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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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-: <u>પરિપત્ર</u> :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન રસાયણશાસ્ત્ર વિષયની તમામ અનુસ્નાતક અભ્યાસક્રમની કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૨–૨૩ થી અમલમાં આવનાર એમ.એસસી. કેમેસ્ટ્રી વિષયનાં સેમે.૧ અને સેમ.૨ નો અભ્યાસક્રમ બોર્ડવતી ચેરમેનશ્રીએ અને ફેકલ્ટી વતી વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલ તા.૨૨/૦૮/૨૦૨૨ની સભાનાં ઠરાવ ક્રમાંકઃ૨૫ થી સ્વીકારી મંજૂર કરેલ છે. જેની આથી જાણ કરવામાં આવે છે.

<u>એકેડેમિક કાઉન્સિલની તા.૨૨/૦૮/૨૦૨૨ની ઠરાવ ક્રમાંકઃ ૨૫</u>

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૨–૨૩ થી અમલમાં આવનાર એમ.એસસી. કેમેસ્ટ્રી વિષયનાં સેમે.૧ અને સેમ.૨ નો અભ્યાસક્રમ બોર્ડવતી ચેરમેનશ્રીએ અને ફેકલ્ટી વતી વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી એમ.એસસી. કેમેસ્ટ્રી સેમ.–૧ અને સેમ.–૨ નો અભ્યાસક્રમ મંજુર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

ક્રમાંક : એસ./રસાયણશાસ્ત્ર/પરિપત્ર/૧૯૩૦૧/૨૦૨૨
તા.૨૬–૦૮–૨૦૨૨

ઈ.ચા. કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન રસાયણશાસ્ત્ર વિષયની તમામ અનુસ્નાતક અભ્યાસક્રમની કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રી.....આપશ્રીની કોલેજ/ડિપાર્ટમેન્ટના 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.

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Master of Science, Chemistry
Semester-I
Paper : I (Inorganic Chemistry)

Course Code	[1803080201010001]	Title of the Course	Inorganic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand the concept of symmetry and group theory with its application. • To understand the basics of Quantum mechanics, familiarize with various types of operators and implant the knowledge of orbital configuration. • To learn the inorganic reaction mechanism. Different types of reaction mechanisms and also various types of transition state theory. • Understanding of concepts of metal clusters, classification of metal clusters, Wade's rule, Carboranes, low and high nuclearity carbonyl clusters.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content		
Unit	Description	Weightage* (%)
1.	**SYMMETRY AND GROUP THEORY IN CHEMISTRY AND ITS APPLICATIONS** Representation of Group: preparation of matrices and vectors matrix notation for geometric transformation, Orthogonality theorem and its consequences, reducible and irreducible representation and their relation, preparation of character table for C_{2v} and C_{3v} point groups, applications of group theory, transformation properties of atomic orbitals, Hybridization of σ-bond.	25
2.	**QUANTUM MECHANICS** Discussion of solution of Schrodinger equation to same model system e.g., the one-dimensional harmonic oscillator, two particle rigid rotator. Ordinary angular momentum, generalized angular momentum, Eigen functions of angular momentum, Eigen values of angular momentum, different types of operators and their uses, addition of angular momentum, spin, Russell-Saunders terms and coupling scheme, term separation energies of the p^n and d^n configuration, magnetic effect: spin orbit coupling and Zeeman effect(splitting).	25

3.	**INORGANIC REACTION MECHANISM** Labile and inert complexes, factors responsible for lability and inertness of complexes. Reactivity of metal complexes, ligand replacement reaction: classification of mechanism and energy profile of reaction. Inert and labile complexes, interpretation of liability and inertness of transition metal complex on the basis of reaction rate, VBT and CFT. Transition state or activated complex, substrate, attacking reagents electrophilic and nucleophilic nature of central atom. Kinetic application of CFT. Determination stability constant by Job's method. Substitution reactions in square planar complexes e.g. kinetic substitution reactions in Pt(II) complexes. Kinetics of octahedral substitution, acid hydrolysis, factor affecting acid hydrolysis, base hydrolysis conjugate base mechanism, direct and indirect evidences in favor of conjugate mechanism.	25
4.	**METAL CLUSTERS** Introduction, classification, carbonyl cluster, low nuclearity carbonyl clusters, high nuclearity carbonyl clusters, electron counting scheme for HNCCS, Wade's rule. Halides types clusters: Dinuclear clusters, Trinuclear clusters, Tetranuclear clusters, Hexanuclear cluster. Chevrel phases and zintl ions, Carboranes, metalloboranes, metallocarboranes, higher boranes (hexaborane-10, decaborane-14), number and types of bonds present in higher boranes.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprises classroom teaching, use of e-resources, library books, 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 / 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 fundamentals of matrices and vectors matrix notations, reducible representation and their relation, applications of group theory
2.	Learn regarding quantum mechanics, angular momentum, understanding the solution of Schrodinger equation, Different types of operators and their uses
3.	Learn different types of inorganic reaction mechanisms, acid hydrolysis, base hydrolysis, conjugate base mechanism their synthetic application
4.	Understand the introduction and classification of metal clusters, electron counting scheme for HNCCS and Wade's rule and their synthetic application

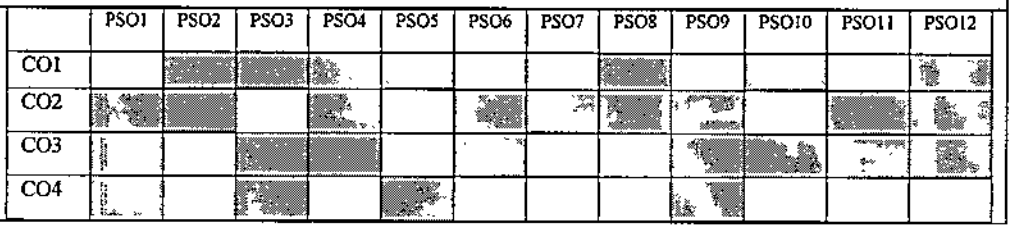
Suggested Reference Books:

1. Chemical applications of group theory by F.A Cotton (Second edition), Wiley Eastern Limited, 1976 New Delhi
2. Group theory and its application by P.K. Bhattacharya, Himalaya publishing hours,Mumbai, 1986
3. Group theory and symmetry by L. R. Hall, McGraw hill, New York, 1989.
4. Quantum Chemistry by Ira N. Levine, Prentice-Hall of India Pvt. Lid, New Delhi, 1994.
5. Introductory Quantum Chemistry (Third edition) by N. W. Hanna, Benjamin, Menlo Park,Cailf, 1988.
6. Quantum Chemistry and Spectroscopy by M. S. Pathania, Vishal Publications, India, 1981.
7. Kinetic and Mechanism' by A. A. Frost and R. G. Pearson, Wiley, New York, 1953, 1961.
8. Mechanism of Inorganic Reactions by F. Basolo and R.G. Pearson, Second Edition, Wiley Eastern Limited, New Delhi, 1977.
9. Advanced Inorganic Chemistry by F. A Cotton and R.G. Wilkinson, John Wiley & Sons, N.Y.
10. Principles of Inorganic Chemistry, by Puri Sharma and Kalia, 33rd Edition, Vishal publishing Co. Jalandhar, Dehli, 2017.
11. Advanced Inorganic Chemistry by S. K. Agarwala and Keemtilal, Pragati Prakashan, Meerut.
12. Advanced Inorganic Chemistry, Volume-II by Gurdeep Raj, Krishna Prakashan Media Lid.,Meerut.
13. Inorganic Chemistry by Gary L. Miessler and Donald A. Tarr, Pearson Education International

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

Master of Science, Chemistry
Semester-I
Inorganic Practicals

Course Code	[1803080201050001]	Title of the Course	Inorganic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To impart basic knowledge of qualitative analysis of Inorganic mixture. • To identify three anions and three cations including one rare earth element by group separation. • To impart knowledge of different radicals by confirmative test. • Preparation of inorganic metal salts and it's crystallization.
Mapping between CO and PSO	

Course Content

1. Inorganic Qualitative Analysis: (Six elements including ONE rare earth element-Any seven Rare earths elements)
2. Inorganic Preparation.
   a) Hexa-ammine nickel (II) chloride
   b) Mohr's salt (Ferrous Ammonium sulphate)
   c) Sodium trioxalato ferrate trihydrate
   d) Sodium cobaltinitrite
   e) Tetra amine cupric sulphate
   f) Reineck's salt (Ammonium tetrathiocyanate diammine Chromate)

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books, and frequent instruction according to the respective practical.

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 basics of analysis of Inorganic mixtures.

2.	Identify anions by dry test of the mixture.
3.	Separation of each anion by group test from mixture.
4.	Identify each cation and confirm it by confirmative test.
5.	Understand different methods of Preparations of inorganic salts.
6.	Appreciate good laboratory practices.

