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SYLLABUS BOOK

SECOND YEAR B. TECH CHEMICAL ENGINEERING

P P SAVANI
UNIVERSITY

SCHOOL OF ENGINEERING
DEPARTMENT OF CHEMICAL ENGINEERING

Effective From: 2018-19
Authored by: P P Savani University

P P SAVANI UNIVERSITY											
SCHOOL OF ENGINEERING											
TEACHING & EXAMINATION SCHEME FOR B.TECH. 2nd YEAR MECHANICAL PROGRAMME											
Sem	**Course Code**	**Course Title**	**Teaching Scheme**				**Examination Scheme**				
			Contact Hours			**Credit**	**Theory**		**Practical/ Tutorial**		**Total**
			Theory + Tutorial	**Practical**	**Total**		**Internal**	**External**	**Internal**	**External**	
3.	SESH2031	Differential Methods for Chemical Engineers	5	0	5	5	40	60	50	0	150
	SECH2010	Chemical Process Calculations	4	0	4	4	40	60	25	0	125
	SECH2020	Solid Fluid Operations	3	2	5	4	40	60	20	30	150
	SECH2030	Unit Processes in Organic Synthesis	3	2	5	4	40	60	20	30	150
	SECH2040	Chemical Engineering Materials and Metallurgy	3	2	5	4	40	60	20	30	150
	SEPD2010	Critical Thinking, Creativity & Decision Making	2	0	2	2	40	60	00	00	100
					26	23					975
4.	SESH2022	Numerical & Statistical Analysis	5	0	5	5	40	60	50	0	150
	SECH2050	Momentum Transfer	3	2	5	4	40	60	20	30	150
	SECH2061	Physical, Inorganic & Analytical Chemistry	3	2	5	4	40	60	20	30	150
	SECH2070	Chemical Engineering Thermodynamics	4+2	0	6	6	40	60	25	0	125
	SECH2080	Mass Transfer Operations	3	2	5	4	40	60	20	30	150
	SECH2091	Biochemical Engineering	3	0	3	3	40	60	0	0	100
	SEPD2020	Values and Ethics	2	0	2	2	40	60	0	0	100
					31	28					925

CONTENT

Semester 1

Semester 2

P P Savani University
School of Engineering

Department of Science & Humanities

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

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to learn

- Orientation to calculus and its applications in solving engineering problems including differential equations.
- Introduction of partial differential equations with methods of its solutions.
- Applications of Integral transforms for solving linear differential equations.
- Introduction of periodic functions and Fourier series with their applications for solving ODEs.

Course Content:

Section I

Module	Content	Hours	Weightage
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	20 %
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.	7	18 %
3.	**Integral Transform-A** Laplace Transform, Linearity, First Shifting Theorem, Existence Theorem, Transforms of Derivatives and Integrals, Unit Step Function, Second Shifting Theorem, Dirac's Delta function, Laplace Transformation of Periodic function, Inverse Laplace transform, Convolution	6	12 %

Section II			
Module	**Content**	**Hours**	**Weightage**
4.	**Integral Transform-B** Introduction of Z transform, Linearity property, Damping rule, Basic theory of Z transform, Inverse Z-transform, Convolutions theorems, Application to Difference Equations	10	20 %
5.	**Fourier Series** Periodic function, Euler Formula, Arbitrary Period, Even and Odd function, Half-Range Expansions, Applications to ODEs.	7	15 %
6.	**Fourier Integral and Transformation** Representation by Fourier Integral, Fourier Cosine Integral, Fourier Sine Integral, Fourier Cosine Transform and Sine Transform, Linearity, Fourier Transform of Derivatives.	6	15 %

List of Practical/Tutorial:

Sr No	Name of Practical/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 Books:

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

Reference Books:

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 Links:

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 15 Marks and 1 Hour of duration.
- Submission of assignments which consists of 10 Questions to be answered under each module and it carries 10 Marks of continuous evaluation.
- End Semester Examination will consist 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.
- MCQ based examination of 10 Marks.
- Internal Viva component of 10 Marks.

Course Outcomes:

The students will be able to

- grasp the respective 1st and 2nd order ODE and PDE.
- analyze engineering problems (growth, decay, flow, spring and series/parallel electronic circuits) using 1st and 2nd order ODE.
- classify differential equations and solve linear and non-linear partial differential equations.
- understanding of 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

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	Total
3	0	1	4	40	60	00	00	25	0	125

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

- know 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	**Content**	**Hours**	**Weightage**
1.	**Introduction:** Chemical Engineering and Chemical Industry, Steady state and unsteady state processes, Unit Operations, Unit Processes and Process Flow Diagrams, Combustion and chemical processes.	02	07%
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, Mathematical techniques in chemical engineering.	03	07%
3.	**Basic Calculations:** State properties: Molecular weight, compositions, density, vapor pressure etc for gas, liquid and solid systems, thermal properties: Heat capacity, sensible heat, latent heat, heat of reaction, heat of solution, enthalpy calculations etc. for gas, liquid and solid systems, Techniques of problem Solution: Analytical, Graphical and Numerical, Gas laws and phase equilibria, Humidity, saturation and crystallization.	09	18%
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.	09	18%
Section II			
5.	**Vapour pressure:** Vapour pressure plots, vapour pressure of immiscible liquids and vapour pressure of solutions; Humidity and saturation humidity chart; Super saturation; Distribution of a solute between immiscible and partially miscible liquids; Solubility of gases.	02	10%
6.	**Thermo physics and Energy Balances:** Energy balances for closed and open systems based on energy conservation principle; Energy balances for non-reactive processes (Unit Operations), Energy balances for reactive processes; Coupled material and energy balances for single unit process: Heats of formation, combustion, reaction, solution, dilution, etc. 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.	10	20%
7.	**Multiple Unit Processes:** Introduction to processes with multiple Units; Material balances on processes with recycle, purge, and bypass. Introduction to DOF analysis and solution strategy for multi-unit process; Degrees of freedom in steady-state processes; Simultaneous material and energy balance problems using flow sheeting codes; Unsteady state material and energy balances.	07	12%
8.	Material and energy balance calculations of some selected process plants such as sulfuric acid, ammonia, urea, caustic soda etc.	03	08%

Text Books:

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 Books:

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.
Process Calculation for Chemical Engineering, Second Revised Edition,		Chemical Engineering Education Development Centre, I.I.T., Madras.
Conservation of Mass and Energy	Whitwell J.C. &Jone R.K.,	McGraw-Hill, Singapore, 1973.

