Sardar Patel University

Programme- M.Sc.
(Under Choice Based Credit Scheme)
Semester- I
Structure with effect from: 2021-22
Industrial Chemistry

Course Type	Course Code	Name of Course	T/P	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total/ Passing	Total/ Passing	Total/ Passing
Core Course	PS01CICH51	Introduction to Chemical Engineering-I	T	4	3	30/12	70/28	100/40
	PS01CICH52	General Chemical Technology-I	T	4	3	30/12	70/28	100/40
	PS01CICH53	Selected Topics in Organic Chemistry	T	4	3	30/12	70/28	100/40
	PS01CICH54	Industrial Analysis-I	P	4	3	30/12	70/28	100/40
	PS01CICH55	Chemical Engineering Practical-I	P	4	3	30/12	70/28	100/40
	PS01CICH56	Comprehensive Viva-Vice	-	1	-	-	50/20	50/20
Any one Elective	PS01EICH51	Wather Pollution Control Technology	T	4	3	30/12	70/28	100/40
	PS01EICH52	Technology of Oleo Chemicals & Surfactants	T	4	3	30/12	70/28	100/40

Sardar Patel University

Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)
Syllabus with effect from the Academic Year 2021-2022
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01CICH51	Title of the Course	**Introduction to Chemical Engineering -I**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. The Objective is to be able to understand concept of entropy and equilibrium and effect of various factors on entropy and equilibrium. 2. It helps to understand the rate of various reaction. 3. It is aimed to have the knowledge of stochiometry. 4. It is aimed to study about material science including metals & alloys corrosion & corrosion resistance. 5. To study the various instruments used for temperature, pressure, vaccum, flow and level in chemical industry.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***Chemical Engineering-*** **a) Thermodynamics** Entropy, thermodynamic definition, molecular interpretation, variation of entropy with pressure, volume and temperature, Trouton's rule, Gibb's energy, (Maxwell relations) equilibrium constants and their calculation, Effect of pressure and temperature cm equilibrium, van't Hoff equation, solutions, nonideality, and partial molar properties. **b) Chemical Kinetics:** Kinetics of complex reactions (Equilibrium, Parallel, sequential with examples), Enzyme Catalysis, Kinetics, rate law, turnover number and examples	25%
2.	***Unit-II Material and energy balance:*** **a) Material balance:** Process classification, Choice of system and basis of molecular processes with chemical reactions, Material balance calculations, Multiple unit processes, Recycle and bypass **b) Energy balance:** Forms of energy, Energy balance, Energy changes in physical processes, Energy changes in reactions, Energy balance Calculations	25%
3.	***Unit-III Equipment Design:*** **a) Material of constructions:** Mechanical properties, Corrosion resistance. Plastics, Ceramics, Metals and alloys, Stainless steel, Special material for food and pharmaceutical equipment Protective coatings, Surface treatment to metals for corrosion resistance	25%

	b) Design of Vessels: Classification of chemical reactors, pressure vessels for internal or external pressure, Maintenance, Storage vessels for liquids and gases. Design of chemical reactors, Reactors with chemical addition, agitation, heating, removal of vapours, gas addition	
4.	***Unit-IV Industrial Instrumentation:*** I) Measurement of temperature, Thermo couples and pyrometers, High temperature thermometers, Optical pyrometers II) Measurement of pressure and vacuum, Manometric and Bourdon gauges, Vacuum gauges, Ionization and pirani gauges. Flow measurement, Pitot tube, Rotameters ii) Liquid level indicators. Hook Type, Sight glass, Float type, Capacitance level indicator, Radiation level indicator,	25%

Teaching Learning Methodology:-	Problem based learning is a cyclic learning process composed of many different stages, starting with asking questions and acquiring knowledge that in turn leads to more questions in a growing complexity cycle. Putting this methodology into practice does not only mean the excercise of inquiry by students but convert it into useful data and infformation. The four great advantages with the use of this methodology are. - The development of critical thinking creative skills. - The improvement of problem solving abilities. - Increased student motivation. - Better knowledge sharing in challenging situations.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Solve material and energy balance problems involved in the chemical process.
.2	Understand the constructona nd working of various equipments such as pilot tube, Rotameter for flow measurement.
	- Thermocouple, opitcal pyrometer for temperature measurement.
	- Bourdon guage, Pirani guage, Ionization guage for pressure & Vaccum measurement.
3.	Do the process and mechanical design of chemical reactors & storage vessels.
4.	Under various concepts of thermodynamics & its implementation in chemical engineering

Suggested References	
Sr. No.	**References**
1.	F. A. Henglein; Chemical technology (Pergamon)
2.	J. M. Coulson, J. F. Richardson: Chemical Engineering, Vol. I, II, III (Pergamon)
3.	R. N. Shreve: The Chemical Process Industries (MGH)
4.	W. L Badger and J. T. Bandchero: Introduction to Chemical Engineering (MGH)
5.	O. A. Hougen, R. M Watson and R. A. Ragetz: Chemical Process Principles (Vol. I, II (JW))
6.	P. H. Groggins: Unit processes in organic synthesis (MGH)
7.	A. A. Frost and R. G. Pearson: Kinetics and Mechanism
8.	P. W. Atkins and Julio de Paule: Physical Chemistry, VIIth Edn. (Ostord Union press, 2002)
9.	S, Glasstone: Textbook of Physical Chemistry, Httd Edn. (McMillan India LTD. 1996)
10.	W. J. Moore: Physical Chemistry, X1hEdn(Qrient Longmans, 1993)
11.	Thermodynamics, A core course, by R. C. Srivastava, S. K. Saha, A. K. Jain Prentice Hall of India Pvt. Ltd, 2004
12.	Industrial Instrumentation and Control by S. K. Singh Tata McGraw-Hill Publishing Company Limited, New Delhi.
13.	Chemical Kinetics by K. J. Laidler
14.	Chemical Kinetics by G. L. Agarwal

Online -resources

On-line Resources:-From time to time are many online resources, including websites, databses, e-books, bibliographies and platforms that offer educational videos, lectures on a range of topics can be suggested or displayed to the students.

Major websites used for chemcial education such as:- Swayam, e-pg Pathshala, Swayam Prabha, NDLI, E-Shodh Sindhu, NPTEL, Virtual Labs, Process Orientaiated Guided Inquiry Learning (POGIL) etc.

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Syllabus with effect from the Academic Year 2021-2022
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01CICH52	Title of the Course	**General Chemical Technology-1**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. To be able to understand the difference between unit operation and unit process in chemical industries. 2. To clarify the concept of different industrial equipment and it's technique. 3. To develop and understanding of kinetics and mechanism for nitration, sulphonation, halogenation, oxidation and esterification. 4. To be able to use the methods of nitration, sulphonation, halogenation, oxidation and esterification or synthesis of it's related compounds. 5. To give the basic concepts of the typical industrial manufacturing process like Batch and continuous process.

