INSTITUTE OF SCIENCE, NAGPUR
(An Autonomous Institute of Government of Maharashtra)
Civil Lines, R. T. Road, Nagpur 440001
NAAC Accredited "A" Grade
Phone: *0712-2561148* *Web: www.iscnagpur.ac.in*
Email:ioscnagpur@gmail.com

Syllabus for Master of Science Two Year (Four Semesters) Degree Course

With effect from 2024-25 as per NEP 2020

SUBJECT- CHEMISTRY
M.Sc. - Second Year: Semester-III
Name of the Course Category: DSC-1
Title of the Paper: Spectroscopy-I
Course Code: M-CH631T
Paper-I

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs.: 60 Hrs. (4h per week)

Expected Learning Outcome: After Studying the course student will be able to:

1. Interpret symmetry elements and point group in molecule.
2. Deduce the character tables for H_2O and NH_3 using Great Orthogonality Theorem.
3. Interpret mass spectrum of molecule.
4. Determine the structure of molecule using Mössbauer spectroscopy.
5. Interpret the ESR spectra of free radicals.
6. Explain working principles and taking spectrum of IR spectroscopy device.
7. Determine the different vibrational modes in molecules.
8. Interpret the IR spectrum of compounds.
9. Explain basic principles of Raman spectroscopy

Unit - I: Symmetry properties of molecules and group theory: 15h

Symmetry elements and symmetry operations. Properties of group. Point groups and Schoenflies symbols. Symmetry operations as a group. Matrix representations of groups. Multiplication table for C2v, C3v and C2h. Reducible and irreducible representations. Similarity transformation. Classes of symmetry operations. Great Orthogonality Theorem. Derivation of character tables for H2O and NH3 using Great Orthogonality Theorem. Application of character tables in selection rules of IR, Raman and Electronic spectroscopy.

Unit - II: **15h**

A] Mass spectrometry: Theory, ion production(EI, CI, FD, FAB), ion analysis, ion abundance, isotopic contribution, N-rule, types of fission processes, high resolution mass spectrometry, metastable peak, molecular ion peak, Mclaffferty rearrangement, mass spectral fragmentation of organic compounds alkanes, alkenes, alkynes, alcohols, amines, amides, acids, aldehydes, ketones, halides, Structure determination of organic molecules by mass spectrometry, problem based on mass spectral data

B] Mössbauer spectroscopy: Basic principle, experimental techniques, recoil emission and absorption, source, absorber, isomer shift, quadrupole interaction, magnetic hyperfine interaction, applications in determining electronic structure, molecular structure, crystal symmetry, magnetic structure, surface studies, biological applications.

Unit - III: **15h**

A] Microwave spectroscopy: Classification of molecules on the basis of M.I., rigid and non-rigid rotor, effect of isotopic substitution on transition frequencies, stark effect, microwave spectrometer, application in deriving: molecular structure, dipole moment, atomic mass, and nuclear quadrupole moment.

B] ESR spectroscopy: Introduction, principle of ESR, ESR spectrometer, hyperfine coupling, zero field splitting, factors affecting g values, Kramer's degeneracy, application of ESR spectra to study free radicals like hydrogen, methyl radical, 1,4-semibenzoquinone, naphthalene, transition metal complexes, biological systems.

Unit IV: **15h**

A] Infrared spectroscopy: Diatomic molecules: 1) Molecules as harmonic oscillator, Morse potential energy function, vibrational spectrum, fundamental vibrational frequencies. Force constant, zero-point energy, isotope effect. The Anharmonic oscillator, the interactions of rotations and vibrations. P,Q,R branches, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies, overtone, and combination frequencies. Structure determination of organic molecules by IR spectroscopy, problem based on IR spectral data

B] Raman Spectroscopy: Rayleigh scattering. Raman Scattering, classical and quantum theories of Raman Effect. Rotational Raman Spectra for linear and symmetric top molecules. Vibrational Raman Spectra, rotational fine structure. Selection rules, coherent antiStokes Raman spectroscopy, Structure determination from Raman and Infra-red spectroscopy.

List of books:

1] Spectroscopic identification of organic compound-RM Silverstein,GC Bassler and TC Morril, John Wally

2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely

3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall

4] Organic Spectroscopy-William Kemp, ELBS with McMillan

5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi

6] Organic Spectroscopy-RT Morrison and RN Boyd

7] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin

8] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming

9] Fundamentals of Molecular Spectroscopy-CN Banwell

10] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro

11] Photoelectron Spectroscopy-Baber and Betteridge

12] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten

13] NMR –Basic Principle and Application-H Guntur

14] Interpretation of NMR spectra-Roy H Bible

15] Interpretation of IR spectra-NB Coulthop

16] Electron Spin Resonance Theory and Applications-W Gordy

17] Mass Spectrometry Organic Chemical Applications, JH Banyon

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC-2
Title of the Paper: Inorganic Chemistry-Special I
Course code: M-CHIC632T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs.: 60 Hrs. (4h per week)

After studying this course, you shall be able to:

1. To explain selected crystal structures explain what kind of parameters that affect the crystal structure of a compound and perform calculations of the lattice enthalpy of ionic compounds
2. To make the students to understand the formation of inorganic. Compounds and their application in various branches of chemistry
3. To make the students importance of solvents, their application in various reaction systems.
4. To make the students to understand the formation of compounds starting from elemental level to molecular level.

Unit I **15h**

Crystal Structure of Some Simple Compounds: i) Ionic Crystals &Their structures, radius ratio rule, effect of polarization on crystals. ii) Covalent structure type- Sphalerite & Wurtzite. iii) Geometry of simple crystal AB type: NaCl, CsCl & NiAs, reasons for preference for a particular structure in above AB type of compounds. iv) AB_2 type: Fluorite, antifluorites, Rutile structures. Li_2O, Na_2O,,$CdCl_2$, CdI2 structures. v) Ternary Compounds ABO_3 type: Perovskite, Barium titanate, lead titanate, $CaTiO_3$, Tolerance factor, charge neutrality & deviation structures. $FeTiO_3$.

Unit II **15h**

A] AB_2O_4 type- compounds: Normal & inverse,2-3 and 4-2 spinel, packing of oxygen in tetrahedral & octahedral sites, sites occupancy number of site surrounding each oxygen, application of charge neutrality principles, site preferences in spinel, distorted spinel. Hausmannite (Jahn-Teller distortions), Factors causing distortion in spinel.

B] Lattice Defects: Perfect &Imperfect crystals, point defects, Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frankel defects. Dissociation, theory of dislocation, plane defects- Lineage boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds. Electronic properties of Non-stoichiometric oxides.

Unit III **15h**

Glasses, Ceramics and composite: Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and Glass Modifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengtheried and Particle

reinforced, fibre reinforced Composites, microscopic composites, nanocrystaline phase, preparation procedure, special properties and applications.

Unit IV **15h**

Liquid Crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematics & smectic mesophases; smectic-Nematic transition clearing temperature-homeotrpic, planer & schlieren textures twisted nematics, chiral nematics, molecular arrngement insmectic A & smectic C phases, optical properties of liquid crystals. Dielectric susceptibility & dielectric constants. Lyotropic phases & their description of ordering in liquid crystals.

List of Books:

1] Akhmetov, N.: General and Inorganic Chemistry.

2] Aylett, B. and Smith, B.: Problems in Inorganic Chemistry, (English University Press)

3] Bertini, et al: Bioinorganic Chemistry (Viva)

4] Charlot, G and Bezier, D.: Quantitative Inorganic Analysis (johnWiley).

5] Douglas, B. E. McDanirl, D. H. et al: Concept and Models of Inorganic Chemistry (4th edt.) J. Wiley 6. Dutt P. K.: General and Inorganic Chemistry.(Sarat Books House) 7. Fenton, David E.: 6.Biocoordination chemistry, Oxford

6] Jolly, W. L. : Inorganic Chemistry (4th edn.) Addison-Wesley.

7] Katakis, D. and Gordon, G.: Mechanism of Inorganic Reactions.(J.Wiley).

8] Peter J. Collings, Liquid Crystals-Nature's delicat

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC-2
Title of the Paper: Organic Chemistry-Special I
Course code: M-CHOC632T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course, the student will be able to

1) Explain and describe different types of reactions of organic molecules and the reactive intermediates involved in them and effect of structure on reactivity, mechanisms involved in various types of organic reactions like photochemical reactions, pericyclic reactions.
2) Stereochemical aspects with advance concepts includes stereochemical reactions
3) Illustrate applications of various reagents involved in oxidation and reduction.
4) Use of Organo Sulphur, Organo Phosphorus, Organo Silicon and Organo Boranes and other. Organometallic reagents in organic synthesis
5) Analyze organic reactions by using retrosynthetic approach

Unit I: Photochemistry **15 h**

Interaction of radiation with matter, types of excitation, rate of excited molecules, quenching, Quantum efficiency, quantum yield, transfer of excitation energy, singlet and triplet states, experimental methods in photochemistry of carbonyl compounds, and transition, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photoreduction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones, Photochemistry of parabenzoquinones, photochemistry of Aromatic compounds with reference to isomerisation additon and substitution Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, Photo-Fries rearrangement, di-pi methane rearrangement, Photo theory reaction of anilides, photochemistry of vision, Applications of photochemical methods in synthesis: Isocomene, Cedrene, Hirsutene

Unit II: Pericyclic Reactions **15 h**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene, allyl system, classification of pericyclic reaction. FMO approach, Woodward-Hoffman correlation diagram method and Perturbation of Molecular Orbital (PMO) approach of pericyclic reaction under thermal and photochemical conditions Electrocyclic reactions, conrotatary and disrotatary motion 4n and (4n+2) systems, Cycloaddition reaction with more emphasis on [2+2] and [4+2], Cycloaddition of ketones Secondary effects in [4+2] cycloaddition. Stereochemical effects and effect of substituents on rate of cycloaddition reaction, Diels-Alder reaction, 1,3-dipolar cycloaddition and chelotropic reaction. Sigmotropic rearrangement, suprafacial, and antarafacial shift involving carbon moieties, retention and

inversion of configuration, [3,3] and [3,5] sigmotropic rearrangements, Claisen, Cope, Sommelet-Hauser rearrangements, Ene reaction.

Unit III: Application of reagents in oxidation and reduction **15 h**

A] Oxidation: Oxidation of alkanes, aromatic hydrocarbons and alkenes, Dehydrogenation with S, Se, Fremy's salt, DDQ, chloranil and PhI(OAc)2, Oxidation with SeO2, Epoxidation of olefins, Synthetic application of epoxides, Sharpless asymmetric epoxidation, Dihydroxylation of olefins using KMnO4, OsO4, Woodward and Prevost dihydroxylation, Oxidative cleavage of olefins, Ozonolysis

a) Oxidation of alcohols: Chromium reagents, pyridinium chlorochromate (PCC), pyridinium dichromate (PDC), Collin and Jones reagent, Combination of DMSO with DCC, (COCl)2, NCS and (CH3CO)2O for oxidation of alcohols, Oxidation with MnO2, Oppenauer oxidation

b) Oxidation of aldehydes and ketones : Conversion of ketones to α, β-unsaturated ketones and α-hydroxy ketones, Baeyer-Villiger oxidation , Chemistry and synthetic applications of Pb(OAc)4, Dess-Martin periiodinane, IBX

B] Reduction: Catalytic heterogeneous and homogeneous hydrogenation, Hydrogenation of alkenes, alkynes and arenes, Selectivity of reduction, Mechanism and stereochemistry of reduction, Raney Ni-catalyst, Adam catalyst, Lindlar catalyst, Wilkinson catalyst.

a) Reduction by dissolving metals : Reduction of carbonyl compounds, conjugated systems, aromatic compounds and alkynes. Birch reduction, Hydrogenolysis

b) Reduction by hydride transfer reagents : Meerwein-Pondorff-Verley reduction, Reduction with LiAlH4 and NaBH4, stereochemical aspects of hydride addition, Derivatives of LiAlH4 and NaBH4, Selectivity issues, Diisobutyl aluminium hydride (DIBAL-H), Sodium cyanoborohydride, Reduction with boranes and derivatives Reduction with Bu3SnH., Reduction of carbonyl group to methylene, Reduction with diimide and trialkylsilanes

Unit IV: Chemistry of P, S, Si and Boron compounds **15 h**

a) **Phosphorus and sulphur ylide** : Preperation and their synthetic application along with stereochemistry

b) **Umpolung concept**: Dipole inversion, generation of acyl anion, use of 1,3-dithiane, ethylmethyl thiomethyl sulphoxide, bis-phenylthiomethane, metallated enol ethers, alkylidene dithiane, ketone thioacetals, 2-propenethiobismethyl thioallyl anion, thiamine hydrochloride based generation of acyl anion

c) **Organoboranes**: preparation and properties of organoborane reagents e.g. RBH_2, R_2BH, R_3B, 9-BBN, catechol borane. Thexyl borane, cyclohexyl borane, ICPBH2, IPC2BH, Hydrboration mechanism, stereo and regeoselectivity, uses in synthesis of primary, secondary tertiary alcohols, aldehydes, ketones, alkenes, Synthesis of EE, EZ, ZZ dienes and alkyenes. Mechanism of addition of IPC2BH. Allyl boranes- synthesis, mechanism and uses.

d) Organo silicon compounds in organic synthesis, Me3SiCl, Me3SiH and Paterson synthesis

List of books:

1] Books as suggested in Semester I for organic chemistry

2] Organic Synthesis, The disconnection approach-S. Warren

3] Designing Organic Synthesis-S. Warren

4] Some Modern Methods of Organic Synthesis-W. Carruthers

5] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press

6] Protective Group in Organic Synthesis-T. W. Greene and PGM

7] The Chemistry of Organo Phosphorous-A. J. Kirbi and S.G. Warren

8] Organo Silicon Compound-C. Eabon

9] Organic Synthesis via Boranes-H. C. Brown

10] Organo Borane Chemistry-T. P. Onak

11] Organic Chemistry of Boron-W. Gerrard

12] Fundamentals of Photochemistry-K. K. Rohatgi-Mukharji, Wiley Eastern Limited

13] Photochemistry-Cundau and Gilbert

14] Aspects of Organic Photochemistry-W. M. Horspoot

15] Photochemistry-J. D. Calvert

16] Photochemistry-R. P. Wayne

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC-2
Title of the Paper: Physical Chemistry-Special I
Course code: M-CHPC632T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course the student will be able to:
1. Classify the various complex chemical reactions.
2. Differentiate between slow, moderate and fast reactions.
3. Predict the kinetics of reactions by apply the steady state approximation..
4. Study the reactions in solutions, photochemical reactions and solid-state reactions
5. Understand the synthesis and applications of different nanomaterial's.