Web Material Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it consists of 10 Marks of Evaluation.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

- Continuous Evaluation Consist of Performance of Practical/Tutorial which should be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 15 Marks.
- Internal Viva component of 10 Marks.

Course Outcomes:

After learning the course, the students 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 principles of chemical engineering reactions.
- enhance their technical skill in the form of numerical analysis.

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2020
Course Name: Solid Fluid Operations

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

- Understand many basic principles in various Chemical Engineering operations such as Size Reduction, Filtration, Sedimentation, Mixing and Agitation etc. and their mathematical relationships.
- 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	Content	Hours	Weightage
1.	**Properties of particulate solid:** Introduction to particle technology, Characterization of solid particles (size, shape, size distribution), particle size measurement techniques, Mixed particles, specific surface of mixture, Particle population.	04	8%
2.	**Size reduction and enlargement:** Types of equipment and their studies, Closed and open circuit grinding, Laws of crushing and grinding, power requirements, Principles of comminution, Energy and power required for comminution, size reduction equipment, Industrial processes for particle size enlargement, size enlargement equipment comminution, Broad classification, Primary breaking operations, Intermediate crushing by crushers, cone, roll and impact crushers, Ball and fumbling mills—fine grinding, Closed and open circuit grinding, Determination of power consumption.	06	12%
3.	**Properties of masses of solids:** Storage of solids: Angle of repose, bulk storage, storage in bins and silos.	08	20%
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.	04	10%

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		
6.	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.	05	10%
7.	**Flow through packed beds. Fluidization:** Types of fluidization, Geldart classification of particles, minimum fluidization velocity, Pressure drop, Particulate and bubbling fluidization, Applications of fluidization.	04	10%
8.	**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%
9.	**Mixing equipment and characteristics, power consumption and efficiency, Mixing of powders and pastes:** Mixers for cohesive and non-cohesive solids, Mixing Index Agitation and mixing of liquids: Basic stirred tank design, Types of impellers, flow patterns, power consumption and scale up.	04	10%
10.	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, silimanite, graphite and coal, Electrical and magnetic concentration, Electrostatic and magnetic separations, dry and wet type separators.	05	10%

Practical/Tutorial: :

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 Books:

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 Books:

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 Links:

http://nptel.ac.in/syllabus/103107091

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation, Three research paper to be studied and submit the report.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

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

On completion of the course, students are expected 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

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help 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	Content	Hours	Weightage
1.	**Introduction** Definition and importance of Unit processes in Chemical Engg., Outlines of unit processes, and operations, Concept of Unit operation and unit processes and their role in systematizing the cognitive structure of Chemical industry; Chemical process kinetics and Factors affecting it, Symbols used in Chem. Engg. Process flow diagram.	03	08%
2.	Classification of Unit processes, their Characteristic features, thermo chemistry etc.	02	06%
3.	**Nitration** Definition & scope of nitration reactions, Classification of nitro-compounds, nitrating agents, types of nitration, equipment, Aromatic Nitration (schimid and Biazz; nitrators)mixed acid for nitration, D.V.S. value and nitric reaction, Comparison of batch Vs. Cont. nitration, Mfg. of Nitrobenzene, Dinitrobenzene, O-and P-Chloronitrobenzene, tri nitrotoluene etc.	04	09%
4.	**Amination by reduction** Definition & scope of Amination reactions, various methods of reductions and factors affecting it, Batch and continuous process for manufacture of Aniline from Nitrobenzene, continuous process for manufacturing of Aniline from nitrobenzene using catalytic fluidized bed reactor, M/c. in such processes.	05	10%

Module	Content	Hours	Weightage
5.	**Hydrogenation** Definition and its scope, properties of hydrogen and sources of hydrogen, gas catalytic hydrogenation and hydrogenolysis, factors affecting it, Apparatus and M/c., Industrial hydrogenation of fat & oil, Mfg. of Methanol from CO2 & H2. Hydrogen production technologies, petroleum fractions etc.	03	08%
6.	**Oxidation** Definition and Types, Oxidizing agents, Liquid phase oxidation with oxidizing agents and 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	09%
	Section II		
7.	Esterification and Hydrolysis, Alkylation, General aspects, reagents, equipment and typical processes.	02	06%
8.	**Halogenation** Definition and scope of various halogenation reactions, Halogenating agents Industrial halogenation with types of equipment and its materials M/c. Manufacturing of Chlorobenzene, Benzene hexa-chloride and vinyl chloride from Ethylene and Acetylene.	06	09%
9.	**Sulfonation and sulfation** Definition and scope of such reactions, General aspects, reagents, catalysts, equipment, use of SO3, SO2, H2SO4 sulfonating and sulfating agents and their applications, Chemical and physical factors affecting it. Industrial equipment and techniques for batch Vs. Cont. sulfonation, Mfg. of Benzene sulfonates, Sulfation of Dimethyl Ether and Lauryl Alcohol.	03	10%
10.	**Amination by ammonolysis** Definition & types of reactions, Aminating agents, Physical and Chemical factors affecting it. Catalyst used in Ammonolysis, Mfg. of Aniline from chlorobenzene and Nitroaniline from Dichloro Nitro Aniline.	03	08%
11.	**Hydrolysis** Definition and types of hydrolysis, Hydrolyzing agents, equipment's 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.	03	09%
12.	**Polymerization** Introduction & chemistry of polymerization reactions, classifications of polymers methods of polymerization.	05	08%

List of Practical :

Sr No	Name of Practical/Tutorial	Hours
1.	Manufacturing of Acetanilide from aniline	04
2.	Manufacturing of Tribromophenol from Phenol	04
3.	Manufacturing of m-dinitrobenzene from Nitrobenzene	04
4.	Manufacturing of Anthraquinone from Anthracene	04
5.	Manufacturing of Phthalic anhydride from Phthalic acid	04
6.	Estimation of phenol by bromination	04
7.	Experiments on Hydrolysis	02
8.	Hydrogenation of Vegetable oil	04

Text Books:

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 Books:

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 Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation and Industrial visit report.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

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

After learning the course, the students will be able to:

- build a basic knowledge of the Fundamental structure of Organic molecules and their manufacturing process.
- analyze scientific concepts and think critically.
- 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.
- learn about the chemistry about Organic Compound.
- understand the Chemical reaction with mechanism.
- know about the Synthetic Organic materials