Course Content		
Unit	Description	Weightage* (%)
1.	***Unit-I.*** **a. Introduction to Unit Processes** **b. Nitration:** Nitrating agents, Kinetics and mechanism of nitration of aromatic compounds, Nitration of paraffinic hydrocarbons, Nitrate esters, N-nitro compounds, Process equipment. Typical industrial manufacturing processes	25%
2.	***Unit-IISulphonatiom:*** Sulphonating agents, Kinetics and mechanism. Desulphonation. Work-up procedures. Industrial equipment and technique, Batch and continuous processes, Manuiacturing processes for detergents, dye intermediates, turky red oil etc.	25%
3.	**Unit-III** **a. Halogenation:** Kinetics and mechanism Survey of methods, Catalytic chlorinatioo, photohalogenation, Manufacturing processes for chlorohenzene, BHC, Chlorinated methanes, monochloroacetic acid, chloral, Vinyl chloride **b. Oxidation:** Oxidising agents with typical applications of each. Liquid phase oxidation with oxidising compounds, Typical manufacturing processes.	25%
4.	***Unit-IV. Esterification:*** Kinetics and mechanism. Esterification of carboxylic acid derivatives, Esters by addition to unsaturated systems, Industrial esterifications, Ethyl acetate, butyl acetate, Vinyl acetate, methyl rnethacrylate, collulose acetate, xanhate and nitroglycerin.	25%

Teaching Learning Methodology:-	1. To approach the effective teaching methodology it comprises chalk-duster. Discussion, group learning, problem solving, focusing on the self-confidence among the students, team work as well as encouraging the students to critical thinking and searching. 2. The students often get an opportunity to ask questions in the middle of lecture. It should maintain a discussion pattern as well as self-learning approach.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
	At the completion of this course, students should be able to.
1.	Understand the basic concept of unit operation and unit process.
2.	Understand the reaction mechanism, kinetics and thermodynamics of unit operation.
3.	Gain knowledge about raw material agents and reaction condition required for carry out the specific unit process.
4.	Knowledge of material construction.
5.	Understand the safety and hazard criteria related to unit process.

Suggested References	
Sr. No.	**References**
1.	P. H. Groggins: Unit Processes in Organic Synthesis (MGH)
2.	F. A. Henglein: Chemical Technology (Pergamon)
3.	M. G. Rao and M. Sittings: Outlines of Chemical Technology (EWP)
4.	Clausen, Mattson: Principles of Industrial Chemistry
5.	H A. Lowenheim and M. K. Moran: Industrial Chemicals
6.	Kirk and Othmer: Encyclopedia of Chemical technology.
7.	Kent, Riegel's Industrial Chemistry (N-R).
8.	S. D. Shukla and G, N. Pandey: A Textbook of Chemical Technology, Vol-II
9.	J. K Stille: Industrial Organic Chemistry (P.I L).

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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01CICH53	Title of the Course	**Selected Topics in Organic Chemistry**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. To learn name-reactions and their mechanism. 2. To understand the role of chemical regents in the oxidation reduction and transformation of various organic functional groups. 3. Recognize and draw structural isomers, steroisomers including enantiomers and diastereomers, racemic mixture and meso compounds.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***Unit-I.*** ***a Introduction to Reaction Mechanism*** ***b. Study of the following reagents:*** Lithium diisopropylamide (LDA), Dicycloliexyl carbodiimide (DCC), Lead tetraacetate (LTA), Tributyltitihydride (TBTH), Polyphosphoric acid (PPA), Trimethyl silyl iodide (TMSI), Litliium dialkyl cuprate (LDC)	25%
2.	***Unit II*** ***Applications of following in synthesis:*** Birch reduction, Clemmensen reduction, Wolff-Kishner reduction, Sodimn borohydride (NaBLLj), Lithium aluminiimi liydridefLiAlHU), Oppenauer oxidation, MVP reduction, use of sodium and ethanol, Phase transfer catalysts, Polymeric reagents, Electro-organic synthesis, Hydroboration.	25%
3.	***Unit - II*** ***Designing of Organic Synthesis:*** Disconnection approach, Introduction to synthesis, synthetic equivalent, types of disconnections Regio-selectivity, Chemoselectivity, Protection of groups, reversal of the polarity (Umpolung), retrosynthesis involving synthesis of hydrocarbons, alkencs, alcohols, ethers, aldehydes, ketones, acids, esters, monocyclic, bicyclic compounds, examples of pharmaceuticals, agrochemicals, perfumaty chemicals, examples	25%

4.	**Unit IV** **a. Rearrangements:** Beckmann, Hofinann, Benzidine, Fries, Baeyer-Villiger, Berizilic Acid, Favorskii, Claisen, Pinacol-penacolon, Dienone-phenol **b. Stereochemistry:** Concept of chiraiity, optical isomerism. R & S- nomenclature, Resolution of racemic modifications, geometrical isomerism, E & Z- nomenclature, stereoselective synthesis	25%

Teaching Learning Methodology:-	1. The goal is to develop students self study ability by applying project teaching according to the blended learning module. 2. The learning strategies that could be incorporated in a comprehensive approach which deliver information, ideas and theories to a large number of students. 3. In the classroom we use chalk-duster method, some powerpoint presentation if need we also provide audiovisual resources in the virtual lab. 4. This method tends to increase the self-confidence among the students, increase the ability of providing and convincing.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Get oneself familiarize with useful chemical transofrmationw ith regiond chemo-selectivity using hydroboration reacion to convert olefins to variety of useful derivatives.
2.	Understand the chemistry involved in oxidation- reductions by employing numerous regents to appereciate chemo-selectivity of the regents.
3.	Understand to use chemical reagents in organic synthesis CDA, DCC, LTA, TBTH, PPA, TMS, LDC etc.
4.	To understand the concept of stereochemistry.
5.	Know about the basics of two group (x disconnection approach)
6.	Design and write the synthetic steps based on two-group (x- disconnection appraoch molecules.