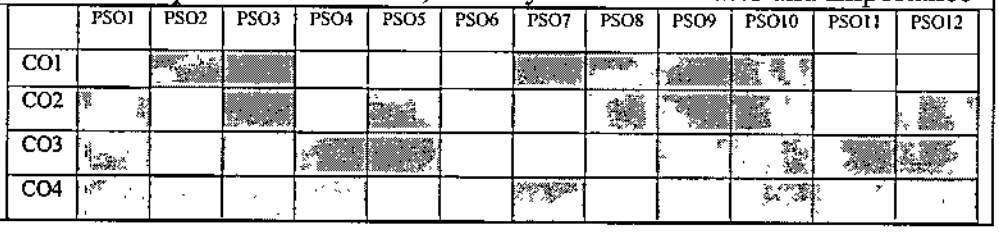
Suggested Reference Books:

1. Textbook of practical inorganic chemistry – A.I. Vogel
2. Practical Chemistry by Dr O. P. Pandey, D. N. Bajpai, Dr. S. Giri
3. Advance inorganic analysis by Agarwal, Keemtilal
4. Qualitative Inorganic analysis - Vogel
5. Inorganic practical by Chatwal and Anand

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

Master of Science, Chemistry
Semester-II
Paper : I (Inorganic Chemistry)

Course Code	[1903080202010001]	Title of the Course	Inorganic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To Understand the definitions of magnetic properties, types of magnetic bodies,determination of magnetic susceptibility and its applications • To learn the classification of metal carbonyls and nitrosyls, structure and bonding. Vibrational spectra studies for bonding and structure elucidation, preparation of metal carbonyls and nitrosyls • To understand the characteristics of inorganic polymer and number average and weight average. Structural features of polymers by different bonding • To understand the Werner's theory, electronic interpretation, factors affecting the formation of complex ions, detection of complex ion in solution, stability of metal chelates and Importance
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content		
Unit	Description	Weightage* (%)
1.	**ELEMENTS OF MAGNETOCHEMISTRY** Definitions of magnetic properties, type of magnetic bodies, the source of paramagnetism, diamagnetism and pascal's constant, Example of pascals constant. Curie and Curie-Weiss law, Magnetic Properties of transition elements. Determination of magnetic susceptibility: (a) Gouy method, (b) Faraday method, (c) Null deflection method, (d) NMR method, (e) Evans method. Application of magnetic susceptibility measurements, Temperatureindependent paramagnetism (TIP), Orbital contribution to magnetic moment, Magnetic properties of first transition elements.	25
2.	**METAL π – COMPLEXES** Metal carbonyls: Introduction, classification of metal carbonyls, structure and bonding, vibrational spectra studies for bonding and structure elucidation. Preparation of metal carbonyls by (1) Direct synthesis and (2) From metal compounds. Preparation, Properties and structure of $Ni(CO)_4$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ and $Co_2(CO)_8$, 18-electron rule and EAN of metal carbonyls	25

	Metal Nitrosyls: Introduction, coordination compounds of metal nitrosyls, preparation & properties of nitrosyl compounds like nitrosyl halides, nitrosyl cyanides, hydroxides and nitrosyl aquo compounds Complex of NO^+, iron, EAN and structures of nitrosyls.	
3.	**INORGANIC POLYMERS** Definition of polymers and their depiction. Classification of inorganic polymers. Characteristics of inorganic polymer. Characterization of inorganic polymers (physical properties) bymolecular weight, number average and weight average. Structural features of polymers: (1) Backbone bonding (2) Branching and cross-linking (3) Chemical and Stereo chemical variability. Glass transition temperature, Phosphorus-based polymers, Phosphorus-based chain polymers, Sulphur-based polymers, Boron-based polymers, Silicon-based polymers, Properties of silicones, Coordination polymers, Two-dimensional coordination polymers, Coordination polymers with three-dimensional network.	25
4.	**COORDINATION COMPOUNDS** Classification. of coordination compounds, Werner's theory of coordination, electronic interpretation of coordination compounds, Factors affecting the formation of complex ions, detection of complex ion in solution, chelation, factors influencing the stability of metal chelates, importance of chelates, role of metal chelates in living system and polynuclear complexes, determination of composition of complex ions.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprises classroom teaching, use of e-resources, library books, 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.	Understand the definitions of magnetic properties, types of magnetic bodies, determination of magnetic susceptibility and its applications.
2.	Understand classification of metal carbonyls and nitrosyls, structure and bonding. Vibrational spectra studies for bonding and structure elucidation, preparation of metal carbonyls and nitrosyls.
3.	To learn the characteristics of inorganic polymer and characterization of physical properties by molecular weight, number average and weight average. Structural features of polymers by different bonding.
4.	Understand the classification of coordination compounds, Werner's theory, electronic interpretation, factors affecting the formation of complex ions,

	detection of complex ion in solution, stability of metal chelates and Importance of chelates, role of metal chelates in living system

Suggested Reference Books:

1. Magnetochemistry by R. L Carlin
2. Element of Magnetochemistry by A. Syamal and R. L. Dutta, Affiliated East-West press,new Delhi, 1993.
3. Introduction to metal π-complex chemistry by M. Tsusui, M. Ichikwa, K. Mori, Plenum press, New york
4. Introductory polymer chemistry by G. S Mishra, Wiley Eastern Ltd,1993.
5. Phosphorous-Nitrogen Compounds, H. R. Allock, Academic, New York, 1972.
6. Advanced in Inorganic Chemistry by S. K. Agarwal, Keemtilal, Pragati prakashan, Meerut
7. Coordination Chemistry by Ajaykumar, Aaryush Education publication, Thind publication
8. Principles of inorganic chemistry by Puri, Sharma and Kalia, Vishal publication Co. Jalandhar, Delhi
9. Coordination Chemistry by Gurdeep Chatwal, M.S. Yadav, Himalaya Publishing house
10. Inorganic polymers by Prof G. R. Chatwal, Himalaya Publishing House

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

Master of Science, Chemistry
Semester-II
Inorganic Practicals

Course Code	[1903080202050001]	Title of the Course	Inorganic Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To impart basic knowledge for carrying out analysis of alloy. • Understand the types of complexometric titrations • To understand and calculate the percentage purity of salt. • Determination of physical constant and confirmation of product. • Concept of estimation and determination of each radical quantitatively and qualitatively.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content

Quantitative Analysis:

1. Analysis of Solder and Type metal (Alloy Analysis)
2. Determine the amount of Ca as $CaC_2O_4.H_2O$ or as $CaCO_3$, in limestone
3. Estimation of Cu^{+2} as CUSCN.
4. Estimation of Iron in Iron ore.
5. Estimation of available chlorine in bleaching powder.
6. Estimation of Ca^{+2} and Pb^{+2} in Admixture.
7. Determine the amount of Fe^{+3} and Cr^{+3} Present in given Admixture.
8. Determine the percentage purity of the given sample of Manganese salt
9. Estimation of Aluminium by back titration.

Teaching-Learning Methodology	Introduction, demonstration of handling equipment, reference books, and frequent instruction according to the respective practical.

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 analysis of alloy and ore and calculation of molarity and mole ratio.
2.	Learn to methods to find copper, zinc gravimetrically and volumetrically.

3.	Learn to find available chlorine bleaching powder.
4.	Learn to determine calcium, lead, Iron and chromium in admixture.
5.	Appreciate good laboratory practices.
6.	Understand the analysis of alloy and ore and calculation of molarity and mole ratio.

Suggested Reference Books:

1. Textbook of practical inorganic chemistry – A.I. Vogel
2. Practical Chemistry by Dr O. P. Pandey, D. N. Bajpai, Dr. S. Giri
3. Advance inorganic analysis by Agarwal, Keemti lal
4. Qualitative Inorganic analysis - Vogel
5. Inorganic practical by Chatwal and Anand

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

VEER NARMAD SOUTH GUJARAT

Master of Science, Physical Chemistry
M.Sc.Physical Chemistry, Semester I

Course Code	[1803080201030001]	Title of the Course	Physical Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand concept of thermodynamics in solution. • To understand type of interactions and orientation of molecules in solution. • To understand basic concept of statistical thermodynamics. • Understanding of concepts of kinetics of different types ofchemical reaction. • To lean basic concept of synthesis of polymer and solution behaviour of polymer

Maping between PSOsand COs		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
	CO1												
	CO2												
	CO3												
	CO4												
Medium of Instruction	English												

Course Content		
Unit	Description	Weightage* (%)
1.	**CHEMICAL KINETICS** Theories of Unimolecular gas reactions: Lindemann theory, Kinetics of some complex reactions (i)Reversible reactions(only first order opposed by first order) (ii)Consecutive reactions(A→B→C); Equation of Relaxation time for (i) first order opposed by first order (ii) first order opposed by second order, Steady state treatment or approximation, Enzyme catalysed reactions, Kinetics of general Chain reaction, Kinetics of photochemical reactions(H_2-$Cl_2$and H_2-Br_2) , Kinetics , Mechanism ,determination of activation energy and chain length of some organic decomposition (i) decomposition of ethane (ii) decomposition of acetaldehyde, (iii) decomposition of Ozone , Effect of Ionic strength on rates of ionic reactions (Primary and secondary salt effect) Numerical.	25
2.	**THERMODYNAMICS** Introduction to Laws of thermodynamics, state and path functions and their applications, thermodynamic description of various types of processes,Maxwell's relations, Partial molar quantities, Calculation of partial molar quantities, determination of partial molar volume and partial molar enthalpy, Ideal and non-ideal liquid mixtures,Thermodynamics functions of mixing of non-ideal solutions (i) free energy of mixing (ii) entropy of mixing (iii) volume of mixing and (iv) enthalpy of mixing ,Excess functions(μ^E,G^E, S^E ,H^E and V^E) for non-ideal solutions and expression for excess thermodynamic functions. Numerical	25
3.	**STATISTICAL THERMODYNAMICS** Basics of Statistical thermodynamics (Assembly,Canonical ensemble, occupation numberstatistical weight factor, probability), Thermodynamic probability, Probability and entropy, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Lagrange's methods of multipliers, Partition function,Thermodynamic properties in term of partition functions(i) Internal energy (ii) Heat Capacity (iii) Helmholtz free energy (iv) Enthalpy (v) Gibb's free energy(vi) Chemical potential Molecular partition functions for an ideal gas , Derivation for Translational, Rotationaland Vibrational partition functions Numerical.	25