P P Savani University
School of Engineering

Chemical Engineering Materials & Metallurgy

Course Code: SECH2040
Course Name: Chemical Engineering Materials & Metallurgy

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

- identify the different chemicals and related materials and their properties described.
- understand the microstructures, crystallography, defects, and phase diagrams of different materials.
- help the students 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	**Content**	**Hours**	**Weightage**
1.	**Introduction to Engineering Materials** Classification, Engineering requirements, basics of internal structure like macro, micro, crystal and atomic and their correlated properties; Methods/ Tools to reveal the different levels of structure, Defects-Point, Line, Planar.	02	07%
2.	**Structure and Imperfections in Crystals** Crystal structure Crystal geometry, structure of solids, methods of determining structures, Imperfection in crystals - types of imperfection, Point imperfection.	01	03%
3.	**Properties of Materials** Mechanical, Electrical and magnetic properties of materials - Deformation of materials - Heat Treatment techniques, Selection of material like SS, Ti/ Zr alloy and design for corrosion control, Factors determining the choice of materials of construction in chemical industries.	04	05%
4.	**Ferrous metals and its Alloys** Iron and their alloys, Aluminium, copper, Zinc, lead, Nickel and their alloys with reference to the application in chemical industries. Phase Diagrams and Phase Transformation, TTT and CCT Diagrams. Iron-Iron Carbide and Iron-carbon diagrams, Overview of different types of irons (Wrought iron Pig iron, Cast iron, White Cast Iron, Grey Cast Iron, Malleable Cast Iron, , Steel, S. G. Iron, Alloy Cast Iron) their properties and characteristics, Structure of high polymers phase transformation, deformation of metals, creep, fracture, fatigue, radiation damage equilibrium diagrams, Types of steel (Chromium, Manganese, Molybdenum and Manganese steels), IS Codification, Classification, properties, applications in chemical industries. Alloy steels, Effects of alloying elements.	06	15%
5.	**Non-Ferrous Alloys** Non-Ferrous Alloys of Aluminium, Magnesium, Copper, Nickel, Titanium, Lead, Tin, Bearing metals, Zinc, Microstructure and mechanical property relationships; Composite, Classification, Processing, Metal Matrix	Laboratory	- -
6.	**Metals: their behaviors and properties** Solidification of metals and an alloy, Nucleation and Growth during freezing of pure metal and alloy ingot/a casting Resultant macrostructures; Effects of Structure on Mechanical Properties, Methods to control the grain structure resulting from solidification, Solidification defects like porosity and shrinkage and remedies. Cooling curve of pure metal and alloy. Properties of metals, Deformation of metals, Mechanisms of deformation, Deformation in polycrystalline materials, Mechanical testing of materials (destructive & non-destructive) testing methods.	06	12%
7.	**Heat Treatment and Surface hardening processes** Annealing and its types, Normalizing, Aus-tempering, Mar-tempering, Quenching and Temper heat treatment, Hardenability, Applications of above processes for the industrial practices. Flame and induction hardening, Carburizing, Nitriding and Carbonitriding, Applications of above processes for the industrial practices.	04	08%
8.	**Powder Metallurgy** Application and advantages, Production of powder, Compacting, Sintering, Equipment and process capability.	Laboratory	- -

Section II			
Module	**Content**	**Hours**	**Weightage**
9.	**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, Cermets; Glass and refractories Glass and porcelain enamels, Cement refractories, Alumina, Zirconia, Silicon Carbide, Sialons, Reaction Bonded Silicon Nitride, Processing Composite materials, Fibre reinforced plastic (FRP). Glasses properties and applications, organic materials: wood, plastics, and rubber and wood; Advanced materials (Biomaterials, and composites) with special reference to the applications in chemical Industries; Polymers: Definition, Classification & characteristics, Types of polymerization, Polymer processing, polymer matrix, properties and applications Elastomers. Smart polymer, advanced polymer Conductive polymer, bio-route prepared nano polymer, Blended polymer, self-cleaning polymer surfaces	08	15%
10.	**Membrane Materials** Membrane Materials, molecular and ionic, in porous or dense, charged or not, membranes, Layer by layer membrane, Proton exchange membrane, biopolymer based membrane, nano-composite membrane, coated membrane, different subtract and active layer membrane.	04	10%
11.	**Applications of advance materials in chemical Engineering** Colloidal Materials and Their Industrial Applications; Surfactants, Mixed surfactants, Micelles, Visicles, Micelles, Reverse micelles, Emulsions, Microemulsions, foams, Thin Films, microbial polymers, green solvents, Industrial enzymes, Protein as Enzymes; Gels and Smart Hydrogels: Hydrogel, Core and shell hydrogel, shell and core hydrogel, green hydrogel, stimuli responsiveness hydrogel	06	15%
12.	**Nano materials** Metal and Semiconductor Nano materials, Quantum Dots, Wells and Wires, Molecule to bulk transitions, Bucky balls and Carbon Nano tubes. Nano composite, Molecular machines, nanofactories, nanocatalysts, nanocomposites, bio-analytical tools, nano/micro arrays, nano devices, lab-on-a-chip etc.	04	10%

List of Practical :

Sr No	Name of Practical/Tutorial	Hours
1.	To understand construction and working of metallographic microscope.	02
2.	To study procedure of specimen preparation for microscopic examination and to carry out a specimen preparation.	02
3.	To understand what is micro examination, importance of micro examination and to study various ferrous, non-ferrous microstructures.	02
4.	To show the effect of different quenching media like Oil, Water and Brine on the hardness of medium carbon steel.	02
5.	To find out the effect of varying section size on hardenability of steel and obtain hardness distribution curves of hardened steel cross-section.	02
6.	To determine machine defects by dye -penetrant test and magnetic particle test.	02
7.	To determine the hardenability by Jominy end quench test.	02
8.	Study of different heat treatment processes- annealing, normalizing, hardening and tempering, surface and casehardening to improve properties of steel during processes and applications with the help of muffle furnace.	02

Text Books:

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.
Nanochemistry A chemical approach to nanomaterials,	Ozin G. A, Andre C. Arsenault,	Royal society of chemistry, UK,2005.

Reference Books:

Title	Author/s	Publication
Callister's Material Science and Engineering	R. Balasubramaniam	Wiley India
Chemical Engineering Materials'	Chaudhry H.	Indian Book Distributing Company, 2nd Edition, Delhi, 1982.
Recent literature from Journals on separations, membranes, polymers and hydrogels		

Web Material Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Tests Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module consisting of 10 Marks of Evaluation, Three research papers to study to be followed by the report.
- End Semester Examination will consist of 60 Marks Exam.

Practical:

- Continuous Evaluation Consist of solution of Practical which should be evaluated out of 10 for each Tutorial in the next turn and average of the same will be converted to 10 Marks.
- Internal Viva component of 10 Marks.
- Performance/Problem solution/quiz/test of 15 Marks during End Semester Exam.
- Viva/Oral performance of 15 Marks during End Semester Exam.

