Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
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વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
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–: પરિપત્ર :–

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ અનુસ્નાતક અભ્યાસક્રમ ચલાવતી કોલેજોનાં આચાર્યશ્રીઓને તથા વિભાગીય વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Chemistry Sem-III નો અભ્યાસક્રમ અભ્યાસ સમિતિ વતી ચેરમેનશ્રીએ મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૩૧ અન્વયે કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૫૧ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૩૧

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Chemistry Sem-III નો અભ્યાસક્રમ અભ્યાસ સમિતિ વતી ચેરમેનશ્રીએ મંજૂર કરવા કરેલ ભલામણ સ્વીકારી M.Sc.Chemistry Sem-III નો અભ્યાસક્રમ સુધારા–વધારા સાથે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૫૧

:: આથી ઠરાવવામાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંકઃ૩૧ અન્વયે કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૧૬૨૩૯/૨૦૨૩
તા.૨૮–૦૬–૨૦૨૩

કુલસચિવ(કા.)

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ અનુસ્નાતક અભ્યાસક્રમ ચલાવતી કોલેજોનાં આચાર્યશ્રીઓ.
તથા વિભાગીય વડાશ્રી.
..... આપશ્રીની કોલેજના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

Veer Narmad South Gujarat University, Surat

Syllabus

M.Sc. Organic Chemistry

Semester-III

To be effective from June-2023

NEP-2020

Name of Program	**Master of Science(Chemistry) and M.Sc. Organic Chemistry (Evening)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. (Organic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Inorganic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Physical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Analytical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M. Sc . Environmental Chemistry** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Pharmaceutical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. Organic Chemistry (Evening)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry.
Objective of Program	The core objective of the M.Sc. programme is to prepare the students for dynamic career in industry and academia by providing an excellent environment of teaching and research in the core and emerging areas of the discipline.

Program Outcome	PO1: To enhance the knowledge of chemistry domains and become master in respective branch of chemistry. To be able to communicate clearly and effectively with in and across disciplinary lines. PO2: Built up entrepreneurship ability by taking advantage of industrial hub in periphery of our university. PO3: Establishment of research center with the aid of interdisciplinary subject being run in university. PO4: Persuasion of doctoral degree in the concern subject and further study. PO5 : Development of related short term courses related to demanded subject in anticipation of strengthening knowledge and application PO6: Training/internship of students for employment in public sector, private sector and national laboratories. PO7: Participation in scientific discussions showing respect and lead interdisciplinary work with experts from other fields. PO8: To understand and adopt the best safety practices in chemical research. PO9: Participation in scientific discussions showing respect and lead Interdisciplinary work with experts from other fields. PO10: To understand and adopt the best safety practices in research.

Program Specific Outcomes	Students need to build up foundation in the fundamentals & application of current chemical and scientific theories in the concerned branches of Inorganic, Organic, Analytical, Physical, Environmental and Pharmaceutical Chemistry. PSO1 : Develop scientific temper, communicate scientific information in a clear, concise and precise manner. PSO2 : Find job opportunities at all level of chemical industries(dyes & pharmaceutical), national laboratories & research centers. PSO3 : Apply the knowledge in sustainable and eco friendly technologies. PSO4 : Inculcate logical thinking to addressess the problem and become result oriented. PSO5 : Development of research culture in persuasion of Ph.D. program at national & international institute/university. PSO6 : Participate in specific competitive examination conducted by various public service commission and other public sector. PSO7 : Develop and apply the fundamental knowledge to build small scale industry in context to Atma Nirbhar Bharat. PSO8 : Scale up the synthetic product to a pilot level plant and gradually to bulk. PSO9 : Enhance the scientific temperament among the students in anticipation of developing research culture and implementation of policies at global & local level. PSO10 : Communicate scientific information clear in both writing and orally. PSO11 : Students shall start to become better readers, thinkers and learners in their discipline by processing their ideas through writing. PSO12 : Will build new scientific understanding as it provides students the opportunity to articulate their thinking as they engage in the science practices during an investigation.

Mapping between POs and PSOs													
		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
	PO1												
	PO2												
	PO3												
	PO4												
	PO5												
	PO6												
	PO7												
	PO8												
	PO9												
	PO10												
Medium of Instruction	English												

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

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Structure of M.Sc. Syllabus
M.Sc. Semester-III
Organic Chemistry

Sr. No.	Course Title	L	Credit
1	Natural Products and Bio-molecules	4	4
2	Selected Topics In Organic Chemistry-I	4	4
3	Organic Chemistry in Industry	4	4
4	Medicinal Chemistry-I OR Dye and Intermediates-I	4	4
5	Skill Enhancement: Industrial Safety & Water Analysis Techniques	2	2
6	Practicals	12	6
		30	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	III	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Elective-I OR Elective-II	04	30	70	100
		V	Skill Enhancement	02	15	35	50
			Practical	06	60	140	200
			Total	24	215	435	650

M.Sc. Semester-III
Organic Chemistry

Sr. No.	Course Title	L	Credit
1	Advance Organic Chemistry	4	4
2	Selected Topics In Organic Chemistry-II	4	4
3	Advance Organic Synthesis	4	4
4	Medicinal Chemistry-II OR Dye and Intermediates-II	4	4
5	Skill Enhancement	2	2
6	Practicals	12	6
		30	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No	Course group	Credit	Internal Marks	External Marks	Total Marks
M. Sc.	IV	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Elective-I OR Elective-II	04	30	70	100
		V	Skill Enhancement	02	15	35	50
			Practical	06	60	140	200
			Total	24	215	435	650

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Organic Chemistry,
Semester-III
To be effective from June-2023
(NEP-2020)
Paper-I: Natural Products and Bio-molecules

Total Periods: 60

Course Code	OCC-301	Title of the Course	**Natural Products and Bio-molecules**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the concept of biomolecules and natural products, structural elucidation of natural pigment and alkaloids of different class, their interrelation to each other, synthesis of intermediates and their confirmation through synthetic pathways. • To learn steroids and their respected sex hormones, structural elucidation of steroid molecules, biosynthetic pathways, synthesis of intermediates, steroid based sex hormones and their interrelation to each other, physiological importance and their synthesis. • To understand biochemical function of vitamins, classification and structural elucidation of vitamins & terpenoids through analytical and synthetic evidences. • To learn about nucleic acid and enzymes. Structural elucidation of DNA, RNA and their role in biochemical function, classification of enzymes & their catalytic activities.

Unit	Description
1.	**NATURAL PIGMENTS and ALKALOIDS** **(15** Periods) **(A) Natural Pigments and PorphyrinsDerivatives** Porphyrins: General structures, Synthesis and Spectral properties. Synthesis of cryptopyrrole, Phytopyrrole, Opsopyrrole and Haemopyrrole and their carboxylic acidderivatives. Structural elucidation of Haemoglobin and Chlorophyll (Analytical evidences only) **(B) Alkaloids** Classification of alkaloids; Structural elucidation of Morphine, Reserpine and Colchicine (Analytical evidencesonly)

2.	**STEROIDS and SEX HORMONES** **(15 Periods)** **(A) Steroids** Introduction to Sterols; Structure determination of cholesterol and ergosterol (no synthesis), Bile acids: Introduction, Structural elucidation and Synthesis of Cholanic acids (α and β both). **(B) Sex Hormones** Classification of hormones: Structure and synthesis of Androgens, Oestrogens and Gestrogens. Name and structures ofAdrenocortical hormones, Partial synthesis ofcortisone.
3.	**VITAMINS and TERPENOIDS** **(15 Periods)** **(A)** **Vitamins** Structure determination, Synthesis and biochemical functions of Vitamin A, Vitamins B1 andB2, Vitamin H **(B) Terpenoids** Classification, nomenclature and isolation Structure determination and synthesis of Farnesol, Santonin,Menthol, Gibrelic acid and Abietic acid.
4.	**NUCLEIC ACIDS & ENZYMES** **(15 Periods)** **(A)Nucleic Acids** Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding, Chemical and enzymatic hydrolysis of nucleic acids, Structure of nucleosides and nucleotides, DNA, RNA (Basics structures only), DNA replication, Transcription, Translation, Protein Biosynthesis. **(B) Enzymes** Classification, nomenclature and inhibition, factors affectingcatalytic activity and specificity in action, regulation of enzyme activity

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the nature of natural pigments & alkaloids, spectral properties of porphyrins, generation of various pyrrole and their carboxylic acid derivatives and their synthesis, structural elucidation of pigments and alkaloids, their analytical evidences for the confirmation of structure including intermediates.
2.	To learn basic skeleton of steroids, structural elucidation of cholesterol, ergosterol, bile acids, male, female sex hormones, their interrelation of each other, corticoids and their physiological activities.

3.	To learn biochemical function of vitamins, classification & structural elucidation, through analytical and synthetic evidences of vitamins and terpenoids, confirmation of intermediates through respective synthetic pathway, their respective oxidation, reduction, hydrolysis etc. and rearrangement reactions.
4.	To understand nucleic acids, respective purine and pyridine bases, theirinterrelation to each other, structural elucidation of DNA & RNA, their classification & nomenclature of enzymes, their next generation, protein synthesis, catalytic activities through various parameters.

Suggested References:

Reference Books Recommended:

1. Organic Chemistry, Vol. I & II (Sixth edition), I. L. Finar.
2. S.W. Pelletier, Chemistry of the Alkaloids, Van Nostrand Reinhold Co., New York (1970).
3. K.W. Bentley, The Alkaloids, Vol. I., Interscience Publishers, New York (1957).
4. Chemistry of Organic Natural Products, Vol. I & II, O. P. Agrawal.
5. Organic Chemistry of Natural Products, Vol. I & II, Chatwal.
6. Organic Chemistry (5/e) by Morrison & Boyd.
7. Chemistry of Vitamins – S. F. Dyke.
8. Natural Products Chemistry, Vol. I & II, K. Nakanishi.
9. The Molecules of Nature, J. B. Hendrickson.
10. Selected Organic Synthesis: Ian Fleming.
11. Chemistry of Natural Products, N. R. Krishnaswamy.
12. The Chemistry of Natural Products, K. W. Bentley, Vol. I – V.
13. J.W. Apsimon, Total Synthesis of Natural Products, Vol. 1-6, Wiley-InterscicncePublications, New York (Vol. 1, 1973).
14. Principles of biochemistry –Donald J.Voet, Judish G.Voet, charlotte w. pratt (John willey and sons)
15. Lehninger principles of biochemistry- David L.Nelson and Michael M.wx (Palgrave Macmillan / w.h. freeman company new york)
16. Biochemistry – U.Satyanarayana Baro and allied P.Ltd., kolkata

On-line resources to be used if available as reference material

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Organic Chemistry,

Semester-III

To be effective from June-2023

(NEP-2020)

Paper-II: Selected Topics in Organic Chemistry-I

Total Periods: 60

Course Code	OCC-302	Title of the Course	**Selected Topics in Organic Chemistry-I**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the familiarize with the basic properties, theory & interpretation of ^{1}H NMR, ^{13}C NMR and 2D NMR spectrometry, to impart knowledge in the theory & principals of spectroscopic techniques for characterization & differentiation of various molecules. • To learn about various pollution-water & air and effluent treatment. Contamination of water through heavy minerals, halogens, pathogens, air pollution, detection of various components and hydrocarbons, effluent treatment of sugar, peeper & pulp and distilleries. • To learn monocyclic, fused and bridged heterocyclic compounds, their nomenclature, synthesis, aromatic character, reactivity and application in the preparation of building blocks, fine chemicals and dye industry. • To understand the role of chemical reagents in oxidation, reduction, cyclisation and transformation of various organic functional groups, their synthesis and industrial application.

Unit	Description
1.	**NMR SPECTROSCOPY** **(15 Periods)** Theory and principles of NMR spectroscopy, Theory of FourierTransform **(i) ^{1}H NMR Spectroscopy** Proton resonance condition, Aspects of PMR spectra – number ofsignals, chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), effect of deuteration, spin- spincoupling, (n+1) rule, factors effecting coupling constant "J", Coupling constant theory **(ii) ^{13}C NMR spectroscopy** Types of ^{13}C NMR Spectra: proton coupled, proton decoupled, off resonance and DEPT of ^{13}C spectra, chemical shift, calculations of chemical shifts of aliphatic carbons, factors affecting chemical shifts **(iii) 2D NMR Techniques** Preliminary idea of 2D NMR , definition of COSY, NOESY and HETCOR
2.	**ENVIRONMENTAL CHEMISTRY** **(15 Periods)** **(i) Water Pollution**: Basic Concepts of Eutrophication, WaterQuality, Water contaminants, Heavy minerals, Organic contaminants, PCBs and other Halogens materials, PAH, Pesticides, Waterborne Pathogens, Aquatic toxicology, Water Purification Methods, Sewage treatment. **(ii) Air Pollution:** Air pollution sources and emissions- Particulates, Aerosols, Photochemical smog, Determination of SOx,NOx, COx and hydrocarbons, Air pollution control technologies of particulate and gaseous pollutants **(iii) Effluent treatment:** Industrial pollution of sugar, distillery,drug, pulp & paper and their analysis. Effluent treatment plants ofabove industries.