4.	**POLYMER CHEMISTRY** Types of polymers, Stereochemistry of polymers, Kinetics of Addition polymerization (free radical, cationic and anionic) and Condensation polymerization,Thermodynamics of polymerization, Phase techniques of polymerization (Bulk, solution, suspension and emulsion), Number & Mass average Molecular mass, Polydispersity Index (P.D.I) Molecular mass determination by Viscometry and Osmometry, Thermal transitions in polymer: glass transition temperature and its significance, Numerical	25

Teaching-Learning Methodology	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 / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination	70%

Course Outcomes: Having completed this course	
1.	Students learn thermodynamic terminology, fundamental thermodynamicproperties, properties of solution, fundamental knowledge assist student to understand related topic in next semester.
2.	Understand kinetics of different types of reaction. Understand the factors responsible for behaviour of different kind of chemical reaction
3.	Learn relation between quantum chemistry and statistical thermodynamics. Understand basic terminology and their application in calculation of thermodynamic function.
4.	Understand the method for synthesis of polymer and their characterization

Suggested References:

Unit I:

1. Chemical Kinetics, Laidler K.J. Tata McGraw-Hill Publishing company Ltd
2. Principles of Chemical Kinetics, James E. House, Elsevier Publication
3. Kinetics and Mechanism of Chemical Transformations,Rajaraman, J. and Kuriacose, J., McMillan (2008)
4. Kinetics of chemical reactions, S.K. Jain, Vishal Publications
5. Engel, T. & Reid, P. Physical Chemistry, Pearson
6. Maron, S. & Prutton Physical Chemistry

UNIT II:

1. Thermodynamics for chemist Samuel Glasstone, East-West Press Pvt. Ltd. (2008)
2. Physical Chemistry, Volume 1: Thermodynamics and Kinetics (10th Edition) by Professor Peter Atkins, Julio De Paula
3. Principles of Physical ChemistryPuri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co
4 A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007
5 An Introduction to Chemical Thermodynamics R P Rastogi and R R Mishra Vishal Publishing Co, 6th edition
6 Advanced Physical Chemistry D.N.Bajpai S.Chand & Company Ltd. 2nd Edition

UNIT III:

1. Statistical Thermodynamics BY M. C. Gupta, New Age International, 2007
2. An Introduction to Statistical Thermodynamics, Terrell L. Hill, Additonal weslay publication company
3. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co
4. A Text Book of Physical chemistry K.L.Kapoor Vol-5 Macillan India Ltd. 2007

UNIT IV:

1. Polymer science by V.R.Gowarikar. Willey estern Ltd
2. Principal of polymer chemistry by A. Ravve, Springer
3. A Textbook of Polymer Chemistry, M S Bhatnagar, S Chand Publications.
4. Principles of Physical Chemistry Puri B.R., Sharma L.R. and Pathania, M.S., Vishal Publishing Co

VEER NARMAD SOUTH GUJARAT

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Practicals

Course Code	[1803081001050001]	Title of the Course	**Physical** Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To study the rate constant of chemical reaction • To understand pH metric and potentiometric titration of between two solution. • To study the properties of surfactant and polymer in aqueous solution • To determine the concentration of solution by colorimetry • To understand the conductivity behaviour of electrolytes solution. • To understand phase behaviour of three component system

Maping between PSOsand COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Medium of Instruction	English

Course Content

1. Determine the dissociation constants of a given dibasic acid pH-metrically.
2. Determine the amount of ferrous sulphate / ferrous ammonium sulphate in given flask potentiometrically using cerric salt solution.
3. Verification of Onsager's equation and determination of equivalent conductance at infinite dilution of strong electrolytes
4. Determine the CMC of a surfactant by conductivity measurements.
5. Calculate the molar absorptivity of each of the given two solutions (A) and (B) and also find out concentration of supplied unknown solution colorimetrically.
6. Investigation the reaction between $K_2S_2O_8$ and KI at two different temperatures and calculate the energy of activation for the reaction.
7. To study the phase diagram of a three component system Water – acetic acid – chloroform.
8. Determination of CMC and area per molecule of a surfactant by surface tension measurement.
9. Determine the molecular weight of a given polymer from viscosity measurement.
10. Deatermine the relative strength of chloroacetic acid and acetic acid by conductance measurement
11. Determine the strength of acid HCl with NaOH spectrophotometriclly.

Teaching-Learning Methodology	Introduction, explanation of theory and procedure of the experiments and interpretation of results.

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 learnerwill be able to	
1.	Understand chemical kinetics of reaction.
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 solvent using phase diagram

Suggested References:

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 6th Ed., Pearson

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VEER NARMAD SOUTH GUJARAT UNIVERSITY

Master of Science, Analytical Chemistry
M.Sc. Sem-I Analytical Chemistry Paper-4 (Elective Paper-A)

Course Code	[1803080201040001]	Title of the Course	**Analytical Chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand concept of electromagnetic radiation, auxochrome, chromophores, various factors affecting the UV-Visible spectra and impart the knowledge to understand the spectra. • To understand basics of concepts of chromatography, their classification and importance as well as working of various parts of the chromatography instruments. Use of this TLC and GC in various application. • To learn the different types of errors that occur in qualitative and quantitative and the validation of result obtained in experiments with the help of Q test and Students' t test. • To understand units of solution their uses in numerical and solution preparation. To understand the uses of non-aqueous titration when aqueous titration fails and also analysis of C, H, N, O, S with various techniques.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content		
Unit	Description	Weightage* (%)
1.	**UV-VISIBLE SPECTROPHOTOMETRY** Types of electronic transition, auxochrome, chromophore, Bathochromic effect, Hypsochromic effect, Hyperchromic effect, Hypochromic effect, Factor affecting λ_{max} like resonance, hyper conjugation, hydrogen bonding, steric effect, Woodward's rules for α, β-unsaturated ketones, Diene systems, aromatic system, Effect of solvent on absorption bands, law of absorption with derivation,	25

	Elementary idea of double beam automatic recording, Spectrophotometer, Application.	
2.	**CHROMATOGRAPHY** **Thin-Layer Chromatography**: Selection of stationary and mobile phase, Detection techniques – Elementary idea of HPTLC **Gas Chromatography:** Selection of mobile phase – Selection of stationary phase in GLC and GSC, Methods of Injection, Detectors: FID (with modifications), TCD and ECD, Their comparison, Packed column, Capillary Column (WCOT, SCOT) (advantages and disadvantages) –Temperature programming – Derivatization in GC – Qualitative (Basic terms: retention Time, Retention Volume, Relative Retention) and Quantitative (Measurement of Area, Area Normalization Method, Internal Standard Method) Analysis.	25
3.	**CHEMICAL MATHEMATICS** Errors in Chemical analysis, classification of errors, nature and origin of errors, Propagation of error, Accuracy and precision, Average deviation and standard deviation and its physical significance, Normal Distribution curve and its properties. Confidence limit and probability, Statistical treatment for error analysis, students' 't' test, rejection criteria and Q test, method of least square.	25
4.	**TITRIMETRIC METHODS AND ELEMENTALANALYSIS** **Solution and Their Concentration**: Molarity, Molality, Normality, ppm, ppb, ppt, %w/v, %w/w, %v/v, Formality, Primary and Secondary standard, Acid Value, Density and Specific Gravity, Numerical. **Non-Aqueous Titration:** Protic and Aprotic Solvent, Solvent system, Dielectric constant, Titrant, Titration Curve, Determination of Equivalence point, Karl Fisher Titration. **Elemental Analysis:** Step on Analysis, C and H Analysis, N Analysis, Halogen Analysis and Sulphur Analysis, Elementary Idea of Modern Elemental analyzer.	25

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

Evaluation Pattern		
Sr.	Details of the Evaluation	Weightage

No.		
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 basic concept of electromagnetic radiation and their interaction with the matter and use of UV-Visible spectrophotometer in structure identification and quantitative determination.
2.	Recognize the use of different stationary and mobile phase for the separation of organic molecule and identify the problems and their solution during the analysis and learn the use of the chromatography for those which can't be identified by the techniques.
3.	Learn difference between different types of errors observed during analysis and use of statistical treatment of data. Also learn to accept and reject the data with help of different type of tests.
4.	Understand the making of different solution with the help of different concentration and learn the non-aqueous titration when aqueous titration fails. Also learn the determination of various elements in organic compounds.

