Sardar Patel University

(Under Choice Based Credit Scheme)

Structure with Effect from 2022-23

M.Sc. (Industrial Chemistry) Semester-3

Programme Outcome (PO) - For MSc Chemistry Programme	Master of Science program provides extended theoretical and practical knowledge of different science subjects. Master of Science programme at Sardar Patel University is designed keeping the overall back ground preparation in mind for the student to either seek a job or to become an entrepreneur. The students, after completion of Bachelor of Science can select the master's programme in the subject they have had at the final year or in a related discipline (depending upon eligibility criteria prescribed by university). **Programme outcomes: At the end of the program, the students will be able to** 1. Have a deep understanding of both the theoretical and practical concepts in the respective subject. 2. Understand laboratory processes and use scientific equipments and work independently. 3. Develop research temperament as a consequence of their theory and practical learning. 4. Communicate scientific information in oral and written form. 5. Understand the issues related to nature and environmental contexts and think rationally for sustainable development. 6. The students are able to handle unexpected situations by critically analyzing the problem.
Programme Specific Outcome (PSO) - For MSc Chemistry Semester - III	Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Chemistry and Industrial polymer Chemistry. After completing M.Sc. chemistry program, students will be able to: ■ Demonstrate and apply the fundamental knowledge of the basic principles in various fields of Chemistry. ■ Apply knowledge to build up small scale industry for developing endogenous product. ■ Collaborate effectively on team-oriented projects in the field of chemistry or other related fields. ■ Communicate scientific information in a clear and concise manner both orally and in writing. ■ Inculcate logical thinking to address a problem and become result oriented with a positive attitude. ■ Enhance the scientific temperament among the students so as to develop a research culture and implementation of the policies to tackle the burning issues at global and local level. ■ Apply the knowledge to develop the sustainable and eco-friendly technology. ■ Take up global level research opportunities to pursue Ph.D programme targeted approach and specific competitive exams conducted by service commission ■ Accept enormous job opportunities at all level of chemical industries, pharmaceutical industries and placements in R & D.

Course Type	Course Code	Name of Course	Type of Course	T/P	Credit	Hours per Week	Exam Duration in hrs	Component of Marks		
								Internal	External	Total
								Total/ Passing	Total/ Passing	Total Passing
Core Course	PS03CICH51	New Separation Techniques	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS03CICH52	Spectroscopy- I	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS03CICH53	Green Chemistry	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS03CICH54	Industrial Organic Chemistry- I	EM & SD	P	4	8	3	30/12	70/28	100/40
	PS03CICH55	Chemical Process Industries	EM & SD	P	4	8	3	30/12	70/28	100/40
	PS03CICH56	Comprehensive Viva-Voce	-	T	1	1	1	-	50/20	20/20
Any one Elective	PS03EICH51	Processing of oils & Fats to utility Products	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS03EICH52	Chemical Analysis in Agro Food and Pharmaceutical	EM & EN	T	4	4	3	30/12	70/28	100/40
		Total			25					650

EM = Employability EN = Entrepreneurship SD = Skill Development

Sardar Patel University
Vallabh Vidyanagar, Gujarat
(Reaccredited with 'A' Grade by NAAC (CGPA 3.25)
Syllabus with effect from the Academic Year 2022-2023
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03CICH51	Title of the Course	New Seperation Techniques
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. The objective is to provide the concept of various unit operations like pressure swing adsorption, short parth distiration. 2. It is aimed to get the idea about the latest separation techniques that can be used to separate the mixture. 3. It is aimed to study about the different memberance separation techniques like Reverse osmosis, per vaporization etc.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**(a) Short path Distillation:-** Concept & working of short path Distillation Unit (SPDU), Difference between short path Distillation & molecular distillation, applications of SPDU, Economics of short path distillation. **(b) Pressure Swing Distillation:-** Concept & Working, Advantage & Disadvantages of PSD over azeotropic and Extractive Distillation, Applications	25%
2.	**(a) Pressure Swing Adsorption:-** Concept & Working, Advantages & Disadvantages of PSA over cryogenic distillation, four step PSA, six step PSA, Purification of hydrogen, oxygen, Nitrogen & other commercial applications of PSA. **(b) Reactive & Catalytic Distillations-** Concept & and History, Advantage & Disadvantages, Various methods of applications, Manufacturing of MTBE, Manufacturing of ETBE and other commercial applications, BALE & KATMAX packing, etc.	25%
3.	**Super Critical Extraction-** Working Principle, Advantage & Disadvantages of supercritical solvents over conventional liquid solvents, Advantage & Disadvantages of supercritical extraction over liquid- liquid extraction, Decaffeination, ROSE process, extraction of aromatic from spice and other commercial applications of supercritical extraction, Applications under research	25%
4.	**Membrane Separation Techniques:-** **a. Reverse Osmosis (R.O.)** Concept of Osmosis & Reverse Osmosis, Different types of Membrane modules and membrane material used for R.O., Advantages & Disadvantages, and Commercial applications of R.O. **b. Ultra filtration:-**	25%

	Concept & working principle, Commercial applications. **c. Per vaporization:-** Working principle, Advantages & Disadvantages, Production of absolute alcohol and other commercial applications. **d. Membrane Reactor-** Concept & working, Various modules of membrane used for membrane reactor, Advantages & Disadvantages, applications under research.	

Teaching Learning Methodology:-	1. To approach the effective teaching methodology. It comprises discussion, group learning, problem solwing, focusing on the self confidence among the students, team work as well as encouraging the students to critical thinking & searching. 2. The students often get an opportunity to ask questions in the middle of lecture. It should be maintained as 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 Continuous 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 advanced mass transfer techniques such as Pressure Swing distillation, Reactive & Catalytic distillation, super critical Extraction etc.
2.	Understand Membrane Separation Techniques that can be used in different chemical industries such as milk industry, food industry.