3.	**HETEROCYCLIC CHEMISTRY-I** **(15 Periods)** (i) Nomenclature of Heterocycles: Hantzsch-Widman nomenclature systems for monocyclic and fused heterocycles and bridged heterocycles (ii) Five and six membered heterocycles with two hetero atoms: Synthesis, reactivity, aromatic character and importance of following heterocyclic rings: Oxazole, Thiazole, Pyrazole, Imidazole, Pyridazine, Pyrimidine, Pyrazine (iii) Condensed five membered heterocycles: Synthesis, reactivity, aromatic character and importance offollowing heterocyclic Rings: Benzoxazole, Benzthiazole, Benzopyrazole, Benzimidazole.
4.	**REAGENTS FOR ORGANIC SYNTHESIS** **(15 Periods)** Introduction, Preparation and Industrial Applications of thefollowing, (1) N-Bromosuccinimide (NBS) (2) Tebbe's reagent (3) N,N-dicyclohexylcarbodiimide (DCC) (4) Lead tetra-acetate (LTA) (5) Hexamine (6) n- butyl lithium (7) $K_3Fe(CN)_6$ (8) Grignard Reagent (9) Diazomethane (10)Polyphosphoric acid

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand fundamental & basic terms involved in ^{1}H NMR, ^{13}C NMR & 2D NMR spectroscopy, know effects of various factors on the spectra, interpretation from spectral data, identify structure of organic compounds by using combined spectral data, distinguish isomers and other closely related compounds by using spectral techniques.
2.	Learn water & air pollution, basic concepts of Eutrophication, water contamination with heavy materials, halogens, hydrocarbons and water purifying techniques and purification of water, sewage treatment, determination of air pollutants SO_X, NO_X, CO_X and hydrocarbons. Development of technologies to compart gaseous pollutants, effluent treatment of various paper pulp & distillation.

3.	To understand the basic concept of name reaction for the heterocyclic chemistry, aware about all heterocyclic ring systems such as mono, bi,tri and fused ring systems with all backgrounds in terms of naming of new compounds, application of heterocycles in medicinal chemistry.
4.	Understand the chemistry involved in oxidation, reduction, transformation, cyclisation etc by employing numerous reactants to appreciate the chemo-selectivity of the reagents, synthesis of reagents with respective mechanism and their application in industry. Suggest the use of miscellaneous reagents in organic synthesis.

Suggested References:

Reference Books Recommended:

1. R.M. Silverstein and F.X. Webster, Spectroscopic Identification of Organic Compounds, 6th Edition (2003) John Wiley, New York.
2. D.H. Williams and I.F. Fleming, Spectroscopic Methods in Organic Chemistry, 4th Edition(1988), Tata-McGraw Hill, New Delhi.
3. P.Y Bruice, Organic Chemistry, 2nd Edition (1998) Prentice – Hall, New Delhi.
4. Nuclear Magnetic Resonance – Basic Principles- Atta-Ur-Rehman, Springer- Verlag (1986).
5. One and Two dimensional NMR Spectroscopy – Atta-Ur-Rehman, Elsevier (1989).
6. Organic structure Analysis- Phillip Crews, Rodriguez, Jaspars, Oxford University Press (1998).
7. G.W. Vanloon, S.J. Duffer, Environmental Chemistry - A Global Perspective, Oxford University Press (2000).
8. F.W. Fifield and W.P.J. Hairens, Environmental Analytical Chemistry, 2nd Edition (2000), Black Well Science Ltd.
9. Colin Baird, Environmental Chemistry, W.H. Freeman and Company, New York (1995).
10. A.K. De, Environmental Chemistry, 4th Edition (2000), New Age International Private Ltd., New Delhi.
11. Peter O. Warner, Analysis of Air Pollutants, 1st Edition (1996), John Wiley, New York.
12. S.M. Khopkar, Environmental Pollution Analysis, 1st Edition (1993), Wiley Estern Ltd., New Delhi.
13. S.K. Banerji, Environmental Chemistry, 1st Edition (1993), Prentice-Hall of India, New Delhi.
14. An introduction to the chemistry of heterocyclic compounds-R M Acheso
15. Heterocyclic Chemistry- J A Joule and Smith
16. Heterocyclic Chemistry-II- R R Gupta, M Kumar, V Gupta, Springer (India) pvt
17. Heterocyclic Chemistry, 4th Edition by J. A. Joule & K. Mills, Published by Chapman & Hall (1995)
18. Principles of modern heterocyclic chemistry, Edited by Leo A. Paquette, Published by Pearson Benjamin Cummings (1968)
19. Heterocyclic Chemistry, 3rd Edition by Thomas L. Gilchrist, Published by Prentice Hall (1997)

20. The Structure & Reactions of Heterocyclic Compounds, Edited by Michael Henry Palmer, Published by Edward Arnold (1967)
21. Heterocyclic chemistry by V. K. Ahluwalia, Narosa publishing house.
22. Organic synthesis using transition metals-Roderick Bates (Wiley).
23. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press).
24. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007).
25. Guidebook to organic synthesis-R K Meckie, D M Smith and R A Atken.

On-line resources to be used if available as reference material

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Organic Chemistry,
Semester-III
To be effective from June-2023
(NEP-2020)
Paper-III: Organic Chemistry in Industry

Total Periods: 60

Course Code	OCC-303	Title of the Course	**Organic Chemistry in Industry**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand process chemistry and research, basic knowledge of drug discovery, preclinical trail of medicines. Classes of agrochemicals and their properties. • To learn about colour industry-dyes and pigments, nomenclature and colour index, types of dyes, theories of dyes, properties, various types of fibre and miscellaneous applications. • To learn about drug & medicines, nomenclature, generic and trivial name. Various theories of drug action, administration of dyes and determination of physiochemical properties. • To understand unit processes and implementation in industry, determination of various agents in unit process and their synthetic route.

Unit	Description
1.	**ORGANIC CHEMISTRY IN INDUSTRY** **(15 Periods)** Introduction, Process Chemistry versus Research Chemistry Pharmaceutical Industry: Drug Discovery, Drug development,Preclinical and clinical testing, Medicine, Future Problems and Opportunities Agrochemical Industry: Classification, Biodegradable and Persistent Pesticides, Toxicity, Chemical Classification ofPesticides-Herbicides and Insecticides

2.	**BASIC CONCEPTS OF DYE AND DYE INTERMEDIATES (15 Periods)** Introduction of Dyes and Pigments, Absorption of visible light, colour of wavelength absorbed, complementary colour. Relation between color and chemical Constitution, Witt's theory, Armstrong's theory, Nietzki's theory, Valence bond theory, Molecular orbital theory, Fastness Properties, Exhaustion and fixation properties. Natural Dyes, Nomenclature of Dye Intermediates, Colour Index Classification of Dyes: Based on structure, based on mode ofapplication to fibres, Non– Textile uses of dyes: Dyes in medicine, leather, paper, colour photography and electro photography, food, cosmetics, displays and laser dyes.
3.	**BASIC CONCEPT OF DRUGS** Introduction, Classifications: On the basis of their chemical structure and therapeutic action, Nomenclature: Proprietary andNon-proprietary name, Nomenclature of new drugs by WHO, Names of drugs: Generic and brand names Theories of drug action: Occupancy theory, Rate theory andinduced fit theory Biological defence, chemical defences, Furguson principle. Drug receptor, drug abuse and drug dependent. Absorption of drugs: Routes of administration, factors that affecton absorption Physico chemical properties: Solubility, Partition coefficients, Ionization constant,Electronic effect, Steric effect, Stereochemical consideration
4.	**UNIT PROCESSES** (i) Nitration:Nitrating agents. Mechanism of aromatic nitration.Industrial chemicals derived from Benzene, Naphthalene, Anthracene using Nitration. (ii) Sulphonation and Sulfation: Sulphonating and Sulfating agents. Mechanism of aromatic Sulphonation. Industrial chemicals derived from Benzene, Naphthalene, Anthracene usingSulphonation. (iii) Amination: Aminating agents, Amination by reduction, Amination by Ammonolysis. Industrial chemicals derived fromBenzene using Amination. (iv) Alkylation: Alkylating agents. Industrial important alkylcompounds derived by various routs (v) Halogenation: Halogenating agents. Industrial importanthalogenated compounds derived by various routs

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand process chemistry versus research chemistry, concept of clinical trials on various phases, FDA, ADMET, classes of agrochemical-pesticides, herbicides, insecticides and toxicity studies.
2.	Learn colour and chemical constitution, various theories , fastness properties of dyes through various parameters. Application of dyes on various fibres, miscellaneous application of dyes like- non textiles, leather, medicines, photography, cosmetics etc.
3.	Understand of drugs, nomenclature & classification, generic and trivial/brand names of drugs, various theories of drug action, biological defence, administration of drug and study their various physico chemical parameters.
4.	Understand unit process & operation. Various unit processes, determination of agents employed in unit process on the basic motif & analogous, establishment of mechanism and their application in industry with different routes.

Suggested References:

Reference Books Recommended

1. Organic Chemistry: A Mechanism Approach; Penny Chaloner, CRC Press, Tailor and Francis; Florida.
2. Pharmaceutical Process development: Current Chemical and Engineering Challenges, J. Blacker and M. T. Williams, RSC Cambridge, UK.
3. Fine Chemicals: The Industry and Its Business, P. Pollak, 2nd Edition, Wiley.
4. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
5. Chemistry of Synthetic Dyes & Pigments by Lubs.
6. Dyes and their intermediates by E. N. Abrahart.
7. Handbook of synthetic dyes and pigments, Vol. I & II by K. M. Shah.
8. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH.
9. Development in the Chemistry and technology of Organic Dyes by J.Griffiths, Blackwell Sci. Pub., Oxford, London.
10. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.
11. Medicinal Chemistry by G. R. Chatwal.
12. A textbook of Pharmaceutical Chemistry by Jayshree Ghosh.
13. Chemical Process Industries by R. N. Shreve.
14. Riegel's Hand-Book of Industrial Chemistry, Ed. by James A. Kent.
15. Industrial Chemicals by Faith, Keyes, Clark.

On-line resources to be used if available as reference material

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Organic Chemistry,

Semester-III

To be effective from June-2023

(NEP-2020)

Paper-IV: Medicinal Chemistry-I (Elective-I)

Total Periods: 60

Course Code	**OEC-301**	Title of the Course	**Medicinal Chemistry-I**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand drug design. Different parameters for drug design, concept of drug design & optimization, SAR, receptor, administration, role of enzymes in biotransformation and relevant parameters. • To understand types of psychoactive drugs, their division, classification, general structure, effect of substituent, their SAR, MOA and synthesis. • To learn about diuretics, hypoglycemic and cardiovascular agents/drugs. Classification, general structure, effect of substituent, their SAR, MOA and synthesis. • To understand Analgesic, antipyretic, NSAIDs Agents, classification, general structure, effect of substituent, their SAR, MOA and synthesis.

Unit	Description
1.	**DRUG DESIGN, PHARMACOKINETICS ANDPHARMACODYNAMICS** **(15 Periods)** Drugs and Drug Design Introduction, drug targets, procedure for drug design, Soft drug and pro- drug, concepts of lead compounds, lead modification, structure activity relationship (SAR), LD_{50}, ED_{50}, therapeutic index. Introduction to Phramacokinetics and Pharmacodynamics, Drug administration, Drug absorption, drug distribution, drug metabolism(general pathway of drug metabolism: Phase-I and Phase-II), Polymorphosis, elementary treatment of enzyme stimulation, biotransformation, Drug excretion, allosteric modulation, avoidance of toxic intermediates, drug deposition.
2.	**PSYCHOACTIVE DRUGS** **(15 Periods)** (i) General anesthetics: General classification and Structural varia tions. (ii) Local Anesthetics: General classification and SAR. (iii) Sedatives and Hypnotics: General classification, Structural variations and mode of action, SAR of Benzodiazepam,Synthesis and therapeutic uses of only the following: Thiopental (Pentothal), Amobarbital (Amytal), Diazepam, Clonazepam, Nikethamide, Benzocaine,Procaine, Lidocaine (xylocaine)

3.	**ANTIPYRETIC ANALGESICS AND NSAIDS AGENTS (15 Periods)** General classification of Antipyretic Analgesics, Narcotic Analgesics and Non-Steroidal Anti- Inflammatory Drugs. Structural variations in Morphine, Morphan and 4- Phenylpiperidine Analogues, SAR of Morphine. Opioid Receptors (Name only). Limitations of opioids. Synthesis and therapeutic uses of only the following: Meperidine (Pethidine). Ibuprofen, Meclofenamate sodium, Oxyphenbutazone, Diclofenac Sodium, Mefanamic acid.
4.	**DIURETICS, ANDCARDIOVASCULAR DRUGS (15 Periods)** **Diuretics:** General classification. Mercurial diuretics, acidifying diuretics, aquaretics, Structural variation and SAR of Thiazide diuretics. Synthesis and therapeutic uses of only the following: Chlorothiazide, Ethacrynic acid, Triamterene, Acetazolamide **Cardiovascular Drugs:** General introduction of Antiarrythmic agents and Antihypertensive drugs Structure variation in ß-adrenergic blockers and Dihydropyridines, Structure – activity Relationship of ACE Inhibitors. Synthesis and therapeutic uses of only the following: Verapamil, Methyldopa, Atenolol, Losartan.