Suggested Reference Books:

1. Fundamental of molecular spectroscopy, C. N. Banwell, Tata Mc-Graw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4th edition/5th edition), Silverstein, Bassler & Morril, John Wiley & Sons.
3. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
6. Modern Methods of Chemical Analysis (2nd ed.), Pecsok, Shields, Cairns &McWilliam, John Wiley & Sons.
7. Instrumental Analysis by R. D. Braun, McGraw-Hill.
8. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
9. Fundamentals of Analytical Chemistry: Skoog D. R. and West D. M. (Holt, Rinehart & Winston, New York).
10. Instrumental Methods of Analysis by G. W. Ewing.
11. Modern Method of Chemical Analysis by Pecsok, Shield, Cairns, McWilliam, John Wiley and Sons.
12. Quantitative Analysis, 6th Ed., R. A. Day and A. L. Underwood, Prentice – Hall of India, 1993.
13. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn & Bacon Inc., New York,2nd edition.
14. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York),

5thedition.

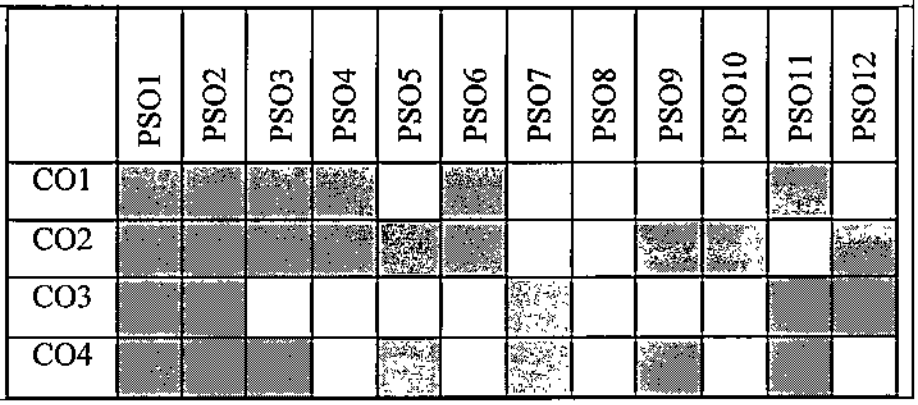
15. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (VanNostrand Reinhold Co., New York), 6th edition.
16. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.
17. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), NewDelhi.
18. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall Internationaledition).
19. Introduction to Modern Liquid Chromatography: L. R. Shyder & J. J. Kirkland (John Wiley &Sons, New York).
20. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Master of Science, Analytical Chemistry
M.Sc. Sem-I Analytical Chemistry Paper-4 (Elective Paper-B)

Course Code		Title of the Course	**Spectroscopy and Extraction Techniques**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand concept of photoacoustic spectroscopy, its instrumentation and comparison of photoacoustic spectra and UV spectra. Use of this spectroscopy in various field. • To understand the basic idea about optical rotatory dispersion and CD spectroscopy. Learn the application of the spectroscopy and the advantages of CD over ORD. • To understand the extraction of solute from liquid and with pressure, to impart the knowledge of doing extraction of different compounds and their application. • To learn use of microwave and super critical fluid for the extraction of compound as well as their application and limitation.
Mapping between CO and PSO	

Course Content		
Unit	Description	Weightage* (%)
1.	**PHOTOACOUSTIC SPECTROSCOPY** Introduction, Principle, Instrumentation, Double beam photoacoustic spectrometer, Comparison photoacoustic spectra with UV spectra, gas monitoring by PAS, Depth profiling condensed systems, chemical, biological and surface application.	25
2.	**OPTICAL ROTATORY DISPERSION AND CIRCULAR DICHROISM SPECTROSCOPY** Introduction, Optical rotation and circular polarization, Rotatory	25

	dispersion, Instrumentation of ORD, Instrumentation of CD, Dichrograph, Cotton effect, Axial haloketone rule, Octant rule, application of ORD and CD, Advantages of ORD, Advantages of CD over ORD, Limitation and Comparison.	
3.	**LIQUID-LIQUID EXTRACTION (LLE):** Introduction, selection of solvents, types of solvent extractions, problems and remedies of LLE process, purge and trap for volatile organics in aqueous samples. **PRESSURIZED FLUID EXTRACTION:** Introduction, Theoretical Consideration to the Extraction Process, Instrumentation, Method development for PFE, Application of PFE.	25
4.	**MICROWAVE ASSISTED AND SUPERCRITICAL FLUID EXTRACTION:** Introduction, concept of magnetron, atmospheric MAE process, pressurized MAE process, Applications. Supercritical fluid extraction: concept of critical state of matter and super critical state, properties of CO2 SFE, instrumentation and applications.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprises classroom teaching, use of e-resources, library books, 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	
5.	Understand the basic concept of photoacoustic spectroscopy, its instrumentation and use of photoacoustic spectra in the field of chemical and biology.
6.	Learn the basic difference between optical rotatory dispersion and circular dichroism spectroscopy. Also learn their advantages, limitation and application.
7.	Learn the process of liquid-liquid extraction and pressurized fluid extraction. Also learn the various method development for the extraction of various compound.
8.	Use of microwave and supercritical fluid for the extraction of various compound when regular extraction has some limitation.

Suggested Reference Books:

21. Fundamental of molecular spectroscopy, C. N. Banwell, Tata Mc-Graw Hill Pub. Camp.
22. Spectrometric Identification of Organic Compounds (4th edition/5th edition), Silverstein, Bassler & Morril, John Wiley & Sons.
23. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw – Hill.
24. Modern Spectroscopy, J.M.Hollas, John Wiley.
25. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
26. Extraction technique in analytical science, John R. Dean, Wiley (2009)
27. Spectroscopy by H. Kaur, New Pragati edition.
28. Instrumental Analysis by R. D. Braun, McGraw-Hill.
29. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
30. Fundamentals of Analytical Chemistry: Skoog D. R. and West D. M. (Holt, Rinehart & Winston, New York).
31. Instrumental Methods of Analysis by G. W. Ewing.
32. Instrumental Analysis: G. D. Caristian and J. E. O'Reilly (Allyn & Bacon Inc., New York,2nd edition.
33. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York), 5th edition.
34. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (VanNostrand Reinhold Co., New York), 6th edition.
35. Modern Methods of Chemical Analysis: Pecsok, Shield & Cairns (John Wiley), 2nd edition.
36. Introduction to Instrumental Analysis (1987), R. D. Braun (McGraw-Hill Book Company), NewDelhi.
37. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall Internationalédition).
38. Introduction to Modern Liquid Chromatography: L. R. Shyder & J. J. Kirkland (John Wiley & Sons, New York).
39. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).

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

Master of Science
M.Sc. Chemistry, Semester-I
(Skill Enhancement Course)
Paper: 5 Chemicals: Solutions and Safety

(Credits: 02)
Total: 30 hours

Course Content		
Unit	**Description**	**Weightage* (%)**
1.	**SOLUTION PREPARATION AND HANDLING** Prepare solution and operate weighing balance for sampling to prepare different types of solution as per the Equivalent weight, Molecular weight, atomic weight, Specific gravity, Normality, Acidity, Basicity, Concentration, Normal Solution and Molar Solutions. Prepare the acid solutions, basic solutions and oxidizing - reducing agent, solutions. Prepare solutions of different concentration and determine the concentration and percentage purity. Complexometric solution Preparations, indicators, sampling in solids, liquids and gases. Standardize the solutions, primary standardize, secondary standards, Prepare the Ethylene diamine tetra acetic acid (EDTA) solution and indicators.	25%
2.	**CHEMICAL SAFETY AND ETHICAL HANDLING OF CHEMICALS** Safe chemical working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. safe storage and use of a hazardous chemicals, procedure for working with substance that pose hazards, flammable or explosive hazards, procedures for working with gases at pressure above and below atmospheric level, safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identifications, verification and segregation of a laboratory waste, disposal of chemicals in the sanitary sewer system, incineration and transportation of hazardous chemicals, knowledge about the Personnel safety and use of personnel protective equipment's, explain the Behavior Based Safety (BBS), Operate firefighting extinguisher and knowledge of the Fire prevention.	25%

Reference Books:

(1) Quantitative analysis by R.A. Day and A.L. Underwood

(2) Elements of Analytical Chemistry by R. Gopalan ; P.S.Subramanian and K. Rengarajan

(3)Vogel's qualitative Inorganic analysis

(4) Vogel's qualitative Organic analysis

(5) Chemical Hazards in the workplace, mesuerment and control, Gangadhar choudhary, American chemical society.

(6) Safety at work by john Ridley

(7) The safe handling of chemicals in industry, Vol. I & II, PA Carsion, CJ Mumford, Longman & JW & sons, New York.