Suggested References	
Sr. No.	**References**
1.	E. S. Gould: Structure and Mechanism in Organic Chemistry (Holt-Reinhart Winston)
2.	Peter Sykes: A guide book to Mechanism in Organic ChemisUy (Orient-Longman)
3.	R L. Eliel: Stereochemistry of Carbon compounds (McGraw Hill)
4.	P. S. Kalsi: Organic Stereochemistiy (Wiley Eastern)
5.	R.T. Morrison and R. N. Boyd: Organic Chemistry (Frentice Hall)
6.	HO. House: Modern Synthetic reactions (Benjamin)
7.	K. K. Carey and R, J. Sundbarg: Advanced Organic Chemistry Vol. I & II.
8.	Fieser and Fieser: Reagents for Organic Synthesis (J.W.)
9.	R. E. Ireland: Organic Synthesis (Prentice Hall)
10.	R. Adams: Organic Reactions : Various volumes ll.S. Warren: Designing Organic Synthesis
12.	J. Fuhrhop and G. Penzlin: Organic Synthesis (VCH)
13.	J. March: Advanced Organic Chemistry

Online -resources

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Syllabus with effect from the Academic Year 2021-2022
M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01EICH51	Title of the Course	**Water Pollution Control Technology**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Aim is to clear concepts of water quantity demand of water and water with different aspects. 2. Able to understand different source of water. 3. Different methods of water treatment are studies. 4. To understand the requirement of minimization of westage of water.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Water quantity:** water and its properties, necessity of water, water demand, factors affecting water demand, population forecast by different methods. Water quality: sampling, sample preservation, physical characteristics, chemical characteristics and biological characteristics, drinking water standards, pathogens and disease, nuisance organisms	25%
2.	**Supply of water:** sources of water and their characteristics: water from precipitation, surface water, ground water & saline intrusion. Sewerage collection and distribution system (types of sewer, types of traps, types of sewerage system etc.)	25%
3.	**Water treatment:** Basic of unit operations: Aeration, limitation of aeration, types of aerators, chemical handling and feeding, coagulation and flocculation, rapid mixing, slow mixing, filtration slow sand, rapid sand pressure. Disinfection: criteria for good disinfection, factors affecting efficiency of disinfection. Chlorination: chlorine chemistry, chloiination practices in India. Introduction to advanced water treatments: Ion exchange, water softening, membrane technology, control of colour, odour, taste	25%
4.	**Waste water minimization** by different methods: Recycle, reuse, process modification, product/raw material substitutions, technology change etc. Water conversion by pinch technology	25%

Teaching Learning Methodology:-	1. The students are given activity or tasks and engages studnets to learn through this way. Hence it is an activity based or commission based studnets are offered or asked to take part in classroom interaction through these interactive activities. 2. One characteristic defines the modern teaching method by very interactive the teacher asks the students to form small group or work as individuals to perform the learning tasks and come up with the desired results.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	It includes importance to reduce demands of water and studyof water with different aspects.
2.	Study of different source of water and distribution system.
3.	Invovles different water treatment to get usable water.
4.	Understand different gestures to make minimum wastage of water.

Suggested References	
Sr. No.	**References**
1.	Water supply and sanitary engineering ,G. S. Birdie & J. S. BirdieDhanpatiypub.Co. Ltd.
2.	Ground water assessment and management.K. R. Karanath,TataMc Graw hill
3.	Advance in waste water treatment tech.vol - 2,R. K. Trivedy& N. S. Roman Globalscieuce
4.	Sewage disposal and air pollution engineering volume - 2 ,Garg S. K.
5.	Water supply engineering volume - 1 ,Garg S. K.
6.	Environmental Engineering, Howard Peavy

Online -resources

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Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01EICH52	Title of the Course	**Technology of oleo chemicals & surfactants**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Study of oil and its constituion of vegetable oil and its analysis. 2. Oil chemical are introduced. 3. Able to understand chemistr of fatty acid provide information of Application of oil chemicals to be able to understand. 4. To be able to understand classification and proporties of surfactants.

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to Oils, The constitution of vegetable oils and other components in vegetable oils, Constitution of fatty acids, Chemical properties of oils, Analysis of Oils, Refining of Oils Introduction to Oleochemicals, Overview of basic oleochemicals: Fatty acids, Fatty esters, Fatty alcohols, Fatty amines & Nitriles, Glycerol, Dibasic acid, Dirner acid	25%
2.	Chemistry of fatty acids, Technology of fat splitting & hydrolysis, Separation of fatty acids, Fatty acid distillation, Fractionation of fatty acids, Fatty Alcohols, Fatty acid methyl esters, Fatty amines.	25%
3.	Applications of Oleochemicals as: Bio fuels , Agrochemicals and lubricants	25%
4.	Introduction to Surfactants, Classification, Physicochemical properties of surfactants, practical importance , of surfactants in various fields, manufacturing technology of various industrial surfactants.	25%

Teaching Learning Methodology:-	1. Real life scenarios that invovle case studiesand ways of analyzing current problem peer to peer teaching, which involves students in their own education. Hands- on activities that engage students beyod the lecture and teach useful scientific concepts. Science project, which teach the scientific method of inquiry and experiment. Field research journals which are notes and other documentation of trusted science experiment or from the students in your classroom.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Understand different components & proprorties of oil & different oil chemicals we studied.
2.	Technology of fat splitting and fractionation of fat.
3.	Understand the application of Bio Fuel.
4.	Understand importance of surfactant in various field.

Suggested References	
Sr. No.	**References**
1.	Treatise on Fats, Fatty acids &01eochemicais (vol.l & 2), Edited by O. P. Narulla, Published by: Industrial Consultants(India), New Delhi.
2.	Oleocheniical manufacture and Applications, Edited by Frank D. Gunstone& Richard J. Hamilton, Published by: Sheffield Academic Press, England.
3.	Handbook of Surfactants by Porter, Mc graw Hill Publishers
4.	Chemistry and Technology of Surfactants, Edited by, Richard J. Farn, Blackwell Publishing.
5.	Surface coatings: Raw materials and then usage(Vol 1), Chapman and Hall publishers, London
6.	Manufacture of Soaps, detergents and glycerine, Edgar, Norwood Pub.
7.	Soaps and Detergents, By K S Parsuram, Tata McGraw Hill Pub.
8.	Soaps their chemistry and Technology, J G Kane, Indian Central Oil seeds Co., Hyderabad.

Online -resources

On-line Resources:-From time to time are many online resources, including websites, databses, e-books, bibliographies and platforms that offer educational videos, lectures on a range of topics can be suggested or displayed to the students.

Major websites used for chemcial education such as:- Swayam, e-pg Pathshala, Swayam Prabha, NDLI, E-Shodh Sindhu, NPTEL, Virtual Labs, Process Orientaiated Guided Inquiry Learning (POGIL) etc.

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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01CICH54 & PS01CICH55	Title of the Course	**Practical**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Synthesis and quantitative analysis of organic and inorganic compounds. 2. Students are trained for the sampling, sample preparation and its standardization. 3. Describe how to use industrial equipments like Rotameter, Orifice meter etc. 4. Identification and quantitative analysis of alloy and ore. 5. The student supervised opportunities to experience the essential practical tasks emphasised in their professional study.