Course Outcome: Having Completed this course, the learner will be able to	
1.	Understand drug design, procedure of drug design, preparation of library of compounds-leads to identification and optimization. Various concept like pro drug, soft drug, SAR, MOA, ADMET and receptor, drug administration, pharmacokinetics and pharmacodynamics, role of enzyme in biotransformation etc.
2.	Learn general classification of psychoactive agents, difference between sedative and hypnotics, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug.
3.	Understand general classification of analgesic, antipyretic, NSAIDs Agents, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug.
4.	General classification of diuretics, general structure of each class of drugs with substituent, their SAR and trivial/generic name, synthesis and uses of selective drug method.

Suggested Reference Books:

1. Burger's Medicinal Chemistry and Drug Discovery (5/e), 1997, Vol. 1, 2, 3, 4,5, Editedby ManFred E. Wolff (John Wiley & Sons, inc., New York).
2. Principles of Medicinal Chemistry, Vol. I & II (5/e), by S. S. Kadam, K. R. Mahadik, K. G. Bothra (Nirali Prakashan).
3. Principles of Medicinal Chemistry by William O. Foye (ed.), Lea and Febiyer,Philadelphia.
4. Wilson and Gisvold's Text-book of Organic Medicinal and Pharmaceutical Chemistry(5/e, 1982) by Robert F. Doerge (J. B. Lippincott Company, Philadelphia/Toppan Co.Ltd., Tokyo).
5. Essential of Medicinal Chemistry (2/e) by Andrejus Korolkovas (A Wiley Interscience Publication, 1988, John Wiley & Sons, Canada).
6. Medicinal Chemistry by Ashutoshkar (Wiley Eastern Ltd., 1993).
7. The Pharmaceutical Basis of Therapeutics by Goodman and Gilman (The MacmillanCo.).
8. The Organic Chemistry of Drug Synthesis, Vol. I, II & III (1980), Ed. By D. Lednicer and L.A.Mitscher (John Wiley and Sons, New York).
9. Topics in Medicinal Chemistry, Vol. I & II by Rabinowitz and Myerson (Editor)(Interscience, 1968).
10. Adhunik Sanshleshit Aushodhonu Rasayanvighyan, Dr. Anamik Shah, University Granth Nirman Board, Ahmedabad.
11. Medicinal Chemistry, D. Sriram and P. Yogeeswari, 1st edi., Pearson Education, 2007.
12. Handbook of pharmaceutical chemicals by Dr. A. R. Shenoy and Dr. V. R. Shenoy Multitech Publishing Co., 15-Yogesh, Hingwala Lane, Ghatkopar (East) Mumbai.
13. Fundamentals of Medicinal Chemistry by G Thomas.

On-line resources to be used if available as reference material

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, M.Sc. Organic Chemistry,

Semester-III

To be effective from June-2023

(NEP-2020)

Paper-IV: Dyes and Intermediates-I (Elective-II)

Total Periods: 60

Course Code	OEC-302	Title of the Course	**DYES AND INTERMEDIATES-I**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand azo dyes, diazotization and coupling, methods of diazotization, types of azo dyes and synthesis. • To learn about fluorocent dye. • To understand classification of dyes according to application and chemical constituents, application of various non-textile dyes, medicinal, indicator, laser dyes etc. • To understand pigment, types of pigment & their application, heterocyclic dyes and their synthesis.

Unit	Description
1.	**AZO DYES** **(15 Periods)** General Introduction: Diazotization, mechanism and differentmethods of diazotization and laws of coupling, General introduction, classification and synthesis of Monoazo dyes, Bisazo dyes and Azoic dyes. Synthesis of the following: Disperse Red 13, Acid Blue 92, Mordant Black 3, Acid Black 1, Acid Blue 113, Direct Blue 15, Direct Violet 1, Direct Red 28,Naphthol AS-BR, Fast Orange GGD.

2.	**FLUORESCENT WHITENING AGENTS** **(15 Periods)** Introduction, Theory of fluorescence, Classification of FWA andsynthesis of important member of each class and their uses. Types of Fibres and Basic Operations in Dyeing Process Types of fibres: Natural, semisynthetic and synthetic, Dyeing and Interactions: Ionic Interactions, Hydrogen bond, Van der Waal'sInteractions and Covalent Interactions. Basic Operations in Dyeing Process: Preparation of the fibres, Preparation of the dyebath, application of the dyebath and finishings, Various methods of dyeing: Direct dyeing, Vat dyeing, Mordant dyeing, Disperse dyeing and Formation of dye on the fibre, Dyeing of wool with the acid dyes, Dyeing with the reactive dyes, Fastnessproperties: Colour fastness, Light fastness, Sublimation fastnessand Burnt gas fumes fastness.
3.	**(A) Classification of Dyes according to application and chemical constitution.** **(15 Periods)** **(B) Evaluation of dyes** **(C) Dyes for Non-Textile Application** Leather dyes, Paper dyes, Hair dyes, Food dyes, Ink dyes, Photographic dyes, Indicator dyes, Laser dyes, Liquid crystaldyes, Solar cell, biological uses of dyes. Synthesis of the following: Eriochrome Black T, Sunset Yellow FCF, Acridine Yellow G,Safranine B, Prontosil, Methylene Blue, Acid Leather Brown FGB, Tartrazine
4.	**(A) Pigments** **(15 Periods)** Different classes of organic and inorganic pigments and theirapplications with examples. **(B) Heterocyclic Dyes** Pyrazolone dyes, cyanine dyes, dyes containing azine, oxazineand thiazine ring systems, Thiazole Dyes Synthesis of only the following: Basic Yellow 11, Basic Orange 21, Safranine B, Rosinduline GG, Sirius Supra Blue FFRL, Brilliant Alizarin Blue 3R, Sirius Supra Yellow RT, Acid Yellow 19, Copper Phthalocyanine, Sirius SupraLight Green FFGL

Course Outcomes: Having completed this course, the learnerwill be able to	
1.	Understand azo and azoic dyes, methods of diazotization & their mechanism, concepts, position of coupling, classification of dyes-mono, bio azo dyes & synthesis.
2.	Understand various FBA, classification of FBA, types of fibres and mechanism of dyeing on different parameters, various methods of dyeing and their fastness properties.
3.	Understand classification of dyes according to their chemical constitution,
	application, application of non textile application-like stanning,, laser, liquid crystal etc and synthesis.
4.	Understand pigments, Inorganic and Organic heterocyclic dyes, classification and synthesis.

Suggested References:

1. The chemistry of synthetic Dyes, Vol. I to VII by Venkataraman, Academic Press, New York.
2. Chemistry of Synthetic Dyes & Pigments by Lubs.
3. Dyes and their intermediates by E. N. Abrahart.
4. Handbook of synthetic dyes and pigments, Vol. I & II by K. M. Shah.
5. Industrial Dyes by Klans Hunger, Germany by Wiley-VCH.
6. Development in the Chemistry and technology of Organic Dyes by J.Griffiths, Blackwell Sci. Pub., Oxford, London.
7. Principles of colour Technology by Fred W. Billmeyer and Max Saltzman, John Wiley & Sons.
8. Advance in colour chemistry, series vol.-3, Modern colourants: Synthesis and structure, edited by A.T.Peters and H.S. Freeman, Blackie Academic & Professional(1995).
9. Colour chemistry: Synthesis, properties and applications of organic dyes and pigments, Heinrich Zollinger VCH, Germajy(1987).
10. Organic Chemnistry in Colour V., P.F.Gordan, P. Gregory, Spinger-Verlag(1983).
11. Textile Auxiliaries, J.W. Batty
12. The production and applications fluorescent brightening agents, Milos Zahradnik, John Wiley & Sons (1982).
13. Chemistry of Dyes and Principles of dyeing-V.A. Shenai
14. Synthetic dyes- G.R. Chatwal
15. Critical reports on Applied chemistry, Vol-7, Developments in chemistry and Technology of organic dyes, Edited by : J. Griffths, Blackwell

On-line resources to be used if available as reference material

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Syllabus of Master of Science, M.Sc.
Organic Chemistry, Semester III

To be effective from June 2023

(NEP-2020)
Paper-V: Industrial Safety & Water Analysis Techniques
(Skill Enhancement Course)

Total Periods: 30

Course Code	**OSEC-301**	**Title of the Course**	Industrial Safety & Water Analysis Techniques
Total Credits of the Course	2	**Hours per Week**	2 hrs.

Course Objectives:	• To teach safety parameters, health & welfare to the students. • To create awareness among students regarding Industrial and laboratory accident, its causes & its prevention. • To learn about various water analysis techniques. • To develop advance analytical skills for Quality Checking and Assurance in Laboratories.

Unit	Description
1.	**INDUSTRIAL SAFETY** **(15 Periods)** Classification of accident, Objectives of safety Management **Risk Assessment:** Process Risk Assessment, Industrial Hygiene Risk Assessment, Environmental Risk Assessment, Fire & Explosive Risk Management **Chemical Storage Safety:** Bulk storage, Solvent storage, Explosive chemical storage, Transportation storage **Static electricity, its hazards, and control measures** **Hazard Identification, Communication and Symbol**
2.	**WATER ANALYSIS TECHNIQUES** **(15 Periods)** 1. Introduction 2. Bacteriology Quality 3. Water Quality 4. Waste water treatment 5. Total Dissolved Solids (TDS) & Total Suspended Solids (TSS) determination 6. Fixed & Total Volatile Solids 7. Fixed Dissolved Solids 8. Mother Liquor Suspended Solids (MSS) & Mother Liquor Volatile suspended Solids (MLVSS)

	9. Oil, Grease and phenol determination 10. Chloride and Fluoride determination 11. Kjeldahl's method for ammoniacal nitrogen determination 12. Nitrite and Nitrate determination 13. Phosphate Determination 14. Sulphide and sulphate determination 15. Sodium and Potassium determination 16. Chromium determination 17. Fanton process 18. Hydrodynamic Cultivation 19. Micro organism purification

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written	15 Marks
2.	University External Written Examination	35 Marks

Course Outcome: Having Completed this course, the learner will be able to	
5.	To get skilled to measure risk assessment for hazardous chemical reaction, its monitoring and preventive actions to avoid accidents.
6.	To get skilled for proper chemical segregation and Industrial hygiene management to maintain safety.
7.	To get skilled for analysis of water quality, its sampling, operational techniques, and to produce results.
8.	Students will be able to use the techniques and get skilled necessary for water resource management.

Suggested Reference Books:

1. Fundamentals of Industrial safety and health by Dr. K.U. Mistry, Vol-1&2.
2. Industrial accidental prevention, H. W. Heinrich
3. Encyclopedia of Occupational Health & Safety, ILO, Geneva, Switzerland
4. Accident, Prevention Manual for Industrial Operation, NSC, USA.
5. Analytical methods for drinking water, Advances in sampling and Analysis by Phillippe Quevauviller, K. Clive Thompson.
6. Industrial Water Analysis Handbook by Natrajan Manivasakan.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Organic Chemistry

M.Sc. Organic Chemistry, Practicals

To be effective from June 2023

Semester- III

Course Code	OP-301	Title of the Course	**Practicals**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives :	• To impart basic knowledge for the separation of organic ternary mixture • To identify nature of mixture i.e., solid-solid, solid-liquid, liquid-liquid etc. • To impart knowledge of different purification techniques including distillation. • Separation and identification of component with their functional group test and M.P. /B.P. • To confirm the structure and prepare the relevant derivative. • Understand nature of reaction and establishment of reaction condition with mechanism • Preparation of reagent to carry out estimation. • To understand the purpose of estimation and establishment of respective condition.