Suggested References

Sr. No.	References
1.	"Membrane Separation Processes"by Kaushik Nath,PHI pvt.Ltd.,2008
2.	"Introduction to Process Engineering & Design" by S.B.Thakore & B.I.Bhatt,Tata McGraw-Hill Ltd.,2007
3.	Perry Chemical Engineers Handbook' 7thEdition by R.H.Perry and D.Green.
4.	Ullman's Encyclopedia of Industrial Chemistry.
5.	"Encyclopedia of Chemical Engineering " by Kirk & Othmer.
6.	"Natural Extracts using supercritical carbon dioxide" M.Mukhopadhyay

Online- Resources

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

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

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Master of Sciene, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03CICH52	Title of the Course	Spectroscopy- I
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. To impart the knowledge of UV, IR, Atomic, Microwave, Molecular Spectroscopy & their applications. 2. Be able to describe what happens to a compound when it absorbs infrared radition & ultraviolet radiation. 3. Be able to use of a chart of functional group IR absorptions & vissible light absorptions. Also able to identify the strcutre of compound. 4. Be able to use of experimental technique that measures the relative energies of electronics in atoms & molecules.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Atomic Spectroscopy** Energies of atomic orbitals, vector representation of momenta, & vector coupling, spectra of hydrogen atom & alkali metal atoms. **Molecular Spectroscopy** Energy levels, molecular obritals, virbonic transtions, vibrational progressions & geometry of the excited state, Frank- condon principle, electronic spectra of polyatomic molecules. Emission spectra-change transfer spectra.	25%
2.	**Microwave Spectroscopy** Basic concepts, rotation spectra of simple inorganic compounds, classification of molecules, rigid rotor model, effect of isotopic substitution on transition frequencies & intensities non-rigid rotor stark effect nuclear & electron spin interaction & effect of external field. Photoelectron & Photo acoustic spectroscopy. Introduction, principle, instrumentation & applications of following techniques photo acoustic spectroscopy (PAS), photo electron spectroscopy (PES), Koopman's theorm, ESCA & chemical informations obtained from it. Auger electron spectroscopy (AES)	25%
3.	**UV Spectroscopy:-** Introduction, origion of UV band specturm, types of electronic transition, selection Rules, presentation of UV spectra, solvents	25%

	effects on UV absorption, chromophores & auxochrome, effect of conjugation, conformation & geometry on UV absorption of polymes Wood Word Fieser rules for dienes, axial haloketone rule, ketones, unsaturated aldehyde, the UV spectra of benzenoids, polynuclear aromatic hydrocarbon & heterocycles.	
4.	**IR Spectroscopy:-** Introduction principles of IR spectroscopy sample, handling, various modes of virbation, presentation of spectra, Functional group & finger print region, combination & overtones, Fermi resonance, bond properties & absorption trends, Factors influencing vibration-frequencies, interpretation of IR Spectra. Characteristic Vibrational frequencies of common functional groups (alkanes, alkenes, alkynes, ethers, aromatic compounds, alcohols, phenols & amines) study of vibrational frequencies of carbonyl compounds ketones, aldehyeles, estres, amides & acids	25%

Teaching Learning Methodology:-	- In the course of spectroscopy aims to make the students have the knowledge of spectroscopy. - This program is desinged to encourage the learning strategies to have the knowledge about recent technologies related to industrial point of view. - A variety of approach to teaching methods like seminars, lectures, power point presentation etc. - A problem solving methodology is also used.

Evaluation Pattern

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1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%
2.	Internal Continuous 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: Understand the basic concept of spectroscopy.	
1.	Will be able to interpret various types of spectroscopy like UV, IR, atomic, molecular, microwave, photoelectron & photoacoustic spectroscopy etc.
2.	Recognize spectroscopy in microwave, Rotational spectra of rigid diatomic molecules, sleection Rule, interaction of spectral lines.
3.	Study of vibrating diatomic molecule, energy levels of a diatomic molecule, simple harmonic & anharmonic oscillator.
4.	Understand principles & Applications of Mossbauer spectroscopy.

Suggested References

Sr. No.	References
1.	Modern spectroscopy: J.M. Hollas: Johnwilley
2.	Introduction of Molecular Spectroscopy G.M. barrow; McGraw Hill.
3.	Basic Principles of Spectroscopy: Rchang Mcgraw Hill.
4.	Theory & Application of UV Spectroscopy H.H. Jaffe & M. Orchin's BH Oxford.

5.	Introduction to Photoelectron Spectroscopy P.K. Ghosh, John Wiley.
6.	Fundamentals of Molecular Spectroscopy C.N. Banwell & E.M. Mc.Cash; McGraw Hill.
7.	Mo0lecular Spectroscopy by I.N. Levine, Willey Interscience.
8.	Organic Spectroscopy William kemp, John Wiley & Sons.
9.	Spectroscopy of Organic Compound, P.S. Kalsi Wiley Edstem, New Delhi.
10.	Absorption Speatroscopy of Organic Molecules (D. Van Nostrand), V.M. Parikh
11.	Organic Spectroscopy- Principles & Application Jag Mohan, 2nd Edition (Narosa Publishing House.