UNIT I: CHEMICAL DYNAMICS - I 15h

A] Dynamics of complex reactions: Reversible, Parallel, Consecutive, Concurrent and branching reactions, free radical and chain reactions, reaction between Hydrogen – Bromine and Hydrogen – Chlorine (thermal and photochemical), decomposition of ethane, acetaldehyde, N_2O_5, Rice Herzfeld mechanism, Oscillatory autocatalytic and Belousov-Zhabotinsky reactions.

B] Fast Reactions: Relaxation methods, flow methods, flash photolysis, magnetic resonance method, relaxation time and numericals.

UNIT II CHEMICAL DYNAMICS - II 15h

A] Overview of Arrhenius rate law, Non-conventional equilibrium between reactants and activated complexes. Potential energy surfaces and reaction coordinate. Derivation of transition state theory based equation for rate constant of bimolecular reaction. Prediction of rate constant using partition function and comparison with that given by collision theory. Arrhenius equation and activated complex theory. Transmission coefficient, quantum mechanical tunneling,

B] Reactions in solution: Cage effect, diffusion controlled reactions, volume of activation its determination and Correspondence with entropy of activation, Ionic reactions: Primary (Ionic strength) and Secondary salt effect and their nature.

UNIT III: PHOTOCHEMISTRY 15h

A] Photophysical Phenomenon: 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.

B] Photochemical reactions: Photoreduction, photo oxidation, photo-dimerization, photochemical substitution, photo isomerization, photosensitization, chemiluminescence, photochemistry of environment: Greenhouse effect.

Unit IV: SOLID STATE REACTIONS AND NANOPARTICLES 15h

A] Solid State Reactions: General principle, types of reactions: Additive, decomposition and phase transition reactions, tarnish reactions, kinetics of solid state reactions, factors affecting the solid state reactions. photographic process.

B] Nanoparticles and Nanostructural materials: Introduction, methods of preparation, physical properties, and chemical properties, sol-gel chemistry of metal alkoxide, application of Nanoparticles, Charecterization of Nanoparticles by SEM and TEM. Nanoporous Materials: Introduction, Zeolites and molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation and applications.

List of books:

1] G. M. Panchenkov and V. P. Labadev, " Chemical Kinetics and catalysis", MIR Publishing

2] E.A. Moelwyn- Hughes, "Chemical Kinetics and Kinetics of Solutions", Academic

3] K. J. Laidler, Chemical Kinetics, Third Edition (1987), Harper and Row, New York

4] J. Raja Ram and J. C. Kuriacose, Kinetics and Mechanism of Chemical Transformations MacMilllan Indian Ltd., New Delhi (1993)

5] J.G. Calvert and J.N. Pitts, Jr., Photochemistry, John Wiley and Sons, New York (1966).

6] K. K. Rohtagi-Mukherjee, Fundamentals of Photochemistry, New Age International, New Delhi(1986).

7] R. P. Wayne, Principles and Applications of Photochemistry, Oxford University Press, Oxford(1988).

8] N. J. Turro, Modern Molecular Photochemistry, Univ. Science Books, Sansalito (1991).

9] J. F. L. Lakowicz, Principles of Fluorescence Spectroscopy, 2nd Edition (1999), PlenumPublishers, NewYork.

10] H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.

11] M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,

12] G. K. Agrawal, Basic Chemical Kinetics, Tata-Mc-Graw Hill Pvt., Ltd. 1990

13] K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

14] C.Kittel, " Introduction to solid state Physics",Wiley

15] L.V.Azaroff, " Introduction to solids", McGraw Hill

16] Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.

17] N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn, N. B. Hanny, Solids,

18] Sulbha Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing House, 2011.

19] T. Pradeep, Nano: The Essentials, Tata Mc-Graw Hill, 2012

20] N. B. Hanny, "Solid State Chemistry"

21] C. N. R. Rao and Gopalakrishnan, "New Directions in Solid State Chemistry" Second Edition, Cambridge University Press.

22] Anthony R. West, "Solid State Chemistry and its Applications" Wiley India Edition.

A. M. Rahatgaonkar

M.Sc. - Two Year: Semester-III
Name of the Course Category: DSC-2
Title of the Paper: Analytical Chemistry - Special I
Course code: M-CHAC632T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs.: 60 Hrs. (4h per week)

Expected Learning Outcomes: After studying this course the student will be able to:
1. Solve the numericals based on the stoichiometric reactions which will help them to work in laboratories.
2. Use different analytical instruments, calibrate them and calculate LOD, LOQ etc.
3. Analyze and calculate the quantity of different elements and functional groups present in the organic compounds.
4. Use Karl-Fisher reagent in analysis of water in organic compounds.
5. Understand physico-chemical parameters of water after sampling, analysis of water with respect to mineral, demand and heavy metals and pollution of water.
6. Do sampling of air, classify air pollutants and study the effect of air pollution on environment and parameters related to air pollution such as SPM, RSPM, Greenhouse effect, acid rain etc.
7. Learn the sources, effects, methods of measurements and control measures of noise pollution.

Unit I: **15h**

A] Volumetric Calculations: Stoichiometric and substoichiometric volumetric analysis. Concentration units: Unified atomic mass unit and the mole, Molarity, Normality, Weight and volume percent, Mole fraction, Formality, etc. Standard solutions. Primary standards and secondary standards. Numerical problems based on standard solution preparation, titrimetric analysis and gravimetric analysis. Calculations involved in acid-base, precipitation, redox and complexometric reactions.

B] Detection and Quantification: Concepts and difference between sensitivity, limit of detection and limit of quantification, role of noise in determination of detection limit of analytical techniques. Methods of quantification: Absolute method, comparison method, calibration curve method, standard addition method and internal standard method.

Unit II: **15h**

A] Elemental analysis: Outline of macro, semi-micro, micro and ultra-micro analysis, Sample dissolution methods for elemental analysis: Dry and wet ashing, acid digestion and dissolution of organic samples. Semi-micro determination of carbon, hydrogen, halogen, sulphur, nitrogen and phosphorous in organic compounds.

B] Functional group analysis: Semi-micro determination of the following functional groups in organic compounds - hydroxyl, amino, nitro, N-acetyl, methyl, aldehydes, ketones, thio, disulphide, sulphonamide, unsaturation and active hydrogen.

C] KF reagent: Karl Fischer reagent and its use in analysis of water in organic compounds.

Unit III: **15h**

A] Analysis of water: Importance of water analysis, sampling of water and sample preservation, Quality and requirements of potable water, composition of potable water, Physico-chemical analysis, Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb).

B] Water pollution: Sources of water pollution, direct and indirect pollutants for potable water reservoirs, rain water harvesting, consequences and harmful effects of water pollution, strategies for water pollution control. Water treatment plants: Sand filters and other types of filters.

Unit IV: **15h**

A] Air pollution and analysis :Classification of air pollutants, pollutants and permissible limits, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO2, NO2, CO, CO2, Sampling methods for air, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP, ozone layer, Greenhouse effect, Heat Islands, photochemical smog, Acid Rain.

B] Noise Pollution: Sources, effects, methods of measurements and control measures.

List of books:

1] Analytical Chemistry: Gary D. Christian (Wiley India).

2] Stoichiometry: B.I.Bhatt and S.M. Vora, 2nd Edition (Tata Mc-Graw Hill publication)

3] Elementary Practical Organic Chemistry Part III, Quantitative organic Analysis By Arthur Vogel, Longman Group Limited, 1958.

4] Instrumental Methods of Analysis: Willard, Meriit and Dean (Van Nostrand)

5] Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)

6] Vogel‘s Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)

7] Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)

8] Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)

9] Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)

10] Environmental Chemistry: Moore J W and Moore E A. Academic Press, New York, 1976.

11] Environment and Man Vol VII: The Chemical Environment Edited by J Lenihar and W Fleecher Vlackie Publication, 1977.

12] The Chemistry of Environment: R A Horne, Wiley Interscience Publication 1978.

13] Chemistry for Environmental Engineering and Science: C N Sawyer, P L McCarty and G F Parkin

14] Laboratory Manual for the Examination of Water, waste water and soil: H H Rupa and H Krist, V C H Publication

15] Environmental Chemistry: B K Sharma and H Kaur

16] Environmental Chemistry: A K De

17] Environmental Pollution- Management and control for sustainable Development: R K Khatoliya

18] Laboratory manual of water analysis: Moghe and Ramteke (NEERI)

19] Analysis of Water: Rodier

20] Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata McGraw Hill)

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSE-1
Title of the Paper: Inorganic Chemistry
Course code: M-CHIC633T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course, you shall be able to:

1. Do classification of organometallic catalysts.
2. Identify the applications organometallic catalyst
3. To make the students to understand the formation of inorganic. Compounds and their application in various branches of chemistry in particular and in science generally.
4. To make the students to understand the formation of inorganic. Compounds and their application in various branches of chemistry in particular and in science generally.

UNIT I: Catalysis **15h**

A] Basic principles, thermodynamics and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous & heterogeneous catalysis, reaction catalyzed by transition metal complexes and Organometallic compounds, Mechanism of reaction viz. Hydrolysis, polymerization, esterification, hydrogenation, ammonia synthesis, sulpur dioxide Oxidation.

B] Zeolites, synthesis of different zeolites, characterization, determination of surface acidity, shape, selectivity and application.

Unit II: **15h**

Inorganic Polymers Classification, types of Inorganic polymers, Chemistry of following polymers a) Silicones b) phosphonitric halides c) condensed phosphates d) coordinated polymers e) silicates f) Isopoly & heteropoly acids . Molecular shape , structure and configuration, crystallinity, stress- strain behavior, thermal behavior , polymer types and their applications, conducting and ferro - electric polymers.

UNIT III: Non-conventional sources of energy **15**h

(a)Alternate source of energy Solar sources: Photochemical methods, thermodynamic efficiency of energy conversion, energy from solar radiations, transition metal complexes for energy production, solar hydrogen system, photochemical processes at semiconductors electrodes, photo galvanic & Photovoltaic cells based on Inorganic photochemical systems. b) Geothermal energy c) Energy from biogas sources d) Tidal wind sources e) Energy from fission and fusion reaction.

UNIT IV: Fertilizers **15h**

Classification of fertilizers, Types of nitrogen fertilizers, Classification and types phosphate fertilizers, Classification and types NPK fertilizers, H_3PO_3 production without using H_2SO_4, position of fertilizer Industries in India. Method of soil analysis, soil fertility its determination, determination of inorganic constituents of plant materials, Chemical analysis as measure of soil fertility, analysis of fertilizers.

List of Books:

1. Heterogeneous catalysis 2nd edn., Bond C. Chapman all (1987)
2. The application & Chemistry of catalysis by suitable transition metal complexes Parashall. W. Weily N. 1980.
3. Homogeneous transition metal catalysis, A general art, Masters C. Chapmann and Hall, London 1981.
4. Introduction to the principles of heterogeneous catalysis, Thomas J.M., Thomas W.J. Academic press N.Y. 1967
5. Inorganic polymers: Mark J.F., Allock H.R. West, Prentice hall
6. Inorganic polymers: Ring N.H., Academic Press N.Y. 1978
7. The Inorganic heterocyclic chemistry of sulphur, nitrogen, phosphorous, Heal A.G. Aca, Press N.Y. 1980.
8. Solar energy Principles of thermal collections and storage, Sukhatme S.P., Tata Macgrow Hill New Delhi 1984.
9. Fuel Cells, Bockeris JOM, Sriniwasan S. and Mac grow Hills 1969
10. Solar Energy Rai C.D.
11. Energy Resources, Simon A.L. 1975
12. Direct Energy Conversion, Addison Wesley, 1970, All M and Kottani S.
13. Outlines in Chemical Technology Vol I, S.D. Sukla & Pandey G.N

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSE-2
Title of the Paper: Organic Chemistry
Course code: M-CHOC633T
Paper-III
To be implemented from 2024-25

\Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4h per week)

Expected Learning Outcomes: After studying this course, the student will be able to
1. Isolate, illustrate the structure determination of natural products
2. Illustrate the applications of Pharmaceutical Chemistry.

Unit I: **15 h**

A] Terpenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, and synthesis of the following representative molecules: Citral, Geraniol, α-terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β-carotene, Vitamin A Genesis of biological isoprene unit, Biosynthesis (**ONLY**) of the following tepenoids: myrecene, linalool, geraniol, α-terpeneol, limonene, camphor, α-pinene, β-pinene, farnesol, β-bisabolene and squelene.

B] Porphyrins: Structure and synthesis of Haemoglobin and Chlorophyll

Unit II: **15 h**

A] Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on nitrogen heterocyclic ring, role of alkaloids in plants Structure, stereochemistry, and synthesis of the following: Ephedrine, (+)- coniine, Nicotine, Atropine, Quinine, Reserpine and Morphine, Biosynthesis (**ONLY**) of the followings: hygrine, tropinone, nicotine, pelletierine, conine

B] Prostaglandins: Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2α

Unit III: **15 h**

A] Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone and Aldosterone. Biosynthesis of steroids (lanosterol)

B] Plant Pigments: Occurrence, nomenclature and general methods of structure determination, isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzein,

Butein, Cyanidin-7-arabinoside, Cyanidin, Hirsutidin. Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway

Unit IV: Pharmaceutical chemistry: 15 h

A] Antidiabetic Agents- Mechanism of action of antidiabetic agents, Type I and II, Synthesis of ciglitazone.

B] Anti-Viral agents: Inroduction, viral diseases, viral replication, and transformation of cells, investigation of antiviral agents,. Chemotherapy for HIV. Synhesis of: Idoexuidine, acyclovir , amantadine and cytarabin.

C] Anti-malarial agents: Introduction, malarial parasite, and its life cycle, development of antimalarials, chemotherapy of malaria. Synthesis of: Chloroquin, primaquin, proguanil, and Quinacrine

D] Histamines and Antihistamic agents: Introduction, histamine H1-receptor antagonists. Inhibitors of histamine release. Synthesis of: alkyl amines, phenothiazines, piperzines derivatives.

E] Anti-inflammatory drugs: Introduction, etiology of inflammatory diseases. The inflammatory response, biochemical response. Synthesis of: Phenyl butazone and its derivatives, pyrazolone derivatives, pyrole and indole acetic acid derivatives.History, medical terms in pharmaceutical chemistry, classification of drugs, antibacterial and antifungal drugs, specific clinical applications, Synthesis and applications of: Benzocaine, Methyl dopa, dilantin, ciprofloxacin, acyclovir, terfenadine, salbutamol

List of books:

1] Chemistry of Alkloids-S. W. Pelletier

2] Chemistry of Steroids-L. F. Fisher and M. Fisher

3] The Molecules of Nature-J. B. Hendricsion

4] Biogenesis of Natural Compound - Benfield

5] Natural Product Chemistry and Biological Significance- J. Mann, R. S Devison, J. B. Hobbs, D. V.