Course content	
Organic Mixtures	6- Credit
Preparation	
Estimation	
Viva-Voce	

1. Mixture analysis: (Minimum eight mixtures)
   Ternary mixture to be given. (S+S+S). Semisolids or (L+L+L). Type, determination, Separation by physical and chemical methods. (both permitted in case of liquids)
2. Green Synthesis (Any four)
   a. Preparation of acetanilide from aniline and acetic acid using Zn dust.
   b. Base catalyzed aldol condensation using LiOH.H2O as a Catalyst.
   c. Bromination of *trans*-stilbene using sodium bromide and sodium bromated.
   d. [4+2] cycloaddition reaction in aqueous medium at room temperature.
   e. Benzil Benzilic acid rearrangement under solvent free condition

3. Organic Estimations (Any four)
   a. Determination of Sulphonamides with Silver Nitrate solution by Volumetrically.
   b. Determination of aromatic primary amines by either diazotization or indirect diazotization.
   c. Estimation of Benzyl Penicillin.
   d. Determination of coupling value (C.V.) of Dye intermediates.
   e. Non-aqueous titration of Sodium Benzoate.
   f. Estimation of Isonazid.
   g. Enzyme inhibition
   h. -NO2 and-OH group

Teaching-Learning Methodology	Introduction, interaction with students in calculation of mole ratios,carrying out experiments at each step according to the respective practical.

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand the basics to carry out reactions, nature of reaction and calculation ofmole ratio.
2.	Establish mechanism of reaction and monitoring specified reaction condition.
3.	Learn to work-up after the completion of reaction, purification.
4.	Confirm the product through the references.
6.	Learn to set up reaction condition for individual estimation of compound.
7.	Understand the calculation with reference to respective factors.
8.	Appreciate good laboratory practices.

Suggested References:

Reference Books Recommended

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Ren Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST
3. Quantitative analysis by Arther I.Vogel
4. Quantitative analysis by V.K.Ahluwalia
5. Quantitative analysis by Mann and sanders

On-line resources to be used if available as reference material

Veer Narmad South Gujarat University, Surat

Syllabus

M.Sc. Inorganic Chemistry

Semester-III

To be effective from June-2023

NEP-2020

Name of Program	**Master of Science(Chemistry)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. (Organic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Inorganic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Physical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Analytical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M. Sc . Environmental Chemistry** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Pharmaceutical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. Organic Chemistry (Evening)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry.
Objective of Program	The core objective of the M.Sc. programme is to prepare the students for dynamic career in industry and academia by providing an excellent environment of teaching and research in the core and emerging areas of the discipline.

Program Outcome	PO1: To enhance the knowledge of chemistry domains and become master in respective branch of chemistry. To be able to communicate clearly and effectively with in and across disciplinary lines. PO2: Built up entrepreneurship ability by taking advantage of industrial hub in periphery of our university. PO3: Establishment of research center with the aid of interdisciplinary subject being run in university. PO4: Persuasion of doctoral degree in the concern subject and further study. PO5 : Development of related short term courses related to demanded subject in anticipation of strengthening knowledge and application PO6: Training/internship of students for employment in public sector, private sector and national laboratories. PO7: Participation in scientific discussions showing respect and lead interdisciplinary work with experts from other fields. PO8: To understand and adopt the best safety practices in chemical research. PO9: Participation in scientific discussions showing respect and lead Interdisciplinary work with experts from other fields. PO10: To understand and adopt the best safety practices in research.

Program Specific Outcomes	Students need to build up foundation in the fundamentals & application of current chemical and scientific theories in the concerned branches of Inorganic, Organic, Analytical, Physical, Environmental and Pharmaceutical Chemistry. PSO1 : Develop scientific temper, communicate scientific information in a clear, concise and precise manner. PSO2 : Find job opportunities at all level of chemical industries(dyes & pharmaceutical), national laboratories & research centers. PSO3 : Apply the knowledge in sustainable and eco friendly technologies. PSO4 : Inculcate logical thinking to addressess the problem and become result oriented. PSO5 : Development of research culture in persuasion of Ph.D. program at national & international institute/university. PSO6 : Participate in specific competitive examination conducted by various public service commission and other public sector. PSO7 : Develop and apply the fundamental knowledge to build small scale industry in context to Atma Nirbhar Bharat. PSO8 : Scale up the synthetic product to a pilot level plant and gradually to bulk. PSO9 : Enhance the scientific temperament among the students in anticipation of developing research culture and implementation of policies at global & local level. PSO10 : Communicate scientific information clear in both writing and orally. PSO11 : Students shall start to become better readers, thinkers and learners in their discipline by processing their ideas through writing. PSO12 : Will build new scientific understanding as it provides students the opportunity to articulate their thinking as they engage in the science practices during an investigation.

Mapping between POs and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
	PO1												
	PO2												
	PO3												
	PO4												
	PO5												
	PO6												
	PO7												
	PO8												
	PO9												
	PO10												
Medium of Instruction	English												

Structure of M.Sc. Syllabus

M.Sc. Semester-III

Inorganic Chemistry

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration Hrs	Internal marks	External marks		
Theory papers:						
(1) Core-I (CC-I) Seleccted Topics in Inorganic Chemistry	4	3	30	70	100	4
(2) Core-II (CC-II) Advanced Inorganic Chemistry	4	3	30	70	100	4
(3) Core-III (CC-III) General Topics in Inorganic Chemistry	4	3	30	70	100	4
Inter/Multidisciplinary (AECC) (4) Elective Paper-I Coordination Chemistry **Or** Elective Paper-II General Chemistry	4	3	30	70	100	4
(5) Skill Based Elective paper/Swayam/MOOC courses	2	2	15	35	50	2
(6) Practical	12	12	60	140	200	6
Total	30	26	195	455	650	24

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Inorganic Chemistry
M.Sc., Inorganic Chemistry, Semester-III
To be effective from June-2023
(NEP-2020)

Paper-I: Core-I (CC-I)

Course Code		Title of the Course	Selected Topics in Inorganic Chemistry
Total Credits of the Course	**4**	Hours per Week	4 hrs.

Course Objectives:	• To learn the properties of non-transition metal elements. • To learn the synthesis, bonding, properties and applications of Organometallic compounds. • To understand the Bioinorganic chemistry of Hemoglobin, Myoglobin, Ferritin and Transferrin. • To understand the chemistry of metal and alloy and its application.

Course Content			
Unit	Description	Weightage* (%)	Periods
1.	**Chemistry of Non-Transition Elements** General discussion on the properties of the non-transition elements, Polymorphism in carbon, phosphorus and sulphur, Synthesis, properties and structure of boranes, carboranes, silicates, carbides, phosphazenes, sulphur-nitrogen compounds, peroxo compounds of boron, carbon, sulphur, structure and bonding in oxyacids of nitrogen, phosphorus, sulphur and halogens, interhoalogen, pseudohalides.	25	15
2.	**Organometallic Compounds** Introduction, definition and scope of organometallic Chemistry. 1. Metal-Carbon multiple bonded compounds: Synthesis, bonding, Properties and applications of : (a) Carbenes (b) carbynes 2. ηC_nR_n carbocyclic polyenes: Synthesis, bonding, Properties and applications of: (a) allyls η^3-C_3R_5 (b) pentadienyls η^5-C_5R_7 (c) cyclobutadienes η^4-C_4R_4 (d) cyclopentadienyls η^5-C_5R_5 (e) arenas η^6-C_6R_6 (f) cycloheptatrienyls η^7- C_7R_7 3. Synthetic applications of Main group organometallic compounds. (a) Organolithium (b) Organomagnesium (c) Organozinc a) (d) Organoboron (e) Organothallium	25	15

3.	**Bioinorganic Chemistry** 1. Biological Chemistry of Iron: (a) Transport of Iron (b) Hemoglobin and Myoglobin (c) Storage and Transport Proteins of Iron viz.Ferritin and Transferrin (d) Cytochromes 2. Biochemistry of Cobalt (a) B_{12} coenzymes and Model compounds (b) Actions of Cobalmins and Cobinamides (c) Adenosylcobalmin as a coenzyme (d) Ribonucleotidereductase 3. Biological Chemistry of Copper (a) Type I, II and III (b) Blue Copper Proteins (plastocyanins, Azurins and Blue Oxidases) (c) Models of Blue Copper compounds (d) Non-blue copper proteins (Tyrosinase, Galactose Oxidase, SOD) 4. Metal complex in Medicines. (a) Disease due to Metal deficiency and its treatment: Fe, Cu, Zn and Mn (b) Metals used in diagnosis: MRI	25	15
4.	Metal and Metallurgy Occurrence of metal, Various steps involved in metallurgical processes, Concentration of ore, Calcinationm, Roasting, Reduction to free metal, Electrometallurgy, Thermodynamics of the oxidation of metals to metal oxides, Ellingham diagram, Hydrometallurgy, Refining or purification of metals, Zone refining, Alloys: Classification and composition of alloys, Applications of alloy.	25	15

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

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

Course Outcome: Having Completed this course, the learner will be able to	
1.	To learn the properties, synthesis, structure and bonding of the non-transitionelements.
2.	To learn the M-C multiple bonded compounds and synthetic applications of main group organometallic compounds.
3.	To learn the biological chemistry of Iron and Cobalt.
4.	To understand the biological chemistry of metals and alloys and their application.

Suggested References:

1. A. F. Wells, Structural Inorganic Chemistry - 5th edition (1984)
2. J. D. Lee, Concise inorganic Chemistry, Elbs with Chapman and Hall, London
3. M. C. Day and J. Selbin, Theoretical Inorganic Chemistry, Reinhold, EWAP
4. F. A. Cotton, R. G. Wilkinson. Advanced Inorganic chemistry
5. Willam L. Jooly, Modern Inorganic Chemistry
6. Advanced Inorganic Chemistry, Bahl and Tuli, S. Chand and Company
7. Inorganic Chemistry 3rd edn. D. F. Shriver and P. W. Atkins, Oxford University Press, 1999, Chapter 16.
8. Organotransition Metal Chemistry, Anthony F. Hill, Royal Society of Chemistry,Tutorial Chemistry Text, 2002. Chapters 1 to 7.
9. Organometallics: A concise Introduction, Ch. Elshebroicn and A. Salzer, VCH, Chapters 12 to 16.
10. Organotransition Metal Chemistry: Applications to Organic Synthesis, S. G. Davies, Pergamon 1982.
11. Bioinorganic Chemistry: A Short Course -Rosette M.Roat-Malone, Wiley Interscience, 2002.
12. Biological Inorganic Chemistry -An Introduction, Robert Crichton, ElsevierScience, 2007
13. The Biological Chemistry of the Elements- The Inorganic Chemistry of Life J. J. R. Frausto da Silva and R. J. P.Williams Clarendon Press, Oxford,1991.
14. Bioinorganic Chemistry, Dr. Asim. K. Das, Books Allied Ltd, Kolkata
15. Principles of Inorganic Chemistry by Puri , Sharma and Kalia . Vishal Publishing Co. 33rd Edition.

On-line resources to be used if available as reference material.

Master of Science, Inorganic Chemistry
M.Sc., Inorganic Chemistry, Semester-III
To be effective from June-2023
(NEP-2020)

Paper-II: CORE- II (CC-2)

Course Code		Title of the Course	ADVANCED INORGANIC CHEMISTRY
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand the classification, methods of production, chemical properties and uses of different fertilizers. • To learn the different types of magnetic bodies and its magneto chemistry • To learn types of corrosion principles and corrosion inhibitors. • To understand the synthesis, characterization and properties of ionexchangers.

Course Content			
Unit	Description	Weightage* (%)	Periods
1.	**Chemical and biofertilizers** Definition, classification and uses of fertilizers, Methods of production, chemical properties and uses of urea, Ammonium sulphate, Ammonium sulphate nitrate, Ammonium chloride, Single super phosphate, triple super phosphate, Biofertilizers: Types of biofertilizers, Nitrogen fixing biofertilizers, Phosphate–solubilizing biofertilizers, Preparation of a biofertilizers, Advantages and disadvantages of biofertilizers.	25	15
2.	**Magneto chemistry** Introduction, Definition, Types of magnetic bodies, Russel-saunders and LS coupling, Derivation of Russel-Saunders terms, Spin-orbit interaction, Thermal energy and magnetic property, Magnetic moment for different multiple widths, Multiple width large compared to KT, Multiple width small compared to KT, Multiple width comparable to KT, Stereo chemical application of magnetic properties of the first transition series, Lanthanides and actinides. Determination of magnetic susceptibility by different methods i.e. Guoy method, Faraday method, Null deflection method, Evans method, NMR method.	25	15

3.	**Corrosion Inhibitors** Introduction, Classification of corrosion and corrosion inhibitors, Principles of corrosion inhibitors, Corrosion as an electrochemical process, Practical aspects of corrosion inhibition, Anion inhibitor properties in neutral electrolytes, Some applications of corrosion inhibitors (cooling water circulation-once through and open systems, engine radiation and cooling systems, central heating systems, refrigeration plants and high chloride systems, water for steam raising ,corrosion inhibitors for paint coating).	25	15
4.	**Ion Exchange** Definition of Ion Exchange, Type of Ion Exchanger, Synthesis, Characterization and properties of ion exchangers, Mechanism of ion exchange: Equilibria-rate theory, Donnan equilibria, liquid ion exchangers and chelate ion-exchange resins. Separation of metal and non-metals using ion exchangers. Inorganic ion exchangers: The clay minerals, Zeolites, heteropoly acid salts, hydrous oxides and insoluble salts and their applications.	25	15

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

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

Course Outcome: Having Completed this course, the learner will be able to	
1.	To understand the classification, methods of production, chemical properties and uses of urea, Ammonium sulphate, ammonium sulphate nitrate, ammonium chloride, single super phosphate, triple super phosphate, bio fertilizers. Learn the types of biofertilizers like nitrogen fixing and phosphate-solubilizing.
2.	To learn types of magnetic bodies, Russell-Saunders and LS coupling. Derivation of Russell-Saunders terms, spin-orbit interaction, thermal energy and magnetic property, magnetic moment for different multiple widths, multiple width large and small compared to KT, lanthanides and actinides. To understand the determination of magnetic susceptibility by different methods.
3.	Learn the types of corrosion principles of corrosion inhibitors, corrosion as an electrochemical process, practical aspects of corrosion inhibition, anion

	inhibitor properties in neutral electrolytes, some application of corrosion inhibitors.
4.	To understand the synthesis, characterization and properties of Ion exchangers, mechanism of ion exchange, equilibria-rate theory, Separation of metal and non- metals using ion exchangers. To learn the Inorganic ion exchangers and their applications.