Course Code	PS01CICH54	Title of the Course	***Industrial Analysis-I***
Total Credits of the Course	4	Hours Per Week	4

Course Content	
Unit	Description
	Industrial Analysis-I
1.	Preparation of Methly Orange from sulphanilic acid (Diazotization & Coupling)
2.	Preparation of P-Bromoanline from acetanlide (Halogenation)
3.	P. Bromonitrobenzene from Bromobenze (NItration)
4.	Preparation of 1,25 Tribromobenzen from Anline (Bromination)
5.	Preparation of 2, 4, 6- Tribromophene from phenol (Bromination)
6.	Prepration of picric acid from phenol (Nitration)
7.	Preparation of m-nitroniline from Nitrobenzene (Nitration & Selective Reduction)
8.	Preparation of P-Idonitrobenzene from p- nitroniline (Sand- mayer Reaction)
9.	Preparation of Terephthalic acid from p-xylene (Oxidation)
10.	Preparation of 2,5 dimethyl - benzene Sulfonic acid (Sulphonation)
11.	Benzalacetophenone from acetophenone (Claisen-schmidt reaction)
12.	Benzanilide from benzophenene oxime (Beckmann rearrangement)

Course Code	PS01CICH55	Title of the Course	***Chemical Engineering***
Total Credits of the Course	4	Hours Per Week	4

Course Content	
Unit	Description
	Chemical Engineering
1.	Determine of molecular weight of a polymer by using ostwald's viscometer.
2.	Determination of Dissociation constant of weak Acid using pH- Meter.
3.	To determine the conc^{n} of strong Acid and weak acid in a mixture by a

	conductometric titation using a strong base.
4.	To determine Hardness of water sample by EDTA method.
5.	Determination of Alkdinity in given water sample by volumetric method.
6.	Electrolysis of Aqucous Sol^{n}
7.	Flow measurement:- Rotameter.
8.	Orifice meter/ Venturic meter
9.	Alloy Solder
10.	Alloy Brass/ Bronze
11.	Determination of the amount of iron in an iron are sol^{n} by $KMnO_4$.
12.	Deterimanation of dissolved oxygen in the given sample of water.

Teaching Learning Methodology:-	1. We have forged over the last few years traditional and some of the innovative approaches as teaching learning methodologies such as:- Direct instruction and performance of experiments in the laboratory.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R. 6.8.3)	30%
2.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Synthesize different dye and drug molecules.
2.	Perform different types of chemical reaction like Bromination, Nitration, diazocoupling, sulphonation, oxidation and partial Reduction.
3.	Analyze water sample.
4.	Determine percentage of metal ion using complexometric titration.

Suggested References	
Sr. No.	**References**
1.	Text book of Chemistry Analsysis A.I vogel
2.	Elementary practical organic chemistry (Part-1 to 3) By A.I. Vogel.
3.	Water Quality- An Introduction Second edition, Calude E. Boyad.
4.	Advanced Practical Inorganic chemistry Gurdeep Raj Goel Publising Huouse, Meerut.
5.	Instrumental Method of AnalysisBy Gurdeep Chatwal and Anand Edition- 2018 by Himalya Publishing
6.	Industrial Instrumentation and Control by S.K. Singh Tata McGraw Hill Publishing Company Limited, New Delhi.
7.	Online Resources to be used if available as reference material- (Same)
8.	Soaps their chemistry and Technology, J G Kane, Indian Central Oil seeds Co., Hyderabad.

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M.Sc. Industrial Chemistry, Semester-I

Course Code	PS01CICH56	Title of the Course	**Comprehensive Viva**
Total Credits of the Course	1	Hours Per Week	1

Course Objectives:	1. To assess the overall knowledge of the student in the relevant subjects covered in core as well as elective courses.

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Sardar Patel University

Programme- M.Sc.
(Under Choice Based Credit Scheme)
Semester- II
Structure with effect from: 2021-22
M.Sc. Industrial Chemistry

Course Type	Course Code	Name of Course	T/P	Credit	Exam Duration in hrs	Component of Marks		
						Internal	External	Total
						Total/ Passing	Total/ Passing	Total/ Passing
Core Course	PS02CICH51	Polymers	T	4	3	30/12	70/28	100/40
	PS02CICH52	Chemistry in Industrial Process-II	T	4	3	30/12	70/28	100/40
	PS02CICH53	Common Chemicals in Industires	T	4	3	30/12	70/28	100/40
	PS02CICH54	Industrial Analysis-II	P	4	3	30/12	70/28	100/40
	PS02CICH55	Chemical Engineering Practicals-II	P	4	3	30/12	70/28	100/40
	PS02CICH56	Comprehensive Viva-Voce	-	1	-	-	50/20	50/20
Any one Elective	PS02EICH51	Modern Instrumental Methods of Analysis	T	4	3	30/12	70/28	100/40
	PS02EICH52	Environment, Health and Safety Measures	T	4	3	30/12	70/28	100/40

Sardar Patel University

Vallabh Vidyanagar, Gujarat

(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)

Syllabus with effect from the Academic Year 2021-2022

Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02CICH51	Title of the Course	**Polymers**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Provide the students with fundamental principles of polymers, classification, preparation, structure and properties. 2. Provide students with an opportunity to identify different types of polymers in our surrounding. 3. The students will be able to differentiate between natural and man-made polymers, explain polymerization methdos, and understand polymerization kinetics and uses of polymers. 4. To study the fundamental concepts of polymer chemistry.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***Unit-1*** Brief history of inacromolecular science General characteristics of polymers in comparison with organic compound, Nomenclature, Distinction between plastics, Elastomers, Fibres and liquid resins, classification of polymers. **TYPES OF POLYMERS AND POLYMERISATION:** Homoplastics and thermosetting, funnctionality concept, Concept of cross-linking-linear, Branched and cross-linked polymers. Addition, Condensation, Ionic, Co-ordination, Addition-Polymerieation Mechanism (Initiation, propagation and termination processes), Initiators, Inhibitors, Mechanism of Ionic polymerization. **METHODE OF POLYMERISATION:** Bulk, Suspension, Emulsion, Solution. Necessity of co-polymers and co-polymerization, blocks and grapht co-polymers.	25%
2.	***Unit- II*** Molecular weight and molecular weight distribution-number, weight and Viscosity average molecular weights of polymers, Methods of determining, Molecular weight. **PROPERTIES OF POLYMERS:** Viscosity, Solubility, Optical, Electrical, Thermal and mechanical properties of polymers. **POLYMER PROCESSING:** Compression, Moulding, causting, Extrusion, Fibre spinning, Injection moulding, Thermoforming, Vulcanisation of elastomers.	25%
3.	***Unit- III*** Introduction, concepts of kinetics of polymerization and car other's relation, Glassy state, Glass transition temperature, TGA, Factor's affecting GTT, Ciystallinity in polymers.Degradation of polymers by thermal, oxidative, Mechanical and chemical methods. Detailed study of the fallowing thermosetting polymers with respect to synthesis, Chemistry properties and applications:	25%