Online- Resources

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Sardar Patel University
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Syllabus with effect from the Academic Year 2022-2023
Master of Sciene, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03CICH53	Title of the Course	Green Chemistry
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	To learn about the environmental status, public awareness in evolution principles involved in green chemistry, bio-catalytic reactions, & its control measures, availability of green analytical methods.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Introduction to Green Chemistry** What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry.	25%
2.	**Principles of Green Chemistry and Designing a Chemical synthesis** Twelve principles of Green Chemistry with their explanations and Designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy);Prevention/minimization of hazardous/toxic products; designing safer chemicals ;Energy requirements for synthesis Selection of appropriate solvent; Selection of starting materials; Use of protectings groups; Use of catalyst; Products Designed should be Biodegradable; Designing of manufacturing plants; Strengthening of analytical techniques.	25%
3.	**Green reagents and Green catalysts** **Green reagents:** Dimethyl carbonate ;Polymer supported reagents like Polymer supported Peracids ; Polymer supported chromic acid ;Polymeric Thioanisolyl Resin; PNBS; Polymer cabodiimide ; Polystyrene Anhydride; Sulfonazide. **Green catalysts:** Acid catalysts; Oxidation Catalysts; Basic Catalyst; Polymer supported catalysts like Polystyrene-Aluminium chloride; Polymeric Super Acid catalysts; Polystryene -metalloporphyrins; Polymer supported photosensitizers ;Polymer supported phase transfer catalysts.	25%
4.	**Examples of Green Synthesis/Reactions** (a) Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizaro reaction, Strecker synthesis, Reformatsky reaction. (b) Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl	25%

		benzamide, methylbenzoate to benzole acid), Oxidation (of toluene, alcohols). Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement, Orthoester Claisen Rearrangement, Diels Alder Reaction, Decarboxylation.	

Teaching Learning Methodology:-	The presence of faculty members to provide advice academic advice & academic guidance to the student in need within the six hours a week available to all students.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage* (%)**
1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%
2.	Internal Continuous 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:	
1.	To understand the environmental status & evolution.
2.	To know about the pollution & its prevention measures.
3.	To familiarise the green chemistry.
4.	To learn about bio-crtalytic reaction.
5.	To learn about ultrasound assisted relations, Microwave assisted reactions in water & Microwave assisted reactions in organic solvents.

Suggested References

Sr. No.	**References**
1.	V.K. Ahluwalia & M.R. Kidwai:- New Trends in Green chemistry, Anamalaya Publishers (2005)
2.	A.S. Matlack:- Introduction to Green Chemistry Marcel Deckkar (2001)
3.	P.T. Anastes & J.K. Warmer:- Oxford Green Chemistry Theory & Practical University Press (1998)
4.	M.C. Cann & M.E. Connely:- Read World Cases in Green Chemistry American Chemical Society, Washington (2000)
5.	M.A. Ryan & M. Tinnes and, Introduction to green Chemistry, American Chemical Society, Washington (2002)

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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03CICH54 PS03CICH55	Title of the Course	Practical's
Total Credits of the Course	8	Hours Per Week	16

Course Objectives:	1.	Describe how to design experiments, execute experiments and investigate and infer the the observations yielded.
	2.	synthesis of organic compounds.
	3.	Identifications and separation of organic mixture.
	4.	The second part of the course covers the manufacturing technology of soap and detergent.
	5.	It includes the topic related to the role of various parameters in the development of a particular chemical process.

Course Code	PS03CICH54	Title of the Course	Industrial Organic Chemistry- I
Total Credits of the Course	4	Hours Per Week	8

1.	Sepration and iidentification of Teritary Organic Mixture (5 Practicals)
2.	Synthesis and Application of Name Reactions and Polymer 1. Connizzaro Reaction 2. Esterification Reaction 3. Preparation of Bakelite 4. Diel- Alder Reaction. 5. Kolbe- Schmidt Reaction

Course Code	PS03CICH55	Title of the Course	Chemical Process Industries
Total Credits of the Course	4	Hours Per Week	8

1.	Preparation of Soap.
2.	Preparation of Caustic Soda.
3.	Determine the acid value of given oil sample
4.	Determination of Sodium carbonate in washing Soda.
5.	To produce biodisel from vegetable oil
6.	Preparation of liquid soap from glycerine
7.	To determine free fatty acids in crude and refine edible oil.
8.	Determination of Saponification value of an oil
9.	Determination of the critical Soln Temperature of phenol/ Water System.
10.	To determine the percentage of calcium carbonate in a given toothpaste.
11.	To determine the total phosphorous as P_2O_5 in detergent.

Teaching Learning Methodology:-	Demonstration / Hands on training of various tyeps of analysis with or without instruments.

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:	
1.	Understand technology of hydrogenation and saponification.
2.	Basic information about edible and non edible oil.
3.	Understand the detergent and soap manufactirng
5.	The students acquired laboratory skills to handle the identificationa nd separation of organic compound.
6.	They have practical approach in synthesis of molecules based upon name reactions like esterification, cannizzaro, Diel- Alder etc.

Suggested References

Sr. No.	References
1.	Comprehensive practical organic chemistry Preparationa nd quantitative. Analsys. By V.K Ahluwalia and Renu Agarwal
2.	Comprehensive practical organic chemistry Qualitative Analysis By V.K. Ahluwalia and Renu Agarwal.
3.	Biodiesal Labs, Teacher Manual with Student Documets. By Loyola University of Chicago, Institute of Environmental Sustainiability Biodiesel program.
4.	Instrumental Analysis of Chemical Compound By Gurdeep R. Chatwal
5.	Vogel's Textbook of Quantitative chemical/ Analysis (5th Ed.) G.H. Jeffrey, J. bassette J. Mendhan, 1999.