Suggested References:

1. CE Harland 1994 Ion exchange theory and practice, second Edn, Royal society ofchemistry Cambridge.
2. J. Korkisch 1989 Handbook of ion exchange resins, their application to inorganicchemistry CRC press, Boca Raton FL.
3. An introduction to metallic corrosion: U. R. Evans, Cambridge, England.
4. UHLIGS Corrosion hand book, R. Winston Revie., John Wiley & Sons JNC.
5. Vogel's text book of quantitative chemical analysis, sixth Edn. J. Mendham R CDenney, J.D. Barnes, M J K Thomas.
6. Advanced in inorganic chemistry vol. 1 & 2, Gurdeep Raj, Krishna Publication Meerut.
7. Collings G. H., Commercial Fertilizers, 5th edition, Mc Graw Hill, New York, 1955.

On-line resources to be used if available as reference material

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Inorganic Chemistry
M.Sc., Inorganic Chemistry, Semester-III
To be effective from June-2023
(NEP-2020)

Paper-III: CORE- III (CC-3)

Course Code		Title of the Course	General Topics in Inorganic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To learn different theories to understand shape and geometry of different molecules. • To learn about nature of nucleus and theory of radio activity. • To learn about principles, different forms and prevention ofcorrosion chemistry. • To understand basic requirement of titration and types of EDTA titration.

Course Content			
Unit	Description	Weightage* (%)	Periods
1.	**Stereochemistry and bonding in compound** Wave mechanical treatment of covalent bond, Valence bond theory, Molecular orbital theory and VSEPR theory,Walsh diagrams, Shapes of molecules having regular and irregular geometry, Orbital configuration of some triatomic molecules, Hybridization, Bent's rule and energetics of hybridization, dπ - pπ bonds, structure of some adducts, characteristic features of hybridization, Rules of hybridization.	25	15
2.	**Nuclear chemistry** The nature of the nucleus, Nuclear stability, Packing fraction, Magic number, Isotopes, Isobars, Isotones and Isomers, Natural radioactivity, Theory of radioactivity disintegration, Radioactive equilibrium, Radioactive series, Units of radioactivity, Measurement of radioactivity, Nuclear transmutation, Artificial radioactivity, Nuclear reaction, Nuclear fission and fusion, Trace elements, Application of radioactive isotopes.	25	15
3.	**Corrosion Chemistry** Principles of corrosion and rate expressions, Different forms of corrosion, Corrosion by sea water and boilers, Contact and crevice corrosion, Stress corrosion, Cracking and related phenomena, Hydrogen cracking corrosion prevention- corrosion inhibitors and passivators, Cathodic and anodic protection, Types of coating, Role of paints and pigments, Plastic linings, Alloying for corrosion resistance,	25	15

4.	**Volumetric Titrimetry** Terminology, basic requirements of a titration reaction, standard and primary standard solution, Expressing concentration of standard solution, Volumetric titration co-relation, p- functions, Acid-base titrations, Theory of acid-base indicators, Redox titration, complexometric titration, EDTA titration, Indicators for EDTA titration, Titration curves, EDTA titration methods, Cautions in volumetric titrimetric, Correction for unavoidable errors.	25	15

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

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

Course Outcome: Having Completed this course, the learner will be able to	
1.	Learn the wave mechanical treatment of covalent bond, valence bond theory, molecular orbital theory, VSEPR theory, Walsh diagrams, shapes of molecules having regular and irregular geometry, orbital configuration of different molecules.
2.	Learn the nature of the nucleus, natural radioactivity, theory of radioactivity disintegration and its equilibrium, series, units, measurement and application of radioactive isotopes.
3.	Understand the principles of corrosion, different forms of corrosion, prevention- corrosion inhibitors and passivators, cathodic and anodic protection, metallic coating, role of paints, plastic linings, alloying for corrosion resistance.
4.	Gained knowledge of basic requirements of a titration reaction, standard and primary standard solution, expressing concentration of standard solution, volumetric titration co-relation, p-functions, acid-base titration, theory of acid base indicators, redox titration, complexometric titration, indicators for EDTA titration, cautions in volumetric titrimetric.

Suggested References:

1. Principle of Inorganic Chemistry: Puri Sharma, Kalia, Thirty Third Edn. (VishalPublishing Co.).
2. Advanced in Inorganic Chemistry: S. K. Agrawal, Keemti Lal, Fifteenth Edn. (PragatiEdition).
3. An introduction to metallic corrosion: U. R. Evans, Cambridge, England.
4. UHLIGS Corrosion hand book, R. Winston Revie., John Wiley & Sons JNC.
5. Vogel's text book of quantitative chemical analysis, sixth Edn.
6. Advanced in Inorganic chemistry vol. 1& 2, Gurdeep Raj, Krishna Publication Meerut.
7. Selected topics in inorganic chemistry: Malik, Tuli, Madan.

On-line resources to be used if available as reference material

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Master of Science, Inorganic Chemistry
M.Sc., Inorganic Chemistry, Semester-III
To be effective from June-2023
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Paper-IV: ELECTIVE PAPER -I (CE-1)

Course Code		Title of the Course	Co-ordination Chemistry (Elective Paper-1)
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• Understand theoretical principle of valence bond theory, Crystal field theory. • Learn the Advanced theory Molecular orbital theory for complexation. • Understand the theoretical aspects of spectra of complexes. • Learn the Crystal field diagram for d^1 and d^{10} configuration, Orgel diagram for Oh and Td complexes (d^1-d^9 states)

Course Content			
Unit	Description	Weightage* (%)	Periods
1.	**1. Theories of Metal Ligand Bonding-I** Theoretical principles of VBT, Inner Orbital complexes and Outer Orbital complexes, Examples of complexes of co- ordination number 2 to 6, Advantages and limitations of valence bond theory.Theoretical principles of CFT, CFT of weak and strong field compounds: Splitting pattern in Octahedral(Oh), Tetrahedral(Td), Square planar(D_4h), Trigonalbipyramidal (TBP) and Square Planar(SP) complexes, limitation of crystal field theory, Structural effects of orbital splitting.	25	15
2.	**THEORIES OF METAL LIGAND BONDING –II** Jahn Teller effects and distortions in Oh complexes. Ligand Field Theory(LFT). Experimental evidences in support of metal ligand overlap. Adjusted crystal field theory (ACFT), Determination of Ligand group of orbitals, σ bonding and π bonding, Qualitative Molecular Orbital energy level diagrams and their interpretation of Oh, Td and square planar complexes with examples.	25	15
3.	**Electronic Spectral Properties of Transition metal and metal complexes-I** Spectroscopic Terms, Coupling of terms, microstates for the p, d and f configurations. Hund's rule for ground state term, Derivation of Russel-Saunders terms, the correlation of spectroscopic terms in	25	15

	Mulliken symbols, Electronic transition selection rules, spin- orbit coupling. Crystal field diagram for d^1 and d^{10} configuration. Orgel diagram for Oh and Td complexes(d^1-d^9 states).		
4.	**Electronic Spectral Properties of Transition metal and metal complexes-II** Tanabe Sugano energy level diagram for Oh and Td complexes (d^1-d^9 states), Charge transfer spectra and interligand spectra, Factors affecting charge transfer spectra, Calculation of Dq, B' and β parameters for Co(II) and Ni(II) complexes using electronic spectral data under different geometries, Spectrochemical series and Nephelauxatic series, Intensity of spectral peak: Oscillator strength and band width.	25	15

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

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

Course Outcome: Having Completed this course, the learner will be able to	
1.	Learn the theoretical principle of VBT Inner orbital complexes and outer orbital complexes, example of complexes of co-ordination number 2 to 6, advantages and its limitations.
2.	Learn advanced theories like Jahn teller effects and distortions in Oh complexes, Ligand field theory (LFT), Adjusted crystal field theory (ACFT), Qualitative molecular orbital energy level diagrams and their interpretation of Oh, Td and SP.
3.	Understand Spectroscopic terms, coupling of terms, microstates for the p, d and f configurations, Hund's rule for ground state term, electronic transition selection rules, spin-orbit coupling. Crystal field diagram for d^1 and d^{10} configuration. Orgel diagram for Oh and Td complexes (d^1-d^9) states
4.	Understand the Tanabe Sugano energy level diagram for Oh and Td complexes (d^1-d^9 states). Charge transfer spectra and inter ligand spectra, factors affecting charge spectra, calculation of Dq, B' and β, spectrochemical series and nephelauxatic series.

Suggested References:

1. Inorganic chemistry (principle of structure and coordination compounds) J.E Huheey,Harper and Row International series, New York (1983).
2. Advanced Inorganic chemistry F.A. Cotton and G. Wildinson, Inter science, New York(1988).
3. Theoretical Inorganic Chemistry (new edition) M.C. Day And J. Selbin East-West Press Pvt. Ltd (New Delhi) 1971.
4. A Modern Introduction Chemistry, T. Moeller John Wiley and Sons, New York.
5. Principle of inorganic chemistry, Puri, Kalia and Sharma, Vishal Publishing Co.Jalandhar.
6. Advanced inorganic chemistry, S. K Agrawal and Keemtilal, Pragati Prakashan.
7. Co-Ordination Chemistry Pimplapure, Jain, Pragati Prakashan.
8. General and Inorganic chemistry, R Sarkar, New Central Book Agency.
9. Advanced inorganic chemistry, Tuli Basu and Madan (Volume-II).
10. Inorganic electronic spectroscopy (II edition), A.B.P. Lever, Elsevier, Amsterdam.
11. Introduction to ligand field, B.N. Feggis, Inter science, New York (1966).
12. Physical Methods in Inorganic chemistry (both edition), R.S. Drago, W.B. Saunders,Philadelphia (1977).
13. Introduction to ligand field theory, C.G. Ballhenson, Mc Graw-Hill, New York (1962).
14. Electron absorption spectroscopy and related techniques, D.N. SathyanarayanaCompound, Indrajeet Kumar, Pragati Prakashan.
15. Organometallic Compound, IndrajeetKumar, Pragati Prakashan

On-line resources to be used if available as reference material

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Inorganic Chemistry
M.Sc., Inorganic Chemistry, Semester-III
To be effective from June-2023
(NEP-2020)

Paper-IV: ELECTIVE PAPER -II (CE-2)

Course Code		Title of the Course	General Chemistry (Elective Paper-2)
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• Understand theoretical principle, effect, theories of Ligand substitution reactions in square planar complexes • Learn the mechanism and theory of oxidation-reduction reactions in co-ordination compounds. • Understand the Electronic Spectral Properties of Transition metal and metal complexes by using analytical teckniqes • Learn the toxicity of Inorganic elements and chemicals, their biological effects and dieases.