	(i) Phenol formaldehyde resins. (ii) Amino resins- urea-formaldehyde and molomine-formaldehyde reaction, polyurethanes. (iii) Epoxy resins -gr ades of epoxy resins, curing process and its importance with mechanism. (iv) Polycarbonates and silicones. (v) Elastomers- polyisoprene, Polybutadiene, Neoprene.	
4.	***UNIT- IV*** Detailed study of the following thermoplastic polymers with respect to synthesis, chemistry, properties and applications: (i) Polyolefms- Polyethylenes, Polypropylene, Ethylene-Propylene Copolymers. (ii) Polyvinyl Chlorides- Grades of PVC, Teflon, Polyvinyl acetates and polyacetals. (iii) Polyestyrene- Homopolyners, copolymers such as SBR, ABS, SAN. (iv) Polyamines- Nylon-6, Nylon-66 and other Nylons. (v) Polyethers and polyesters- Terephthatates, Crown ethers. (vi) Cellulosics such as esters, ethers, acetates, butyrates, nitrates, CMC Regenerated celluloses.	25%

Teaching Learning Methodology:-	The presence of faculty members to provide advice, academic advice and academic guidance to the student in need within the six hours a week available to all students. The course consists of classroom lessons, the resolution of numerical example relating to the issues addressed and discussions with students. Video projection of the lessons is used in classroom. The students are also able to obtain directly the above material form the Department/ Univeristy/ Digital Library Service.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Explain the step-growth and chain-growth polymerization with respect to synthesis mechanisms and kinetics.
.2	Explain the cystalline melting temperature and glass transition temperature including the influence of kinetics.
3.	Explain the flow properties of polymer melts and polymer solutions with respect to both temperature and Mol. Wt.
4.	Distinguish between enthalpic and entropic contributions to polymer cystalization and evaluate factor such as polymer structure, Molecular weight, branching and dilution on cystallinity.

Suggested References	
Sr. No.	**References**
1.	"Heterocyclic Chemistry" Vol, 1-3 R.R. Gupta, M. Kuinar and V. Gupta, Springer, Verlag
2.	The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3.	Heterocyclic chemistry, J.A. Joule, K. Mills and G.F.Smith, Chapman and Hall.
4.	Heterocyclic chemistry, T.L. Gilchrist, Longmane Scientific Technical
5.	Contemporary Heterocyclic chemistry. G.R. Newkome and W.W. Poaudler, Wiley-Inter Science.
6.	An Introduction to the Heterocyclic Compounds, R.M. Acheson, John Wiley.
7.	Comprehensive Heterocyclic Chemistry, A. R. Katritzky and C.W. rees. Eds. Pergamon Press.

Online -resources

On-line Resources:-From time to time are many online resources, including websites, databses, e-books, bibliographies and platforms that offer educational videos, lectures on a range of topics can be suggested or displayed to the students.

Major websites used for chemcial education such as:- Swayam, e-pg Pathshala, Swayam Prabha, NDLI, E-Shodh Sindhu, NPTEL, Virtual Labs, Process Orientaiated Guided Inquiry Learning (POGIL) etc.

Sardar Patel University

Vallabh Vidyanagar, Gujarat
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Syllabus with effect from the Academic Year 2021-2022
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02CICH52	Title of the Course	**Chemistry in Industrial Process-II**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. The objective of this course is to introduce the basic concept of chemical engineering to students. 2. To introduce the concepts of mass transfer operations like distination, drying, leadhing, extroction, cystalization & gas absorption to students. 3. To make them understand about heat transfer operations carried out in chemical industry.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***Unit -I*** **Distillation:** Boiling and distillation, vapor-liquid equilibria, Rault's law & Henry's law, relative volatility, azeotropic mixtures, flash distillation, steam distillation, vacuum distillation, fractional distillation, plate columns (Bubble cap, Sieve plate & Valve plate). **Extractions:** Liquid equilibria, Extraction with reflux, Extraction with agitation, equipment, it's use and performance, continuous contact equipment, agitator extractors, packed spray extractors, Leaching, flow sheets of solid-liquid extraction, continuous leaching, counter current extraction.	25%
2.	***Unit -II*** **Filtration:** Classification of filters, Sand filters, filter press, plates & frame press, filter aids, principles of leaf filters. **Flow of Heat:** Introduction, Conduction (Fourier law, Thermal conductivity, thermal insulation & problems), Convection (rate of heat transfer and heat transfer coefficients), Radiation (Absorptive, Reflectivity, & Transmissivity, Kirchoff s law concept of black body & examples) Heat Exchange Equipments: Introduction, Double Pipe, Shell& tube, Fixed tube, U tube heat exchangers.	25%
3.	**Unit -III** **Crystallization:** Growth of Crystal, saturation, nucleation supersaturation, (Mier's theory), Caking of crystals, effect of impurities, Classification of ciystallizers, Agitated tank, Swenson walkers, Kiystal, Oslo, continuous vaccum crystallizers. **Drying:** General Principles (Significance, moisture content), Rate of drying (Constant & falling rate period, factors affecting drying), Drying equipments, Tray diyers, Rotary dryers, Single Drum diyer & Spray dryers.	25%
4.	***Unit IV*** **Evaporation:** Types of evaporators, jacketed, horizontal and vertical tube evaporators, forced circulation evaporations, enttainment separators	25%

	(upturned, deflector type, tangential type), effect of scale formation, multiple effect evaporators. ***Gas Absorption:*** Definition, examples, comparison of absorption and distillation, conditions of liquid- gas equilibrium, solution criteria for gas absorption, mechanically agitated vessels. Packed columns, and plate columns, (Characteristics of tower packing, Types of packing) merits of plate & packed tower.	

Teaching Learning Methodology:-	Design thinking applied stems from industrial designers and their unique method to solve problems and satisfy the needs of their clients. Applied to education this model makes possible to identify with greater accuracy the individual problems of each studnet and generate in their educational experience the creation and innovation towards the satisfaction of others which then become symbiotic.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage**
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Understand the construction and working of various equipments used for distillation, gas absorption, vaporation, drying, crytalization, extraction and leaching.
.2	Analyse various mass transfer systems.
3.	Design common heat exchanges like shell & tube heat exchanger, double pipe heat exchanges with design parameters.
4.	Understand the three modes of heat transfer.
5.	Understand filtration operation that is carried out in chemical industry.