6] Banthripde and J. B. Horborne

7] Introduction to Flavonoids-B. A. Bohm, Harwood

8] Chemistry of Naturally Occurring Quinines-R. H. Thomson

9] The Systematic Identification of Flavonoids- Marby, Markham, and Thomos

10] Organic Chemistry of Natural Products Vol I and II-O. P. Agrawal

11] Organic Chemistry of Natural Products -Gurudeep Chatwal

12] A Textbook of Pharmaceutical Chemistry-Jayshree Ghosh

13] Synthetic Dyes Series -Venkatraman

14] Text Book of Organic Medicinal Chemistry-Wilson, Geswold

15] Medicinal Chemistry Vol I and II-Burger

16] Synthetic Organic Chemistry -Gurudeep Chatwal.

17] Chemistry Process Industries-Shreve and Brink

18] Principal of Modern Heterocyclic Chemistry-L. A. Paquelte

19] Heterocyclic Chemistry-J. Joule and G. Smith

20] Heterocyclic Chemistry-Morton

21] An Introduction to Chemistry of Heterocyclic Compound-J. B. Acheson

22] Introduction to Medicinal Chemistry-A. Gringuadge

23] Wilson and Gisvold Text Book of Organic Medicinal and Pharmaceutical Chemistry-Ed. Robert F Dorge

24] An Introduction to Drug Design-S. S. Pandey and J. R. Demmock

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSE-3
Title of the Paper: Physical Chemistry
Course code: M-CHPC633T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course the student will be able to:
1. Classify the various crystal structures.
2. Understand the concept of defect in crystals.
3. Predict the corrosion type and its prevention.
4. Understanding of radiation and its applications
5. Understand the theory behind electrical and thermal properties of solids.

UNIT I: SOLID STATE CHEMISTRY 15h

A] Introduction to crystals, Unit Cell and lattice parameters, Symmetry elements in crystals, Absence of fivefold axis, Space groups, The Bravais Lattices, Miller Indices, Bragg's Equation, seven crystal system, Packing in crystals, Hexagonal Closest Packing (HCP) Cubic Closest Packing (CCP), Voids, packing fraction, Numericals.

B] Crystal Defects and Non-stiochiometry: Perfect and imperfect crystals, point defects, line and plane defects. Thermodynamics of Schottky and Frenkel defect formation, colour centers, nonstiochiometry and defects.

UNIT II: CORROSION AND CORROSION ANALYSIS 15h

A] Scope and economics of corrosion, causes (Change in Gibbs free energy), Electrochemical Series and Galvanic series, dry (atmospheric) and wet (electrochemical) corrosion, other types of corrosion-Pit, Soil, chemical and electrochemical, inter-granular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

B] Thermodynamics of corrosion, corrosion measurements (Weight loss, OCP measurements, Polarization methods), passivity and its breakdown, corrosion prevention (electrochemical Inhibitor and coating methods).

UNIT III: RADIATION CHEMISTRY 15h

Interaction of radiation with matter, Radiation track spurs, Gamma-rays. Linear energy transfer, Bathe's equation for linear energy transfer, Bresstrahlung effect, Passage of neutron through matter, Interaction of Gamma-radiation with matter, photoelectric effect and Compton effect, pair production phenomena,

units of measuring radiation absorption, Radiolysis of water, Radiolysis of some aqueous solutions. Effect of radiation on biological substances, genetic effects, Radiation effects on organic compounds and Polymers.

UNIT IV: ELECTRICAL AND THERMAL PROPERTIES OF SOLIDS 15h

A] Classical free electron theory, electrical conductivity, thermal conductivity, Wiedemann-Franz Law, Lorenz number, Electronic distribution in solids using Fermi Dirac Statistics, The Fermi Distribution function and effect of temperature, Quantum theory of free electrons, periodic potential, The Kronig-Penney Model, Brillouin Zones, Distinction between metals, insulators and intrinsic semiconductors based on above theory.

B] **Thermal Properties**: Specific heat of solids, Classical theory, Einstein's theory of heat capacities, Debye theory of heat capacities or Debye T-cubed law

List of Books:

1] D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000

2] G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.

3] H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.

4] S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.

5] C.Kittel, " Introduction to solid state Physics",Wiley

6] L.V.Azaroff, " Introduction to solids", McGraw Hill

7] Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.

8] N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,

9] N. B. Hanny, "Solid State Chemistry"

10] M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,

11] C.N.Rao. Nuclear Chemistry

12] B. G. Harvey, *Introduction to Nuclear Physics and Chemistry*, Prentice Hall, Inc. (1969).

13] H.J. Arnikar, *Essentials of Nuclear Chemistry*, 4th Edition (1995), Wiely-Eastern Ltd., New Delhi.

14] W. Loveland, D. Morrissey and G. Seaborg, Modern Nuclear Chemistry, Wiley-Interscience, 2006.

15] P. P. Milella, Fatigue and Corrosion in Metals, Springer, 2013.

16] Corrosion- Understanding the Basics, asminternational.org, 2000.

17] H. H. Uhlig, Corrosion and Corrsion Control – 3rd edn, John Wiley & sons, New York.

18] J. W. T. Spinks and R. J. Woods, An Introduction to Radiation Chemistry, John Wiley and sons., New Yoek, 1975.

19] K. L. Kapoor, Text Book of Physical Chemistry, Vol – I to Vol-VI, 2011.

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSE-4
Title of the Paper: Analytical Chemistry
Course code: M-CHAC633T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. Study the principle, instrumentation and applications of Spectrophotometry and Colorimetry as the optical methods of analysis.
2. Study theory and instrumentation of some electron microscopic techniques such as SEM and TEM their applications.
3. Know the fuel value of food and importance of food nutrients and analyze the food products such as milk, fats and oils.
4. Study the dressing, analysis and purification of ores, minerals and alloys in the metallurgical process.
5. Understand the Calorific value, Proximate and Ultimate analysis of coal.
6. Know the meaning, types, measurement of Corrosion and do the corrosion analysis.

Unit I: Optical methods of analysis **15h**

A] Spectrophotometry and Colorimetry: Principle of colorimetry. Beer's law, its verification and deviations. Instrumentation in colorimetry and spectrophotometry (single and double beam). Sensitivity and analytical significance of molar extinction coefficient and λ_{max}. Comparison method, calibration curve method and standard addition method for quantitative estimation. Photometric titrations. Determination of pK value of indicator. Simultaneous determination. Derivative spectrophotometry. Numerical problems.

B] Electron microscopy: Principle, instrumentation and applications of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM).

Unit-II: **15h**

A] Food Analysis: Fuel value of food and importance of food nutrients, Food Additives – General idea about Food processing and preservation, Chemical preservatives, fortifying agents, emulsifiers, flavours, colours, artificial sweeteners. Food packaging – Introduction, types of packing materials, properties and industrial requirements.

B] Analysis of Milk – Processing and Quality requirements of Milk and milk products (cheese, butter and ice cream), Fat content, proteins, acidity, bacteriological quality and milk adulterants.

C] Analysis of Oils and Fats – Acid value, Saponification value, Iodine value. Determination of rancidity and antioxidants.

Unit-III: **15h**

A] Ores and minerals: Sources of raw material, Concentration of ores, methods of metal dressing (hand picking, magnetic separation, centrifuge, froth flotation etc.), pollution due to metallurgical processes (metal dressing, calcination, smelting). Principles of hydrometallurgy, extraction of Al from bauxite. Principles of Electrometallurgy, extraction of Cu from Copper pyrites. Chemical analysis of ores for principal constituents: Pyrolusite, Bauxite and Hematite.

B] Alloys: definition, analysis of Cupronickel, Steel and Bronze. Techniques of purification: Zone refining, analysis of high purity materials like silicon, vacuum fusion and extraction techniques.

Unit-IV: **15h**

A] Coal analysis: Proximate analysis (moisture content, ash content, volatile matter, fixed carbon).Ultimate analysis (carbon, hydrogen, sulphur, nitrogen, oxygen content). Combustion of carbonaceous fuel- Flue gas. Calorific value and its units, Bomb calorimeter.

B] Corrosion and corrosion analysis: Definition, draw backs and theories of corrosion-dry and wet corrosion, Different types of corrosion - Pit, Soil, chemical and electrochemical, intergrannular, waterline, microbial corrosion, measurement of corrosion by different methods, factors affecting corrosion, passivity, galvanic series, protection against corrosion, design and material selection.

List of books:

1. Instrumental Methods of Analysis: Willard, Meriit and Dean (Van Nostrand)
2. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
3. Vogel‘s Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
4. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
5. Instrumental Methods of Chemical Analysis: Braun (Tata McGraw-Hill)
6. Electroanalytical chemistry: Joseph Wang
7. Electroanalytical stripping methods: Brainina and Neyman (Wiley-Interscience)
8. Food Analysis: Theory and practice, Yeshajahu Pomeranz, Clifton E. Meloan, Springer.
9. Food Analysis, Edited by S. Suzanne Nielsen, Springer
10. Principles of package development, Gribbin et al
11. Modern packaging Encyclopedia and planning guide, Macgra Wreyco.
12. Analytical Biochemistry, D, J. Homes and H. Peck, Longman (1983)
13. Bioanalytical Chemistry, S. R. Mikkelesen and E. Corton, John Wiley and sons 2004
14. Analysis of food and beverages, George Charalanbous, Accademic press 1978
15. Advance dairy chemistry, vol 3, P. F. Fox, P. L. H. McSweeney Springer
16. Chemical analysis of metals ; Sampling and analysis of metal bearing ores: American Society for Testing and Materials 1980 - Technology & Engineering

17. Manual of Procedures for Chemical and Instrumental Analysis of Ores, Minerals, and Ore Dressing Products. Government of India Ministry of Steel & Mines, Indian Bureau of Mines, 1979.
18. Alloying: understanding the basics, edited by Joseph R. Davis, ASM International (2001).
19. Zone refining and allied techniques, Norman L. Parr, G. Newnes Technology & Engineering (1960).
20. Chemistry in Engineering and Technology- Vol I and II: J.C. Kuriacose and J. Rajaram (Tata-McGraw Hill)
21. Environmental Chemistry: Moore J W and Moore E A. Academic Press, New York, 1976.
22. Environment and Man Vol VII: The Chemical Environment Edited by J Lenihar and W Fleecher Vlackie Publication, 1977.
23. The Chemistry of Environment: R A Horne, Wiley Interscience Publication 1978.
24. Chemistry for Environmental Engineering and Science: C N Sawyer, P L McCarty and G F Parkin
25. Environmental Chemistry: B K Sharma and H Kaur
26. Environmental Chemistry: A K De

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC
Title of the Practical: Inorganic Chemistry Special – I Practical
Course code: M-CHIC634P
Paper-IV
To be implemented from 2024-25

Number of Credits: 12 **Marks: 100M**
Total Number of Hrs: 180 Hrs (12h per week)

Expected Learning Outcomes: After studying this course and performing the given experiments, the student will be able to:

1. Estimate quantitatively analyte present in different samples using classical and instrumental methods of analysis. Design experiments based on classical and instrumental techniques.
2. Select and use appropriate apparatus and techniques for various types of experiments related to chemistry.
3. Detect the rare metal ions in an inorganic mixture by its semi-micro analysis containing cations.
4. Record observations and calculate the results after performing the experiments and to maintain laboratory records for the experiments performed during this course.

A] INSTRUMENTAL METHOD

I: pH METRY:

1. Stepwise proton ligand and metal ligand constant of complexes by Irving Rossetti method

II: COLORIMETRY AND SPECTROPHOTOMETRY

1. Simultaneous determination of manganese ($KMnO_4$) and chromium ($K_2Cr_2O_7$)
2. Simultaneous determination of cobalt (II) and nickel(II)
3. Determination of composition and stability constant of complexes by Job's method of continuous variation , mole ratio method and slope ratio method

III: POTENTIOMETRY

1. Estimation of halide in a mixture by Potentiometry
2. Determination of stepwise stability constant of silver thiosulphate complex by potentiometrically

IV: CONDUCTOMETRY 1.

1. Estimation of amount of acid in a mixture by conductometric titration

B] INORGANIC REACTION MECHANISM Kinetics and mechanism of following reactions:

1. Substitution reactions in octahedral complexes (acid/base hydrolysis)
2. Redox reactions in octahedral complexes 3. Isomerization reaction of octahedral complexes C

C] BIOINORGANIC CHEMISTRY (CHLOROPHYLL)

1. Extraction and absorption spectral study of chlorophyll from green leaves of student choice
2. Separation of chlorophyll and their electronic spectral studies
3. Complexation study of metal ions with biologically important amino acids

List of Books:

1. Day And Underwood :Quantitative Analysis
2. Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman
3. Flaschka : Edta Titration 4. Merits And Thomas:Advanced Analytical Chemistry
4. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill
5. Drago, R.S:Physical Methoods In Inorganic Chemistry
6. Christain G.D:Analytical Chemistry 8. Khopkar S.M.:Basic Concept Of Analytical Chemistry
7. Koltath And Ligane:Polorography

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC
Title of the Paper: Organic Chemistry Special -I Practical
Course code: M-CHOC634P
Paper-IV

Number of Credits: 12 **Marks: 100M**
Total Number of Hrs: 180 Hrs (12h per week)

Expected Learning Outcomes: After studying this course and performing the givenexperiments, the student will be able to:

1) Study the isolation of organic compounds from natural sources.
2) Quantitatively analyze different functional groups by volumetric titrations such as iodometry, bromate-bromide etc.
3) Separate and identify organic compounds from the unknown organic ternary mixture by different physical and chemical transformation reactions.
4) Record observations and calculate the results after performing the experiments and to maintain laboratory records for the experiments

[A] Quantitative Analysis:

Student is expected to carry out following estimations (minimum 6 estimations)

1. Estimation of Vitamin ―C‖ Iodometry.
2. Estimation of Phenol by KBrO3-KBr.
3. Estimation of Amine by Bromate/ Bromide solution.
4. Estimation of Formaldyde by Iodometry.
5. Estimation of Glucose by Benedict‘s solution.
6. Estimation of given carbonyl compound by hydrazone formation.
7. Estimation of Aldehyde by Oxidation method.
8. Determination of percentage of number of hydroxyl group in an organic compound by acetylation method.

[B] Isolation of Organic Compounds from Natural Source (Any six)

(a) Isolation of caffeine from tea leaves.
(b) Isolation of casein from milk (the students are required to try some typical colour reactions of proteins)
(c) Isolation of lactose from milk (purity of sugar should be checked by TLC and PC and Rf value reported.)
(d) Isolation of nicotine dipicrate from tobacco
(e) Isolation of cinchonine from cinchona bark
(f) Isolation of piperine from black pepper
(g) Isolation of lycopene from tomatoes
(h) Isolation of β-carotene from carrots

(i) Isolation of cysteine from hair

(j) Isolation of oleic acid from olive oil (involving the preparation of complex with urea and separation of linoleic acid

(k) Isolation of eugenol from cloves

(l) Isolation of (+) limonine from citrus rinds

(m)

[C] QUALITATIVE ANALYSIS

Separation of the components of a mixture of three organic compounds (three solids, two solids andone liquid, two liquids and one solid, all three liquids and identification of any two components using chemical methods or physical techniques. Minimum 10-12 mixtures to be analyzed.