Course Content			
Unit	Description	Weightage* (%)	
1.	**Ligand substitution reactions in square planar complexes** The trans-effect, Trans-effect series, Uses of trans-effect, Theories of trans-effect: Electrostatic polarization theory, Bonding theory; Mechanism of substitution reactions, Factors affecting the rates of the substitution reactions in square planar complexes, Cis-Trans isomerization in planar complexes.	25	15
2.	**Electron-Transfer (or oxidation-reduction reaction) in co-ordination compounds.** Mechanism of one electron transfer reactions: (a) Atom (or group) transfer or inner sphere mechanism, (b) Direct electron transfer or outer mechanism, Factors affecting the rates of direct electron transfer reactions, Two electron transfer reactions, Complementary electron transfer reactions and its mechanism	25	15
3.	**Electronic Spectral Properties of Transition metal and metal complexes-I** Basic idea and applications of Neutron activation analysis, Anodic stripping voltammetry (ASV), Atomic Absorption Spectroscopy (AAS), Inductively- Coupled Plasma Emission spectroscopy (ICPES), X-ray fluorescence, non-dispersive infrared spectroscopy,	25	15

	Chemiluminescence, Gas chromatography, High performance (pressure) liquid chromatography (HPLC), Ion- selective electrodes, Ion chromatography.		
4.	**Chemical Toxicology** Introduction, Toxic Chemicals in the environment, Impact of toxic chemical on enzymes, Biochemical Effect of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, Nitrogen Oxides, Sulfur Dioxide, Ozone and PAN , Cyanide, Pesticide, Carcinogens, Bio warfare Agents, nironemtn and Public Health , Health and disease: Vector-Borne disease, water-borne disease, Factors for spread of Cholera, control of Cholera, Prevention of Amoebiasis.	25	15

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

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

Course Outcome: Having Completed this course, the learner will be able to	
1	Learn the different effects, theories, mechanism of substitution reactions, Factors affecting the rates of the substitution reactions, isomerization in square planar complexes
2	Learn mechanisms, Factors affecting of Electron-Transfer (or oxidation-reduction reaction) in co-ordination compounds.
3	Understand the basic idea and applications of Neutron activation analysis, different analytical teckniques for studying Electronic Spectral Properties of Transition metal and metal complexes
5.	Understand the toxicity of chemicals, their impacts on Health, Biochemical effects of different inorganic elements, water borne disease.

Suggested References:

1. Inorganic Chemistry (Principles of structure and coordination compounds) J.E Huheey Harper and Row International series, New York (1983).
2. Advanced Inorganic Chemistry F.A.Cotton and G.Wildinson, Interscience, New York (1988).
3. Theoretical Inorganic Chemistry (New Edition) M. C. Day and J. Selbin East-WestPressPvt. Ltd. (New Delhi) 1971.
4. A modern Introduction Inorganic Chemistry T. Moeller John Wiley and Sons, NewYork,
5. Principle of Inorganic Chemistry, Puri, Kalia and sharma, Vishal Publishing Co. Jalandhar
6. Advanced Inorganic Chemistry, S. K Agrawal and Keemtilal, Pragati Prakashan
7. Co-ordination Chemistry Pimplapure, Jain, Pragati Prakasham
8. General and Inorganic Chemistry, R Sarkar, New Central Book Agency
9. Advanced Inorganic Chemistry, TuliBasu and Madan(Volume II)
10. Inorganic Electronic Spectroscopy (II Edition), A.B.P. Lever, Elsevier, Amsterdam
11. Introduction to Ligand Field, B. N. Feggis, Interscience, New York (1966).
12. Introduction to Ligand Field Theory, C.G. Ballhenson, McGraw-Hill, New York (1962).
13. Electron Absorption Spectroscopy and Related Techniques. D.N. SathyanarayanaUniversities Press (India) Ltd. Hyderabad (2001).
14. Selected topics in inorganic chemistry by Wahid U Malik, G D Goel and R D Madan, S. Chand Co. publication, 7th Ed.
15. Environmental Chemistry by A.K. De, New Age International, 6th Ed.

On-line resources to be used if available as reference material

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Master of Science, Inorganic Chemistry
M.Sc., Inorganic Chemistry, Practical
Semester-III
To be effective from June-2023
(NEP-2020)

Course Code		Title of the Course	Inorganic Practicals
Total Credits of the Course	6	Hours per Week	12 hrs.

Course Objectives:	• To impart basic knowledge of constituents of Ores, alloys, samples. • Understand the opening of alloy and ores. • To learn the analysis of constituents in alloys and ores. • To learn practical methods for estimation of different metals in ores, alloys gravimetrically and volumetrically • To learn mole-ratio method and Job's method to know the composition of the complexes.

Course Content	
Estimation of Ore-Alloy	
Analysis of Sample	
Job's Method	
Viva-Voce	

1. Analysis of Brass alloy
2. Analysis of Ultramarine sample
3. Analysis of Hydrogen peroxide (H_2O_2)
4. Analysis of Dolomite Ore
5. Analysis of fertilizer sample
6. Analysis of Stainless Steel
7. Analysis of German Silver
8. Analysis of Portland Cement.
9. Analysis of Available lime
10. Analysis of PO_4^{-3} for K_2HPO_4 spectrometrically
11. Determine the λmax for Cu-en complex[(1:1), (1:2),(1:3)] complex
12. Determine the composition of Cu-en complex by Job's method

13. Determine the λmax for Ni-en complex[(1:1), (1:2),(1:3)] complex 14. Determine the composition of Ni-en complex by Job's method.

Teaching-Learning Methodology	Introduction, interaction with student for analysis of Ore/Alloy.Sample and estimation of metal-ligand by Mole-ratio method andperforming the experiment according to the respective method.

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

Course Outcome: Having Completed this course, the learner will be able to	
1.	Understand the basics of opening of ores and alloys.
2.	Learn the percentage of constituents in different samples, alloys and ore by different methods.
3.	Learnt to perform experiments using different references.
4.	Learn to perform practical by qualitative methods.
5.	Learn Mole-ratio of metals and ligands.
6.	Understand the calculation using different references.
7.	Appreciate good laboratory practices.

Suggested References:

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Ren Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry TaskForce Committee, DST.
3. Quantitative analysis by Arther I. Vogel.
4. Quantitative analysis by V.K. Ahluwalia.
5. Quantitative analysis by Mann and sanders

On-line resources to be used if available as reference material

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M.Sc., Inorganic Chemistry, Semester-III
To be effective from June-2023
(NEP-2020)

Paper-V: Skill Enhancement Course

Course Code		Title of the Course	Atmospheric Pollution
Total Credits of the Course	2	Hours per Week	2 hrs.

Course Objectives:	• To teach particulate matter and aerosols in atmosphere, acid rain and depletion of ozone layers to the students. • To create awareness among students regarding source of air pollution and their generation of particulate matter. • To learn about various effects of acid rain and depletion of ozone.

Unit	Description	Weight (%)	Periods
1.	**Particulate matter and Aerosols in atmosphere** Introduction, Classification of aerosols and their sources, physical properties of particulate matter, mechanisms of particulate formation in atmosphere, chemical composition of ambient particulate matter, inorganic particulate matter, organic particulate matter, chemistry in aqueous systems-aerosols, clouds, fogs and rain, effect of particulate matter on plants, humans, materials and solar radiation and climate, particulate matter control	**50**	**15**
2.	**Acid rain and depletion of ozone layer** Introduction, chemistry of acid rain, oxidation of SO_2, oxidation of NO_2 to nitric acid, role of meteorology in acid rain, geological effects of acid rain, effects of acid rain on plants and freshwater biota. Inroduction, ozone in atmosphere, the SST problem, Inter relation between ClO_x and CH_4, NO_x and HO_x, ozone hole affect to us, ozone depletion in mesosphere, overcome the ozone depletion problem.	**50**	**15**

Teaching-Learning Methodology	Introduction, interaction with student for analysis of Ore/Alloy, Sample and estimation of metal-ligand by Mole-ratio method andperforming the experiment according to the respective method.

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

Course Outcome: Having Completed this course, the learner will be able to	
1	Understand the basics of Particulate matter and Aerosols in atmosphere
2	Learn the chemistry and effects of acid rain on plants and freshwater biota **and depletion of ozone layer in atmosphere (15 Periods)**

Suggested References:

1. Fundamentals of Industrial safety and health by Dr. K.U. Mistry, Vol-1&2.
2. Industrial accidental prevention, H. W. Heinrich
3. Encyclopedia of Occupational Health & Safety, ILO, Geneva, Switzerland
4 Accident, Prevention Manual for Industrial Operation, NSC, USA.
5. Analytical methods for drinking water, Advances in sampling and Analysis by Phillippe Quevauviller, K. Clive Thompson.
6. Industrial Water Analysis Handbook by Natrajan Manivasakan

On-line resources to be used if available as reference material

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Veer Narmad South Gujarat University, Surat

Syllabus

M.Sc. Physical Chemistry
Semester III

To be effective from June-2023

NEP-2020

Name of Program	**Master of Science(Chemistry) and M.Sc. Organic Chemistry (Evening)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**M.Sc. (Organic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Inorganic Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Physical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Analytical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M. Sc . Environmental Chemistry** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. (Pharmaceutical Chemistry)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry. **M.Sc. Organic Chemistry (Evening)** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry.
Objective of Program	The core objective of the M.Sc. programme is to prepare the students for dynamic career in industry and academia by providing an excellent environment of teaching and research in the core and emerging areas of the discipline.

Program Outcome	PO1: To enhance the knowledge of chemistry domains and become master in respective branch of chemistry. To be able to communicate clearly and effectively with in and across disciplinary lines. PO2: Built up entrepreneurship ability by taking advantage of industrial hub in periphery of our university. PO3: Establishment of research center with the aid of interdisciplinary subject being run in university. PO4: Persuasion of doctoral degree in the concern subject and further study. PO5 : Development of related short term courses related to demanded subject in anticipation of strengthening knowledge and application PO6: Training/internship of students for employment in public sector, private sector and national laboratories. PO7: Participation in scientific discussions showing respect and lead interdisciplinary work with experts from other fields. PO8: To understand and adopt the best safety practices in chemical research. PO9: Participation in scientific discussions showing respect and lead Interdisciplinary work with experts from other fields. PO10: To understand and adopt the best safety practices in research.

Program Specific Outcomes	Students need to build up foundation in the fundamentals & application of current chemical and scientific theories in the concerned branches of Inorganic, Organic, Analytical, Physical, Environmental and Pharmaceutical Chemistry. PSO1 : Develop scientific temper, communicate scientific information in a clear, concise and precise manner. PSO2 : Find job opportunities at all level of chemical industries(dyes & pharmaceutical), national laboratories & research centers. PSO3 : Apply the knowledge in sustainable and eco friendly technologies. PSO4 : Inculcate logical thinking to addressess the problem and become result oriented. PSO5 : Development of research culture in persuasion of Ph.D. program at national & international institute/university. PSO6 : Participate in specific competitive examination conducted by various public service commission and other public sector. PSO7 : Develop and apply the fundamental knowledge to build small scale industry in context to Atma Nirbhar Bharat. PSO8 : Scale up the synthetic product to a pilot level plant and gradually to bulk. PSO9 : Enhance the scientific temperament among the students in anticipation of developing research culture and implementation of policies at global & local level. PSO10 : Communicate scientific information clear in both writing and orally. PSO11 : Students shall start to become better readers, thinkers and learners in their discipline by processing their ideas through writing. PSO12 : Will build new scientific understanding as it provides students the opportunity to articulate their thinking as they engage in the science practices during an investigation.

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Mapping between POs and PSOs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
	PO1		■	■				■	■	■	■		
	PO2	■		■		■		■	■	■	■		■
	PO3	■		■	■	■				■	■	■	■
	PO4	■	■	■	■			■		■	■	■	■
	PO5		■	■	■			■			■		■
	PO6	■		■	■	■				■	■		■
	PO7		■	■	■	■			■		■		■
	PO8	■	■		■		■	■	■	■		■	■
	PO9	■		■	■		■			■	■	■	■
	PO10	■		■		■				■			■
Medium of Instruction	English												

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

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library, IT tools, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Structure of M. Sc Syllabus

M.Sc. Semester-III

(PHYSICAL CHEMISTRY)

To be effective from June 2023

Sr. No.	Course Title	L	Credit
1	Advanced Thermodynamics	4	4
2	Physical Chemistry of Materials	4	4
3	Electro Analytical Techniques	4	4
4	Molecular Spectroscopy (Elective I) OR Selected topics in Physical Chemistry (Elective II)	4	4
5	Skill enhancement	2	2
6	Practicals	12	6
		30	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No.	Course group	Credit	Internal Marks	External Marks	Total Marks
M.Sc.	III	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Elective I OR Elective II	04	30	70	100
		V	Skill enhancement	02	35	15	50
			Practical	06	60	140	200
			Total	24	215	435	650

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M.Sc. Semester-IV (PHYSICAL CHEMISTRY)

Sr. No.	Course Title	L	Credit
1	Advanced Chemical Kinetics	4	4
2	Polymer Chemistry	4	4
3	Separation Techniques	4	4
4	Atomic Spectroscopy (Elective I) OR Project work /Industrial Training (Elective II)	4	4
5	Skill enhancement	2	
6	Practicals	12	8
		30	24

External Examination Time Duration: 03 hrs

Name of Exam	Semester	Paper No.	Course group	Credit	Internal Marks	External Marks	Total Marks
M.Sc.	III	I	Core	04	30	70	100
		II	Core	04	30	70	100
		III	Core	04	30	70	100
		IV	Elective I OR Elective II	04	30	70	100
		V	Skill enhancement	02	35	15	50
			Practical	06	60	140	200
			Total	24	215	435	650

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Semester IIIPAPER-I
(Advanced Thermodynamics)
To be effective from June 2023
(NEP-2020)