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Syllabus with effect from the Academic Year 2022-2023
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03CICH56	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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Master of Sciene, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03EICH51	Title of the Course	Processing of Oils & Fats to Utility Products
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. The fundamental concepts would reflect the latest understanding of the field. 2. The learner are expected to know the basics of deterget, soaps, oil and fat industries. 3. The learners expected to be equipped with problem solving in allied industries. 4. Understanding new frontiers of knowledge in industrial chemistry for professional development.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	Processes and plants employed for hydrogenation of oils, chemisry of hydrogenation of oils, catalyst for hydrogenation of oils, hydrogen production for hydrogenation of oils.	25%
2.	Raw materials and technology of peanut butter and edible oil blends.	25%
3.	Raw material for soap industries, plant & process employed in soap manufacturing.	25%
4.	Raw materials for detergents, plants & processes employed for detergents detergent additives.	25%

Teaching Learning Methodology:-	To meet the effective teaching & the learning requirements, teaching-learning methodology comprises classrom teaching use of e-resources, library books, IT-tools, encouraging students to participate in seminars/ workshops, presentation by students, assigning work based upon subject requirement etc.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage* (%)**
1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%
2.	Internal Continuous 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:	
1.	To build a basic knowledge of the process carried out in soap, detergent & oil industries.
2.	To review the practical importance & relevance of process take place in soap, detergent & oil industries.
3.	To study about the salient features of the processes.
4.	To build a bridge between theoratical & practical concept used in industry.

Suggested References

Sr. No.	**References**
1.	Continuous processing of fats, M.K. Schwitzer, Chem Pub Comp., New York.
2.	Baileys Industrial Oils & Fats products, Vol 1-5, John Wiley & Sons.
3.	Manufacture of soaps, detergents & glycerine, edgar, Norwwod Limited
4.	Treaties on fats, fatty acids & oleo chemicals, O.P. Narulla, Indl Constultants India Ltd., New Delhi.
5.	Soaps & Detergents, Parsuram K.S., Tata McGraw Hill Pub, New Delhi.
6.	Soaps, their chemistry & technology, J.G. Kane, Indian Central oil seeds comp. Hyderabad.

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Master of Sciene, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - III

Course Code	PS03EICH52	Title of the Course	Chemical Analysis in Agro Food and Pharmaceutical Industires
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. To demonstrate a systematic, extensive and coherent knowledge and understanding of academic field of study as a whole and it's application in the various industry. 2. The subject provides knowledge about the basics of chemical processes take place in chemical industries and allied industries. 3. It gives the knowledge about the clinical, Drug, Food and Fuel Industries.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Analysis of soil:** Moister, pH, total nitrogen, phosphorous, silica, lime, Magnesia, Manganese, sulfur and alkali salts. **Fuel analysis:** Solid, liquid and Gas , ultimate and proximate analysis heating values, grading of cool, liquid fuels , flasks points , aniline point, octane number and carbon residue , gaseous fuels - producer gas and water gas - calorific value.	25%
2.	**Clinical Chemistry:** Composition of blood collection, and preparation of samples, clinical analysis - serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, barbiturates, acidic and alkaline phosphates, Immunoassay , principals of radiimmunoassy and applications. The blood- gas analysis -trace elements in the body.	25%
3.	**Drug analysis:** Narcotics and dangerous drugs, classification of drugs, screening by gas m thin layer chromatography and spectrophotometric analysis. Introduction to Fluorescence, instrumentation and its application in Biological, Medical and Drug Development.	25%
4.	**Food analysis :** Moister, ash, crude protein, fat, crud fiber, carbohydrate, calcium,potassium, sodium, and phosphates, food adulteration - common adulteration in food,contamination of food stuffs, microscopic examination of foods for adulterants,Pesticide analysis in food products, Extraction anc| purification of sample, HPLC, gas chromatography for organo -phosphates, thin layer chromatography for identification of chlorinated pesticides in food products.	25%

Teaching Learning Methodology:-	1. It possess minimum standards of communication skills. They are expected to read and understand documents with in depth analyses and logical arguments. 2. They are trained to be equipped with problem solving philosophical approaches as well as analytical reasoning. 3. The teaching and learning process involved class lecture, Seminars, Questions, preparation, field based learning as well as peer teaching & learning.

Evaluation Pattern		
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3.	University Examination	70%

Course Outcomes:	
1.	To build a basic knowledge of the process carried out in chemical industry.
2.	To be able to utilize the technological methods in problem solving in process plant.
3.	To study about the salient features of the process.
4.	To build a bridge between theoretical and practical concepts used in industry.

Suggested References

Sr. No.	**References**
1.	Fundamentals of analytical chemistry by D.A. Skoog, D.M. West and F.J. Honer, W.B. Saunders.
2.	Chromic Phenomenon, The Technological application of colour chemistry peter, Bamfield.

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Sardar Patel University

(Under Choice Based Credit Scheme)

Structure with Effect from 2022-23

M.Sc. Industrial Chemistry Semester-4

Programme Outcome (PO) - For MSc Chemistry Programme	Master of Science program provides extended theoretical and practical knowledge of different science subjects. Master of Science programme at Sardar Patel University is designed keeping the overall back ground preparation in mind for the student to either seek a job or to become an entrepreneur. The students, after completion of Bachelor of Science can select the master's programme in the subject they have had at the final year or in a related discipline (depending upon eligibility criteria prescribed by university). **Programme outcomes: At the end of the program, the students will be able to** 1. Have a deep understanding of both the theoretical and practical concepts in the respective subject. 2. Understand laboratory processes and use scientific equipments and work independently. 3. Develop research temperament as a consequence of their theory and practical learning. 4. Communicate scientific information in oral and written form. 5. Understand the issues related to nature and environmental contexts and think rationally for sustainable development. 6. The students are able to handle unexpected situations by critically analyzing the problem.
Programme Specific Outcome (PSO) - For MSc Chemistry Semester - IV	Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Chemistry and Industrial polymer Chemistry. After completing M.Sc. chemistry program, students will be able to: ■ Demonstrate and apply the fundamental knowledge of the basic principles in various fields of Chemistry. ■ Apply knowledge to build up small scale industry for developing endogenous product. ■ Collaborate effectively on team-oriented projects in the field of chemistry or other related fields. ■ Communicate scientific information in a clear and concise manner both orally and in writing. ■ Inculcate logical thinking to address a problem and become result oriented with a positive attitude. ■ Enhance the scientific temperament among the students so as to develop a research culture and implementation of the policies to tackle the burning issues at global and local level. ■ Apply the knowledge to develop the sustainable and eco-friendly technology.