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC
Title of the Paper: Physical Chemistry Special -I Practical
Course code: M-CHPC634P
Paper-IV
To be implemented from 2024-25

Number of Credits: 12 **Marks: 100M**
Total Number of Hrs: 180 Hrs (12h per week)

Expected Learning Outcomes: After studying this course and performing the given experiments, the student will be able to:

1. Apply the theoretical concept of partial molar properties, Solutions, phase rule, Kinetics,
2. Potentiometric, Conductometric and colorimetric concepts by performing the experiments based on these principles and learn the applicability.
3. Work out various types of titrations by using different instruments such as conductivity meter,
4. Potentiometer and spectrophotometer etc.
5. Calibrate instruments and use different electrodes according to the type of instrument.
6. Record observations and calculate the results after performing the experiments and to maintain
7. Laboratory records for the experiments performed during this course.

Thermodynamics:

1. Determination of partial molar volume of solute and solvent (ethanol-water, methanol-water, KCl-water mixture)

Solutions:

2. Study the variation of solubility of potassium hydrogen tartarate with ionic strength using a salt having a common ion and hence determine the mean ionic activity coefficients.
3. Determination of temperature dependence of the solubility of a compound in two solvents having similar intermolecular interactions(benzoic acid in water and DMSO – water mixture) and calculation of the partial molar heat of solution.

Phase equilibrium:

4. To study the effect of addition of an electrolyte such as NaCl, KCl,Na2SO4,K2SO4 etc. on the Solubility of an organic acid (benzoic acid or salicylic acid).
5. To determine the heat of crystallization of CuSO4.5H2O
6. To determine the heat of reaction involving precipitation of a salt BaSO4
7. To determine transition temperature of CaCl2 by thermometric method and to determine Transition temperature of CaCl2, sodium bromide by solubility method

Kinetics:

8. To determine the activation energy of hydrolysis of an ester by acid.
9. Kinetics of reaction between sodium thiosulphate and KI. Determination of rate constant and
10. Study of influence of ionic strength Kinetics of decomposition of H2O2 catalysed by iodide ion. Also determination of activation energy of reaction.

Conductometry:

11. Estimate the concentration of H_2SO_4, CH_3COOH, $CuSO_4.5H_2O$ in a given solution by carrying out conductometric titration against NaOH solution.
12. Determine the eq. conductance of strong electrolyte (KCl, NaCl, HCl, KNO_3) at several concentration and hence verify Onsager's equation.
13. Carry out the following precipitation titration conductometrically. a. 50 ml.0.02N $AgNO_3$ with 1N HCl; b.50 ml.0.02N $AgNO_3$ with 1N KCl; c. 50 ml 0.004 N $MgSO_4$ with 0.1 N $Ba(OH)_2$;d. 50 ml 0.002 N $BaCl_2$ with 1 N Li_2SO_4; e. 50 ml.0.02 N $BaCl_2$ with 1N K_2SO_4

Potentiometry:

14. To prepare calomel electrode and to determine the potential of calomel electrode by potentiometry.
15. To determine stability constant of Fe^{3+} with potassium dichromate in presence of dilute sulphuric acid by redox titration.
16. To determine solubility product of Silver chloride by potentiometric method.
17. Determination of redox potential of the couples(Fe^{2+}/Fe^{3+},Co^{3+}/Co^{2+},Cr^{3+}/Cr^{2+},MnO_4^-/Mn^{2+}(any two) and equilibrium constant.
18. Study of complex formation by potentiometry e.g.Ag^+-$S_2O_3^{-2}$, Fe^{3+}-SCN^-,Ag^+-NH_3(any two) and calculation of stability constant.

Spectrophotometry:

19. To verify Beers law for solution of potassium permanganate and to find molar extinction coefficient.
20. To determine the indicator constant (pKIn) of methyl orange/red spectro photometrically.

List of Books:

1. Vogel A, 3rd Edition : A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc-Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty,
   Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
5. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data Analysis, The University of Alabama in Huntsville, Fall 2006
6. Day And Underwood :Quantitative Analysis
7. Merits And Thomas:Advanced Analytical Chemistry
8. Ewing, G. W. : Instrumental Methods Of Chemical Analysis, Mcgraw-Hill

9. Drago, R.S:Physical Methoods In Inorganic Chemistry
10. Braun:Instrumental Methods Of Chemical Analysis
11. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
12. Strouts,Crifi;Llan And Wisin: Analytiacal Chemistry
13. Skoog S.A. And West D. W.:Fundamental Of Analytical Chemistry
14. Dilts R.V.: Analytiacal Chemistry
15. Jahgirdar D.V :Experiments In Chemistry
16. Chondhekar T.K: Systematic Experiments in Physical Chemistry, Rajbog S.W., Aniali Pubn.
17. Wlehov G. J: Standard Methods Of Chemicalanalysis 6th Ed
18. Ramesh Rand Anbu M, Chemical Methods For Envirnmental Analysis : Watewr And Sedient , Macmillion India

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-III
Name of the Course Category: DSC
Title of the Paper: Analytical Chemistry Special-I Practical
Course code: M-CHAC634P
Paper-IV
To be implemented from 2024-25

Number of Credits: 06 **Marks: 100M**
Total Number of Hrs.: 180 Hrs. (12h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. Calibrate and handle different analytical instruments
2. .Estimate quantitatively different elements and functional groups present in organic compounds.
3. Perform different Instrumentation methods of analysis of water, air and food.
4. Learn different Instrumentation methods of analysis of coal and ores.
5. Perform experiments based on radiation chemistry and determine half-life of radioactive isotopes
6. Estimate the analytes by UV-Spectrophotometry.

It is expected to perform minimum 15-20 experiments in a semester.

A. Organoanalytical chemistry:

1. Estimation of sulphur, nitrogen, phosphorous, chlorine in organic compound.
2. Estimation of phenol.
3. Estimation of aniline.

B. Water analysis:

1. Sampling of water-tap water, overhead storage tank water, pond water and lake water
2. Physico –chemical and organoleptic characteristics of the above water sample
3. Statistical evolution of the data obtained for optimization of result
4. Determination of total solids, total dissolved solids and total suspended solids and its significance
5. Determination of acidity and alkalinity in water samples
6. Determination of total, permanent and temporary hardness of water sample
7. Determination of DO, COD, and BOD of water sample
8. Analysis iron and manganese in water sample by visual titrimetry
9. Analysis of copper and nickel in water sample by Spectrophotometry
10. Analysis of phenol in water sample by Spectrophotometry
11. Analysis of nitrite in water sample by Spectrophotometry
12. Analysis of chromium in water sample
13. Analysis of chloride in water sample
14. Analysis of sulphate in water sample
15. Determination of turbidity of a given water sample
16. Estimation of Na, K, by flame photometry in given water

C. Air analysis:

1. Determination of SOx and NOx and TSPM (total suspended particulate matter) and RSPM in ambient air

D. Colorimetry/spectrophotometry:

1. Simultaneous determination of chromium and manganese in given mixture.
2. Simultaneous determination of two dyes in a mixture.
3. Estimation of Mn in steel.
4. Estimation of Cu/Ni in alloys.
5. Estimation of iron in water sample using 1,10-Phenanthroline.
6. Estimation of Fe(III) in given solution by photometric titration with EDTA (salicylic acid method).

E. Food Analysis:

1. Analysis of lactose in milk
2. Estimation of Vitamin C
3. Analysis of Calcium, Iron and phosphorous in milk
4. Estimation of saponification value/acid value/Iodine value of oil / fat
5. Analysis of commercial vinegar by conductometric titration.
6. Inversion of cane sugar in the presence of HCl polarimetrically.
7. Determination of percentage of two optically active substances (d-glucose and d-tartaric acid) in mixture polarimetrically.

F. Coal and Ore analysis:

1. Estimate the proximate analysis of coal.
2. To analyze Pyrolusite for: Fe by colorimetry and / or Mn by volumetry.
3. To analyze Magnelium for Mg by complexometry.
4. Analysis of Bauxite for Ti by colorimetry / Al by gravimetry / Fe (volumetry)

Demonstrations

1. UV-spectrophotometry

List of books:

1. Vogel‘s Text Book of Quantitative inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)
2. Instrumental Methods of Analysis: Willard, Merit and Dean(Van Nostrand)
3. Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)
4. Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)
5. Instrumental Methods of chemical Analysis: Braun (Tata McGraw-Hill)
6. Analysis of Water: Rodier
7. Ion selective electrods: Koryta (Cambridge University Press)

8. Instrumentation in analytical chemistry: Borman (American Chemical Society)
9. Industrial Chemistry: Arora and Singh (Anmol Publications)
10. Diffraction Methods: John Wormald (Clarendon Press)
11. Electroanalytical Chemistry: Bard (Dekker)
12. Analytical Chemistry by Open Learning (Wiley)
13. Practical Physical Chemistry: J. B. Yadav (Goel Publishing House)
14. Water analysis : J. Rodier
15. A Text book of Inorganic Analysis : A.I.Vogel
16. Colorimetric Determination of metals : E.B.Sandell

M.Sc.- Two Year: Semester-III
Name of the Course Category: RP
Name of the Course: Research Project / Dissertation (Core)
Course Code: M-CH635P
Paper V
To be implemented from 2024-25

Number of Credits: 04 **Marks: 100M**
Total Number of Hrs.: 120 Hrs. (8h per week)

Objectives: To make Students:

1. Learn about writing background with historical information and a review of existing material.
2. Understand to describe the issue, methodology adopted for the study.
3. Discern Presentation of data collected and detailed analysis of results.
4. Know about Discussion on the data and results obtained and presentation of method suggested solving the problem.
5. Recognize about summary of the dissertation and important conclusions drawn at the end of the investigation.

Expected Learning Outcomes: After studying this course and completing the Research Project / Dissertation (Core) based on Research or Lab work, the student will be able to:

1. Prepare background with historical information and a review of existing material
2. Utilize the knowledge to Describe the issue, methodology adopted for the study Carryout
3. Elucidate Presentation of data collected and detailed analysis of results
4. Interpret Discussion on the data and results obtained and presentation of method suggested for solving the problem

RP: **Research Project / Dissertation (Core)** **Marks: 50M**

Research based project work (Instructions for Students):

Candidates will write a project on issues related to Chemistry under the guidance of their respective guides. The regular full-time teacher of the department approved by university/autonomous institute/scientist of government/private research laboratory appointed by university as a contributory teacher and having M. Phil. or Ph. D. degree can supervise the project work of the student.

The students will have to carry out the research-based project work in lieu of practical in the third semester in their department or depending on the availability of placement; he/she will be attached to any of the national/ regional/ private research institute / organization for the duration of the third semester. The student will be randomly allotted the priority number for the selection of the supervisor in the third semester on the basis of research specialization/ area of specialization of supervisor.

Each student will work independently on the topic. The project work must consist of review of literature and produce a deep insight of the subject on the basis of personal research. Project work will be initiated after passing M.Sc.-I. The students will undertake field work in terms of collection of data and surveys. The project will have to be submitted at the end of the academic semester for evaluation. The students should submit their project in the following format.

- **Chapter I : Introduction with Aims and Objectives**.

  A background with historical information and a reference of existing research or data on the subject along with the aims and objectives of the study, scope of study and the limitation of study.
- **Chapter II: Review of Literature**

  Reference to the relevant research papers reviewed for the study highlighting the present scenario about research topic.
- **Chapter III: Research Methodology**

  Description of the issue, Hypothesis, methodology adopted for the study, source of data.
- **Chapter IV: Result and Discussion**

  Discussion on the data and results obtained and presentation of method suggested solving the problem.
- **Chapter V: Summary and Conclusions.**

  A summary of the dissertation and important conclusions drawn at the end of the investigation.
- **Chapter VI: Bibliography or References**
- **Annexure**

A list of references must be cited in the text. The project should be typed on A4 size bond paper with 1.5 line spacing. Illustrations and photographs should be of high quality. The report should be flawless without any spelling mistakes or grammatical errors. If the project contains such mistakes the student will have to resubmit their project after the necessary corrections. The project should be bound in hard black mounted cover. Project with spiral binding and paper cover will not be accepted. The students are expected to prepare 4 copies of the project of which one should be submitted to the Department.

The project will carry 50 marks. Assessment of the project will be done at the end of the semester. Students have to appear for Power Point presentation and viva based on project work. In the presentation, students are expected to describe their project problem, the data they are going to analyze, and the objectives of their project. In addition to this, they should also mention their methodology. Students will have to submit their project at the time of final project evaluation examination. The project report as well as presentation will be evaluated by an Examiner (as per norms) appointed by the institute. When an external examiner is not available, the Head may appoint an external examiner from the Department with the prior permission of the Director.

Distribution of Marks (Project/ Dissertation)	**Maximum Marks: 100**
1. Introduction & Review of literature	**05M**
2. Presentation of Work (PPT)	**05M**
3. Reasoning Capability	**05M**
4. Subject Knowledge	**10M**
5. Interpretation of Results	**10M**
6. Project Viva:	**15M**
7. **Project/Dissertation Marks (ESE)** (Evaluated jointly by External & Internal Examiner)	**50M**
8. Internal Assessment(CIE) (Evaluated by Internal Examiner)	**50M**
9. **Total Marks**	**100M**

INSTITUTE OF SCIENCE, NAGPUR
(An Autonomous Institute of Government of Maharashtra)
Civil Lines, R. T. Road, Nagpur 440001
NAAC Accredited "A" Grade
Phone: *0712-2561148* *Web: www.iscnagpur.ac.in*
Email:ioscnagpur@gmail.com

Syllabus for Master of Science Two Year (Four Semesters) Degree Course

With effect from 2024-25 as per NEP 2020

SUBJECT- CHEMISTRY
M.Sc. - Second Year: Semester-IV
Name of the Course Category: DSC-1
Title of the Paper: Spectroscopy-II
Course Code: M-CH641T
Paper-I

Number of Credits: 04 **Marks: 80 M**
Total Number of Hrs. 60 Hrs (4 h per week):

Expected Learning Outcome: After Studying the course student will be able to:

1. Explain basic principles of UV-Visible spectroscopy.
2. Explain working principle, taking spectra and outline of UV spectroscopy device.
3. Will be able to interpret UV-Visible spectrum.
4. Explain basic principles of photoelectron spectroscopy
5. Interpret photoelectron spectrum of simple molecule.
6. Explain basic principles of Nuclear Magnetic Resonance Spectroscopy (NMR)
7. Determine the structure of molecule Nuclear Magnetic Resonance Spectroscopy
8. Interpret the ^{1}H and ^{13}C NMR spectra of compounds.
9. Explain different X-ray diffraction methods.
10. Identify the unit cells from systematic absences in diffraction pattern.