Course Code	PCC-301	Title of the Course	**Advanced Thermodynamics**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• Application of statistical thermodynamics to gas , liquid and solid • To learn the calculation of partition function for differentensembles and gaseous systems. • Theoretical explanation on thermodynamic function of liquidmixtures. • The behaviour of gaseous stems in terms of empirical equations

Course Content	
Unit	**Description**
I	**Statistical Thermodynamics of Ensembles** **(15** Periods) Phase Space, The Liouville theorem, Ergodic Hypothesis, Ensemble and probability, ensemble averages and postulates. Types of ensemble: Canonical ensemble, Micro-canonical ensemble and Grand canonical ensemble. Partition function and Probability distribution for canonical ensemble, Partition function for Grand canonical ensemble (using Lagrange's method of undetermined multipliers), Thermodynamic functions (Helmholtz free Energy function, pressure, Internal energy, Entropy) for canonical ensemble and Grand canonical ensemble, Partition function and Probability distribution for Micro canonical ensemble, Numerical Fluctuations, Mean distribution and mean square deviation, Fluctuation in energy in a canonical ensemble
II	**Statistical Thermodynamics of Ideal Gases and Solid** **(15** Periods) Ideal mono atomic gas, Thermodynamic function for mono atomic gas (statistical derivation of Helmholtz free Energy function, pressure, Internal energy, Entropy), Derivation of Sackur-Tetrode equation, Gibbs Paradox, Partition function and Thermodynamic function for diatomic and polyatomic gas (Helmholtz free energy, Internal energy, heat capacity, entropy). Molecular partition function: electronic and nuclear partition function, Treatment of diatomic and polyatomic molecules – entropy, vibrational entropy and rotational entropy, Statistical thermodynamic of solid, characteristic of crystalline solid, Einstein model and Debye theory of heat capacity of solid, Numerical

III	**Thermodynamics of Liquid Mixtures**	**(15** Periods)
	Types of molecular interactions in solution of electrolytes and non-electrolyte: ion-dipole, London dispersion forces (LDF), dipole- dipole interactions, dipole induced dipole and hydrogen bonding. Activity and activity coefficient in solution, determination of Activity and activity coefficient, Variation in activity and activity co efficient with respect to T & P. ideal and non- ideal behaviour of phase equilibria (isothermal and isobaric), semi empirical equations explaining multi component thermodynamics properties for binary data, Theories of solutions non-electrolyte liquids: van Laar theory, van der Waals theory, Scatchard- Hildebrand theory, Lattice theory. Theory of electrolytes: limitations/modifications of Debye Huckle limiting law, Bromley's Method, Pitzer's Method	
IV	**Thermodynamics of Gas State**	**(15** Periods)
	Ideal Gas law, empirical equation for ideal gas, deviation of real gas from ideal behaviour, Adiabatic expression of ideal gas, thermodynamic representation of real gas: Fugacity, Reference state for real gas, Determination of Fugacity and activity coefficient for real gas: Approximate method, graphical method, viral expression representation of real gas. Variation in activity and activity co efficient with respect to T & P. the fugacity of gases in mixtures, determination of fugacity in mixtures of gases, The van der Waals equation : correction due to excluded volume, force of attraction, Internal pressure, Second Viral Coefficient, van der Waals equation as function of pressure and temperature, intermolecular forces, critical phenomena, phase transition and van der Waals, Reduced van der Waals equation, other equation of state	

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / 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.	Understand the contribution of different partition function to the assigned system. Calculation of thermodynamic functions for the systems
2.	Understand sets of partition functions and calculation for various gaseous systems. The fluctuations in calculation of thermodynamic functions
3.	To learn different types of interactions in liquid mixtures the derivation of empirical equation for excess thermodynamic functions for liquid mixtures
4.	To understand critical phenomena of gaseous systems.

Suggested Reference Books

1. Statistical Thermodynamics by M. G. Gupta, New Age Publication
2. Statistical Thermodynamics : Fundamental and Applications by Normanad Laurendeau,Cambridge Press
3. Introduction to Statistical Thermodynamics by Terrell Hill, Addison Welsey Publication
4. Applied Statistical Thermodynamics by Klaus Lucas Springer
5. Molecular Thermodynamics of Fluid Phase Equilibria by J.M.Prausnitz, R.N. Lichtenthaler, E.G.Azevedo
6. Thermodynamic Properties of Nonelectrolyte Solutions By William Acree, Acadamic Press
7. Physical Chemistry : Concepts and Theory: Kenneth Schmitz, Elsevier
8. Advanced Physical Chemistry by Puri, Sharma and Pthania

Online resources to be used if available as reference materials

Online Recourses

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Physical Chemistry

M.Sc. Physical Chemistry, Semester III

PAPER-II (Physical Chemistry of Materials)

To be effective from June 2023

(NEP-2020)

Course Code	PCC-302	Title of the Course	**Physical Chemistry of Materials**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand kinetics of enzyme catalyst reaction. Enzymes inhibition immobilization, thermodynamics of biological reactions • To understand phase diagrams for the mixtures. • To learn about arrangements of molecules in solids. • To understand concept of Electronic Behavior of Materials

Course Content	
Unit	**Description**
1	**Biophysical Chemistry** **(15 Periods)** Bioenergetics: Standard free energy change in biochemical reactions (exergonic and endergonic). ATP hydrolysis, synthesis of ATP, Energy rich compounds and energy coupling (Formation and hydrolysis of energy rich bonds in energy rich molecule). Enzyme Kinetics: Michaelis-Menten, Michaelis-Menten for all types of Inhibition, Lineweaver-Burke plots. Application of L-B plot, Enzyme inhibition: reversible and irreversible inhibition, Immobilized enzymes, Techniques and methods of immobilization of enzymes, Application of immobilized enzymes. Cell Membrane: Structure and Transport functions of cell membrane. Passive and active transport, Facilitated diffusion, Targeted Diffusion
2	**Phase Equilibria of Multi Component Systems** **(15 Periods)** Thermodynamic aspects of phase transition, The dependence of stability on conditions: temperature on phase stability, melting point on pressure, vapour pressure of liquids on pressure. Location of phase boundary Phase rule for three component systems, Representation, methods of computing composition of ternary systems : methods of parallel and perpendicular lines, lever arm rule,

	Systems of three liquid component exhibiting partial miscibility (Formation of (a) one pair, (b) two pair and (c) three pairs of partially miscible liquids System composed of two solids and liquid components (a) crystallization of pure components (b) double salt formation (c) hydrate formation (d) formation of solid solution (Phase transitions in the ternary system
III	**Solid State Chemistry** **(15 Periods)** Ionic Crystals & Their structures, detailed explanation of types of packing and co-ordination number, Radius ratio rule and prediction of packing of crystals, Polarization, Crystalline solids: Geometry of AB_2 type: Fluorite (CdI_2), antifluorites ($CdCl_2$), Rutile structures (TiO_2). AB_2 type: ReO_3, BiI_3, A_2B_3 type: Fe_2O_3 ,Corundum Al_2O_3, Ternary Compounds ABO_3 type: Perovskite, AB_2O_4 type : Spinel structure Perfect & Imperfect crystals, Schottky defect, Frenkel defect, thermodynamics of Schottky & Frankel defects, Line defects: Dissociation, Extended defects: Lineage boundary, grain boundary, stacking fault
IV	**Electronic Behavior of Materials** **(15 Periods)** Metals, Insulators and Semiconductors, Electronic structure of solid, bond theory, band structure of metals, insulators and semiconductors, Intrinsic and extrinsic semiconductors, doping of semiconductors and conduction mechanism, the band gap. Temperature dependence of conductivity, carrier density and carrier mobility in semiconductors, synthesis and purification of semiconducting materials, single crystal growth, zone refining, fractional crystallization. Superconductivity: Introduction, basics of super conductivity, BCS theory Meissner effect, Josephson effect, Type I&II superconductors, Applications of superconductors, Low Temperature Superconductor (LTSC) and High Temperature Superconductor (HTSC)

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / 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.	Understand biophysical chemistry of enzyme catalysed reaction. Immobilization of enzymes and role of cell membrane.
2.	Identify the separation of solid or liquid using phase diagram.
3.	Designing of new compounds using concept of solid state
4.	Different theories help to understand the behaviour of Electronic materials in depth

Suggested Reference books:

1. Phase equilibria by Mats Hillert
2. Biochemistry by C.B.Powar and G.R. Chatwal
3. Physical chemistry by P.W.Atkins & dePaula 7Th Edition
4. Advanced physical chemistry by Gurtu & Gurtu
5. West A.R.,Solid State Chemistry and its Applications, Plenum
6. Solid state chemistry : introduction by Lesley E.Smart Elaine A.Moore, CRC press
7. West A.R.,Solid state Chemistry,John Wiley
8. Solid State Chemistry by D.K.Chakraburti, New Edge InternationPublication 1996.
9. West A.R.,Solid State Chemistry and its Applications, Plenum

Online resources to be used if available as reference materials

Online Recourses

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Physical Chemistry

M.Sc.Physical Chemistry, Semester III

PAPER-III (Electro AnalyticalTechniques)

To be effective from June 2023

(NEP-2020)

Course Code	PCC-303	Title of the Course	**Electro AnalyticalTechniques**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand process chemistry and research, basic knowledge of Polarography. • To learn about calculation of concentration of compound using Polarography. • To learn about types of electrodes and their selectivity for the ionsin solution. • Concept of Chronopotentiometry.

Course Content	
Unit	**Description**
I	**Potentiometric Titration and Chronopotentiometry** **(15 Periods)** (a)Fundamentals of potentiometry, Instrumentation, electrode system, accuracy of direct potentiometric measurements and its limitations, potentiometric titrations, neutralization titrations, end- point detection, oxidation- reduction, precipitation titrations, complexometry titrations with example, applications and advantages. Numerical (b) Chronopotentiometry Principle, Instrumentation and procedure, applications
II	**DC-Polarography** **(15 Periods)** Theory and Applications of Polarography, Types of currents: Residual Current, Migration Current and Diffusion Current, Nature of the Limiting Current: 1) Kinetic currents, 2) Catalytic currents and 3) Adsorption currents, Electro capillary maxima, Maxima of first kind and second kind , Maxima suppressors, DME as electrode, Wave equation, Ilkovic equation (derivation), Reversible electrode reactions at DME half wave potential, Interference and removal of oxygen, Reversible Electrode Reactions of Metal Complexes at D.M.E (Ligane method) Determination of stability constants of complexes. Amperometric titrations: Principle, DME & RPE, curves, Biamperometric titration.

III	**Morden Polarographic Methods**	**(15 Periods)**
	A.C. Polarography: Principle of Sinusoidal alternating applied potential, AC peak polarogram, Peak current equation, Characteristic of AC polarographic peak, Importance of signal to noise ratio for the sensitivity, Comparison with DC polarography. **Square-wave Polarography:** Principle of alternating rectangular wave voltage applied, Frequency of square wave applied, Problems of large condenser currents in A.C., Peak polarogram, Peak current equation, Limitations of techniques. **Pulse Polarography:** Effect of capillary response with frequency of applied square wave potential , Principles and difference between Normal Pulse Polarography and Differential Pulse Polarography, Importance of charging and Faradaic currents.	
IV	**Ion selective electrodes**	**(15 Periods)**
	Classification of ion selective electrodes, Solid state electrodes – Glass electrode effect of glass structure on selectivity function of the glass electrode. Acid error, Alkali error, Silver halide, Sulphide, Lanthanum fluoride ion selective electrodes. Liquid ion exchange electrode – Calcium selective ion electrodes. Gas electrodes, ammonia, sulphur dioxide, oxygen and CO_2 sensing electrode, Micro ion selective electrode, enzyme electrodes. Application and Numerical	

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / 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.	Understand concept of polarography and its importance in analysis of elctroactive compounds
2.	Learn types of various electrodes their characteristics and their uses
3.	Understand the application of different Polarography in identification of compounds
4.	Understand the Potentiometric Titration and Chronopotentiometry

Suggested Reference books:

1. Polarography: Kolthoff I. M. and Lingane J. J. (Vol. I & II) (Interscience Publishers, New York).
2. Polarographic Techniques: L. Meites (Interscience Publishers, New York).
3. Principles of Instrumental Analysis (5th ed.) by Skoog, Holler and Nieman (Saunders College Publishings).
4. Modern Polarographic Methods in Analytical Chemistry by A M Bond CRC Press Inc
5. Undergraduate Instrumental Analysis (5th ed.), J. W. Robinson (Marcel Dekker Inc.).
6. Advanced Potentiometry: Potentiometric titrations and their errors by Erzsébet Néher-Neumann, Spinger
7. Potentiometry and Potentiometric Titrations by E. P. Serjeant
8. Ion selective electrodes by Konstantin N. Mikhelson

Online resources to be used if available as reference materials

Online Recourses

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Physical Chemistry

M.Sc. Physical Chemistry, Semester III

PAPER-IV (Elective I) Molecular Spectroscopy

To be effective from June 2023

(NEP-2020)