	■ Take up global level research opportunities to pursue Ph.D programme targeted approach and specific competitive exams conducted by service commission ■ Accept enormous job opportunities at all level of chemical industries, pharmaceutical industries and placements in R & D.

Course Type	Course Code	Name of Course	Type of Course	T/P	Credit	Hours Per Week	Exam Duration in hrs	Component of Marks		
								Internal	External	Total
								Total/ Passing	Total/ Passing	Total Passing
Core Course	PS04CICH51	Energy Technology	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS04CICH52	Spectroscopy - II	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS04CICH53	Analytical Chemistry	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS04CICH54	Industrial Organic Chemistry- II	EM & SD	P	4	8	3	30/12	70/28	100/40
	PS04CICH55	Analytical aspects in Industries.	EM & SD	P	4	8	3	30/12	70/28	100/40
	PS04CICH56	Comprehensive Viva-Voce	-	T	1	1	1	-	50/20	50/20
Any one Elective	PS04EICH51	Natural Products	EM & EN	T	4	4	3	30/12	70/28	100/40
	PS04EICH52	Introduction to biochemistry	EM & EN	T	4	4	3	30/12	70/28	100/40
		Total			25					650

EM = Employability EN = Entrepreneurship SD = Skill Development

Sardar Patel University

Vallabh Vidyanagar, Gujarat

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Syllabus with effect from the Academic Year 2022-2023

Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04CICH51	Title of the Course	Energy Technology
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	To provide an idea of the challenges in the field of energy management and to provide a perspective on energy technology. Students will learn the systems dimensions of the energy prolems and its historical perspective on energy technology and system development. For different types of energy sources utilization in industries, the procedure of power generation, transportation along with conventional and advanced application in different sectors should be known by the students. This subject will guide students in the same direction.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**(a) Solar Energy** Solan constatn, solar radiation & related terms, measurement of solar radiation, solar energy collectors- flat plate collector,	25%

	air collector, collectors with porous absorbes, concentrating collectors, applications & advantages of various collectors, selective absorber coatings, solar energy storage systems (thermal electrical, chemical & mechanicla), solar pond, applications of solar energy. **(b) Wind Energy** Basic principles, power in wind, force on blades & turbines, wind energy conversion, site selection, basic componets of wind energy conversion system (WECS), classification of WECS, wind energy collectors, applications of wind energy.	
2.	**(a) Geothermal Energy** Geothermal resources, hydrothermal resources, liquid dominated systems, geo pressured resources, petro thermal systems, magma resources, energy conservation & comparison with other resources, applications of geothermal energy. **(b) Nuclear Energy** Fission, fusion, fuel for nuclear fission reactor (exploration, mining, milling, concentrating, refining, enrichment, fuel fabrication, fuel use, reprocessing, waste disposal), storage & transportation, fast & slow neutrons, multiplication factors & reactor control, uranium enrichment process, nuclear reactor power plant, fast breeder reactor, boiling water reactor, pressurised heavy & light water reactor.	25%

3.	**(a) Energy From Oceans** OTEC, methods (open cycle & close cycle) energy from tides, components of tidal power plants, operation, methods of utilization of tidal energy, storage, ocean waves, wave energy conversion devises. **(b) Energy from Biomass** Types of biogas plants construction details, applications biogas from plant wastes, thermal gasification of biomass, properties & utilization of bigras.	25%
4.	**Fuels and Fuel Cell** **(a) Fuels** Wood & charcoal, peat, lignite, sub-bituminous & bituminous coals, semi anthracite and anthracite coals, cannel & bighead coal, origin of coal, composition of coal, analysis & properties of coal gasification & liquefaction of solid fuels. **(b) Fuel Cell** Introduction, hydrogen- oxygen fuel cell, ion exchange membrane cell, fossil fuel cell, molten carbonate cell, advantages & disadvantages, conversion efficiency, polarization, type of electrodes, applications of fuel cells.	25%

Teaching Learning Methodology:-	To meet the effective teaching and the learning requirements, teaching-learning methodology comprises classroom teaching, use of e-resources, library books, encouraging students to participate in seminars, presentation by students, assigning work based upon subject requirements.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage* (%)**
1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%
2.	Internal Continuous 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	
	After learning the course the students should be able:
1.	To make students aware about all the energy sources avaialable and the ways to turn it into power.
2.	To understand the principles behind different non covnentional energy sources.
3.	To make student understand the global scenario of energy sector and to work on better economical solutions of it.
4.	To utilize the renewable energy in problem solwing where conventional energy are not fruitful and reqire replacement.
5.	To understand the design and applications of power generating devices using renewable energy sources as per industrial requirements

Suggested References

Sr. No.	References
1.	Energy sources 2nd Ed. by G.D. Raj, Khanna Publications, New Delhi
2.	Fuels & combustion by Samir Sarkar, Orient Longmans (1974)
3.	Solar Energy by Sukatame, Tata McGraw Hill, New Delhi.
4.	Energy Technology by Rao & Parulaker

Online- Resources

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

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

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Syllabus with effect from the Academic Year 2022-2023

Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04CICH52	Title of the Course	Spectroscopy- II
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. Know how nuclear spins are affected by a magnetic field, & be able to explain what happens when radiofrequency radiation is absorbed. 2. Be able to predict the splitting pattern in the NMR & CMR signal expected from a compound given its structure. 3. Be able to predict the fragmentation patterns expected to arise in the mass specturm of alkanes, alkyl, halides, ethers, alcohols & ketones. 4. Be able to use the mass specturm of a compound to find the molecules mass & to help identify the structure of a compound. 5. Provide students with a basic under standing of the design, operation & control of an HPLC system.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Nuclear Magnetic Resonance (NMR) Spectroscopy:-** Principles of NMR spectroscopy, nucler spin states, nuclear magnetic moments, absorption of energy, chemical shift & its measurement shilding & deshilding of protons, anisotropy, chemical shift & chemical equivalence, integrals, spin-psin, splitting, N+1 rule, mechanism of coupling & cooling constant, presentation of spectra, magnetic equivalence, allylic coupling, exchangeable protons, Interpretation of NMR spectra of simple organic compounds effect of enantiotropy, diastereotopic protons, karplus curves- variation of coupling constant with dihedral angles. Techniques of simplifying NMR. Spectra, doble resonance, shift reagents & deputation.	25%
2.	**Carbon - 13 NMR Spectroscopy:-** Carbon-13 nucleus, operating frequency, carbon-13 chemical shifts & their calculation, spin-spin coupling, proton-coupled, proton- decoupled & off resonance carbon spectra. use of 13c Sepctra- differentiating stereoisomers, nuclear overhauser effect. 13 C Dept Spectra- Dept Spectra - Differentiation in primary, secondary And Tertiary carbons By Dept-45, Dept-90, Dept-135 Spectra.	25%

3.	**Mass Spectroscopy:-** Basic Principles, interpretation of mass spectra, molecular ions, metastable ions & isotopes ion, ion abundances fragmentation process representation of fragmentation, basic fragmentation types & rules. Malafferty rearrangement. Fragmentation of organic compounds with respect to their structure determination associated with functional groups- alkanes, alkene cycloalkanes, aromatic hydrocarbons, Halides, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids esters, amides, acid chlorides, nitro compounds & amine, retro Diels- Alder Fragmentation & Nitrogen rule.	25%
4.	**High Performance Liquid chromatography (HPLC)** Principle , instrumentation, identification of peaks, effect of temperature & packing material, types of HPLC: partion, adsorption, ionexchange, size-exclusion or gel derivatization in HPLC: Post & Pre coloumns, applications.	25%

Teaching Learning Methodology:-	To meet the effective teaching & the learning requirements teaching learning methodology comprises classroom teaching use of e-resources, library books, IT tools, encouraging students to participate in seminars/ workshops, presentation by students assigning work based upon subject requirement etc.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage* (%)**
1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%
2.	Internal Continuous 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.	Relate NMR & CMR parameters such as chemical shift, coupling constant etc.
2.	The ability to investigate & determine the structure of typical organic chemical compounds using suitable NMR & CMR spectra.
3.	Explain the theory behind mass spectroscopy.
4.	Describe how ionization of molecules can take place.
5.	Compare different technologies & applications of HPLC.

Suggested References

Sr. No.	**References**
1.	"Spectroscopic methods in organic chemistry" D.H. Williams & Ian Fleming.
2.	"Organic mass spectroscopy", K.G. Das & E.P. James, Oxford & IBH Publishing Co.

3.	"Spectroscopy" Pragati Prakashan by H.Kaur.
4.	Introduction to Spectroscopy D.L. Pavia, G.M. Lampman & G.S. Kriz, 3rd Edition (Thomson Books/ Cole)
5.	Spectroscopic methods in organic chemistry, D.H. Williams. & I.Fleming 4th Edution. (McGraw-Hill Book Company)
6.	Chromatography: Basic Principles, Sample Preparations & Related Methods by Elsa Lundanes, Leon. Reubsaed, Type Greibrok, John. Willey & Soncs.
7.	Principles & Practicies of chromatography by R.P.W. Scott, Library for Science.
8.	Practical HPLC Method Development By Lloyd R. Snyder, Wiley-Interscience.
9.	Organic Analytical Chemistry Theory & Practice Jag Mohan, Narosa Publishing House 2003.
10.	Spectrophotometric Identificationof Organic Compounds 6th Ed. John Wiley & Sons, Inc, New York, 2004.

Online- Resources

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Syllabus with effect from the Academic Year 2022-2023

Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04CICH53	Title of the Course	Analytical Chemistry
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. One will be able to understand different techniques of analysis. 2. Different types of chromatographic techniques are covered. 3. Able to perform electroanalysis of chemical. 4. Learning of advanced instrumental techniques.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Titration techniques** Precipitation phenomena: Precipitation from homogeneous solutions, organic precipitants in inorganic analysis. Solvent extraction of metal ions, nature of extractant, distribution law, partition coefficients, types of extractions and	25%

	applications. Theories of redox indicators, titration curves, feasibility of redox titrations. Chelometric titrations-titration curves with EDTA, feasibility of EDTA titrations, selective masking and demasking techniques, industrial applications of masking.	
2.	UNIT II Chromatography Chromatographic Techniques: Principles, classifications and theory of chromatographic separations. Gas Chromatography: Principles, columns, detectors-TCD, FID, ECD and column efficiency, capacity factors, resolution. Practical aspects of GC-Hypernated techniques. Liquid Chromatography HPLC: Principles, equipment, columns, detectors, choice of column, materials GC, GCMS and LCMS. Ion exchange chromatography: Structures of resins, selectivity, capacity of resins, ion exchange equilibria, applications-removal of interfering ions, concentration and recovery of traces, anion and cation separations and application for the separation of lanthanides and actinides. Techniques of column chromatography and size exclusion chromatography. Thin layer chromatography, efficiency of TL plates, selection of stationary and mobile phases. Qualitative and quantitative analysis Paper chromatography: Theory and principle. Techniques:	25%

	one, two- dimensional and circular paper chromatography. Mechanism of separation, structure of cellulose and types of paper. Methodology- Factors affecting Rf values. Advantages and applications.	
3.	**Electroanalytical Techniques** Introduction, theory, principle, methodology, instrumentation and application of the following techniques: Conductometry, Potentiometry, Colometry, Voltammetry. **Fluorometry and Phosphorimetry:** Introduction fluorescence and phosphorescene, factors affecting fluorescence and phosphorescence, internal conversion intersystem crossing (radiationless proceses) quenching theory, relatiponship between intensity of fluorescence and concentration, instrumentation- basic difference in the measurement of fluorescence and phosphorescence, spectrofluorometers, advantages, limitations and precautions.	25%
4.	**Advanced instrumental techniques:** Spectrophotometry, atomic spectroscopy Thermal Analysis:- T.G, DTA and DSC- Principles and applications. X-ray differaction techniques- Powder and single crystal XRD, Principal applications.	25%