Unit I: **15 h**

A] Ultraviolet and visible spectroscopy: Natural line width, line broadening, transition probability, Born-Oppenheimer approximation, rotational, vibrational, and electronic energy levels. General nature of band spectra. Beer- Lambert Law, limitations, Frank-Condon principle, various electronic transitions, effect of solvent and conjugation on electronic transitions, Fiesher Wooodward rules for dienes, aldehydes, and ketones. Structure differentiation of organic molecules by UV Spectroscopy

B] Photoelectron spectroscopy: Basic principles, photoelectric effect, ionization process, Koopman theorem, PES and XPES, PES of simple molecules, ESCA, chemical information from ESCA, Auger electron spectroscopy.

Unit II: Nuclear magnetic Resonance Spectroscopy **15 h**

Magnetic properties of nuclei, resonance condition, NMR instrumentation, chemical shift, spin spin interaction, shielding mechanism, factors affecting chemical shift, PMR spectra for different types of organic molecules, effect of deuteration, complex spin spin interaction (1st order spectra), stereochemistry, variations of coupling constant with dihedral angle, electronegativity, Karplus equation etc., classification of molecules as AX, AX2, AMX, A2B2, Shift reagents. NMR studies of 13C, chemical shift in aliphatic, olefinic, alkyne, aromatic, heteroatomic and carbonyl compounds, 19F, 31P. Structure determination of organic molecules by NMR spectroscopy

Unit III: **15 h**

A] Application of NMR spectroscopy: FT-NMR, advantages of FT-NMR, two-dimensional NMR spectroscopy-COSY, HETCOR, NOSEY, DEPT, INEPT, APT, INADEQUATE techniques, Nuclear overhauser effect, use of NMR in medical diagnosis

B] Problems based on structure determination of organic molecules by using NMR (1H and 13C nuclei) data, Structure elucidation using combined techniques including UV, IR, NMR and mass spectrometry (based on data and copies of the spectra)

Unit IV: Diffraction techniques **15 h**

X ray diffraction: Braggs condition, Miller indices, Laue method, Bragg method, Debye Scherrer method, identification of unit cells from systematic absences in diffraction pattern, structure of simple lattices and x-ray intensity, structure factor and its relation to intensity and electron density, absolute configuration of molecules. Electron diffraction: scattering intensity vs scattering angle, measurement techniques, elucidation of structure of simple gas phase molecules, low energy electron diffraction and structure of surfaces. Neutron diffraction: Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques, elucidation of structure of magnetically ordered unit cell.

List of books:

1] Spectroscopic identification of organic compound-RM Silverstein, GC Bassler and TC Morril, John Wally

2] Introduction to NMR spectroscopy-R. J. Abraham, J. Fisher and P Loftus Wiely

3] Application of Spectroscopy to Organic Compound-J. R. Dyer, Printice Hall

4] Organic Spectroscopy-William Kemp, ELBS with McMillan

5] Spectroscopy of Organic Molecule-PS Kalsi, Wiley, Esterna, New Delhi

6] Practical NMR Spectroscopy-ML Martin, JJ Delpench, and DJ Martyin

7] Spectroscopic Methods in Organic Chemistry-DH Willson, I Fleming

8] Fundamentals of Molecular Spectroscopy-CN Banwell

9] Spectroscopy in Organic Chemistry-CNR Rao and JR Ferraro

10] Photoelectron Spectroscopy-Baber and Betteridge

11] Electron Spin Resonance Spectroscopy-J Wertz and JR Bolten

12] NMR –Basic Principle and Application-H Guntur

13] Interpretation of NMR spectra-Roy H Bible

14] Interpretation of IR spectra-NB Coulthop

15] Electron Spin Resonance Theory and Applications-W gordy

16] Mass Spectrometry Org

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC-2
Title of the Paper: Inorganic Chemistry-Special II
Course code: M-CHIC642T
Paper-II

To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs.: 60 Hrs. (4h per week)

Expected learning outcomes: After studying this course, you shall be able to:

1. Do classification of Nanoparticals & Nanostructural materials
2. Identify the applications of Nanoparticals & Polymer materials
3. To make the students to understand the formation of inorganic. Compounds and their application in various branches of chemistry in particular and in science generally.

Unit I: **15h**

A] Nanoparticals & Nanostructural materials: Introduction, methods of preparation, physical properties, and chemical properties. Molecular Precursor routes to inorganic solids:- Introduction, sol-gel chemistry of metal alkoxide, hybrid organic-inorganic compounds. Nanoporous Materials: Introduction, Zeolites & molecular sieves, determination of surface acidity, porous lamellar solids, composition-structure, preparation & applications.

B] Solid State Reaction: General principles, reaction rates, reaction mechanism, reaction of solids, factors influencing reactivity, photographic process.

Unit II: **15h**

A] Coordination Polymers: Coordination polymers and their classification. Synthesis and applications of coordination polymers. Use of polymeric ligands in synthesis of coordination polymers. Organosilicon polymers. Synthesis and their uses.

B] Characterization of coordination polymers on the basis of: i) Spectra (UV, Visible, IR and NMR) ii) Magnetic and thermal (TGA,DTA and DSC) studies

Unit III: **15h**

A] Catalysis: Basic principles, thermodynamic and kinetic aspects, industrial requirements, classification, theories of catalysis, homogeneous and heterogeneous catalysis .Introduction, types & characteristics of substrate-catalyst interactions, kinetics and energetic aspects of catalysis, selectivity, stereochemistry, orbital symmetry and reactivity.

B] Catalytic reactions of coordination and Organometallic compounds: including polymerization activation of small molecules, addition to multiple bonds, hydrogenation Zeigler-Natta polymerization of olefins, hydroformylations, oxidations, carbonylations and epoxidation. Name organic reaction involving inorganic compounds: Suzuki Coupling, Heck Reaction, Negishi

reaction and Sonogirhra reaction

Unit IV: **15h**

A] Optical sensor for metal Ions: Chelates ligand (Multidentates, Ruthenium bipyridyls, calixarenes, Lanth

B] anide ion); Macrocyclic ligands (Flexible Macrocycles, Azamacrocycles, Cryptands, porphyrins); Crown ether and Cryptands(Napthalene and Anthracene crowns, Cryptands, structural features)

C] Thin films and languir-Biodgett films: Preparation technique, evaporation/spultering, chemical processe MOCVD, solgel etc. Languir-Biodgett(LB) film, growth techniques, photolithography properties and applications of thin and LB films.

List of books:

1] Barsoum ,M.W.,Fundamentals of Ceramics,McGraw Hill ,New Delhi

2] Ashcroft ,N.W. and Mermin,N.D.,SolidStaePhysics,Saunders College

3] CallisterW.D.,Material Science and Engineering, An Introduction,Wiley

4] Keer,H.H,Principals of Solid State,Wiley Eastern

5] Anderson J.C., LeverK.D., Alexander J.M and Rawlings,R.D.,ELBS 6. GrayG.W.Ed.Thermotropic Liquid Crystals,John Wiley

6] Kelkar and Hatz Handbook of Liquid Crystals,ChemieVerlag.

7] Kalbunde K.I.,Nanoscale Materials in Chemistry,JohnWiley,NY.

8] Shull R.D.,McMichael R.D. and SwartzendrubL.J.,Studies of Magnetic Properties of Fine particles and their relevance to Mataerials Science, Elsevier Pub. Amsterdam

A.M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC-2
Title of the Paper: Organic Chemistry-Special II
Course code: M-CHOC642T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. Learn the role of carbanions in organic chemistry
2. Study synthesis and applications Organometallic reagents
3. Role of transition metals in the synthesis of organic compounds
4. Understand Advanced Stereochemistry and Protection and De-protection of functional groups

Unit I: **15 h**

A] Carbanions in organic Chemistry: Ionization of carbon hydrogen bond and prototopy, Base and acid catalysed halogenation of ketones, keto-enol equilibria, structure and rate in enolisation, concerted and carbanion mechanism for tautomerism, geometry of carbanions, kinetic and thermodynamic control in the generation of enolates, LDA, hydrolysis of haloforms, use of malonic and acetoacetic esters, Aldol, Mannich, Cannizzaro, Darzens, Dieckmann, Claisen Baylis-Hillman reactions, Knoevenagel, benzoin condensation, Julia olefination, alkylation of enolates and stereochemistry thereof, Conjugate additions, enamines in organic synthesis

B] Organometallic reagents –I: Synthesis and applications of organo Li and Mg reagents, nucleophilic addition to aldehyde, ketones, ester, epoxide, CO2, CS2, isocyanates, ketenes, imines, amides, lactones, Stereochemistry of Grignard addition to carbonyl compounds, o-metallation of arenes using organolithium compounds.

Unit II: **15 h**

A] Organometallic reagents-II: Organozinc reagents: Preparation and applications, Reformatsky reaction, Simon-Smith reaction. Organocopper reagents: Preparation and applications in C-C bond forming reaction, mixed oragnocuprates, Gilman's reagent. Organo Hg and Cd reagents in organic synthesis.

B] Transition metals in organic synthesis: Transition metal complexes in organic synthesis-Introduction-oxidation states of transition metals, 16-18 rule, dissociation, association, insertion, oxidative addition, reductive elimination of transition metal Organopalladium in organic synthesis-Heck reaction, carbonylation, Wacker oxidation, coupling reactions: Kumada Reaction, Stille coupling, Sonogashira, Negishi and Suzuki coupling reactions and their importance. Applications of Co2(CO)8, Ni(CO)4, Fe(CO)5 in organic synthesis. Wilkinson catalyst of Ruthenium and Rhodium – synthesis and uses its use in hydrogenation reactions-deallylation, C-C, C-O, C-N bond cleavages.

Olefin metathesis by Ist and IInd generation catalyst, reaction mechanism and application in the synthesis of homo and heterocyclic compounds

Unit III: **15 h**

A] Advanced Stereochemistry: Conformation of sugars, monosaccharides, disaccharides, mutorotation, Recapitulation of Stereochemical concepts- enantiomers, diastereomers, homotopic and heterotopic ligands, Chemo-, regio-, diastereo- and enantio-controlled approaches; Chirality transfer, Stereoselective addition of nucleophiles to carbonyl group: Re-Si face concepts, Cram's rule, Felkin Anh rule, Houk model, Cram's chelate model. Asymmetric synthesis use of chiral auxiliaries, asymmetric hydrogenation, asymmetric epoxidation and asymmetric dihydroxylation, Examples of Stereoselective, Stereospecific and Enantioselective reactions

B] Protection and Deprotection of functional groups: Protection and deprotection of functional groups like, hydroxyl, amino, carbonyl and carboxylic acids groups, Solid phase peptide synthesis.

Unit IV: Designing the synthesis based on retrosynthetic analysis **15 h**

A] Disconnection Approach: An introduction to synthons and synthetic equivalents, disconnection approach, functional group inter-conversions, the importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections, chemoselectivity, reversal of polarity, cyclisation reactions, amine synthesis

B] One Group C-C Disconnections: Alcohols and carbonyl compounds, regioselectivity, alkene synthesis, use of acetylenes and aliphatic nitro compounds in organic synthesis

C] Two Group C-C Disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, α, β-unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annelation, Methods of ring synthesis, Linear and convergent synthesis.

List of books:

1] Principle of Organic Synthesis R. O. C. Norman and J. M. Coxon

2] Modern Synthetic Reaction. H. O. House and W. A. Benjamin

3] Organic Synthesis: The Disconnection Approach-S. Warren

4] Designing Organic Synthesis-S. Warren

5] Some Modern Methods of Organic Synthesis-W. Carruthers

6] Advance Organic Reaction. Mechanism and Structure-Jerry March

7] Advance Organic Chemistry Part-B-F. A. Caray and R. J. Sundberg Plenum Press

8] Organic Reaction and their Mechanism-P. S. Kalsi

9] Protective Groups in Organic Synthesis-T. W. Greene

10] The Chemistry of Organo Phosphorous-A. J. Kirbi and S. G. Warren

11] Organo Silicon Compound-C. Eabon

12] Organic Synthesis via Boranes-H. C. Brown

13] Organo Borane Chemistry-T. P. Onak

14] Organic Chemistry of Boron-W. Gerrard

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC-2
Title of the Paper: Physical Chemistry-Special II
Course code: M-CHPC642T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course the student will be able to:
1. Classify the materials as Metals, Insulators and Semiconductors.
2. Predict the magnetic behavior of materials.
3. Study Predict the electrical properties of materials.
4. Explain the liquid properties and phenomenon of liquid gas interfaces.
5. Understand the construction, working and applications of different commercial batteries.

UNIT I: SOLID STATE AND THEIR MAGNETIC PROPERTIES **15h**

A] Solid State Chemistry: Metals, Insulators and Semiconductors, Electronic structure of solids—band theory. Band structure of metals, Insulators and Semiconductors, Intrinsic and Extrinsic Semiconductors, p-n junction, energy band formation, forward bias and reversed bias p-n junction, their applications, Superconductors— types, Meissner effect, BCS theory, Low Temperature Superconductor (LTSC) and High Temperature Superconductor (HTSC), Conventional and organic Superconductors, their applications.

B] Magnetic Properties: Behaviour of substances in magnetic field, effect of temperature, Curie and Curie-Weiss law, calculation of magnetic moments, magnetic materials, their structure and properties, Applications, structure/ property relations, numericals.

UNIT II: ELECTRICAL PROPERTIES OF MOLECULES **15h**

Dipole moments of molecules, basic ideas of electrostatic interactions, polarizability, orientation polarization, Debye equations, limitation of the Debye theory, Clausius-Mossotti equation. electrostatic of dielectric medium, molecular basis of dielectric behavior, structural information from dipole moment measurements, use of individual bond dipole moments, application to disubstituted benzene derivatives, dipole moment and ionic character of a molecule, determination of dipole moment from dielectric measurements in pure liquids and in solutions. The energies due to dipole-dipole, dipole induced dipole and induced dipole-induced dipole interaction. Dispersion, dielectric loss and refractive index. Lennard-Jones potential.

Unit III: LIQUID STATE AND INTERFACES **15h**

A] Theory of liquids: Theory of liquids, partition function method or model approach, single cell

models, communal energy and entropy, significant structure model.

B] Liquid gas and liquid interfaces: Surface tension, methods of determination of surface tension, surface tension across curved surfaces, vapor pressure of droplet (Kelvin equation), surface spreading, spreading coefficient, cohesion and adhesion energy, contact angle, constant angle hystereis, wetting and detergency.

Unit IV: IONIC LIQUIDS AND BATTERY TECHNOLOGY 15h

A] Super cooled and ionic liquids: Super cooled and ionic liquids, theories of transport properties, non-Arrhenius behavior of transport properties, Cohen-Turnbull free volume model, configurational entropy model, Macedo- litovitz model, glass transition in supercooled liquids.