Course Outcomes:

Students 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

Centre for Skill Enhancement & Professional Development

Course Code: SEPD2010
Course Name: Critical Thinking, Creativity and Decision Making

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	Total
02	00	00	02	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

- develop a familiarity with the mechanics of critical thinking and logic.
- understand basic concepts of critical and creative thinking.
- explore and understand critical thinking for the purpose of creativity in context of professional, social and personal spectrum.
- explore an application critical thinking and creativity in personal, social, academic, global and profession life.
- Understand Decision making as a skill to be learned through critical thinking.

Course Content:

Section I

Module	Content	Hours	Weightage
1.	**Introduction to Critical Thinking** • Concept and meaning of Critical Thinking • Significance of Critical Thinking in personal, social and professional life • Thinking with arguments, evidences and language	06	20 %
2.	**Applied Critical Thinking** • Inductive and Deductive Thinking • Questioning for Generating Ideas	06	20 %
3.	**Conceptual Thinking** • Second order thinking • Three step technique • Synthesizing	06	20 %

Section II			
Module	**Content**	**Hours**	**Weightage**
4.	**Creative Thinking and Decision Making** • Problem Solving • Adapting Various Structures of Decision Making	06	20 %
5.	**Moral Thinking** • Generating and structuring ideas • Designing and Evaluating the solutions • Case Study	06	20 %

Text Books:

Title	Author/s	Publication
Thinking Skills for Professionals	B. Greetham, Palgrave	Macmillan, 2010

Reference Books:

Title	Author/s	Publication
An Introduction to Critical Thinking and Creativity: Think More, Think Better	J. Y. F. Lau	John Wiley & Sons., New hercy
Critical Thinking: A Beginner's Guide to Critical Thinking, Better Decision Making and Problem Solving	Jennifer Wilson	CreateSpace Independent Publishing Platform, 2017
Creativity and Critical Thinking	edited by Steve Padget	Routledge 2013

Course Evaluation:

Practical/Tutorial:

- Continuous Evaluation Consist of Two Test Each of 30 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carries 10 Marks of Evaluation.
- End Semester Examination will consist of 60 Marks Exam.

Course Outcomes:

Students will be able to :

- Comprehend the concept and application of critical thinking as well as its applications.
- Understand the critical thinking in context of creativity, logical arguments, moral reasoning.
- Understand the application of critical thinking for social, academic, global and professional spectrum.
- Correlate their thinking skills for better productivity and outcome based tasks.
- Be in a better position to apply 360o analysis of the situation for decision making.

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, SESH2011-Differential Equations/ SESH2031-Differential Methods for Chemical Engineers

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

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

Course Content:

Section I

Module	Content	Hours	Weightage
1.	**Complex Variables** Complex numbers with operators and geometric representation, Analytic function, Derivative of complex function, Cauchy-Riemann equation, Trigonometric and Hyperbolic functions, Complex Integration, Conformal Mapping, Linear functional transformations, Cauchy's Integral, Calculation of residue	10	20 %
2.	**Numerical Solutions of Linear and Non-linear Equations** Errors and Their computations, General error formula, Bisection Method, Iteration Method, Newton-Raphson Method, Solution of system of non-linear equation, Solution of linear system, Gauss Elimination	6	13 %
3.	**Numerical Differentiation and Integration** Interpolation, Finite Differences, Error in numerical differentiation, Cubic Splines Method, Differentiation Formulae, Numerical solution of ODEs, Picard's Method, Euler's Method, Runge-Kutta Method, Numerical Integration, Trapezoidal Rule, Simpson's 1/3-rule, Simpson's 3/8-rule, Euler-Maclaurin Formulae	7	17 %

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

List of Practical :

Sr No	Name of Practical/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 Books:

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 Books:

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 Links:

1) http://nptel.ac.in/courses/111106094/
2) http://nptel.ac.in/courses/111106084/
3) http://nptel.ac.in/courses/111105035/
4) http://nptel.ac.in/courses/111101003/
5) http://nptel.ac.in/courses/111105090/

Course Evaluation:

Theory:

- Continuous evaluation consists of two tests each of 15 Marks and 1 Hour of duration.
- Submission of assignments which consists of 10 Questions to be answered under each module and it carries 10 Marks of continuous evaluation.
- End Semester Examination will consist 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.
- MCQ based examination of 10 Marks.
- Internal Viva of 10 Marks.

Course Outcomes:

Students 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: SEME2050
Course Name: Momentum Transfer (Fluid Flow Operations)

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners 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	Content	Hours	Weightage
1.	**Properties of fluids and concept of pressure** Definitions of Unit operations, Basic concepts of fluids and its application area, Properties of fluids (Density, Viscosity, Surface Tension, Compressibility, Capillary, Vapour Pressure, Bulk Modulus, Cavitation, Classification of Fluids), Unit systems, Standards, Conversion on units, Units and equations, Dimension analysis, Dimension and units, Dimensional homogeneity, Dimensionless equations, Raleigh and Buckingham π theorem, Common π groups, examples, Non Dimensional Numbers, Similarities – Geometrical, Kinematics and Dynamic.	03	5%
2.	**Fluid statics & its application** Nature of fluids: Incompressible and compressible fluids, Pressure concepts, Force and Pressure, Pascal's law of Pressure at a point, Pressure measurement by Manometers – U tube, Inclined U tube and Differential, Centre of Pressure, Hydrostatic equilibrium in gravitational and centrifugal field, Hydrostatic forces on surface – Vertical, Horizontal and Inclined, Forces on curved Surfaces, Buoyancy and Buoyant Force, Centre of Buoyancy and Meta Centre, Determination of Metacentric Height, Stability of Floating and Submerged Body, Position of metacentre relative to Centre of buoyancy. Manometers, Inclined manometer, Continuous gravity and centrifugal decanter.	04	10%