Course Code	PEC-301	Title of the Course	**Molecular Spectroscopy**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the familiarize with the basic properties, theory & interpretation of IR, ^{1}H NMR, Mass and Luminescence Spectroscopy. • To impart knowledge in the theory & principals of spectroscopic techniques for characterization & differentiation of various molecules. • To impart knowledge on identification of compounds using spectroscopy

Course Content	
Unit	**Description**
I	**IR and Raman Spectroscopy** **(15 Periods)** Theory of IR and Raman, selection rules, IR absorption, Raman scattering, Mutual exclusion rule, complimentary techniques, Instrumentation - FTIR and Raman, Cells and sampling techniques, Resonance Raman spectroscopy, Interpretation of IR spectra using correlation charts, Advantages of FTIR spectroscopy, Mid-IR Reflection– DRS, ATR, Data processing in Near IR, Applications in structure elucidation of inorganic and organic molecules.
II	**NMR Spectroscopy** **(15 Periods)** Theory of NMR, Relaxation, population of energy levels, Larmor precession, chemical shift and factors affecting it, references and solvents, Spin-spin splitting, Coupling constant, Magnetic Anisotropy, Instrumentation, Shift Reagents, Interpretation of simple NMR spectra, Signal averaging, FT-NMR, Pulse FT-NMR spectroscopy, ^{13}C NMR spectra, Calculation of chemical shift in ^{13}C NMR, NMR in medical diagnostics, Double resonance technique, Multi-dimensional NMR, Problems to elucidate structure from NMR spectra

III	**Molecular Mass Spectroscopy**	**(15 Periods)**
	Instrumentation, Methods of ion production (EI, CI, FI, FD, Electro Spray, MALDI), Ion separators, Ion collection and recording, Double focusing, Time of flight analyser, Quadruple-mass spectrometer, Sample handling techniques, Resolution, Parent peak, Base peak, Metastable ions isotope effect, Molecular formula from mass spectra, Nitrogen rule, Ring rule, Fragmentation rules, Behavior of classes of compounds, Interpretation of mass spectra, Additional applications, Problems to elucidate structure from mass spectral data.	
IV	**Molecular Luminescence Spectroscopy**	**(15 Periods)**
	Introduction to molecular luminescence (fluorescence, phosphorescence and chemiluminescence), theory of luminescence, energy level diagram, Deactivation process,; instruments for measuring fluorescence (fluorometer and spectrofluorometer), factor affecting, Emission and excitation spectra, wavelength selector, detector, application and problems.	

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / 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.	Understand fundamental & basic terms involved in IR, ^{1}H NMR, Mass and Luminescence Spectroscopy, know effects of various factors on the spectra, interpretation from spectral data, identify structure of organic compounds by using combined spectral data, distinguish isomers and other closely related compounds by using spectral techniques
2.	Identify drug testing contamination in food, isotope ratio determination and protein identification with the help of spectroscopy
3.	Identify the name of compounds using spectroscopy
4.	Understand the instrumental set up for all instruments.

Suggested Reference books:

1. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York), 5th edition.
2. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A.Settle (Van Nostrand Reinhold Co., New York), 6th edition.
3. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.
4. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), New Delhi.
5. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
6. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).
7. Photometric and Fluorometric Methods of Analysis: F. D. Snell (John Wiley & Sons Inc., New York).
8. Instrumental Methods of Chemical Analysis: B. R. Sharma (Goel Publishing House, Meerut).

Online resources to be used if available as reference materials

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Physical Chemistry

M.Sc.Physical Chemistry, Semester III

PAPER-IV (Elective II)

Selected topics in Physical Chemistry

To be effective from June 2023

(NEP-2020)

Course Code	PEC -302	Title of the Course	**Selected topics in Physical Chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the chemical equilibria and condition of thermodynamics of chemical reactions • To impart knowledge in the theory & principals of Nuclear chemistry. • To impart knowledge on physical phenomena of photochemical reactions

Course Content	
Unit	**Description**
I	**Chemical equilibria of chemical system** **(15 Periods)** Spontaneous chemical reactions: The Gibbs energy minimum, The description of equilibrium, The response of equilibria to the conditions: How equilibria respond to pressure, The response of equilibria to temperature Impact on engineering: The extraction of metals from their oxides Equilibrium electrochemistry: Half-reactions and electrodes, Varieties of cells, The electromotive force, Standard potentials, Applications of standard potentials
II	**Photophysical phenomenon** **(15 Periods)** Introduction, photo and photochemical excitation and de-excitation, fluorescence, delayed fluorescence, and phosphorescence, fluorescence quenching: concentration quenching, quenching by excimer and exciplex emission, fluorescence resonance energy transfer between photoexcited donor and acceptor systems. Stern-Volmer relation, critical energy transfer distances, energy transfer efficiency, examples and analytical significance, bimolecular collisions, quenching and Stern-Volmer equation.

III	**Nuclear Chemistry**	**(15 Periods)**
	General characteristics of radioactive decay, decay kinetics parent daughter decay growth relationship. α decay, β decay, nuclear de-excitation, Secular and transient equilibrium, a- particle energy spectrum, Geiger-Nuttal's Law, Theory of α, β and γ decay process, Detection and measurement of activity: The electrometer, the ionization chamber, electro pulse counter, scintillation, semiconductor, thermo-luminescence and neutron detector. Nuclear reactions: Bathe's notation, types of nuclear reactions, conservation in nuclear reaction, reaction cross section, compound nucleus theory	
IV	**Irreversible Thermodynamics**	**(15 Periods)**
	Microscopic reversibility and Onsager reciprocity relation, conversation of mass and energy in open and closed systems, phenomenological equations, Transformation of generalized fluxes and forces. Conversation of mass and energy in closed and open systems, Entropy production due to heat flow, entropy production in chemical reaction, entropy production and entropy flow in open systems, Prigogine's principle of minimum entropy, Onsager reciprocal relations, Electrokinemetic phenomena	

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / 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.	Understand fundamental & basic terms involved in Irreversible thermodynamics to under the reactions
2.	Concept of Nuclear chemistry and to understand the calculation of various parameters related to nuclear reactions.
3.	The physical parameter to understand the photo physical chemistry
4.	Understand the molecular interactions exist in mixtures of solid liquid and gas

Suggested Reference books:

1. I.Prigoggine, "An Introduction to Thermodynamics of Irreversible Processes," Wiley-Interscience.
2. R. P. Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.
3. J.O.M.Bokris and A.K.N.Reddy, "Modern Elcrtrochemistry", Wiley
4. S. Glasstone, "Introduction to Electrochemistry" Affilisated East West Press, New Delhi
5. Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd)
6. Substoichiometry in Radioanalytical Chemistry: J. Ruzicka and J Stary (Pergamon Press)
7. Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods
8. P. W. Atkins and D. Paula, Physical Chemistry, 11th Edition, Oxford University Press, 2020.

Online resources to be used if available as reference materials

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M.Sc. Physical Chemistry, Semester-III
Paper-V: Industrial Safety & Water Analysis Techniques
(Skill Enhancement Course)
To be effective from June 2023
(NEP-2020)

Course Code	PSEG-301	**Title of the Course**	Industrial Safety & Water Analysis Techniques
Total Credits of the Course	2	**Hours per Week**	2 hrs.

Course Objectives:	• To teach safety parameters, health & welfare to the students. • To create awareness among students regarding Industrial and laboratory accident, its causes & its prevention. • To learn about various water analysis techniques. • To develop advance analytical skills for Quality Checking and Assurance in Laboratories.

Unit	Description
1.	**INDUSTRIAL SAFETY** **(15 Periods)** **Risk Assessment:** Process Risk Assessment, Industrial Hygiene Risk Assessment, Environmental Risk Assessment, Fire & Explosive Risk Management **Chemical Storage Safety:** Bulk storage, Solvent storage, Explosive chemical storage, Transportation storage **Static electricity, its hazards, and control measures** **Hazard Identification, Communication and Symbol**
2.	**WATER ANALYSIS TECHNIQUES** **(15 Periods)** 1. Total Dissolved Solids (TDS) & Total Suspended Solids (TSS) determination 2. Fixed & Total Volatile Solids 3. Fixed Dissolved Solids 4. Mother Liquor Suspended Solids (MSS) & Mother Liquor Volatile suspended Solids (MLVSS) 5. Oil, Grease and phenol determination 6. Chloride and Fluoride determination 7. Kjeldahl's method for ammoniacal nitrogen determination 8. Nitrite and Nitrate determination 9. Phosphate Determination 10. Sulphide and sulphate determination 11. Sodium and Potassium determination 12. Chromium determination 13. Fanton process 14. Hydrodynamic Cultivation 15. Micro organism purification

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written	15 Marks
2.	University External Written Examination	35 Marks

Course Outcome: Having Completed this course, the learner will be able to	
1.	To get skilled to measure risk assessment for hazardous chemical reaction, its monitoring and preventive actions to avoid accidents.
2.	To get skilled for proper chemical segregation and Industrial hygiene management to maintain safety.
3.	To get skilled for analysis of water quality, its sampling, operational techniques, and to produce results.
4.	Students will be able to use the techniques and get skilled necessary for water resource management.

Suggested Reference Books:

1. Fundamentals of Industrial safety and health by Dr. K.U. Mistry, Vol-1&2.
2. Industrial accidental prevention, H. W. Heinrich
3. Encyclopedia of Occupational Health & Safety, ILO, Geneva, Switzerland
4. Accident, Prevention Manual for Industrial Operation, NSC, USA.
5. Analytical methods for drinking water, Advances in sampling and Analysis by Phillippe Quevauviller, K. Clive Thompson.
6. Industrial Water Analysis Handbook by Natrajan Manivasakan.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Master of Science, Physical Chemistry

M.Sc.Physical Chemistry, Practicals Semester- III

Course Code	PP-301	Title of the Course	**Practicals**
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To impart basic knowledge for preparation of solution and instrumental set up for the experiments. • Understand theories of the experiments • To learn about the interpretation of results and graphical representation of results. • To understand the purpose of experiments to meet the objectives of the experiments.

Course Content

1	Full Experiment (instrumental/ non instrumental)	4- Credit
2	Half experiment (instrumental)	
3	Half experiment (non-instrumental)	4- Credit
4	Viva-Voce	

FULL EXPERIMENT (Any Seven)

1	To Study the kinetics of reaction between $K_2S_2O_8$ and KI. Determine rate constant, order ofreaction and influence of ionic strength on rate constant
2	Determination of CMC of surfactant by conductance method and calculatethermodynamic parameters for micellization
3	To study the kinetics of hydrolysis of ethyl acetate by NaOH at two different temperatures by conductance measurement and find out energy of activation of the reaction
4	Determine the effect of salts on the cloud point of nonionic surfactant.
5	Determine ionic composition of synthetic sea water samples by flame photometer.
6	Determination of constants of Mark-Houwink equation for polymer by viscosity method
7	Determine parachor/density/refractive index of binary solutions
8	To determine the Ca^{+2}, Mg^{+2} and Fe^{+2} content in a sample of dolomite ore.
9	Study influence of ionic strength on solubility of $CaSO_4$ and determine thermodynamic solubility product and mean ionic strength.

HALF EXPERIMENT (Any Seven)

1	Study the ratio of complex formation formed by titration of Zn2+ with potassium ferrocyanide potentiometrically.
2	Study Electrogravimetric determination of copper from solution
3	Determine equivalence conductance of solutions of strong electrolytes and weak electrolytes.Application of Kohlrausch's law and Onsager constant.
4	Determination of Ka of weak organic acid [benzoic acid] conduct metrically
5	Study stability constant of complex formation between Fe (III) and salicylic acid
6	Determine ionization constant of bromophenol blue using pH meter.
7	Preparation of simple colloids and determination flocculation value for different salts.
8	Study Hydrolysis constant of methyl acetate catalyzed by HCl and equinormal urea hydrochloride, determine degree of hydrolysis for the salt.
9	Determine basicity of organic acid by conductometer
10	Structure Identification and Elucidation by IR/NMR/MS spectroscopy

Teaching Learning Methodology	classroom teaching, use of e-resources, library, IT tools,, encourages students to participate in seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / 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.	Understand preparation of solutions.
2.	Qualitative analysis of compound
3.	Calculate the concentration of unknown solution by pH, potentiometer and colorimeter
4.	Understand behaviour of surfactant and polymer
5.	Separation of compounds using different solvent systems
6.	Theories of indicators

Suggested Reference books:

1. Advanced Practical Physical Chemistry by Yadav J. B., Krishna Prakashan Media
2. Practical Physical Chemistry, Dr. M. Satish Kumar Sankalp Publication
3. Gurtu, J. N., Kapoor, R., Advanced Experimental Chemistry S. Chand & Co. Ltd.
4. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis, Pearson Publication

Online resources to be used if available as reference materials