Suggested References	
Sr. No.	**References**
1.	F. A. Henglein: Chemical Technology (Pergamon).
2.	J. M. Coulson, J. F. Richardson: Chemical Engineering, Vol. I, II, IE (Pergamon).
3.	R.N. Shrove: The Chemical Process Industries (MGH).
4.	WX. Badger and J.T. Bandchero: Introduction to Chemical Engineering (MGH).
5.	A. Hougen, K.M. Watson andRA. Ragetz: Chemical Process Principles, Vol. I, II (JW).
6.	P.H. Groggins: Unit Processes in Organic Synthesis (MGH)
7.	G.H. Morrison & H. Freiser: Solvent extraction in Analytical Chemistry (John Wiley)
8.	K.A. Gavhane: Unit operations II (Nirali Prakashan, Pune)

Online -resources

On-line Resources:-From time to time are many online resources, including websites, databses, e-books, bibliographies and platforms that offer educational videos, lectures on a range of topics can be suggested or displayed to the students.

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Syllabus with effect from the Academic Year 2021-2022
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02CICH53	Title of the Course	**Common Chemicals in Industries**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Imparting knowledge and technical skills for better processing and value adition of Food and Agro-products. 2. Cultivating strong ethical values for sustainable modern and safe food to society. 3. To make the students understand chemistry various intermediates used for chemical industry in general and Dyestuff industry in particular. 4. To make them undersand the unit process and their relevance in chemical industries.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***Unit-I:*** **Dairy Chemistry:** Milk and milk products, composition and structure of milk, milk proteins, enzymes, vitamins, minerals, density and viscosity of milk, effect of heat on milk, milk processing, basic milk categories, butter, ghee and clarified butter- **Leather Chemistry:** Introduction, constituents of animal skin, manufacture and preparation of hides, cleaning, soaking, limiting and degreasing, finishing and sharing, tanning; leather, vegetable, chrome, tanning effluents; pollution and control. **Phosphorus industries:** Calcium phosphate, manufacture of phosphoric acid, single and triple superphosphate, baking powder and DAP. **Sulphur and Sulphuric acid:** Mining and manufacture of sulphur and manufacture of sulphuric acid by contact process. **Nitrogen Industries:** Manufacture of Urea, calcium cyanamide, ammonium nitrate, nitric acid.	25%
2.	***Unit-II*** ***Dyes and Pigments:*** Classification of Dyes, Methods of preparation of commercial dyes of different classes with suitable examples. Typical manufacturing processes of few dyes, Fluorescent brightening agents, Photosensitive dyes, dyes as food additives, natural dyes. Oils, Soaps and Detergents: Refining of edible oils, Manufacturin g of soaps, Detergents, Liquid Soaps. Manufacturing of fatty Acids and glycerol, greases from fatty acids, turkey -red oil ***Soil Chemistry:*** Introduction, formation, classification and reactions of soil, soil acidity, alkalinity, productivity and fertility, chemical fertilizers and then effect, organic manures, micronutrients, bio-fertilizers.	25%
3.	***Unit-III*** **Food Chemistry:** Classification, chemical composition and nutritional value of common food stuffs, properties of foods, food preservation and processing, food deterioration, methods of preservation and processing by	25%

	heat, cold, chill storage, deep freezing, drying, concentration, fermentation, and radiation, Food quality; senoiy evaluation, objective methods, non-nutritional constituents and food safety. Permitted food additives and their role; Antioxidants, coluring agents, flavours, emulsifiers, curating agents, non-curative sweeteners, flour improvers, leavening agents, stabilizers, thicckners and preservatives. **Glass and Refractory materials:** Raw materials, Soda glass, borosilicate glass, Lead Glass, Colored Glass, Refractory: Raw materials, clay pots, Zeolites.	
4.	***Unit-IV*** ***Agrochemicals:*** **Organophosphorus pesticides:** Malathion, Monoerotophos, dimethoate, chloropyriphos, Dichlorpyriphos, Dichlororous, phentlioate. **Carabamates:** Carbonyl, Bygon, Zirman, Zineb, Maneb, Alaicarb. **Pyrenthroids:** Natural pyrenthrins, Isolation and structures, synthetic Pyrethroids; Allethrin, cypennethriiL Phenvalerate. **Insect Pheromones and Repellants:** Pheromones, general introduction and applications in integrated pest management (No Synthesis). **Repellents: Survey and synthesis of the repellents:** N,N, Diethyl - 3methyl- Benzamide, N,N-Diethyltohiamide, 2 - Ethyl -1,6- hexanedial, Butopytranexyl, Dimethylcabonate, Dhnethylteiphthalate, Use Pheromones in pest management.	25%

Teaching Learning Methodology:-	The development of skills in problem solving, critical thinking and analytical reasoning as applied to scientific problms. Syllabus includes classroom teaching, e-resources, demonstration discussion, group learning, focusing on the self-confidence among the students, brain storming or combination of all. It is used to stimulate students in reflection and help them improvement of technical skills and social relations.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Students will learn about shelf life of different dairy products.
.2	Understand the important industrial process for surfactnat.
3.	Understand the importance of vegetable and animal fats and oil as renewable source of chemicals.
4.	Understand the basic rules of glas formation, chemical compopsition of glass and the process steps.
5.	Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.

Suggested References	
Sr. No.	**References**
1.	N.N. Melnikow: Chemisfty of Pesticides, Springer
2.	M. B. Green, G. S. Hartley West: Chemicals for Crop Protection and Pest Management, Pergamon.
3.	R. Cremlyn: Pesticides
4.	K.H. Buchel: ChemisUy of Pesticides.
5.	H.B. Scher: Advances in pesticides formulation Technology (ACS)
6.	K. Venkatraman: The Chemistiy of Synthetic Dyes Vol. 1-7 (A.P)
7.	Abranart: Dyes and Their intermediates (Pergainan).
8.	Beech: Fiber reactive Dyes (Logos Press).
9.	Frig and David - Dyes intermediate.
10.	Allan: Color Chemistry
11.	Kent-Riegels: Industries Chemistry.
12.	M Ash & I Ash: A formulaiy of paints & other coatings.
13.	L. W. Aurand, A. E. Woods, Food Chemistiy, AVI Publishing Inc.
14.	L. H. Mayer, Food ChemisUy, Affiliated East-West Press Ltd., New Delhi.
15.	N. Shakuntala Manay, M. Shadakhsara Swamy, Foods-Facts and Principles.
16.	JohnM. deMan, Principles of Food Chemistiy.
17.	F A Henglein: Chemical Technology (pergamon).
18.	R.W. Thomas and P. Farago: Industrial Chemistry (HEB).
19.	K. Bhogavathi Somdavi: Applied ChemisUy, MJP Publications, 2006.
20.	C.K. Sharma: Industrial Chemistry, Goel Publishing House, Meemt, 2011