B] Battery Technology: Basic concept, classification of batteries, primary, secondary and reserve batteries, Construction, working and application of Acid Storage batteries, Lithium - MnO2 batteries, Nickel- Metal hydride batteries, Fuel Cells, Construction and working of H2O2 and methanol-O2 Cell.

List of books:

1] S. O. Pillai, Solid State Physics, New Age International, New Delhi, 2102.

2] D. Mcquarie and J. Simon, Physical Chemistry – A Molecular Approach, University Press, 2000

3] G. M. Barrow, Physical Chemistry, Tata Mc-Graw Hill, V edition 2003.

4] H. K. Moudgil, Text Book of Physical Chemistry, Pretice Hall of India, New Delhi, 2010.

5] M. C. Day and J Selbin, Theoretical Inorganic Chemistry, Reinhold Pub. Corp., New York,

6] A. Kokorin, Ionic Liquids: Theory, Properties and New Approaches, Intech, Croatia, 2011.

7] Gholam-Abbas Nazri, Gianfranco Pistoia, Lithum Batteries-Science and Technology, Springer, 2003.

8] N. H. March and M. P. Tosi, Introduction to Liquid State Physics, World Scientific, London, 2002.

9] George Kackson, Liquid State Theory,

10] C. Kittel, " Introduction to solid state Physics",Wiley

11] L. V. Azaroff, " Introduction to solids", McGraw Hill

12] Santosh Kumar Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer 2006.

13] N. B. Hanny, Treaties in Solid State Chemistry, 4th Edn,

14] H. Y. Erbil, Surface Chemistry of Solid and Liquid Interfaces, Blackwell Publishing, 2013.

15] N. B. Hanny, "Solid State Chemistry"

A. M. Rahatgaonkar

M.Sc. - Two Year: Semester-IV
Name of the Course Category: DSC-2
Title of the Paper: Analytical Chemistry - Special II
Course code: M-CHAC642T
Paper-II
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs.: 60 Hrs. (4h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. Study different types of electrochemical methods of analysis and apply them for analyzing environmentally important anions by the use of ISE.
2. Study theory and instrumentation of some new microscopic techniques such as SPM, STM, AFM, SECM and their applications to determine surface characteristics of the samples.
3. Learn what radioactivity, different types of radiations, types of counters, detectors used in radioanalytical analysis.
4. Classify and study the types of polymers and different polymerization techniques.
5. Understand important Properties of polymers such as Glass transition temperature and Crystallinity of Polymers.
6. Study the analysis of soil and fertilizers.

Unit I: Electrochemical methods of analysis **15h**

A] Ion selective electrodes: Theory of membrane potential. Types of ion-selective electrodes. Construction of solid state electrodes, liquid membrane electrodes, glass membrane electrodes and enzyme electrodes, Selectivity coefficients, Glass electrodes with special reference to H+, Na+ and K+ ions. Applications and advantages of ISE.

B] Electrochemical microscopy: Introduction to Scanning Probe Microscopy (SPM), Scanning Tunneling microscopy (STM), Atomic Force Microscopy (AFM) and Scanning Electrochemical Microscopy (SECM).

Unit II: Radioanalytical Chemistry **15h**

A] Radioactivity-Radiation-Units-Curie, Becquerel, Gray, Rad, Sievert, RBE, REM, Half-life, mixed halflife, branching decay, different types of radiations and their interactions with matter, radioactive equilibrium.

B] Elementary principles of GM and proportional counters, Gamma Ray Spectrometer, Ionization chamber, HPGe detector, NaI(Tl) detector, calibration using standard sources, resolution, numericals.

Unit III: **15h**

A] Introduction of Polymers: Classification of polymers based on: Origin, structure, stereochemistry, synthesis, type of chain and mechanical properties. Plastics, fibers, elastomers and adhesives. Application of polymers. Polymerization techniques: bulk, solution, suspension, emulsion, melt

polycondensation, solid and gas phase polymerization.

B] Properties of polymer: Glass Transition Temperature (Tg): State of aggregation, transition and associated properties, factors affecting on Tg, relation of Tg with molecular weight, Tg and copolymers. Crystallinity of Polymers: Degree of crystallinity, polymer crystallization, structural regularity, Helix structures, spherulites, effect of crystallinity on polymer properties.

Unit-IV: 15h

A] Analysis of Soil: Chemical and mineralogical composition of soil, classification of soil, macro and micronutrients (functions and deficiency) for plant growth, Sampling, determination of Moisture Content, Water Holding Capacity. Analysis of Carbonate, Organic carbon, and organic matter, Total nitrogen, ammonia and nitrates. Total determination of major soil constituents by fusion analysis, silica and total combined oxides of iron, aluminium, and titanium, Determination of Ca, Mg, Na, K, Exchangeable cations, Cation exchange capacity.

B] Analysis of Fertilizers: Synthetic fertilizers and their long term effect on soil quality, Determination of total nitrogen, total phosphorus, potassium and ammonium oxalate in fertilizers.

List of books:

1] Instrumental Methods of Analysis: Willard, Merit and Dean (Van Nostrand)

2] Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)

3] Vogel‘s Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)

4] Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)

5] Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman

6] Day And Underwood : Quantitative Analysis

7] Merits And Thomas: Advanced Analytical Chemistry

8] Ewing, G. W. : Instrumental Methods of Chemical Analysis, Mcgraw-Hill

9] Christain G.D: Analytical Chemistry

10] Khopkar S.M.: Basic Concept Of Analytical Chemistry

11] Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods

12] Radiochemistry: A. N. Nesmeyanov (Mir Publications)

13] Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd).

14] Textbook of polymer science: F.W. Billmayer Jr. Wiley.

15] Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.

16] Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.

17] Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.

18] Principles of polymer Chemistry: Flory, Cornell Univ. press.

19] Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.

20] Principles of polymerization: Odian.

21] A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.

22] Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.

23] A practical course in polymer chemistry: S. J. Punea , Pergamon Press

24] Soil pollution, S.G. Misra and Dinesh Mani, APH Publishing Corporation, (2009).

25] Soil Pollution: origin, monitoring and remediation, Abrahim Mirsal, Springer (2010).

26] Methods in Agricultural Chemical Analysis: A Practical Handbook, N.T. Faithfull, CABI Publishing, Typeset by Wyvern 21 Ltd, Bristol (2002).

27] Soil Sampling and Methods of Analysis, Edited by M.R. Carter E.G. Gregorich, Canadian Society of Soil Science, Second Edition (2008).

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSE-1
Title of the Paper: Inorganic Chemistry
Course code: M-CHIC643T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. The objective of the course is to appraise the students about the organometallic Chemistry.
2. To learn about the 18 e rule and its violation.
3. To identify the basic concept, terms, and important events in the development of organometallic chemistry.
4. To learn methods, including spectroscopy techniques, used to determine the structure of organometallic complexes and to probe reaction mechanism.
5. To develop an appreciation for the scope, diversity, and application of organometallic chemistry.
6. To learn about the photochemical reactions and to be able to draw reasonable reaction mechanisms.

Unit I: **15h**

A] Basics of Photochemistry: Absorption, excitation, photochemical laws, quantum yield, electronically excited states-life times-measurements of the times. Flash photolysis, stopped flow techniques, Energy dissipation by radiative and no-radiative processes, absorption spectra FrankCondon principles; photochemical stages-primary & secondary processes.

B] Properties of excited states: Photochemical kinetics, Calculation of rates of radiative processes.

C] Excited States of Metal Complexes: Electronically excited states of metal complexes, charge transfer spectra, charge transfer excitations, methods for obtaining charge transfer spectra.

Unit II: **15h**

A] Photophysical and photochemical properties of Gold(I) complexes: Introduction, Binuclear and trinuclear complexes, Mixed metal Systems, Photochemical reactivity, Solid state studies, Mononuclear Gold(I) complexes, Mononuclear three coordinate Gold(I) complexes.

B] Redox reactions by Excited Metal Complexes: Energy transfer under conditions of weak interaction & strong interaction – exciplex formation, conditions of excited states to be useful as redox reactants, excited electron transfer, metal complexes as attractive candidates (2,2-bipyridine & 1,10-Phenanthroline complexes.), illustration of reducing and oxidizing character of ruthenium (II); role of spin-orbit coupling, lie time of these processes. Application of redox processes of electronically excited states for catalytic purposes, transformation of low energy reactants in to high

energy products, chemical energy in to light.

Unit III: **15h**

Organotransition Metal Chemistry: Alkyls and Aryls of Transition Metals: Types, routes of synthesis, stability &decomposition pathways of alkyls & aryls of transition metals. Organocopper in Organic synthesis. Compounds of Transition Metal–Carbon Multiple bonds: Alkylidenes, alkylidynes, low valent carbenes & carbynes–synthesis, nature of bond, structural characteristics, nucleophilic & electrophilic reactions on ligands, role inorganic synthesis.

Unit IV: **15h**

Transition Metal Pi Complexes-Carbon multiple bonds. Nature of bonding, structural characteristics & synthesis, properties of transition metal pi- Complexes with unsaturated organic molecules, alkenes alkynes, allyl, diene, dienyl, arene & trienyl complexes. Application of transition metal, organometallic intermediates in oraganic synthesis relating to nucleophilic & electrophilic attack on ligands, role in organic synthesis.

List of books:

1] Elschenbroich Ch.and Salzer A.: Organometallics, VCH,Weinheim, NY. BalzaniV and Cavassiti V.:Photochemistry of Coordination compounds,AP,London

2] Purcell K.F.and Kotz J.C., An Introduction to Inorganic Chemistry,HoltSounder,Japan.

3] RohtagiK.K.and Mukharjee,Fundamentals of Photochemistry,Wiley eastern

4] CalvertsJ.G.and Pits.J.N., Fundamental of Photochemistry, John Wiley

5] Wells, Inorganic Solid State Chemistry, Oxford University, Vth , Edition

6] Paulson,OrganometallicChemistry,Arnold

7] Rochow,OrganometallicChemistry,Reinhold

8] Zeiss,OrganometallicChemistry,Reinhold

9] Gilbert A.andBaggott,J,Essential of Molecular Photochemistry,BlackwellSci.Pub.

10] TurroN.J.and Benjamin W.A.,Molecular Photochemistry

A.M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSE-2
Title of the Paper: Organic Chemistry
Course code: M-CHOC643T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. Classify, isolate and determine the structure of naturally occurring aromatic compounds.
2. Learn structural and chemical properties of different heterocyclic compounds such as azoles, fused heterocycles, diazines and some bioactive compounds.
3. Study design and development new drugs.
4. Understand the meaning of Pharmacokinetics and pharmacodynamics in drug development process and significance of drug metabolism.

Unit I: Naturally Occurring Aromatic compounds: 15h

Classification, nomenclature, occurrence, isolation, general methods of structure determination and synthesis of Benzenoids**,** Coumarins**,** Isocoumarins, chromanones, chromones and cannabinoids**,** Macrocyclic lactones**,** Pyrones, butenolides, lignans and benzofurans**,** Terphenyls**,** Xanthones and benzophenones**,** Naphthalenes and naphthoquinones**,** Anthraquinones**,** Anthracyclines**,** Some other polycyclic antibiotics.

Unit II: Heterocyclic Compounds 15h

A] Azoles: Structural and chemical properties; Synthesis of pyrazole, isothiazole and isoxazole; Synthesis of imidazoles, thiazoles and oxazoles; Nucleophilic and electrophilic substitutions; Ring cleavages, Carbonyldiimidazole as coupling agent

B] Benzofused heterocycles: Synthesis of indole, benzofuran and benzo-thiophene, quinoline and isoquinoline Nucleophilic, electrophilic and radical substitutions; Addition reactions; Indole rings in biology.

C] Diazines: Structural and chemical properties; Synthesis of pyridazines, pyrimidines, pyrazines; Nucleophilic and electrophilic substitutions.

D] Synthesis of following bioactive compounds: Vitamin B6, Ondansetron, Serotonin, Indometacin, Cyanamid, fentiazac, trimethoprim, papaverine

Unit III: Drug Design and Development 15h

A] Development of new drugs, factors affecting development of new drugs, sources of lead compounds,

serendipity and drug development. Concept of QSAR, QSAR methods and parameters, procedure followed in drug design, structure activity relationship (SAR) method, Free and Wilson analysis, Hansch analysis, concept of prodrugs and softdrugs, SOFT DRUGS, isosterism, bioisosterism, drug receptors, theories of drug action, types of reversible enzyme inhibitors, some special inhibitors and design of inhibitors.

B] Pharmacokinetics and pharmacodynamics: Introduction drugs absorption, distribution and disposition of drugs, excretion and elimination, Pharmacokinetics of elimination and Pharmacokinetics in drug development process. Pharmacodynamics: Introduction, enzyme stimulation, enzyme inhibition, membrane active drugs, drugs metabolism, biotransformation and significance of drug metabolism

Unit IV: Mode of action and synthesis of Drug molecules 15h

A] Analgesics and Antipyretics: Introduction, mode of action, evaluation of analgetic agents.Synthesis of: Aspirin, salsalate, phenacetin, phenylbutazone, Indomethacin, Analgin.

B] Cardiovascular Drugs: Introduction, cardiovascular diseases, Synthesis and uses of cardiovascular drugs; amyl nitrate, diltiazem, varapamil, methyldopa, atenolol, sorbitrate, quinidine, oxyprenolol

C] Antineoplastic Agent: Introduction, mechanism of tumor formation, treatment of cancer, types of cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer, carcinolytic antibiotics, mitotic inhibitors, harmones, natural products. Synthesis of melphalan, thiotepa, lomustine

D] Antibiotics: Introduction and general mode of action, β-lactam antibiotics, classification, SAR and chemical degradation of penicillin, cephalosporins-classification , tetracycline antibiotics-SAR, miscellaneous antibiotics. Synthesis of ampicillin, cephradine, methacycline ,chloramphenicol, Synthesis of sulphonamides, ciprofloxacin, norfloxacin, dapsone ,amino salicylic acid, isoniazid, ethionamide, ethambutal, econozole, griseofulvin.

List of books:

1] Textbook of Polymer Science, F. W. Billmeyer Jr, Wiley

2] Polymer Science, V. R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern

3] Functional Monomers and Polymers, K. Takemoto, Y. Inaki and R. M. Ottanbrite

4] Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Hermann Dugas and C. Penny, Springer-Verlag

5] Understanding Enzymes, Trevor Palmer, Prentice Hall

6] Introduction to Medicinal Chemistry, A. Gringuage, Wiley-VCH

7] Wilson and Gisvold's Text Book of Organic Medical and Pharmaceutical Chemistry, Ed Robert FDorge

8] Burger's Medicinal Chemistry and Drug Discovery, Vol-1, Ed. M. E. Wolff, John Wiley

9] Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley

10] The Organic Chemistry of Drug Design and Drug Action, R. B. Silverman, Academic Press

11] The Chemistry of Natural Products Second edition R.H. THOMSON Springer-Science

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSE-3
Title of the Paper: Physical Chemistry
Course code: M-CHPC643T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs: 60 Hrs (4 h per week)

Expected Learning Outcomes: After studying this course the student will be able to:
1. Classify the polymer materials.
2. Learn the methods for molecular weight determination of polymers.
3. Understand the polymerization techniques and polymer characterization.
4. Study the electrochemistry of solutions.
5. Understand the concept of Irreversible thermodynamics.