3.	**Fluid statics, boundary layers & its applications** **Nature of fluids:** Incompressible and compressible fluids, Pressure concepts, Hydrostatic equilibrium in gravitational and centrifugal field, Manometers, Inclined manometer, Continuous gravity and centrifugal decanter; Concept of Boundary Layer, Boundary layer Thickness, Momentum Thickness, Displacement Thickness, Drag and Lift, Separation of Boundary layer, Streamlined and Bluffed Bodies.	03	05%
4.	**Momentum Balance and their Applications** Kinematics of fluid flow, Types of flow, Steady and Unsteady Flow, Potential flow, One – two and three Dimensional Flow, Uniform and Non Uniform Flow, Rotational and Irrotational Flow, Stream Lines and Stream Function, Velocity Potential Function, Relation between stream and velocity potential function, Flow nets, Continuity Equation for 2D and 3D flow in Cartesian co-ordinates system , Laminar flow, Reynolds number, Newtonian and non-Newtonian fluids, Velocity gradient and Rate of shear, Expression for co-efficient of friction – Dracy Weishbach Equation, Moody's Diagram resistance for smooth and rough pipes, Viscosity of gases and liquids, Turbulent flow, Nature of turbulence, Eddy viscosity, Eddy diffusivity of momentum, Flow in boundary layers, Laminar and turbulent flow in boundary layers, Reynolds number, Boundary layer formation in straight tube and flat plates, Boundary layer thickness, Boundary layer separation and wake formation.	04	10%
5.	**Basic fluid equations & fluid dynamics** Stream line and stream tubes, Average velocity, Mass velocity, Momentum balance, Bernoulli's equation without friction& its applications, Correction of Bernoulli's equation for fluid friction, Pump work in Bernoulli's equation. Newton's law of motion, Euler's Equation and its applications, Momentum Equation, Pitot Tube, Determination of volumetric flow with pitot tube, Principle of Venturimeter, Pipe Orifice and Rotameter.	03	05%
6.	**Flow of incompressible fluids through ductsand its applications in conduits and thin layers** Flow of incompressible fluids in pipes, Friction factor, Laminar flow of Newtonian and non-Newtonian fluids, Turbulent flow in pipes and closed channels, Effect of roughness, Friction factor chart, Drag reduction in turbulent flow Friction factor in flow through channels of noncircular cross section, Friction from changes in velocity or direction, Effect of fittings and valves, Major and Minor Losses in Pipes, Hydraulic Gradient line and Total energy line, Equivalent Pipes, Pipes in series and parallel, Siphon, Power transmission through pipe, Moody's Diagram, Practical use of velocity heads in design, Minimization expansion and contraction losses. Flow through Open Channel: Specific Energy and Specific Force, Critical Flow, Hydraulic Jump, Measurement of Discharge in open Channels.		
7.	**Flow of compressible fluids and its applications** Introduction to compressible flow, flow through pipes and nozzles, Fans, Blowers ejectors and compressors; Continuity equations, Velocity of sound, Stagnation temperature, Processes of compressible flow.		
8.	**Flow of Fluids through Solids** Form drag - skin drag - Drag co-efficient. Flow around solids and packed beds. Friction factor for packed beds. Ergun's Equation - Motion of particles through fluids - Motion under gravitational and centrifugal fields - Terminal settling velocity. Fluidisation - Mechanism, types, general properties – applications		

9.	**Transportation and Metering** Transportation of fluids, Pipes, pipe standards, fittings, pipe joints, valves and their constructional features, Fluid moving machinery: Positive displacement and centrifugal pumps, centrifugal pump theory, concept of NPSH, pump performance and characteristics. Measurement of fluid flow: Orifice meter, venturi meter, pitot tube, rotameter, weirs and notches Wet gas meter and dry gas meter. Area meters; Head meters; Mass flow meter; Hot-wire anemometer. Hot wire and hot film anemometers. Transportation of fluids: Fluid moving machinery performance. Selection and specification. Air lift and diaphragm pump. Positive displacement pumps: Rotary and Reciprocating pumps. Centrifugal pumps and characteristics.	06	15%
10.	**Applications of fluid mechanics** Transportation and metering of fluids, Pipe, fitting and valves, pumps, compressor, blowers and fans, Flow past immersed bodies: Drag, Drag coefficients, Flow through beds of solids, Particle motion, Terminal velocity, Hindered settling, Settling and rise of bubbles and drops, Fluidization, Special cases of Single and two phase flow through packed beds, two-phase gas liquid flow in pipes, Essentials of gas solid flows. Introduction to computational fluid dynamics (CFD).	06	15%

List of Practical :

Sr No	Name of Practical/Tutorial	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 / rectangularnotch.	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 Books:

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 & Biswas.G	Tata McGraw Hill Publication
Unit Operations of Chemical Engineering	McCabe W.L., Smith J.C., Harriott P.	McGraw Hill

Reference Books:

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 Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation, Three research paper to be study and submit the report Or industrial visit report.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

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

Course Outcomes:

After learning the course, the students 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: SESH1220 Chemistry

Teaching & Examination Scheme:

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

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners 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	**Content**	**Hours**	**Weightage**
1.	**Properties of Liquid and preparation of solution** Define the terms: (Solute, Solvent and Solution), Different standards of solutions ((i) Primary standards and (ii) Secondary standards), Definition and different methods of expressing concentration, Definition of the Surface tension, Parachor, Refractive index, Molar refraction, Specific refraction, Viscosity.	01	03%
2.	**Electro analytical techniques for analysis** Basic concepts, Standard reduction potentials, Measurement of overall redox reaction tendency, Introduction to Potentiometry, Electrodes (Reference electrode, Saturated calomel reference electrode, indicator electrode, pH electrode), potentiometric titration, Karl Fischer titration (End point detection, The coulometric method)	06	15%
3.	**Phase Rule** Introduction, Phase Rule and its merits and demerits, Phase diagrams of single component systems (H2O and Sulphur), two component systems involving eutectic systems (Pb-Ag, Sn-Mg), Applications.	06	15%
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	07%
5.	**Emerging Trends in Green Chemistry** Introduction, What is Green Chemistry and its requirement to engineering, Twelve principles of Green Chemistry with examples, Atom Economy, Designing a Green Synthesis, Example of green synthesis (adipic acid, catechol, Methyl Methacrylate)	02	05%
6.	**Microscopy Techniques** Principles, Instrumentation, Analysis of images/artifacts, Applications, AFM (Atomic force microscopy), SEM (Scanning electron microscope), TEM (Transmission electron microscopy)	02	05%