Teaching Learning Methodology:-	We have forged over traditional and some of the innovative approaches as teaching learning methodologies such as direct instructions, flipped class rooms, class room discussion unit based quiz, problem solving unit activities student presentation etc. 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 Continuous 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:	
1.	It includes various techniques of chemical analysis. - Will be able to understand the aspects of some advanced techniques of analysis. - Able to perform various types of chromatographic techniques. - Principle technique and performance of absorption spectra and X-ray diffraction will be cleared.

Suggested References

Sr. No.	References
1.	G.D. Christian, Analytical Chemistry, John Wiley, 1986.
2.	R-A. Day and A.L. Underwood: Quantitative Analysis, (Prentice Hall, India), 1998.
3.	B.K. Sharma, Instrumental methods of chemical analysis, Goel publishing House, 2000.
4.	Skoog, Holler and Nieman: Principles of Instrumental Analysis, Harcourt Acta, 2001.
5.	B.K. Sharma, Chromatogarphy, Krishna Prakashan media, 1997.
6.	S. K. Chatterjee , X-Ray Diffraction theory and application, ISTE, 2007.
7.	A.G. Jackson: Handbook of Crystallography For Electron Microscopists and Others Library of Congress Cataloging-in-Publication Data Jackson, A. G. (Allen G.) ISBN-13: 978-1-4612-7776-7 1, 1991.

Online- Resources

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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04CICH54 PS04CICH55	Title of the Course	Practical's
Total Credits of the Course	8	Hours Per Week	16

Course Objectives:	1.	The students are trained to handle the experimental set up including standardization.
	2.	Qualitative Analysis of Organic Compounds.
	3.	Estimation of Organic functional group/ molecules by titrimetric methods.
	4.	Be able to interpret the spectrum of any organic compounds / molecules.
	5.	This course gives an idea of various analytical techniques.

Course Code	PS03CICH54	Title of the Course	Industrial Organic Chemistry II
Total Credits of the Course	4	Hours Per Week	8

Description
Spectrum Analysis (5 Practical's)
Estimation 1. Determine the amount of phenol in the given solution. 2. Determine the amount of crotonic acid in the given solution. 3. Determine the No and percentage of Hydroxy / goup (-OH) of a given sample. 4. To determine % of Vitamin C in a given table. 5. To determine the amount of acetic acid and acetamide in the given soultion

Course Code	PS04CICH55	Title of the Course	Analytical aspects in Industries
Total Credits of the Course	4	Hours Per Week	8

1.	To determine the rate of acid-catalyst Iodination of acetone in presence of excess acid and acetone at room temperature.	
2.	To determine the transition temperature of alauber's salt by solubility method.	
3.	To determine the amount of aspirin in a given tablet by conduct metrically.	

4.	To determine the rate constant of the saponification of ethyl acetate at different temperatures conductometrically and calculate the energy of activation of the reaction.	
5.	To determine the neutralisation capacity of given antacid tables.	
6.	Preparation of pure sample of ferrous ammonium sulphate.	
7.	Preparation of pure sample of potash alum	
8.	To determine % Fe in iron tablet by colorimetry.	
9.	Assay of Fe in pharmaceutical preparation using potassium thiocynate by colorimetric.	
10.	Determination of distribution co-efficient of ammonia between chloroform & water.	
11.	Proximate analysis of coal	

Teaching Learning Methodology:-	Demonstration/ Hands on training of various types of analysis with or without instruments.

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:	
1.	Be able to perform hydroxy/ group estimation, phenol estimation, crotonic acid estimation, ascorbic acid estimation and acetic acid and acetamide estimation.
2.	To get an expertise in spectrum analysis.
3.	Students will be able to understand rate of reaction with/ without catalyst.
5.	Determine the amount of aspirin in drugs.
6.	Students will know about the colorimetric analysis.

Suggested References

Sr. No.	**References**
1.	Comprehensive practical organic chemistry Preparationa nd quantitative. Analsys. By V.K Ahluwalia and Renu Agarwal
2.	Comprehensive practical organic chemistry Qualitative Analysis By V.K. Ahluwalia and Renu Agarwal.
3.	A Laboratory Manual of Experiments in Physical Chemistry By D. Breman and C.F.H. Tipper. (Mcgraw Hill Publishing Company Ltd. London)
4.	Systematic Experimental Physical Chemistry by S.W. Rajbhoj and T.K. Chondhekar (Anjali Publication Auran Gabad)
5.	Advanced Practical Inorganic chemisty by Gurdeep Raj (Goel Publishing House)

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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04CICH56	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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Master of Science, Industrial Chemistry

M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04EICH51	Title of the Course	Natural Products
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	1. The student is able to understand basic importance of Natural products. 2. Learn the different types of alkaloids, Vitamins, Steroids & Terpenoids. 3. The student is able to learn about the synthesis of alkaloids, vitamins, steroids & Terpenoids. 4. Learn the different biogenesis of Alkaloids, Terpenoids, Carotenoids & Steroids.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	Introduction of natural products, General methods for the structure determination of natural products. Vitamins: Structure & Synthesis of Vitamin Al, Vitamin B_1 (Thiamine), Vitamin B6 (Pyriodoxine) and Biotin (Vitamin	25%