UNIT I: POLYMER PHYSICAL CHEMISTRY 15h

A] Introduction: Polymer Science, fundamental terms, historical outline, classification based on: the origin (natural, semi synthetic, synthetic etc.), the structure (linear, branched, network, hyper branched, dendrimer, ladder, cross linked, IPN), the type of atom in the main chain (homo-chain, hetero-chain), the formation (condensation, addition), homo polymers, co polymers(random, alternate, block, graft), the behavior on application of heat (thermoplastic and thermosetting),the form and application (plastics, fibers, elastomers and resins). (05h)

B] Molar Mass: Molecular mass and molar distribution. Number average, mass average, viscosity, average molecular mass and relation between them. molecular weight determination by end group analysis, viscometry, vapour phase osmometry, and molecular weight distribution curve. (05h)

C] Types of polymerization: condensation, addition (cationic and anionic) and copolymerization (with kinetics),chain transfer reactions. (05h)

UNIT II: TECHNIQUES OF POLYMERIZATION AND CHARACTERIZATION OF POLYMERS 15h

A] Techniques of polymerization: suspension, emulsion and bulk polymerization, coordination, polymerization mechanism of Ziegler Natta polymerization, stereospecific polymerization, Interfacial polycondensation, mechanism of polymerization.

B] Characterization of polymers: Thermal and Diffraction Methods: Thermogravimetry (TG): Principle and Instrumentation, factors affecting thermo gravimetric curves, Interpretation of thermo gravimetric curves. Applications of thermo gravimetric analysis. Differential thermal analysis (DTA) and Differential scanning calorimetry (DSC) and thermo mechanical analysis: Principle and instrumentation, heat flux and power compensated DSC, Interpretation of DTA, DSC and thermo

mechanical curves, applications of DTA DSC and thermo mechanical analysis.

UNIT III: ELECTROCHEMISTRY OF SOLUTION 15h

A] **Metal/Electrolyte interface**: OHP and IHP, potential profile across double layer region, potential difference across electrified interface; Structure of the double layer: Helmholtz-Perrin, Gouy Chapman model, Stern region, Graham Devanathan- Mottwatts, Tobin, Bockris, Devnathan Models.

B] Over potentials, exchange current density, derivation of Butler Volmer equation under near equilibrium and non-equilibrium conditions, Tafel plot.

C] Electrical double lever, theories of double layer, electro-capillary phenomena, electro-capillary curve. Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential.

UNIT IV: IRREVERSIBLE THERMODYNAMICS 15h

A] Microscopic reversibility and Onsager reciprocity relation, phenomenological equations, Transformation of generalized fluxes and forces. The cyclic version of Clausius' inequality and its integrated form and their correspondence with time's arrow and irreversibility, Clausius' uncompensated heat. Derivation of the differential form of Clausius' inequality.

B] Rate of entropy production and the concept of Chemical affinity and its application to the cases of chemical reactions, coupled reactions, electrochemical reactions. Derivation of Gibbs relation and its DeDonderian version (time rate form) for spatially uniform chemically reacting closed systems, entropy production in spatially non-uniform systems like heat flow, Electrokinetic effect – Saxen relation.

List of Books:

1] P. Bahadur and N. V. Sastry, Principles of Polymer Science, second edition,Narosa Publishing House,2005. 2. C. E. Carraher, Jr., Carraher's Polymer Chemistry, 8thedition, CRC Press, New York,2010.

2] Joel R.Fried, Polymer Science and Technology, Prentice-HallofIndia Pvt. Ltd., 2000.

3] V.R.Gowarikar, H.V.Viswanathan and J.Sreedhar, Polymer Science. New Age International Pvt. Ltd., New Delhi, 1990.

4] F. W. Billmeyer Jr., Text Book of Polymer Science, 3rdedition, John Wiley and Sons, 1984.

5] V.K.Ahluwalia &A. Mishra, Polymer Science, A text book, Ane-Books Pvt. Ltd,2008.

6] R.Sinha, Outline of Polymer Technology manufacture of Polymers, Prenticehall ofIndiaPvt.Ltd.2000

7] F.J.Davis,Polymer Chemistry,Oxford UniversityPress,2000.

8] R.Young, Introduction to Polymers, Chapman & Hall, reprint, 989.

9] V.Jain Organic Polymer Chemistry, IVY Publishing House, 2003.

10] A.Singh, Polymer Chemistry, Campus Book International, 2003.

11] G.S.Misra, Introductory Polymer Chemistry,New Age International(P) Limited, Publishers,1993.

12] Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.

13] Contemporaty polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.

14] Principles of polymer Chemistry: Flory, Cornell Univ. press.

15] Introduction to polymer chemistry: R. B. Seymour, McGraw Hill.

16] A first course in polymer chemistry: A. Strepikheyew, V. Derevistkay and G. Slonimasky, Mir Publishers, Moscow.

17] Skoog DA, West DM, Fundamentals of Analytical Chemistry, Thomson Asia Pvt ltd.,8th Ed,(2004)

18] Wendlandt., Thermal Methods, WW John Wiley,(1986).

19] Willard Merrit and Settle, Instrumental Methods of Analysis.

20] Douglas A.Skoog, Holler & Crouch, Instrumental analysis India edition CENGAGE Learning (EighthIndianReprint2011)

21] Robert D.Braun. Introduction to Instrumental Analysis(IndianReprint2006)

22] J.W.Dodd, K.Tonge, Thermal Methods. Analytical Chemistry, open Learning.

23] M.Mahindersingh, Analytical chemistry, Instrumental techniques, Dominant Pub. Delhi.

24] Sharma B. K., Instrumental Methods of Chemical Analysis, Goel Publishing House.

25] G.W.Ewing,Instrumental methods of Chemical analysis, MacGrawHill.

26] S. R. DeGroot and P. Mazoor, Non-Equilibrium Thermodynamics, North-Holland Co., Amsterdam,1969.

27] G. Lebon, D. Jou and Casa Vazquez, Understanding Non-equilibrium Thermodynamics, Springer,2008.

28] I.Prigoggine, “An Introduction to Thermodynamics of Irreversible Processes,” WileyInterscience.

29] R. P. Rastogi, Introduction to Non-equilibrium Physical Chemistry, Elsevier, Amsterdam, 2008.

30] J.O.M.Bokris and A.K.N.Reddy, “Modern Elcrtrochemistry”. Wiley

31] S. Glasstone, “Introduction to Electrochemistry” Affilisated East West Press, New Delhi.

32] D. R. Crow, “ The Principle of electrochemistry”, Chapman Hall

33] Text Book of Physical Chemistry by K.L. Kapoor

34] Principles of Physical Chemistry by Puri, Sharma &Pathania

A.M. Rahatgaonkar

M.Sc. - Two Year: Semester-IV
Name of the Course Category: DSE-4
Title of the Paper: Analytical Chemistry
Course code: M-CHAC643T
Paper-III
To be implemented from 2024-25

Number of Credits: 04 **Marks: 80M**
Total Number of Hrs.: 60 Hrs. (4h per week)

Expected Learning Outcomes: After studying this course the student will be able to:

1. Explain preparation of radioactive isotopes, principle, methodology and applications of IDA, basic principle, technique, sensitivity and detection limits applications of NAA.
2. Understand pharmaceutical analysis with respect to drugs, formulations and dosage forms used.
3. List the importance and role of FDA. Define basic concepts related to pharmaceutical chemistry.
4. Learn methods of analysis of different drugs.
5. Study theory, instrumentation, chemical and surface applications of PAS.
6. Learn theory, instrumentation and applications of Electrogravimetry and Electronic microscopy such as SEM and TEM.
7. Understand the principle and classification of automation and automated instruments used in different laboratories.

Unit I: Radioanalytical Chemistry-II **15h**

A] Preparation of some commonly used radioisotopes (^{22}Na, ^{60}Co, ^{131}I, ^{65}Zn, ^{32}P), Use of radioactive isotopes in analytical and physico-chemical problems, Industrial applications,

B] Neutron sources, Neutron Activation Analysis, Isotope Dilution Analysis, Radiometric titrations (Principle, Instrumentation, applications, merits and demerits), Radiochromatography, Carbon dating, Numericals based on above.

Unit II: **15h**

A] Pharmaceutical analysis: General idea regarding the Pharmaceutical Industry, definition and classification of drugs, introduction to pharmaceutical formulations. Introduction to FDA. Dosage form and analysis: Introduction, classification of dosage forms. Route of administration, factors affecting on dosage, Tablets, different types of tablets, additives used in tablet manufacture.

B] Analysis of drugs: Amoxicillin, Azithromycin, Cetirizine, Cinnarizine, Thymine hydrochloride (Vitamin-B1) Riboflavin (Vitamin-B2), Ascorbic acid (Vitamin-C), Paracetamol and Aspirin.

Unit III: Miscellaneous analytical techniques **15h**

A] Photoacoustic Spectroscopy: Theory, Instrumentation. Chemical and surface applications of PAS.

B] Electrogravimetry: Theory of electrolysis. Electrode reactions. Decomposition potential. Overvoltage. Instrumentation. Application in separation of metals.

C] Electron microscopy: Principle, instrumentation and applications of scanning electron microscopy (SEM) and transmission electron microscopy (TEM)

Unit IV: Automation in analytical chemistry **15h**

A] Automation in the Laboratory: Principle of automation, automated instruments, classification, continuous analyzer, automatic instruments and semiautomatic instruments. GeMSAEC Analyzer, Flow Injection Analysis (FIA), Dispersion coefficient, Factors affecting Peak Height, microprocessor based instruments, Numerical based on above.

B] Hyphenated techniques: Introduction to GC-MS, LC-MS, ICP-MS and MS-MS (Tandem) spectrometry

List of books:

1] Introduction to Radiation Chemistry: J. W. T. Spinks and R. J. Woods

2] Radiochemistry: A. N. Nesmeyanov (Mir Publications)

3] Essentials of Nuclear Chemistry: H. J. Arnikar (Willey Eastern Ltd).

4] Indian Pharmacopeia Volume I and II.

5] Practical Pharmaceutical chemistry third edition volume 1. By A. H. Beckett & J. B. Stenlake.

6] Remington‘s Pharmaceutical sciences.

7] Ansel’s Pharmaceutical Analysis.

8] Electroanalytical Chemistry: Bard (Marcel-Dekker)

9] Instrumental Methods of Analysis: Willard, Merit and Dean (Van Nostrand)

10] Instrumental Methods of Analysis: G. Chatwal and S. Anand (Himalaya Publishing House)

11] Vogel‘s Text Book of Quantitative Inorganic Analysis: Bassett, Denney, Jeffery and Mendham (ELBS)

12] Advanced Analytical Chemistry: Meites and Thomas (McGraw-Hill)

13] Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman

14] Day And Underwood : Quantitative Analysis

15] Merits And Thomas: Advanced Analytical Chemistry

16] Ewing, G. W. : Instrumental Methods of Chemical Analysis, Mcgraw-Hill

17] Christain G.D: Analytical Chemistry

18] Khopkar S.M.: Basic Concept Of Analytical Chemistry

19] Food Analysis: Theory and practice, Yeshajahu Pomeranz, Clifton E. Meloan, Springer.

20] Food Analysis, Edited by S. Suzanne Nielsen, Springer

21] Principles of package development, Gribbin et al

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC
Title of the Practical: Inorganic Chemistry Practical Special – II
Course code: M-CHIC644P
Paper-IV
To be implemented from 2024-25

Number of Credits: 12 **Marks: 100M**
Total Number of Hrs: 180 Hrs (12h per week)

Expected Learning Outcomes: After studying this course and performing the given experiments, the student will be able to:

1. To make the students to prepare simple coordination complexes
2. Declare the principles and applications of different wet chemical methods.
3. Analyze the principles, instrumentation and applications of spectroscopic methods.
4. Illustrate the principles and applications of chromatographic techniques
5. Record observations and calculate the results after performing the experiments and to maintain laboratory records for the experiments performed during this course.

A. Preparation and characterization of following complexes/organometallic compound including their structural elucidation by the available physical methods. (Element analysis molecular weight determination, conductance and magnetic measurement and special studies)

1. Preparation of mercury tetrathiocyanotocobaltate(II)
2. Preparation of Iron (II) oxalate & potassium trioxalatoferrate (III) trihydrate
3. Preparation of cis & trans potassium dioxalatodiaquochromate (III)
4. Preparation of hexa-aminecobalt(III) chloride
5. Preparation of hexa-aminenickel(II) chloride
6. Preparation of tris (acetylacetonato) manganese (III)
7. Preparation of N-N bis (salicyldehyde) ethylene diaminonato nickel (II)
8. Preparation of trinitrotriaminocobalt(III)
9. Preparation of chloropentammine cobalt (III) chloride
10. Preparation of potassium trioxalatochromate (III)
11. To prepare copper (II) acetylacetonate complex
12. To prepare cis and trans bis (glycinato) Cu II monohydrate complex
13. To prepare dipyridineiodine (I) nitrate 14 Preparation of ammonium nickel(II) sulphate B

B. SOLID STATE

1 Preparation of oxides and mixed oxides(MnO_2 , NiO, Cu_2O,Fe_3O_4,$ZnFe_2O_4$,$ZnMn_2O_4$,$CuMnO_4$and $NiFe_2O$)

2 Preparation of silica and alumina by sol –gel technique

3 To study the electrical conductivity of ferrites, magnetite's, doped oxides and pure samples and

determine band gap

C. SEPARTION AND QUANTITATIVE ESTIMATION OF BINARY AND TERNARY MIXTURE BY THE USE OF FOLLOWING TECHNIQUES:

1. Paper and thin layer chromatography 2 Ion exchange 3 Solvent extraction

D. INORGANIC PHOTOCHEMISTRY

1. Synthesis of potassium ferrioxalate and determination of intensity of radiation
2. Photo oxidation of oxalic acid by UO2 + sensitization
3. Photo decomposition of HI and determination of its quantum yield

List of books:

1. Practical Inorganic Chemistry - Pass
2. Practical Inorganic Chemistry - Marr & Rocket
3. Basic Concept Of Analytical Chemistry - Khopkar S. M.
4. Synthesis And Characterisation Of Inorganic Compounds – W. L. Jolly, Prentice Hall
5. Inorganic Experiments – J. Derck Woollins, Vch.
6. Practical Inorganic Chemistry – G. Marrand, B.W. Rockett, Van Nostrand

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M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC
Title of the Paper: Organic Chemistry Practical Special -II
Course code: M-CHOC644P
Paper-IV
To be implemented from 2024-25

Number of Credits: 12 **Marks: 100M**
Total Number of Hrs: 180 Hrs (12h per week)

Expected Learning Outcomes: After studying this course and performing the givenexperiments, the student will be able to:

1) Estimate elements present in the organic compounds quantitatively.
2) Estimate natural products by different instrumentation methods of analysis
3) Synthesize different organic compounds by following multi-step preparation.
4) Precautiously handle different hazardous reagents of the laboratory.
5) Elucidate structure of organic compounds on the basis of spectral data such as UV, IR, ^{1}H and ^{13}CNMR and Mass).
6) Record observations and calculate the results after performing the experiments andto maintain laboratory records for the experiments.