Section II			
Module	**Content**	**Hours**	**Weightage**
7.	**Corrosion and its Control** Introduction and theories of corrosion, Dry corrosion (chemical), Wet corrosion (electrochemical), Bio corrosion, Mechanism of corrosion, Factors influencing corrosion (ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium - pH, conductivity, and temperature), Corrosion control and prevention methods, corrosion inhibitors, cathodic and anodic protection and Electroplating. Protective coatings, chemical principles involved. Pourbiax diagram, boiler corrosion, inter granular corrosions	06	15%
8.	**Instrumental Methods Of Chemical Analysis :** Spectroscopic methods Basic concepts, Instrumentation, Interpretation of data and relevant applications, Ultraviolet spectroscopy (UV), Infrared spectroscopy (IR), Nuclear Magnetic Resonance (NMR), Mass Spectrometry	06	15%
9.	**Thermal methods of analysis** TGA, DTA, DSC (Principle, Instrumentation, Quantitative aspects of curves and/or Interpretation of curves, Applications)	05	10%
10.	**Separation Techniques** Principle, Instrumentation, selection of column and its 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/Tutorial	Hours
1.	Introduction to laboratory, safety rules for chemistry laboratories	02
2.	Phase diagram of given three components system.	02
3.	Titration of Cu2+ by titration with EDTA (Potentiometric or Conductivity).	02
4.	Spectrophotometric analysis of PO4-3 from unknown sample of water.	02
5.	Separation of amino acid mixture by Paper Chromatography.	02
6.	TLC Separation of Drug	02
7.	Study of Corrosion of metal at different concentration of Acid	02
8.	Determine total salt content of a given sample using ion-exchange column.	02
9.	Photometric titration of (Cu+2 + Ca+2) in a mixture.	02
10.	Determine % purity of sodium benzoate via ion-exchange column.	02
11.	Determine the amount of ferrous sulphate / ferrous ammonium sulphate by potentiometric method.	02
12.	Determination of Ka1 and Ka2 of phosphoric acid by pH meter.	02
13.	Elecrto gravimetric determination of Cu+2 in brass.	02
14.	Interpretation of UV, IR, NMR, and Mass Spectra (Dry lab)	02
15.	Revision	02

Text Books:

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 Books:

Title	Author/s	Publication
Analytical Chemistry for Technicians (4th 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 Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation and Industry/Laboratory visit report.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

- Continuous Evaluation Consist of Performance of Practical/Tutorial which should be evaluated out of 14 for each practical/Tutorial and average of the same will be converted to 10 Marks.
- Internal Viva component 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 Outcomes:

After learning the course the students will:

- be familiar with the basics of different chemistries used in chemical industries
- have theoretical and practical knowledge about modern analytical techniques and its quantitative analysis.
- be 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

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	Total
4	0	2	6	40	60	00	00	25	00	125

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

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

Course Content:			
Section I			
Module	**Content**	**Hours**	**Weightage**
1.	Thermodynamic functions and relations for mixtures, Partial molar property, chemical potential, fugacity & fugacity coefficients, excess functions and activity coefficients, correlations for excess Gibbs free energy.	04	05%
2.	PVT behavior including EOS for mixtures; Fugacity estimation/ calculations based on PVT behavior, Heat effects accompanying chemical Reactions. Phase equilibrium criteria and VLE calculations for different pressure ranges including flash calculations. Activity coefficient calculation from experimental VLE data and data reduction, applications of Gibbs-Duhem relation for calculations of and consistency check for VLE data. Phase diagrams for miscible, partially miscible and immiscible liquid mixtures, introduction to LLE and VLLE calculations.	08	15%
3.	Applications to Laws of Thermodynamics - Flow processes: Flow in pipes, Flow through nozzles, Compression- Refrigeration Thermodynamic Properties of Pure Fluids-Gibb's Free energy-Fundamental Property relations-Maxwell's equations-Gibb's Helmholtz Equation-Properties of Jacobians-Thermodynamic Relations through method of jacobians.	09	10%
4.	Thermodynamic Properties of Solutions - Introduction to fugacity and activity, Activity coefficients-Partial molar properties- miscible system, immiscible system, Chemical potential as a partial molar property-Lewis randall rule-Roults and Henry's law-Gibbs Duhem Equation Mathematical relation among thermodynamic functions, Mexwell's relations, Interrelation between H, S, U, G, Cp, Cv, properties of single and two phase system. Types of thermodynamic diagrams. Partially immiscible system, testing of vapor-liquid equilibrium data, Van Laar equation. Margules equation, Redlich-Kister equation, P-X-Y, T-X-Y, & X-Y Diagram, vapor-liquid equilibrium of ideal and non-ideal solution	09	20%
5.	Phase Equilibria and Chemical Reaction Equilibria - Criteria for phase equilibrium, Criteria of chemical equilibrium, Criterion of stability, Phase equilibria in single and multiple component systems, Duhem's theorem, VLE for Ideal solutions, Calculation of activity coefficients- Reaction stoichiometry-Equilibrium constant- Feasibility of reaction- Effect of temperature, pressure, volume and other factors- Simultaneous Reactions effect of P and T on equilibrium conversion (Xe) and equilibrium constant (K), methods of evaluation of K & Xe, Xe charts for Exothermic, Endothermic, Reversible and irreversible reactions etc.	10	20%
6.	Equilibrium of complex reactions, introduction to equilibrium conversion calculation under adiabatic and non-isothermal conditions, introduction to liquid phase, heterogeneous and electrochemical reaction equilibria, thermodynamic analysis of some chemical reactions of industrial importance.	09	15%
7.	Prediction of thermodynamic properties by group contribution and other methods inclining .	04	05%
8.	Statistical thermodynamics: Distribution of molecular states, Partition function; Estimation of mean energies, residual entropies, and equilibrium constant. Stefen-Boltzman, Bose-Einstein and Fermi-Dirac distributions, corrected boltzman statistics, partition function etc.	07	10%

List of Tutorials:

1. Heat of Solution by Solubility Method
2. Equilibrium Constant Determination
3. Liquid – Liquid Equilibrium
4. Excess Property Determination
5. Vapour Compression Refrigeration
6. VLE using Othmer Still

Text Books:

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

Reference Books:

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

Web Material Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration or a submission of assignments
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation. Three research papers to study to be followed by the report.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

- Continuous Evaluation Consist of Performance of Practical/Tutorial which should be evaluated out of 10 for each practical/Tutorial and average of the same will be converted to 15 Marks.
- Internal Viva component of 10 Marks

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2080
Course Name: Mass Transfer Operations

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	Total
3	2	0	5	40	60	20	30	00	00	150