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Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02EICH51	Title of the Course	**Modern Instrumental Methods of Analysis**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. It helps to understand the concept of errors and types of errors and also help to evaluate data without error. 2. Study of electircal activity of chemical compound through Polarography technique. 3. Concepts of thermogravimetric analysis, differential scanning and thermal scanning are covered. 4. Clear the Fundamental of chromatography, HPLC, GEL permeation chromatography and Ion exchange chromatography.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***Unit-I*** **Errors and Evaluation:** Definition of terms mean and median, precision, standard deviation, relative standard deviation, accuracy, absolute error, relative error, types of error in experimental data, determinate (systematic), indeterminate (random) and gross, sources of errors and their effects upon the analytical results, statistical evaluation of data-nonnal distribution, interval estimation, methods of least squares.	25%
2.	***Unit-II*** ***Polarographic Techniques and Voltammetry:*** Polarography; Theory, Instrumentation mid itn working; Advantages of using dropping mercury electrode, Derivation of Ilkovic equation, Factor* iiffecling the limiting current, The half wave potential, Criterion of reversibility, Applications of polarography, Square-wave polarography, Differential pulse polarography and cyclic voltammetry showing cyclic voitmiimetric excitation.	25%
3.	***Unit-III*** **Thermal Methods:** Thennogravimetric analysis, Instrumentation and Applications, Diftbrcntml thermal analysis, General principles and applications with special reference to polymers; DUTorential scanning calorimetiy, Theory and different types of thermal scanning calorimetry, Instruments, Power compensated DSC instrument, Heat flux DSC instrument and modulated DSC instrument, SC data analysis and applications.	25%
4.	***Unit-TV*** **Chromatography:** Chromatographic mechanism, Classification of chromatography, ptitioipleH, typos, techniques of colnmn chromatography and techniques of elution, dun layer chrwnatogniplіy, Gas chromatography, Applications of gel permeation and ion exchange chromatography. Introduction of 11 PLC, instrumentation, reverse phase HPLC, industrial applications of HPLC..	25%

Teaching Learning Methodology:-	The study activities are supposed to be spread over the period which gives significant results. Students are encouraged to do distributed practice in which they learn the subject throughout the term. Some brainstorming sessions are included in the classroom. E-learning is also included so that students can imagine the instruments properly.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Able to conclude chemical evaluation without error.
2.	Easily compute electrical activity of chemical compound using polarographic technique.
3.	One can easily conclude data analysis through thermal gravimetric method.
4.	Will have complete theoretical knowledge of chromatography and HPLC.

Suggested References	
Sr. No.	**References**
1.	Fundamentals of Analytical chemistiy, Douglas A, Skoog, Donald M. West, F. JamoH Holler, 7th edition, Harcourt college publications.
2.	Principles and practice of analytical chemistry, F. W. Fifteid, D. Keatey, 5 ih edition, Blackwull publication.
3.	Analytical chemistry, Gary D. Christian, 6thedition, Wiley and sons publication.
4.	Handbook of instrumental techniques for analytical chemistry, Frank A Settle, Prentice I lall Publication. Analytical chemistiy- Instrumental Techniques (Vol II) - Mahindu Singh, Dominant publishers.
5.	Basic concepts of analytical chemistry, S. M. Kopper, New Age International Publishers
6.	Analytical chemistry, D. Kealey, PJ.Haines, Viva books Pvt Ltd.

Online -resources

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M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02EICH52	Title of the Course	**Environment, Health and Safety Measures**
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Demonstrate knowledge of chemical and biochemical principles of fundamental environmental processes in air, water etc. 2. To recognize different types of toxic subcutaneous & responses and analyze toxicological information. 3. To Apply basic chemical concepts to analyze chemical processes involved in different environmental problems. 4. To describe water purification and waste treatment processes and the practical chemistry inovlved. 5. To make the students aware about GLP for understanding of uniformity, consistency, reliability, reproducibility, quality and integrity of chemical non-clinical safety tests, from physio-chemical properties through acute to chronic toxicity tests.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	***UNIT I:*** **Air Pollution, Analysis & Control Methods:** Qualitative study of environmental segments, air pollutants, prevention & control, Green house gases & acid rain. Carbon monoxide, industrial sources & tranportation sources. SOx-sources, control techniques-scrubbing, limestone injection process. Ozone hole & CFCs.Photochemical smog & PAN. NOx -Sources, NO*,control techniques. Particulates: Size distribution, particulate collection-settling chambers, centrifugal separators, wet scrubbers, electrostatic precipitators & fabric filters. Analysis of air pollutants, Dispersion of air pollutants-weather, wind speed and acidity	25%
2.	***UNIT II:*** **Water, Waste Water Treatment and Analysis:** Hydrologic cycle, sources, criteria & standards of water quality- safe drinking water, maximum contamination levels of inorganic & organic chemicals, radiological contaminants, turbidity, microbial contaminants. Public health significance & measurement of colour, turbidity, total solids, acidity, fluoride, alkalinity, hardness, chloride, residual chlorine, sulphate, fluoride, phosphate 8l different forms of nitrogen in natural & polluted water.	25%
3.	***UNIT III:*** **Quality Control and Quality Assurance:** Role, Government standards like ISI, MINAS, Agmark, I.P., ASTM. Concepts of quality and quality control, the nature of variabilities. Specification and tolerances, sampling inspection, cost reduction and quality improvement experiments. Optimization. Basic concepts of quality assurance, quality acceptance, sampling,	25%

	reliability, cost aspects of quality decisions. Quality control in raw materials, production (in process) and finished product, Current trends in quality control, ISO 9000 and ISO 14000 series. Laws related to quality control. ISO 17025. **Chemical Warfare Convention:** Definitions and schedules. Toxic chemicals, remote control systems, tear gas, chemical weapons, ocean dumping of chemical weapons.	
4.	***UNIT -IV:*** ***Good Laboratory Practices:*** Safety equipments, personal protective equipments, compressed gas safety, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals. Emergency response-Chemical spills, radiation spills, biohazard spills, leaking compressed gas cylinders, fires, medical emergency accident reporting.Safety rulesof laboratory acquaintance of experimental set up and instruments, intellectual property and intellectual property rights. Data management, importance of safety and security of data.	25%

Teaching Learning Methodology:-	It is a teaching strategy generally adopted to promote team-work and develop critical thinking, analytical abilities and positive attitude among learners. The environmental issues to be discussed by the students could be presented through slide shows or explain by teacher. The syllabus is designed on the method of acquisition of knowledge on the development of skills and the establishment of work habits as their main goals.