Master of Science, Chemistry
Semester-II
Paper : II (Organic Chemistry)

Course Code	[1903080202020001]	Title of the Course	**Organic Chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To learn transition metal catalysts based on C-C, C-N coupling reaction, formylation reaction, various acid base catalyzed condensation reactions, reactions which changes configuration etc., and their mechanism. • To learn aromaticity based on different concept, measurement of aromaticity through various parameters, annulenes, azulene and types of aromaticity. • To understand the role of chemical reactants in oxidation, reduction, dehydration, cyclisation and transformation of various organic functional groups. • To understand photochemistry, various types of its reaction, photochemical cleavage of carbonyl compounds, their mechanism and application in synthesis.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content		
Unit	Description	Weightage* (%)
1.	**ORGANIC NAME REACTIONS** General nature, method, mechanism and synthetic applications of thefollowing reactions: 1) Heck reaction 2) Dakin reaction 3) Darzen's glycidic ester synthesis 4) Leuckart reaction 5) Suzuki reaction 6) Willgerodt reaction 7) Ene reaction 8) H. V. Z reaction 9) Mitsunobu reaction 10) Sonagashira reaction	25
2.	**AROMATICITY** Aromaticity and Aromatic character; structure and stability of benzene,Frost circle diagram, concept of aromaticity; Resonance and chemicalstabilization; Robinson methods, criteria to check aromatic character-IR, UV & NMR, heat of hydrogenation; Huckel's rule; HMO method, Antiaromaticity, homoaromaticity, nonaromaticity, aromaticity in benzanoid compounds: naphthalene, pyrene, acepleialdelene. Aromaticity non- benzenoid compounds: azulene, tropolones, charged rings, annulenes.	25
3.	**ORGANIC TRANSFORMATION AND REAGENTS** 1) Sharpless epoxidation 2) Umpolung reagent (1,3-dithiane) 3) Dess martin periodinane 4) DDQ 5) Baker's yeast. 6) Di-isobutyl aluminum hydride (DIBAL-H) 7) Lithium diisopropylamide (LDA) 8) Ozone 9) Phase transfer catalyst-Crown ethers 10) Wilkinson's Catalyst	25

4.	**PHOTOCHEMISTRY** A. Energy of molecules, photochemical energy, electronic excitation, Jablonski diagram, laws of photochemistry, quantumefficiency. B. Photochemistry of carbonyl compounds- α-cleavage of acyclic,cyclic and α,β-unsaturated cleavage of carbonyl compounds, β-cleavage of inter and intramolecular hydrogen abstraction, additionto carbon- carbon double bond, photo reduction of carbonyl compounds. C. Photo induced rearrangement of enones, dienones and alkenes. Photochemistry of alkenes and aromatic compounds- isomerization,dimerization and addition reactions	25

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.	Understand the role of transition metal in organic synthesis by studying Heck, Suzuki, Sonagashira and Buchwald-Hartwig reaction, formylation by Villsmayer Heck reaction, substituted amines, amides formation reaction, cyclisation through condensation reaction and inverted configuration through Mitsunobu reaction.
2.	Understand aromaticity, various parameters for the measurement of aromaticity,frost circle method and calculation of energy for the determination of aromaticity. Aromaticity measurement through NMR, types of aromaticity and aromaticity measurement in fused rings, annulenes and azulenes etc.
3.	To learn the chemistry involved in oxidation-reduction reactions by employing numerous reagents & appropriate chemo-selectivity of the reagents, suggest use of miscellaneous reagents in organic synthesis including Wilkinson catalyst, DIBAL- H, PTC-crown ether, 1,3-Dithiane etc.
4.	Get oneself familiarize with usual photochemical reactions, terms of photochemistry, understanding fluorescence, phosphorescence by photoexcitation decay/dissipation of energy. Types of photochemical reactions like Norrish type-I & II, Paterno-Buchi etc., Photo-dimerization and their application in organic synthesis.

Suggested Reference Books:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, JohnWiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S. Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey & Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Name Reactions by A. R. Parikh & H.A.Parikh
8. Name reaction: A collection of detailed reaction mechanisms by Jie Jack Li
9. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).
10. Organic Chemistry-Reactions and Mechanism by P S Kalsi
11. Advanced Organic Chemistry: Reactions and Mechanisms by M.S. Singh
12. Organic chemistry by Cram, Hammond, Pine and Handrickson
13. Photochemistry and Pericyclic Reactions by Jagdamba Singh
14. Pericyclic reactions: A text book by S. Sankararaman
15. Excited states in Organic Chemistry by J. D. Coyle and J. A. Barltrop
16. March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure byMichael B.Smith
17. Advanced Organic Chemistry: Part B: Reaction and Synthesis by Carey & Francis
18. Organic Chemistry by Jonathan Clayden

Master of Science, Chemistry
Semester-II
Organic Practicals

Course Code	[1903080202050001]	Title of the Course	
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To impart basic knowledge for carrying out preparation. • Understand nature of reaction and establishment of reactioncondition with mechanism. • To understand calculation of mole and mole ratio for eachreaction. • Isolation of product from individual step and purification by crystallization. • Determination of physical constant and confirmation ofproduct. • Concept of estimation and determination of each component quantitatively.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Content

Preparation of organic compounds:

1. Nitration : m-Dinitrobenzene from nitrobenzene
2. Bromination: p-Bromoacetanilide from acetanilide
3. Reduction: m-Phenelene diamine from m – dinitrobenzene.
4. Oxidation: p-Nitrobenzoic acid from p-nitro toluene.
5. Diazotization reaction: Preparation of orange-II
6. Friedel-Craft's reaction: Resacetophenone from resorcinol
7. Cannizzaro reaction: Benzolic acid from benzaldehyde.
8. Aldol condensation: Chalcone from benzaldehyde and acetophenone.

Quantitative Estimations:

1. Estimation of ester + acid
2. Estimation of amide + acid.
3. Estimation of formaldehyde via oxime.
4. Determination of number of carboxylic acid (succinic acid, oxalic acid)

Teaching- Learning Methodology	Introduction, demonstration of handling equipment, reference books,and frequent instruction according to the respective practical.

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 to carry out reactions, nature of reaction and calculationof mole and mole ratio.
2.	Establish mechanism and monitor a reaction at specified condition.
3.	Work-up after the completion of reaction and purification.
4.	Confirmation of product through the references.
5.	Appreciate good laboratory practices.

Suggested Reference Books:

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis V K Ahluwalia& S.Dhingra.
5. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis VK Ahluwalia & R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

Master of Science, Chemistry
Semester-I
Paper : II (Organic Chemistry)

Course Code	[1803080201020001]	Title of the Course	**Organic Chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand the concept of reactive intermediate and their application in organic synthesis. • To understand the basics of pericyclic reaction, familiarize with various theories of pericyclic reaction to access the feasibility of various pericyclic reactions and implant the knowledge to predict the stereochemical outcome of various pericyclic reactions. • To learn anchimeric assistance, stereochemistry and internal substitution reaction of aliphatic and allylic compounds. Aromatic nucleophilic substitution, cine substitution, elimination reactions, their stereochemistry and mechanisms. • Understanding of concepts of chirality, topicity, prochirality, dynamic resolutions, types of stereoselective and stereospecific reactions, the conformation of substituted and fused aromatic rings along with respective strains theories.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content		
Unit	Description	Weightage* (%)
1.	**REACTION MECHANISM & REACTIVE INTERMEDIATES** Detailed study of organic reaction intermediates. Generation, structure, stability and reactions of – **Carbocations (Classical and non-classical):** Phenonium ion, norbornyl system, common carbocation rearrangements- Demjanov, Dienone -Phenol, Rupe. **Carbanions:** Mechanism of condensation involving enolates - Aldol, Mannich, Dieckmann, Michael and Shapiro reactions. **Carbenes:** Mechanism of Arndt-Eistert reaction, Wolf rearrangement and Bamford Steven's rearrangement reaction. **Free Radicals:** Coupling of alkenes and arylation of aromatic compounds by diazonium salts. Sandmeyer reactions. Free radical rearrangements, Hunsdiecker reaction.	25
2.	**PERICYCLIC REACTIONS** **Introduction** - Definition, Characteristics and Classification Molecular orbitals and symmetry properties of ethylene, 1,3-butadiene, 1,3,5- hexatriene **Electrocyclic Reactions:** Woodward-Hoffman Correlation diagram and derivation of selection rules, Conrotatory and disrotatory motions, FMO and PMO approach for 4n and (4n+2) Π-electron system. **Cycloaddition Reactions:** Antarafacial and suprafacial additions. FMO and PMO approach for 4n and (4n+2) Π-electron Systems Diels-Alder reaction, stereoselectivity. **Sigmatropic rearrangements:** Suprafacial and antarafacial shifts involving H & C moieties, retention and inversion of configurations. 1, 3- dipolar cycloadditions. Examples of electrocyclic, cycloaddition and sigmatropic Rearrangements.	25
3.	**SUBSTITUTION AND ELIMINATION REACTIONS** **A: Aliphatic Nucleophilic Substitution**: The SN^1, SN^2, SN^i mechanisms. Reactions of Allylic halides, neighboring group participation by -OH, $-NH_2$, -COO-, -RS, - halogen, aromatic ring. **B: Aromatic Nucleophilic Substitution**: The SN^1,addition –elimination reaction and elimination-addition reaction. Reactivity - effect of substrate structure, leaving group and attaching nucleophile, The Von Richter rearrangement. **C: Elimination reaction:** Hoffmann and Zaitsev's rule of elimination, E_1, E_2 and E_1CB Reaction and their regioselectivity.	25