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help 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	Content	Hours	Weightage
1.	**Introduction** Introduction to Mass Transfer Operation: classification & method. Fundamentals of mass transfer.	03	05%
2.	**Molecular diffusion in fluids** Stefan- Maxwell's diffusion equations Prediction of diffusion coefficients for gases and liquids. Definition, Ficks law, Molecular and eddy diffusion, Diffusion in gaseous mixtures, liquid mixtures and solids, Types of solid diffusion, Pseudo steady state diffusion, measurement and calculation of diffusivities. Ordinary diffusion in multicomponent gaseous mixtures. Unsteady state Diffusion.	07	15%
3.	**Diffusion in solids** Introduction to diffusion in solids, Fick's law, types of solid diffusion	03	05%
4.	Inter-phase mass transfer, mass transfer theories, Equilibria, Mass transfer coefficients - Individual and overall with relations, Analogies between momentum, heat and mass transfer to predict mass transfer coefficients.	04	10%
5.	Humidification Theory, Methods of Humidification and dehumidification operations; Psychometric Chart, Adiabatic Saturator, Wet and dry bulb hygrometry. Cooling. Air conditioning. Cooling tower theory, Design of cooling towers. Industrial cooling towers, Air conditioning process, Recirculating water gas humidification system.	05	15%

Section II			
Module	**Content**	**Hours**	**Weightage**
6.	**Drying** Internal flow of moisture; Surface evaporation and shrinkage; Drying rates; Theory and mechanism of drying, drying rates, different dryers and their design principles. Elements of drying description and application of hearth and rotary dryers. Dewatering. Draining, Different types of dryers Batch and continuous driers.	07	15%
7.	**Crystallization** Factors influencing nucleation and crystal growth. Crystal geometry, Caking of crystals. Different crystallizers and their design principles. Nucleation and crystal growth; Controlled growth of crystals; Industrial crystallizers. Solubility curves, supersaturation, theories of nucleation & crystal growth, calculation of yield, classification and selection of equipment for solution crystallization, MSMPR crystallization model, melt crystallization.	07	15%
8.	**Reactive Separations** Concept, Different types of crystallization, phase equilibrium, different techniques, commercial applications, Ultrasound, Sonication and its application in crystallization, Reactive crystallization	05	10%
9.	**Super Critical Fluid (SCF) Extraction** Working Principal, Advantage & Disadvantages of supercritical solvents over conventional liquid solvents, commercial applications of supercritical extraction, Applications under research	04	10%

List of Tutorials:

Sr No	Name of Practical/Tutorial	Hours
1.	Study of diffusion coefficient	02
2.	Study of mass transfer coefficient	02
3.	Study of latent heat of vaporization	02
4.	Study of Humidification and dehumidification operations	06
5.	Study of cooling tower	02
6.	Study of drying rate	02
7.	Study of Drying Operations – Batch, Rotary, Spray	02
8.	Study of Fluid bed dryer	04
9.	Study of Crystallization Operations	04
10.	Study of Crystal rate formation	04

Text Books:

Title	Author/s	Publication
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 Books:

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 Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation, Three research paper to be study and submit the report OR Industry visit report.
- End Semester Examination will consist of 60 Marks Exam.

Practical/Tutorial:

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

After learning the course, the students should be:

- 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
- able to understand the properties as applied to ideal and real gases
- able to understand the equilibrium states for mixture of gases, phases and chemical reaction
- able to 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

P P Savani University
School of Engineering

Department of Chemical Engineering

Course Code: SECH2091
Course Name: Bio-Chemical Engineering

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	Total
3	0	0	3	40	60	00	00	00	00	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

- impart the basic concepts of biochemical engineering and basics of bioprocesses.
- develop understanding about biochemistry and bio chemical processes.
- develop understanding about application of engineering principles in biochemical.

Course Content:

Section I

Module	Content	Hours	Weightage
1.	Introduction to Bioscience and Biotechnology. Basic microbiology Types of Microorganisms: Structure and function of microbial cells. Fundamentals of microbial growth, batch and continuous culture. Isolation and purification of Enzymes from cells. Cell Growth Measurement.	03	10%
2.	Rates and Patterns of Changes in cell cultures: Kinetics of substrate utilization, biomass and product formation in cellular cultures. Stoichiometry of growth and product formation	02	05%
3.	Functioning of Cells and Fundamental Molecular Biology: Introduction to Metabolism and bio-energetics, Photosynthesis, carbon metabolism, EMP pathway, tricarbocyclic cycle and electron transport chain, aerobic and anaerobic metabolic pathways. Synthesis and regulation of biomolecules, fundamentals of microbial genetics, role of RNA and DNA Technology. Fermentation Technology. Characteristics and classification of biological matter; Nutrient transport; Glycolysis; TCA cycle; Control of metabolism; Factors affect microbial growth; Growth kinetics; measurement of growth.	10	20%
4.	Enzyme kinetics: Simple enzyme kinetics, Enzyme reactor with simple kinetics. Inhibition of enzyme reactions. Other influences on enzyme activity. Immobilization of enzymes. Effect of mass transfer in immobilised enzyme particle systems. Industrial applications of enzymes. Cell kinetics and fermenter design: Growth cycle for batch cultivation, Stirred-tank fermenter, Multiple fermenters connected in series. Cell recycling. Structured Model. Proteins as enzymes; Michaelis-Menten kinetics; Inhibition; Effect of various parameters; Immobilized enzymes: methods and mass transfer considerations; Industrial enzymes and its applications.	07	15%

Section II			
Module	**Content**	**Hours**	**Weightage**
5.	Sensors, Instrumentation, Monitoring and control systems in Bioprocesses: Instrumentation and process control in Bioprocesses. Bio-process Technology and Genetic Engineering. Microwave heating; Transport phenomena in Bioprocess systems.	04	05%
6.	Biomass characteristics & preparation: Biomass sources and classification. Chemical composition and properties of biomass.. Aqueous wastes containing biodegradable organic matter, animal residues sugar rich materials. Microbial and biochemical aspects and operating parameters for biogas production, Kinetics and mechanism. Dry and wet fermentation, Digestors for rural application-High rate digesters for industrial waste water treatment; Bio Separation: Biomass removal; Biomass disruption; Membrane based techniques; Extraction; Adsorption and Chromatography.	08	20%
7.	Pyrolysis and thermos-chemical conversion: Thermo-chemical conversion of ligno-cellulose biomass. Incineration for safe disposal of hazardous waste, Biomass processing for liquid fuel production, Pyrolysis of biomass-pyrolysis regime.	04	10%
8.	Industrial Biotech products & Case Studies : Ethyl alcohol based on various substrates including lignocelluloses. Penicillin citric Acid, SCP, Bio-fertilizers, Baker's yeast – other modern biotech products. Bioremediation; Biocatalysts; Biofouling; Microbial Polymer and plastics; Natural resources recovery Case studies: Biotechnology in the evolution of food quality, HFCS (High fructose corn syrup) and Myco-proteins. Combustion of rice husk, Use of bagasse for cogeneration. Biochemical engineering for flavour and food production	07	15%

