat of pure substances, approximate methods for the estimation of the latent heat of vaporization, standard heat of reaction, standard heat of formation, standard heat of combustion, temperature dependence of standard heat of reaction	6	10
Section - II			
Module No.	Content	Hours	Weightage in %
1.	**Second law of thermodynamics** Limitation of first law of thermodynamics, Statements of second law of thermodynamics, Heat engines, Carnot engine, Thermodynamic temperature scale, concept of entropy, entropy changes of an ideal gas, Clausius inequality, Third law of thermodynamics	8	15
2.	**Thermodynamic Properties of Fluids** The fundamental property relations for homogeneous phases, Maxwell's equation, Mnemonic diagram, Clapeyron equation, entropy – heat capacity relationships, differential equations for entropy, moldified equations for U and H, Effect of temperature, pressure and volume on U, H and S, relationship between Cp and Cv, Joule – Thomson coefficient, Residual properties, Residual properties by equation of state	08	20
3.	**Some applications of the laws of thermodynamics** Flow processes: continuity equation, energy equation, flow in pipes, flow through nozzles, ejectors, throttling process, compression, Refrigeration: Coefficient of performance, refrigerator capacity, Carnot cycle, vapour – compression cycle, choice of refrigerant, air refrigeration cycle, absorption refrigeration Liquefaction Processes: Vaporization of liquid, free expansion, isentropic expansion	08	20

Text Book(s):

Title	Author/s	Publication
Introduction to Engineering Thermodynamics	J.M. Smith, Hendrick Van Ness, Michael M. Abbott	Mc Grow 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	Mc Grow 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 Willey & Sons, (CBS Publishers & Distributors, New Delhi)

Web Material Link(s):

https://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 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.
- Tutorial performance/quiz/drawing/test consists of 15 marks during End Semester Exam.
- Viva/ Oral performance consists of 15 marks during End Semester Exam.

Course Outcome(s):

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

- Explain laws of thermodynamics and calculation of thermodynamic properties
- Calculate real gas properties using equation of state
- Calculate heat effects for different system
- Application of laws of thermodynamics in flow processes.

P P Savani University
School of Engineering

Department of Chemical Engineering

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

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

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

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

Course Content:

Section I			
Module No.	Content	Hours	Weightage in %
1.	**Introduction** Introduction to Mass Transfer Operation, Classification of mass transfer	02	05
2.	**Diffusion** Introduction**,** Molecular diffusion, Flux, Models of diffusion, Fick's law, Molecular and eddy diffusion, Molecular diffusion in gases, Steady state molecular diffusion in a binary mixture through constant area - fluids at rest and laminar condition and for gases, A diffusing in non-diffusing B, equimolar counter current diffusion for gases, A diffusing in non-diffusing B, equimolar counter current diffusion for liquids, Diffusion in solids, Some special types of diffusion in solids.	10	20
3.	**Mass Transfer Coefficients and Analogy Equations**	06	15

	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.		
4.	**Interphase Mass Transfer** Introduction, Theories of interphase mass transfer – two film, penetration, surface renewal and boundary layer theory.	04	10
	Section II		
Module No.	Content	Hours	Weightage in %
1.	**Humidification and dehumidification** Introduction, Terminologies used, Adiabatic saturation temperature, Wet-bulb temperature, Operation involving gas-liquid contact, Water cooling, Adiabatic Humidification – Cooling, Cooling range and approach, Nonadiabatic operations – evaporative cooling, Equipment for air-water contact, some accessories and operational features of cooling tower.	09	15
2.	**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
3.	**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

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

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 completion of the course, the student will be able to

- familiar with the basic phenomenon of mass transfer involving phases.
- able to apply the mathematical and design concepts of mass transfer in gas liquid systems like absorption, humidification, drying and crystallization.
- gaining good knowledge of required optimum condition for a gas-liquid system.
- familiar with fundamentals of thermodynamics as applied to various processes.
- understand the properties as applied to ideal and real gases.
- understand the equilibrium states for mixture of gases, phases and chemical reaction.
- verify the fundamentals learnt viz., application of thermodynamic laws, solution thermodynamics, phase equilibrium and reaction equilibrium in Chemical Engineering thermodynamics by conducting experiments and carry out the evaluation.