4.	**STEREOCHEMISTRY** **A.** Stereo chemical principles; Enantiomeric relationships; Diastereomeric relationship; R-S and E-Z nomenclature; Dynamicstereochemistry; Chiral-Prochiral relationships; Stereo selective and Stereospecific reactions; Racemates and racemic modification,Resolution of racemic modification, Optical activity in the absenceof chiral carbons biphenyl, allenes, spiranes. **B.** Confirmational Analysis: Interconversion of Fischer, Newman and Sawhorse projections. Newer method of asymmetric synthesis (including enzymatic and catalytic nexus), enantio- and diastereo selective synthesis. Simple acyclic and cyclic (chair and boat cyclohexanes, Decalins, Perhydrophenanthrene) systems. Effects of conformation on reactivity in acyclic compounds, mono and disubstituted cyclohexanes and determination of their stability order.	25

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching- learning methodology comprises classroom teaching, use of e-resources, library books, 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 / 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 generation of reactive intermediates, their mechanism, rearrangement based on each intermediate, application of reactive intermediate in organic synthesis and industries application.
2.	Recognize pericyclic reactions, understanding of thermal and photochemical reaction, determination of mechanistic pathway, symmetry properties, aromaticity based on Mobius method, application of pericyclic reactions in organic synthesis.
3.	Learn the difference between elimination and addition reaction, the concept of anchimeric assistance in various groups like sulphide, halogen, phenyl, hydroxyl,tosylates & mesilates, amino group etc., aromatic nucleophilic substitution through addition - elimination, elimination-addition, cine substitution and their synthetic application.
4.	Detect chirality in molecular structure, recognize the relationship between enantiomeric and diastereomeric structures, understand & distinguish stereoselectiveand stereospecific reactions, dynamic resolution, the confirmative study of various substituted aromatic and fused aromatic rings and their application in the pharmaceutical industry.

Suggested Reference Books:

Unit I:

1. Carbenes, Benzynes and Nitrenes by Gilchrist, T. L. and Rees.
2. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, JohnWiley.
3. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh (McMillanIndia Ltd., 1976).
4. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S.Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
5. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
6. Advanced Organic Chemistry by Carey & Sundberg (3rd edition).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
8. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
9. Organic chemistry 2nd ed. Jonathan Clayden, Nick greeves, Stuart Warren.
10. Reaction Mechanism and Reagents in Organic Chemistry by C. R. Chatwal (Himalaya Publishing House, Bombay, 1987).

UNIT II:

1. March's Advanced Organic Chemistry Reactions, Mechanisms, And Structure 7th ed. 2013 Michael B. Smith. Wiley.
2. Mechanism And Theory in Organic Chemistry-2007 by Thomas H. Lowry, Kathleen S. Richardson, Forbes. Harper& Row, Publishers. New York, Hagerstown, San Francisco,London.
3. Advanced Organic Chemistry Part A: Structure and Mechanisms by Carey & Sundberg (5th edition), 2000, Springer.
4. Pericyclic Reactions, S. M. Mukherji, Macmillan, India.
5. Photochemistry And Pericyclic Reactions 3rd ed. by Jagdamba Singh 2010. New Age International Publishers Ltd. New Delhi.
6. Pericyclic Reactions: A mechanistic and problem-solving approach by Sunil Kumar, VinodKumar, S. P. Singh Academic Press 2015

UNIT III:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, JohnWiley.
2. Reaction Mechanism in Organic Chemistry by S. M. Mukherji and S. P. Singh(McMillan India Ltd., 1976).
3. Organic Chemistry (3/e) by J. B. Hendrickson, Donald J. Crem and George S.Rammond (McGraw-Hill Book Co. & Kogekusha Co. Ltd., 1970).
4. Organic Chemistry (5/e) by Morrison & Boyd (Prentice Hall).
5. Advanced Organic Chemistry by Carey &Sundberg (3rd edition).
6. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
7. Physical organic chemistry by Jack Hyne
8. Reaction mechanism by Jagdamba Singh.
9. Organic chemistry - Reaction mechanism, by P.S. Kalsi, New age internationalpublishers.

UNIT IV:

1. Advanced Organic Chemistry: Part A: Structure and Mechanisms; By Francis A. Carey,Richard J. Sundberg, fifth edition, Published by Springer.

2. Advanced Organic Chemistry: Part B: Reaction and Synthesis; By Francis A. Carey,Richard
3. J. Sundberg, fifth edition, Published by Springer.
4. Stereochemistry of Carbon Compounds; By Ernest L. Eliel, Published by TataMcGraw- Hill Publishing Company Ltd.
5. Basic organic stereochemistry; By Ernest Ludwig Eliel, Samuel H. Wilen, Michael P.Doyle, Published by Wiley-Inter-science.
6. Introduction to Stereochemistry; By Kurt Martin Mislow, Dover Publication INC.
7. Stereochemistry of Organic Compounds: Principles and Applications; By D. Nasipuri,NewAge International (P) Ltd. Publisher.
8. Stereochemistry Conformation and Mechanism; By P.S. Kalsi, New Age International (P) Ltd.Publisher.
9. Basic Stereochemistry of Organic; By Subrata Sen Gupta, first edition, Published byOxford University Press.

Master of Science, Chemistry
Semester-I
Organic Practicals

Course Code	[1803080201050001]	Title of the Course	
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To impart basic knowledge for the separation of organic ternarymixture. • To identify nature of mixture i.e., solid-solid, solid-liquid,liquid-liquid etc. • To impart knowledge of different purification techniquesincluding distillation. • Separation and identification of component with theirfunctional group test and M.P. /B.P. • To confirm the structure and prepare the relevant derivative.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Content

1. Mixture analysis: (Minimum eight mixtures) Ternary mixture to be given. (S+S+S),Semisolids or (L+L+L) or (S+L+L) or (S+S+L). Type, determination, Separation by physical and chemical methods. (Both permitted in case of liquids)
2. Paper Chromatography (amino acid/dyes)

Teaching- Learning Methodology	Introduction, demonstration of handling equipment, reference books,and frequent instruction according to the respective practical.

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 basics of separation of organic tertiary mixtures.
2.	Identify and chemical nature of mixture.
3.	Separation of each component from mixture.
4.	Identify each component through their functional group test, elemental analysisand M.P/B.P.
5.	Purify the compounds using different techniques including distillation, crystallization etc.
6.	Record physical constants for individual compounds.
7.	Appreciate good laboratory practices.

Suggested Reference Books:

1. A text book of practical organic chemistry – A. I. Vogel
2. Practical organic Chemistry – Mann and Saunders
3. A handbook of quantitative and qualitative analysis – H. T. Clarke
4. Comprehensive Practical Organic Chemistry: Qualitative Analysis V. K. Ahluwalia & S. Dhingra.
5. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis V. K. Ahluwalia & R. Aggarwal Universities Press.
6. An Advance Course in practical Chemistry, A K. Nad, B. Mahapatra and A. Ghoshal.

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Semester II

Course Code	[1903080202030001]	Title of the Course	Physical Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To learn conductivity behaviour of strong electrolytes in solution, factors affecting electrolysis process. • To learn basics and application of colloids. • To understand the basics of surface chemistry. • To understand basics of molecular spectroscopy.

Maping between PSOsand COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Medium of Instruction	English

Course Content

Unit	Description	Weightage* (%)

1.	**UNIT-I:THEORIES OF ELECTROLYTIC CONDUCTANCE AND OVER VOLATEGE** Debye-Huckel theory of strong electrolytes, relaxation effect and electrophoretic effect, Debye Falkenhagen effect, Weineffect.Ionic strength and its determination, Debye-Huckel limiting law. Activity and activity coefficient, determination of activity coefficient by (i) solubility (solubility product principle) (ii) EMF method (cell without transference), Determination of dissociation constant of monobasic acid by conductance method and approximate EMF method, Electrolytic polarization, Dissolution and Decomposition potential, Concentration polarization, Decomposition potential and its determination, over voltage, determination of over voltage,theories of over voltage:combination of atom as slow process (Tafel theory) Numerical.	25
2.	**UNIT-II: SURFACE CHEMISTRY** Adsorption Multilayer Adsorption, the BET adsorption isotherms, derivation of BET equation, determination of surface area and area of cross section of molecules by BET equation.Derivation of Langmuir equation from BET equation. Explanation of different adsorption isotherms, Change in enthalpy ,entropy and free energy of adsorption, Adsorption at the surface of liquid : Gibbs adsorption isotherms (derivation).Thermodynamic treatment of adsorption,Surface –Active substances, orientations of surfactants on the surface of solution , surface inactive substances, surface pressure,Insoluble surface films on liquid Numerical	25
3.	**UNIT-III: COLLOIDS:** Types of colloidal systems, preparation of lyophobic colloidal, Properties of Colloidal systems: (i) electrical properties origin of charges on colloidal, electrical double layer, Zeta potential and its determination by electrophoresis, factor affecting zeta potential, Explanation and derivaion DLVO theory of colloid stability (ii) Electrokinetic properties: Electrophoresis, elecroosmosis. Surface active agents, critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization: mass action and phase separation model, solubilisation, emulsion, types of emulsion, methods for determination of types of emulsion, microemulsion, types of microemulsion, theories of microemulsion.	25