	H), Synthesis of Vitamin C.	
2.	Alkaloids: Introduction of opium alkaloids, Structure and Synthesis of Morphine, rearrangement in opium alkaloids, structure and synthesis of Sceletium alkaloid A4, Structure and synthesis of Mahanimbine, Synthesis of Resperpine and Tylophorine, biogenesis of Alkaloids	25
3.	Terpenouids and Cartenoids: Structure and synthesis of cyclic sesqiterpenoids eudesmol and cadinene, Structure and Synthesis of B- Carcotene, Synthesis of Caryophyllene and Khusimone, molecular rearrangement of Caryophyllene and Logifolene, biogenesis of Terpenoids and Carotenoids.	25
4.	**Steroids:** Structure and Synthesis of Cholestrol, Synthesis of Cortisone, Androgens and Oestrogens, Chemistry of bile acids, Biogenesis of Steroids.	25

Teaching Learning Methodology:-	To meet the effective teaching & the learning requirements, teaching learning methodology, comprises, classroom teaching, use of e-sources, library books, IT tools, encouraging students to participate in Seminar/ workshops, presentation by students, assigning work based upon subject requirements etc.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage* (%)**
1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%
2.	Internal Continuous 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:	
1.	Able to classify natural products from their chemical structure & to indicate their possible biosynthesis.
2.	Students able to know about structure, synthesis & different biogenesis of Alkaloids, Terpenoids, Carotenoids & Steroids.
3.	Students able to know about the significance & importance of Alkaloids, Terpenoids carotenoids & steroids.

Suggested References

Sr. No.	**References**
1.	The Chemistry of Natrual Products, K.W. Bentley, Vol. I-V, (interscience)
2.	Organic Chemistry, Vol.2, I.L. Finar, 5th Edition (1994), ELBS Publications.
3.	Natrual Products Chemistry Vil. I & II, Nakanishi et al., Academic Press Pub. (1974)

4.	The molecules of Natre, J.B. Hendrickson, W.A. Benjamin Inc (1965)
5.	Selected Organic Synthesis, Ian Fleming, John Wiley (1977)
6.	Chemistry of Natrual Products, N.R. Krishnaswamy, University Press Ltd. (1999)

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Syllabus with effect from the Academic Year 2022-2023
Master of Science, Industrial Chemistry
M.Sc. Industrial Chemistry, Semester - IV

Course Code	PS04EICH52	Title of the Course	Introduction to Biochemistry
Total Credits of the Course	4	Hours Per Week	4

Course Objectives:	The objective of the course 1. To provide basic understanding of the Chemistry of biomolecules. 2. To study the properties, classification and function of various biological molecules such as vitamins, proteins, carbohydrates and nucleic acids. 3. To gain knowledge about enzymes, erzyme kinetics and their regulation. 4. To enlighten students about the role of water in interaction of biomolecules.

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**Vitamins:** Classification, introduction, chemistry absorption, transport, mobilization and biochemical functions of Vitamins: A, E,K,C,B_1,B_2,B_6, B_{12}, H, CoA, Folic acid Niacin.	25%

	Lipids: Nomenclature, Structure and physical properties of some natrually occurring fatty acids, triacelgylycerol and waaxes as sources of stored energy, insulation and water repellents, Types of membrane lipids, Introduction to glycerophospho lipids, galacto lipids, sphingo lipids, phospho lipids and sterols.	
2.	**Proteins:** Properties, Classification and Conventions of common amino acids, stereoisomerism in a - amino acids, Peptides: Formation, Merrifelds Synthesis, compositions and sizes, protin separation, purificationa nd Characterization: Sequencing of Peptides: Sanger's method Adman degradation, outline of other mehtods: Protein Sequences and Evoluation: Oxygen binding proteins- hemoglobin and Myoglobin in Oxygen transport and storage.	25%
3.	**Carbohydrates:** Classification and stereochemistry, Biologically important hexose derivatives, Nomenclate for disaccharides, strcutre and role of some Homo and Hetero Polysaccharides, Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids, Introduction to Glycobiology (The Sugar Code) **Water:** Interaction among biomolecules in aquenous systems, Buffering aginst pH changes in biological systems, participation of water in biological rections.	25%

4.	**Enzymes:** Classification Nomenclature & extraction factors affections, catalytic activity and specificity in action, regulation of enzyme activity, enzyme inhibition. Illustrative enzymatic recations using Chymotrypsin, Hexokinase, enolase and Lysozyme **Nuclelc acids:** Components of nucleic acids, nomenclature of nucleotides, strucre of DNA Chargaff's Rule of DNA Composition, Watson and Crick Model, structure and types of RNA.	25%

Teaching Learning Methodology:-	- Topics in the course will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power-point presentations & videos. - Course material will be provided from primary and secondary sources of information. - To develop critical thinking and conceptual knowledge, group discussions and seminar presentations will be conducted by the students.

Evaluation Pattern		
Sr. No.	**Details of the Evaluation**	**Weightage* (%)**
1.	Internal Written/ Practical Examination (As per CBCS R 6.8.3)	15%

2.	Internal Continuous 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:	
1.	After the successful competition of the course, the learner will be able to: 1. Carry out laboratory experiments using biomolecules. 2. Get trained & work with the application of bimolecular industries. 3. Describe all the biomolecules with their classification & function 4. Explain the importance of water in biological relations.

Suggested References

Sr. No.	**References**
1.	Lehninger Principles of Biochemistry, David L. Nelson and Michael M. Cox {Palgrave MacMillan / W.H. Freeman & Company, New York]
2.	Principles of Biochemistry, Donald J. Voet, Judith G. Voet, Charlottee W. Pratt [John Wiley & Sons]
3.	Biochemistery, U. Satyanarayana, Books & Allied (p) Ltd., Kolkata (India)

Online- Resources

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

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