Text Books:

Title	**Author/s**	**Publication**
Biochemical Engineering Fundamentals, 2nd Edn.,	J. E. Bailey and D. F. Ollis	McGraw Hill, New York, 1986.
Biotechnology	M. D. Trevan, S. Boffly, K.H. Golding and P. Stanbury	Tata McGraw Publishing Company, New Delhi 1987
Biochemical Engineering	H. W. Blanch and D. S. Clark	Marcel Dekker, Inc., New York, 1996.
Bio Process Engineering: Basic concepts, 2ndEdn.	M. L. Shuler and F. Kargi	Prentice Hall of India, New Delhi, 2002.
Basic Food Microbiology	George J Banward	CBS Publishers, New Delhi, 1987
Biotechnology challenges for the flavour and food industry	Lindsay	Elsevier Applied Science, 1988

Reference Books:

Title	Author/s	Publication
Biochemical Reaction Engineering in Chemical Engineering, Vol. III, 3rd Edn.,	R.Lovitt and M.Jones Edited by J. F. Richardson and Peacock,	Pergamon, London, 1994.
Food Microbiology, 4th Edition,	William Frazier , Dennis Westhoff,	Mcgraw Hill Education, 2008.
Food Biotechnology, Volume 7,	Roger Angold, Gordon A. Beech, John Taggart,	Cambridge University Press, 1989.
An Introduction to Tropical Food Science	H.G.Muller,	C L P Edition, Cambridge, University Press, 1989.
Biotechnology and Alternative Technologies for Utilisation of Biomass or Agricultural Wastes	A. Chakraverthy	Oxford & IBH publishing Co., New Delhi, 1989
Biogas Systems: Principles and Applications	K.M.Mital	New Age International Publishers (p) Ltd., 1996
Biomass Energy Systems	P. VenkataRamana and S.N.Srinivas	Tata Energy Research Institute, New Delhi, 1996.
Biochemical Engineering	S. Aiba, A.E. Humphrey, and N.F.Mills	2nd edition, Academic Press, New York, 1973
Biochemical Engineering Fundamentals	J. E.Bailey, D.F. Ollis	2nd edition, McGraw Hill, 1986
Bioprocess Engineering: Basic concepts	M.L. Shuler & F.Kargi	Prentice Hall, 2001.
Biochemical Reactors	B. Atkinson	Pion Ltd., London, 1974
Separation for biotechnology	D. L. Pyle	Royal society of chemistry, Cambridge, 1994

Web Material Links:

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

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Test Each of 15 Marks and 1 Hour of duration or a submission of assignments
- Submission of assignment which consists of 5 Questions to be answered under each module and it carried of 10 Marks of Evaluation, Three research papers to study to be followed by the submission of the report (Industry/Laboratory visit report)
- End Semester Examination will consist of 60 Marks Exam.

Course Outcomes:

After learning the course, the students should be able to

- analyze the kinetics of cell growth and product formation in area of bio chemical
- understand models of bioprocesses and design downstream processes involved in product recovery
- identify instruments and model control systems involved in bio Chemical Engineering
- identify and familiarize with advanced technologies in bio Chemical and its processes

P P Savani University
School of Engineering

Centre for Skill Enhancement & Professional Development

Course Code: SEPD2020
Course Name: Values and Ethics

Teaching & Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)						
				Theory		Practical		Tutorial		
Theory	Practical	Tutorial	Credit	CE	ESE	CE	ESE	CE	ESE	Total
02	00	00	02	40	60	--	--	--	--	100

CE: Continuous Evaluation, ESE: End Semester Exam

Objectives of the Course:

To help learners to

- Develop a familiarity with the mechanics of values and ethics.
- Understand basic concepts of values and ethics
- Explore and understand values, ethics in context of professional , social and persona spectrum
- Explore an understand values, ethics in context of globalization and global issues
- Explore an application of values and ethics in personal, social, academic, global and professional life.
- To facilitate the learners to understand harmony at all the levels of human living and live accordingly.

Course Content:

Section I

Module	Content	Hours	Weightage
1.	**Introduction to Values** • Definition and Concept • Types of Values • Values and its Application	06	20 %
2.	**Elements and Principles of Values** • Universal & Personal Values • Social, Civic & Democratic Values • Adaptation Models & Methods of Values	06	20 %
3.	**Values and Contemporary Society** • Levels of Value Crisis • Value Crisis Management • Values in Indian Scriptures	06	20 %

Section II			
Module	**Content**	**Hours**	**Weightage**
1.	**Ethics an Ethical Values** • Definition and Concept • Acceptance and Application of Ethics • Ethical Issues and Dilemma • Universal Code of Ethics: Consequences of Violation	06	20 %
2.	**Applied Ethics** • Professional Ethics • Organizational Ethics • Ethical Leadership • Ethics in Indian Scriptures	06	20 %

Text Books:

Title	Author/s	Publication
Values and Ethics in Business and Profes-sion	By Samita Manna, Suparna Chakraborti	PHI Learning Pvt. Ltd., New Delhi, 2010

Reference Books:

Title	Author/s	Publication
Just a Job?: Communication, Ethics, and Professional life	George Cheney	Oxford University Press, 2010
Professional Ethics and Human Values	M. Govindarajan, S. Natarajan, V. S. Senthilkumar	PHI Learning Pvt. Ltd, 2013
Creating Values In Life: Personal, Mor-al, Spiritual, Family and Social Values	By Ashok Gulla	Author House, Bloomington, 2010

E-Books:

- Ethics for Everyone, Arthur Dorbin, 2009. (http://arthurdobrin.files.wordpress.com/2008/08/ethics-for-everyone.pdf)
- Values and Ethics for 21st Century, BBVA. (https://www.bbvaopenmind.com/wp-content/uploads/2013/10/Values-and-Ethics-for-the-21st-Century_BBVA.pdf)

Course Evaluation:

Theory:

- Continuous Evaluation Consist of Two Tests Each of 15 Marks and 1 Hour of duration.
- Submission of assignment which consists of 5 Questions to be answered under each module and it carries 10 Marks of Evaluation.
- End Semester Examination will consist of 60 Marks Exam.

Course Outcomes:

After learning the course, the students should be able to

- Understand and relate the concepts and mechanics of values and ethics in their life.
- Correlate the significance of value and ethical inputs in and get motivated to apply them in their life and profession.
- Realize the significance of value and ethical inputs in and get motivated to apply them in social, global and civic issues.
- Learn to apply such principles with reference to Indian Scriptures

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