4.	**UNIT IV: MOLECULAR SPECTROSCOPY** Molecular spectra, Microwave spectroscopy (Rotational spectroscopy): The Rotation of molecules, Linear molecule, Symmetric tops ,Spherical tops, Asymmetric tops, Rotational spectra of rigid diatomic molecule ,Intensities of spectral lines , Effect of isotopic substitution, Techniques and instrumentation of rotational spectrum, IR Spectroscopy: Classical frequency of harmonic oscillator,The classical potential energy of harmonic vibration of a diatomic molecule, Quantum expression of potential energy, energy level diagram, Relative population of energy levels ,Mechanism of interaction with radiation, selection rule, determination of force constant, Amplitude of vibration, The anharmonicvibrationor oscillator , Morse potential , Vibrational energy of diatomic molecule following the Morse potential, energy level diagram, vibrational transitions. Vibrational – Rotational spectra of diatomic molecule(CO molecule) Application of Vibrational rotational spectra Numerical	25
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 learnerwill be able to	
1.	Understand the electrolytes in conductance of solutions. Importance of polorization decomposition potential and over voltage in electrolysis process and in industries
2.	Understand physical phenomena of surface chemistry. Application of surface active substance and factor affecting surface chemistry, adsorption of surface active materials
3.	Understand the solution behaviour of surfactants. Colloidal chemistry explain the importance of micelle formation for colloidal industry
4.	Identify the molecular interactions and concentration and identification ofcompounds

Suggested References:

UNIT: I

1. Atkins, P.W., Physical Chemistry, W.H. Freeman (2017) 10 th editon
2. Samuel Glsstone, Introduction to Electro chemistry, East-West Press Pvt. Ltd. (2008)
3. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
4. Engel, T. & Reid, P. Physical Chemistry, Pearson
5. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)
6. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd

UNIT: II

1. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
2. Engel, T. & Reid, P. Physical Chemistry, Pearson
3. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)
4. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd

UNIT: III

1. Puri, B.R., Sharma, L.R., and Pathania, M.S., Principles of Physical Chemistry, Vishal Publishing Co.
2. Engel, T. & Reid, P. Physical Chemistry, Pearson
3. Maron, S. & Prutton Physical Chemistry, Collier Macmillan Ltd
4. Colloid Science: Principles, Methods and Applications by T Cosgrove
5. Physical Chemistry of Surfaces" by A W Adamson and A P Gast

UNIT:IV

1. Fundamentals of Molecular Spectroscopy C N Banwell TATA McGRAW-HILL15th edition
2. Handbook of Molecular Spectroscopy, by D.N. Sathyanarayana
3. Introduction to Spectroscopy by Donald L. Pavia, George S. Kriz, Gary M. Lampman, James
4. R. Vyvyan
5. Fundamentals of molecular spectroscopy by Walter S. Struve
6. Barrow, G.M. Physical Chemistry Tata McGraw Hill (2007)

Master of Science, Physical Chemistry
M.Sc. Physical Chemistry, Practicals

Course Code	[19030811002050001]	Title of the Course	Physical Chemistry
Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To study the physical chemistry parameters for reaction betweenacid and base. • To study rate of reaction and behaviour of electrolytes solution by conductometry. • To determine the concentration of solution by colorimetry • Partitioning behaviour of component in two phases

Course Content

1. Determine the dissociation constant and strength of borax solution pH-metrically.
2. Determine the velocity constant of the hydrolysis of ethyl acetate with sodium hydroxide atroom temperature by conductance measurements.
3. Determine the solubility of silver chloride in water potentiometrically.
4. To determine the concentration of given components in a mixture colorimetrically.
5. Determine the equilibrium constant of the reaction $I^- + I_2 = I_3^-$ by distribution method.
6. Investigation the reaction between H_2O_2 and HI at two different temperatures and calculatethe energy of activation for the reaction
7. Determine the formula of a complex between $Cu^{+2}$and NH_3 by distribution method.
8. Determine CST of Phenol -Water system
9. Determine CST of Phenol –NaCl system
10. Trtrate Fe(II) against potassium permanganate spetrophotometrically
11. Determine the degree of hydrolysis and hydrolysis constant of (i) CH_3COONa (ii) NH_4Cl

Teaching-Learning Methodology	Introduction, explanation of theory and procedure of the experiments and interpretation of results.

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.	Understand chemical kinetics of reactions
3.	Calculate the concentration of unknown solution by pH, potentiometer and colorimeter
4.	Understand partitioning behaviour of compound
5.	Understand effect of concentration on solubility product

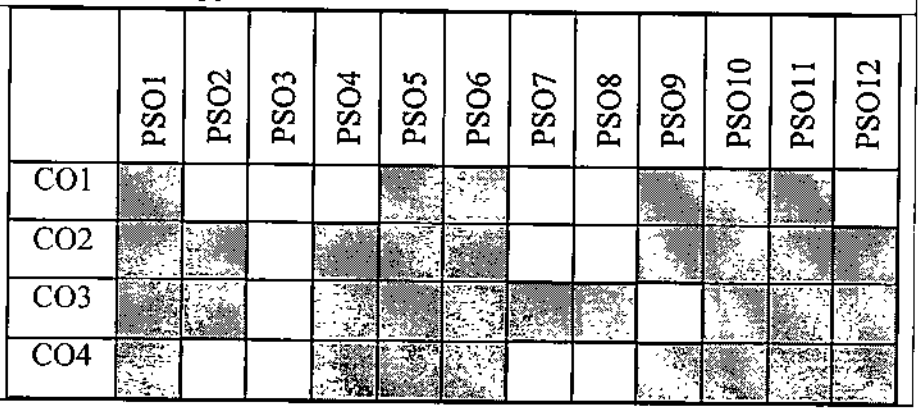
Suggested References:

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 6th Ed., Pearson

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Master of Science, Analytical Chemistry
M.Sc. Sem-II, Analytical Chemistry Paper-4 (Elective Paper-C)

Course Code	[1903080202040001]	Title of the Course	**Analytical Chemistry**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand theory and instrumentation of infrared spectroscopy with working of various parts of instruments. Structure elucidation is also learnt with help of IR spectra. • To learn liquid chromatography with special focus on the instrumentation of high-pressure liquid chromatography and their application in various field. • To understand the basic concept of radio analytical methods, their detection with various instrumental methods, and their application in various field. • To learn the thermal methods, their instrumentation, effect of various factors on the experimental results and their application in various field.
Mapping between CO and PSO	

Course Content		
Unit	Description	Weightage* (%)
1.	**IR SPECTROSCOPY** Introduction: Theory, Useful terms: IR region, types of vibrations: fundamental and overtones, linear and non-linear molecule, equation for vibrational frequency, selection rule, coupling interactions, Instrumentation: single beam, double beam spectrophotometers, FTIR: principle, instrument design, and function of beam splitter, radiation sources, sample cells, monochromators, detectors, sample handling, Resolution, wave number measurement, Advantages of FTIR vs. IR. , hydrogen bonding information, Fermi resonance. IR spectra: group frequency, group frequency region, fingerprint region, spectra	25

	interpretations and structure elucidation.	
2.	**LIQUID CHROMATOGRAPHY** Principle, Comparison with GC, Principle of HPLC, Instrument and significance of each component, Pumps, Guard column, Method of introducing sample, Criteria in selection of mobile phase, Stationary phases (solid, liquid), Bonded phase supports, Detectors: UV absorption, RI detectors – Normal phase and Reversed phase, Gradient Elution.	25
3.	**RADIO-ANALYTICAL TECHNIQUES** (a) Interaction of radiation with matter, Unit of Radioactivity. (b) Detection of Radiation a. Gas Ionization Detector (Ion-Chamber, Proportional Chamber, GM Counter) b. Scintillator Detector (Principle, Organic, Inorganic Scintillator) c. Solid-state Detector (c) Radiochemical principle & Application of tracers a. Reaction mechanism (Example of Esterification, Ester hydrolysis, Friedel-Craft reaction) b. Structural Determination c. Radiometric Titration. d. Isotopic Dilution Methods e. Neutron Activation Analysis	25
4.	**THERMAL METHODS OF ANALYSIS** **THERMOGRAVIMETRY** Thermogravimetry, Instruments for TGA- thermobalance and furnace, Calibration of temperature scale (Curie Point & Melting Point), Factors affecting TGA results instrumental and experimental, Applications (Mixture, Proximate analysis, Polymer identification, Carbon black and Structure of Copper Sulfate) **THERMOMETRIC TITRATION:** Thermometric Titration (TT), Advantages, Instrument, Applications of TT in Neutralization Titration, Precipitation Titration, Complexometric Titration and Redox Titration.	25

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.	Understand the basic concept of Infrared radiation and their interaction with the matter and use of FTIR spectrophotometer in structure identification and quantitative determination.
2.	Recognize the use of different stationary and mobile phase for the separation of organic molecule in liquid chromatography and identify the problems and their solution during the analysis.
3.	Learn various interaction of radiation with matter and their detection, also learn the determination of radiation with different techniques and their application in various field.
4.	Use of the thermometric techniques when the other methods are failed. The requirement of this technique is to identify the problems arising during the analysis.