Evaluation Pattern		
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1.	Internal Written/ Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Have knowledge of key themes, theories and problems and describe important chemical reactions in connection with smog formation ozone chemistry and acid rain chemistry.
2.	Studnets able to know about air pollution and its effects group and scale air pollution sources, plan measurement and monitoring of air pollutatnts.
3.	Students are familiar with application of safety in good laboratory and field practices.
4.	To make aware about the concepts and requirements necessary for compliance with good laboratory practice. (GLP)
5.	To understand the principles of GLP and it's regularity basis, and provide guiodeliness & better control for maintanance of instruments, environment control, preservation of test records etc.

Suggested References	
Sr. No.	**References**
1.	Environmental Chemistry, A.K. Dey, Wiley Eastern.
2.	Environmental Chemistry, S.K.Baneqi, Prentice Hall India, 1993.
3.	Chemistry of Water Treatment, S.D. Faust and O.M. Aly, Butterworths,1983,
4.	Environmental chemistry, Ahluwalia V K, Anne Books India, 2008.
5.	Chemistry for Environmental Engineering, Sawver and McCarty, McGraw Hill, 1978,
6.	Evnironmental Chemistry, I Williams, John Wiley, 2001.
7.	Staistical Quality Control, 2nd Edn., Manohar Mahajan Dampat Rai and Sons. 1995.
8.	Quality Management Process improvement approach, Fryman Mark A, Cengage Larning, 2002.
9.	Quality Control, Paranthaman D, Tata, McGraw Hill, 1987.
10.	Gupta R.N. Chmecial Warfare and Causility management 2011.
11.	Vyas M.N. Safety and Hazards Managemnet in Chemical Industries 2013. Atlantic Publication.
12.	Dikshith T.S.S. Safety Evaluation of Environment Chemicals. New Age International, 1996.
13.	Chemical Safety Matters- IUPAC - IPCS, Cambridge Univ. Press, 1992.

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Sardar Patel University

Vallabh Vidyanagar, Gujarat

(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)

Syllabus with effect from the Academic Year 2021-2022

Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02CICH54 & PS02CICH55	Title of the Course	**Practicals**

Course Objectives:	1. Introduce students to the practical application of polymers. 2. Introduction of heat-transfer concepts and mass-transfer cocnepts to students. 3. Introduction about chemistry fundamentals involved in dairy industry to the students. 4. The students will be exposed to and will apply the basic principles involved in the study of critical micelle concentrations (CMC) and surface active parameters of surfactants by surface tension method. 5. Introduction of the quantities involved in water analysis.

Course Code	PS02CICH54	Title of the Course	**Industrial Analysis-II**
Total Credits of the Course	4	Hours Per Week	4

Course Content		
Unit	Description	
1.	***Industrial Analysis -II*** 1. Determination of fat in Milk by Gerber method. 2. Detection of Adulterants in Milk by odified Seliwanoffs method. 3. Detection of Sodium Chloride in Milk. 4. Turbidity test for checking Efficiency of Sterilization in liquid milk. 5. Determination of CO3 and HCO3 in water. 6. Determination of the CMC and Surface active parameters of surfactoants by Surface tension method. 7. To deterime the chloride content of give water sample. 8. Interfacial polycondensation of PA using hexymethylenediamine and Sebacic acid chloride 9. Synthesis of Isotactic PMMA (Polymethy / Methacrylate) 10. Synthesis of Syndiotactice Polymethyl Methacrylate (PMMA)	

Course Code	PS02CICH55	Title of the Course	**Chemical Engineering Practical - II**
Total Credits of the Course	4	Hours Per Week	4

Chemical Engineering Practical - II

1. Single stage teaching
2. Multistage teaching
3. Single stage extraction.
4. Humidifiction.
5. Drying
6. Batch distillation
7. Steam distillation
8. Multicomponent distilation
9. Filtration

Teaching Learning Methodology:-	It is a teaching strategy generally adopted to promote team-work and develop critical thinking, analytical abilities and positive attitude among learns. The environmental issues to be discussed by the students could be presented through slide shows or explain by teacher. The syllabus is designed on the method of acquisition of knowledge on the development of skills and the establishment of work habits as their main goals.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Practical Examination (As per CBCS R. 6.8.3)	30%
2.	University Examination	70%

Course Outcomes: having completed this course, the learner will be able to	
1.	Demonstrate an ability to quickly acquire knowledge in new polymerrelated applications and to acquire new knowledge for the innovation and development of polymer materials and related process also with respect to sustainability considerations.
2.	Learning about basic concept of design in dairy plant in milk and other products.
3.	Current awareness of quality and safety of dairy farm.
4.	Students would get the knowledge about teaching, filtration, distilation and Extraction instruments.
5.	They will have an exposure to chemical industry on a lab scale.

Suggested References	
Sr. No.	**References**
1.	Mass- Transfer Operations by Robert E. Treybal, 3rd Edition Mc.Graw Hill International Edition.
2.	Unit- Operation of Chemical Engineering, 7th Edition by Warren L. McCabe, Julian C. Smith and Peter Harriott, Mc.Graw Hill Internaional Edition.
3.	Unit- Operation (II) Heat and Mass Transfer by. K.A. Gavahane, Nirali Publication.
4.	Polymer Science by V.R. Gowariker, N.V. Viswanathan and Jaydev Sreedhar, new Age International Publishers.
5.	The Elements of Polymer Sciecne and Engineering- Second Edition by Alfred Rudin

6.	Milk- Analysis, a Practical Treatise on the Examination of Milk and It's derivatives, Cream, Butter and Chese. By James Alfred.
7.	Water- Analysis: A Practical Treatise ont he Examination of Potable Water by James Alfred Wanklyn, Ernest Theophron Chapman.
8.	Water Quality - An Introduction, Second Edition, Claude E- Boynd.

Online -resources

On-line Resources:-From time to time are many online resources, including websites, databses, e-books, bibliographies and platforms that offer educational videos, lectures on a range of topics can be suggested or displayed to the students.

Major websites used for chemcial education such as:- Swayam, e-pg Pathshala, Swayam Prabha, NDLI, E-Shodh Sindhu, NPTEL, Virtual Labs, Process Orientaiated Guided Inquiry Learning (POGIL) etc.

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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester-II

Course Code	PS02CICH56	Title of the Course	**Comprehensive Viva**
Total Credits of the Course	1	Hours Per Week	01

Course Objectives:	1. To assess the overall knowledge of the student in the relevant subjects covered in core as well as elective courses.

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