Suggested Reference Books:

1. Fundamental of molecular spectroscopy, C.N. Banwell, Tata McGraw Hill Pub. Camp.
2. Spectrometric Identification of Organic Compounds (4th edition/5th edition),Silverstein, Bassler & Morril, John Wiley & Sons.
3. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw – Hill.
4. Modern Spectroscopy, J.M.Hollas, John Wiley.
5. Essential of Nuclear Chemistry by H.J. Arnikar, New Age Interanational Publishers
6. Basic Principles of Spectroscopy, R.Chang, McGraw-Hill.
7. Modern Methods of Chemical Analysis (2nd ed.), Pecsok, Shields, Cairns & Mc Williom, John Wiley & Sons.
8. Instrumental Analysis byR. D. Braun, McGraw-Hill.
9. Mathematics for Chemistry, Doggett and Sucliffe, Longman.
10. Mathematical preparation for Physical Chemistry, F. Daniels, McGraw-Hill.
11. Introduction to Instrumental Analysis by R. D. Brawn, McGraw-Hill Book.
12. Fundamentals of Analytical Chemistry: Skoog D.R. and West D.M. (Holt, Rinehart & Winston, New York).
13. Quantitative Analysis, 6th Ed., R.A. Day and A.L. Underwood, Prentice– Hall of India, 1993.
14. Instrumental Analysis: G. D. Christian and J. E. O'Reilly (Allyn& Bacon Inc., New York, 2nd edition.
15. Instrumental Methods of Chemical Analysis: G. W. Ewing (McGraw-Hill, New York),

5th edition.

16. Instrumental Methods of Analysis: H. R. Willard, L. L. Merrit, J. A. Dean, F. A. Settle (Van Nostrand Reinhold Co., New York), 6thedition.
17. Analytical Chemistry: Principles and Techniques: Larry G. Hargis (Prentice-Hall International edition).
18. Treatise on Analytical Chemistry: I. M. Kohthoff & P. J. Elving (John Wiley & Sons, New York).
19. Handbook of Analytical Chemistry: L. Meites (McGraw-Hill, New York).
20. Spectrometric Identification of Organic Compounds; By Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, 8TH edition, Published by Wiley
21. Introduction to Spectroscopy; By Donald L. Pavia, Gary M. Lampman, George S. Kriz, Vyvyan, Fourth edition, Published by Brooks cole.
22. Spectroscopic Methods in Organic Chemistry; By D.H Williams, I. Fleming, Sixth edition, Published by Tata McGraw-Hill Education.
23. Spectroscopy of Organic Compounds; By P S Kalsi, Sixth edition, New Age International Publisher.
24. Organic Spectroscopy: Principles and Applications; By Jag Mohan, second edition, Published by Alpha Science International Ltd.
25. Organic Spectroscopy (NMR, IR, Mass and UV); By Dewan S.K., First edition, CBS Publisher & Distributors Pvt Ltd.
26. Basic Principles of Spectroscopy; By Raymond Chang, Published by McGraw-Hill Inc.
27. Elementary Organic Spectroscopy; By Y R Sharma, S. Chand & Company Pvt. Ltd.
28. Organic Spectroscopy: By William Kemp, Published by Palgrave Macmillan.

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Master of Science, Analytical Chemistry
M.Sc. Sem-II, Analytical Chemistry Paper-4 (Elective Paper-D)

Course Code		Title of the Course	**Applied Analysis**
Total Credits of the Course	4	Hours per Week	4 hrs.

Course Objectives:	• To understand the basic concept of sampling, prevention of water sample. Also learn the uses of various instrumental and classical method in the analysis of water for removal of toxicants • To understand the theory of fats, oils and ferroalloys, their properties and analysis of oils, fats, ferroalloys by various instrumental techniques. • To understand basic concepts of clinical analysis, their properties and analysis of cholesterol, blood serum and urine sample by various methods. • To understand different adulteration in food, their properties and analysis of various adulteration present in food and molecules present in food by various methods

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Course Content

Unit	Description	Weightage* (%)
1.	**ANALYSIS OF WATER POLLUTANTS** Objectives of analysis, sampling, preservation and preconcentration methods, physical analysis - colour, odour, temperature, pH, EC, redox potential, total dissolved solids (turbidimetry), Chemical analysis of anions – CN^-, Cl^-, F^-, NO_2^-, NO_3^- (spectrophotometry), SO_4^{2-}, PO_4^{3-}. Determination of BOD, COD, TOC & DO. Analysis of Toxic Metals: Hg, As, Pb, Cd, Be, Al, Cr (Atomic Absorption Spectroscopy and Spectrophotometry)	25
2.	**INDUSTRIAL ANALYSIS**	25

	Analysis of Ferroalloys: Analysis of steel - Molybdenum, Phosphorous. Analysis of Ferromanganese, Ferrovanadium. **Analysis of Oils & Fats:** Theory, Melting point of fats, Chemical Characteristics: Saponification value, Iodine value, Thiocyanogen value, ketone or perfume rancidity. Analysis of fatty acid composition in oil by GLC, Oxidation levels of fats by TLC.	
3.	**CLINICAL ANALYSIS:** Determination of (1) Serum Calcium (2) Serum/Plasma Bicarbonate (Titrimetry). (3) Serum sodium and potassium (Flame-photometry). Determination of Serum Chloride (Coulometry) - Determination of (1) Cholesterol (2) Total Protein (3) Blood Urea in Serum (4) Amylase (5) Aspartate Amino Transferase (AST) and Alanine Amino Transferase (ALT) (by Spectrophotometry). Determination of (1) Thyroxin and (2) Thyroid-Stimulating Hormone (TSH)(by RIA Method)	25
4.	**FOOD ANALYSIS:** Analysis of Chemical Additives in foods: Division of color additives, Chromatographic identification of colors, and quantitative estimation of added dyes in foods (Titanium Trichloride Method) - chemical preservatives and synthetic sweetening agents (Organic-ether extractable and Non-ether extractable) - Sodium Benzoate (Chemical Methods), Sorbic Acid (Chromatography) - Types of Antioxidants used in Foods, Analysis of Butylated Hydroxy Toluene (BHT) (Spectrophotometry).	25

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	
5.	Understand fundamental & theory of the sources and available contents in water analysis. Also learn the different approaches and classical as well as instrumental techniques used for the analysis.

6.	Understand fundamental & theory of ferro alloys, fats and oils. Also learn the different approaches and classical as well as instrumental techniques used for the analysis.
7.	Understand fundamental & theory of clinical analysis. Also learn the different approaches and classical as well as instrumental techniques used for the analysis.
8.	Understand fundamental & theory of the adulteration in food. Also learn the different approaches and classical as well as instrumental techniques used for the analysis.

Suggested Reference Books:

1. Analytical Chemistry, Gary Christian, VI Ed, John Wiley & Sons Inc, New York
2. Fundamentals of Analytical Chemistry, Skoog & West
3. Vogel's Text Book of Quantitative Chemical Analysis, 6th Ed, Pearson Education Ltd
4. Environmental Pollution Analysis, S M Khopkar, Wiley Eastern Ltd 1995
5. Environmental Analytical Chemistry, F W Fifield, P J Haines, Blackie Academic& Professional.
6. Environmental Chemistry, B K Sharma, Goel Publishing House, Meerut.
7. Handbook of Analysis and quality control for fruit and vegetable products, S Ranganna, Tata Mc Graw Hill Publishers Ltd, 1986
8. Introduction to chemical analysis of foods, S Suzanna & Nielsen, CBS Publishers & Distributors
9. Practical pharmaceutical Chemistry, a H Beckett and J B Stenlake, III Ed, Vol I and Vol II, CBS Publishers & Distributors,1997
10. Pharmaceutical Analysis, David G Watson,Churchill Livingstone Harcourt Brace and Company Ltd, 1999
11. Text Book of Clinical Chemistry V Edn Carl.A. Burtis Edward R. Ashwood Saunders Harcourt India 2001.

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

Master of Science
M.Sc. Chemistry, Semester-II
(Skill Enhancement Course)
Paper: 5 Perfumes and Cosmetics

(Credits: 02)
Total: 30 hours

Course Content		
Unit	Description	Weightage* (%)
1.	**NATURAL PERFUMES, SYNTHETIC PERFUMES AND FLAVORS** Perfumes, plant and animal sources, examples, Components of perfumes, vehicle, characteristic of good vehicle, fixatives and it's and it's types, Odoriferous compounds, Extraction of essential oils by distillation, enflurege and solvent extraction methods, Rose and Jasmine: composition and preparation of rose and Jasmine perfumes, Natural fruit concentrates as flavors: Vanilla and Cocoa Preparation and uses of methyl anthranilate, methyl salicylate, methyl cinnamate, phenyl ethanol, citronellol, vanilline, coumarin and heliotrope	25
2.	**SOAP, SHAMPOO, COSMETICS AND PERSONAL HYGIENE PRODUCTS** Cleansing action of soaps, additives in cleansing agents, ingredient of washing and bathing soap, TFM of Bathing soap, Types of Shampoo and compositions, Characteristics of good cosmetics Evaluation of powder and basic composition of talcum powder, face cream, nail polish, hair dye, toothpaste, mouthwash (Formulation only)	25

REFERENCE BOOKS:

1. Shreve's Chemical Process Industries by George T. Austin, Mc Graw Hill India; 5th edition.
2. Perfumery technology: art, science, industry by Marcel Billot and F.V. Wells, Ellis Horwood, Ltd.; 2nd edition.
3. A textbook of cosmetic formulation by Gaurav Kumar Sharma, Jayesh Gadhiya, Meenakshi Dhanawat.
4. A handbook of cosmetics by B.M. Mithal and R.N. Saha, Delhi Vallabh Prakashan, 5th edition