A] Quantitative Analysis based on classical and instrumental technique (any 9-10)

1] Estimation of nitrogen.
2] Estimation of halogen.
3] Estimation of sulphur.

Spectrophotometric/calorimetric and other instrumental methods of estimation

1] Estimation of streptomycin sulphate.
2] Estimation of vitamin B-12.
3] Estimation of amino acids.
4] Estimation of proteins.
5] Estimation of carbohydrates.
6] Estimation of Ascorbic acid.
7] Estimation of Aspirin.
8] Solvent extraction of oil from oil seeds and determination of saponification value, iodine value of the same oil.

B] Organic multi-step preparations (Two/Three steps): Minimum 10-12 preparations

1] Aniline→ Diaminoazobenzene →p-aminoazobenzene
2] Benzoin →Benzyl →Dibenzyl
3] Aniline → acetanilide → *p*-bromoacetanilide → *p*-bromoaniline
4] Aniline → Acetanilide → *p*-nitroacetanilide → *p*-nitroaniline
5] Benzaldehyde (thiamine hydrochloride) → benzoin → benzil → benzilic acid
6] *p*-Nitrotoluene → *p*-nitrobenzoic acid → PABA → *p*-iodobenzoic acid
7] *p*-Cresol → *p*-cresylacetate → 2-hydroxy-5-methyl acetophenone → 2-hydroxy chalcone
8] Benzaldehyde → benzilidene acetophenone → 4,5-dihydro-1,3,5-triphenyl-1*H*-pyrazole
9] Aniline → phenylthiocarbamide → 2-aminobenzthiazole (Microwave in step I)

10] Chlorobenzene → 2,4- Dinitrochlorobenzene → 2,4- Dinitrophenylhydrazine.
11] Acetophenone → acetophenone phenyl hydrazone → 2-phenylindole
12] Benzion → benzoin benzoate → 2,4,5-triphenyl oxazole
13] Benzophenone → benzpinacol → benzopinacolone (Photochemical preparation)
14] Benzophenone →Benzophenone oxime →Benzanilide →Benzoic acid + aniline
15] Aniline → aniline hydrogen sulphate → sulphanilic acid → Orange II
16] Aniline → N-arylglycine → indoxyl → indigo
17] Phthalimide →Anthranilic acid →Phenyl glycine-o-carboxylic acid →Indigo
18] Phalic anhydride →Phthalimide →Anthranilic acid →o-chlorobenzoic acid
19] Phalic anhydride →Phthalimide →Anthranilic acid →Diphenic acid
20] Ethyl acetoacetate →3-methyl-pyrazol-5-one →4,4-dibromo-3-methyl-pyrazol-5-one Butanoicacid
21] Biosynthesis of ethanol from sucrose
22] Enzyme catalyzed reactions

C] SPECTRAL INTERPRETATION

Structure Elucidation of organic compounds on the basis of spectral data (UV, IR, 1H and 13CNMR and Mass) (Minimum 12 compounds are to be analysed during regular practical's).

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC
Title of the Paper: Physical Chemistry Practical Special - II
Course code: M-CHPC644P
Paper-IV
To be implemented from 2024-25

Number of Credits: 12 **Marks: 100M**
Total Number of Hrs: 180 Hrs (12h per week)

Expected Learning Outcomes: After studying this course and performing the given experiments, the student will be able to:

1. Apply the theoretical concept of Adsorption, Kinetics, Potentiometric, Conductometric and Colorimetric concepts by performing the experiments based on these principles and learn the Applicability.
2. Work out various types of titrations by using different instruments such as conductivity meter, Potentiometer etc. and its applications.
3. Calibrate instruments and use different electrodes according to the type of instrument.
4. Record observations and calculate the results after performing the experiments and to maintain Laboratory records for the experiments performed during this course.

Physical Chemistry Special

Adsorption:

1. To verify Freundlich adsorption isotherm.
2. To verify Langmuir adsorption isotherm.
3. To verify Gibbs adsorption isotherm and to find surface excess concentration of solute.
4. Study of variation of surface tension of solution of n-propyl alcohol with concentration and hence determine the limiting cross section area of alcohol molecule.

Kinetics:

5. Clock reaction- activation energy of bromide-bromate reaction.
6. Temp dependence of persulfate-iodide reaction by iodine clock method and calculation of Thermodynamic and Arrhenius activation parameters. Study of ionic strength effect on Persulfate iodide reaction.
7. Kinetics of B-Z reaction; Kinetics of modified B-Z reaction
8. Investigate the Autocatalytic reaction between potassium permanganate and oxalic acid.
9. Determination of pKa value of a weak acid by chemical kinetic method (formate-iodine reaction)

Potentiometry:

10. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the hydrolysis constant of salt by potentiometry method.

11. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
12. Complexation between Hg2+and I- conductometrically.

Conductometry:

13. To determine degree of hydrolysis of aniline hydrochloride and hence to determine the Hydrolysis constant of salt by conductometric method.
14. To determine pK of weak acids, succinic acid, acetic acid, Malonic acids, (dibasic acids).
15. Complexation between Hg2+and I- conductometrically.
16. To determine solubility product of lead chromate.
17. Kinetic study of saponification ethyl acetate by conductometry.

Spectrophotometry:

18. To determine the stability constant of reaction between Ferric ion solution and SCN- ion solution by Job's method.
19. To determine the stability constant between Fe3+ and SCN- ion solution by Ostwald & Frank method.

List of Books:

1. Vogel A : A Textbook Of Quantitative Inorganic Analysis, Longman
2. Das and Behra, Practical Physical Chemistry
3. Carl W. Garland, Joseph W. Nibler and David P. Shoemaker, Experiments in Physical Chemistry, Mc- Graw Hill, 8th Edition, 2009.
4. Farrington Daniels, Joseph Howard Mathews, John Warren Williams, Paul Bender, Robert A. Alberty,
5. Experimental Physical Chemistry, Mc-Graw Hill, Fifth Edition, 1956.
6. John W. Shriver and Michael George, Experimental Physical Chemistry, Lab Manual and Data
7. Analysis, The University of Alabama in Huntsville, Fall 2006
8. Day And Underwood :Quantitative Analysis
9. Merits And Thomas:Advanced Analytical Chemistry
10. Ewing, G. W. : Instrumental Methods of Chemical Analysis, Mcgraw-Hill
11. Drago, R.S:Physical Methoods In Inorganic Chemistry
12. Christain G.D:Analytical Chemistry
13. Khopkar S.M.:Basic Concept Of Analytical Chemistry
14. Koltath And Ligane:Polorography
15. Braun: Instrumental Methods Of Chemical Analysis
16. Willard, Merritt And Dean: Instrumental Methods Of Chemical Analysis ,Van Nostrand
17. Strouts,Crifi;Llan And Wisin: Analytical Chemistry
18. Skoog S.A. And West D. W.: Fundamental of Analytical Chemistry
19. Dilts R.V.: Analytical Chemistry

20. Jahgirdar D.V :Experiments In Chemistry
21. Chondhekar T .K: Systematic Experiments In Physical Chemistry, Rajbog S.W., Aniali Pubn.
22. Wlehov G. J: Standard Methods Of Chemical analysis 6th Ed

M.Sc.- Two Year: Semester-IV
Name of the Course Category: DSC
Title of the Paper: Analytical Chemistry Practical Special-II
Course code: M-CHAC644P
Paper-IV
To be implemented from 2024-25

Number of Credits: 06 **Marks: 100M**
Total Number of Hrs.: 180 Hrs. (12h per week)

Expected Learning Outcomes: After studying this course and performing the given experiments, the student will be able to:

1. Estimate metals and ions by using ion selective electrodes by electrochemical methods.
2. Determine different physical and chemical characteristics of polymers.
3. Perform physical analysis of soil and study its quality.
4. Perform different separation techniques such paper and thin layer, ion exchange chromatography, and solvent extraction to separate the components present in a mixture.
5. Estimate the analytes by Gas chromatography, HPLC etc.

It is expected to perform minimum 15-20 experiments in a semester.

A. Electrochemical methods of analysis

1. Measure the chloride content in water using ion-selective electrodes.
2. Estimation of nickel and copper individually as well as in mixture Electrogravimetry.

B. Polymers:

1. Molecular weight of polyvinyl alcohol by Viscometry or Light Scattering Analysis.
2. Determination of water absorption by polymer
3. Determination of chlorine content in PVC
4. Determination of carbon black content in polymer
5. Determination of swelling and solubility parameters of polymers.
6. Crystallinity of polymers by density measurement

C. Soil analysis:

1. Determination of textured and particle size distribution (sand, silt and clay) Porosity, water holding capacity, cation exchange capacity, electrical conductivity and infiltration rate.
2. Qualitative test for phosphate in soil sample
3. Determination of Fe / Cu/ Zn / Mn / B by AAS from soil sample.
4. Estimation organic nitrogen by Kjeldahl's Method or semi-micro Kjedahl's method.
5. Flame photometric analysis of soil sample for Na+ and K+ by calibration curve method.
6. Estimation of K+ from soil sample by internal standard and its confirmation by standard addition method.

7. Estimation of any two-metal ion by atomic absorption spectroscopy from soil.

D. Drug analysis:

1. Volumetric estimation of Ibuprofen.
2. Estimation of aspirin by volumetric and instrumental methods.
3. Analysis of ascorbic acid in tablet sample.
4. Determination of Paracetamol by colorimetry.
5. Analysis of ampicillin trihydrate.
6. Determination of vitamin B12 in commercial sample by spectrophotometry.
7. Determination of phenobarbitone in given cough syrup.
8. Determination of tetracycline in given capsule.
9. Determination of iron, calcium and phosphorus drug sample.
10. Separation and determination of sulpha drugs in tablets or ointments.
11. Drug action of salicylic acid by spectrophotometry

List of books:

1. Text book of organic medicinal chemistry-Wilson, Geswold
2. Medicinal chemistry Vil I and II-Burger
3. A textbook of pharmaceutical chemistry-Jayshree Ghosh
4. Introduction to medicinal chemistry-A Gringuadge
5. Wilson and Gisvold text book of organic medicinal and pharmaceutical chemistry-Ed.Robert F Dorge
6. An introduction to drug design-S S Pandey,and JR Demmock
7. Goodman and Gilmans pharmacological basis of therapeutics- Stragies for organic drug sythesis and design-D Lednicer
8. Textbook of Medicinal Chemistry- A. Kar
9. Medicinal Chemistry – D Sriram and P. Yogeeswari
10. The Handbook of Drug Laws, M L Mehra, University Book Agency, Ahmedabad, 1997.
11. Chemical Analysis of Drugs, Takeru Higuchi, Interscience Publishers, 1995.
12. Text book of Pharmaceutical Analysis, Kenneth Antonio Connors, Wiley, 2001.
13. Textbook of polymer science: F.W. Billmayer Jr. Wiley.
14. Polymer science: V.R. Gowarikar, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern.
15. Fractional monomers and polymers: K Takemoto, Y. Inaki, and R.M. Ottam Brite.
16. Contemporary polymer chemistry: H.R. Alcock and F. W. Lambe, Prentice Hall.
17. Laboratory preparation of macro chemistry: EMM effery, McGraw Hill Co.
18. A practical course in polymer chemistry: S. J. Punea , Pergamon Press

A. M. Rahatgaonkar

M.Sc.- Two Year: Semester-IV
Name of the Course Category: OJT
Name of the Course: Research Project / Dissertation (Core)
Course Code: M-CH645P
To be implemented from 2024-25

Number of Credits: 06 **Marks: 150M**
Total Number of Hrs.: 180 Hrs. (12h per week)

Objectives: To make Students:

1. Learn about writing background with historical information and a review of existing material.
2. Understand to describe the issue, methodology adopted for the study.
3. Discern Presentation of data collected and detailed analysis of results.
4. Know about Discussion on the data and results obtained and presentation of method suggested solving the problem.
5. Recognize about summary of the dissertation and important conclusions drawn at the end of the investigation.

Expected Learning Outcomes: After studying this course and completing the Research Project / Dissertation (Core) based on Research or Lab work, the student will be able to:

1. Prepare background with historical information and a review of existing material
2. Utilize the knowledge to Describe the issue, methodology adopted for the study Carryout
3. Elucidate Presentation of data collected and detailed analysis of results
4. Interpret Discussion on the data and results obtained and presentation of method suggested for solving the problem

RP: **Research Project / Dissertation (Core)** **Marks: 75M**

Research based project work (Instructions for Students):

Candidates will write a project on issues related to chemistry under the guidance of their respective guides. The regular full-time teacher of the department approved by university/autonomous institute/scientist of government/private research laboratory appointed by university as a contributory teacher and having M. Phil. or Ph. D. degree can supervise the project work of the student.

The students will have to carry out the research-based project work in lieu of practical in the fourth semester in their department or depending on the availability of placement; he/she will be attached to any of the national/ regional/ private research institute / organization for the duration of the fourth semester. The student will be randomly allotted the priority number for the selection of the supervisor in the third semester on the basis of research specialization/ area of specialization of supervisor.

Each student will work independently on the topic. The project work must consist of review of literature and produce a deep insight of the subject on the basis of personal research. Project work will be initiated after passing M.Sc.-II Sem.-III. The students will undertake field work in terms of collection of data and surveys. The project will have to be submitted at the end of the academic semester for

evaluation. The students should submit their project in the following format.

- **Chapter I: Introduction with Aims and Objectives**.

  A background with historical information and a reference of existing research or data on the subject along with the aims and objectives of the study, scope of study and the limitation of study.

- **Chapter II: Review of Literature**

  Reference to the relevant research papers reviewed for the study highlighting the present scenario about research topic.

- **Chapter III: Research Methodology**

  Description of the issue, Hypothesis, methodology adopted for the study, source of data.

- **Chapter IV: Result and Discussion**

  Discussion on the data and results obtained and presentation of method suggested solving the problem.

- **Chapter V: Summary and Conclusions**

  A summary of the dissertation and important conclusions drawn at the end of the investigation.

- **Chapter VI: Bibliography or References**
- **Annexure**

A list of references must be cited in the text. The project should be typed on A4 size bond paper with 1.5 line spacing. Illustrations and photographs should be of high quality. The report should be flawless without any spelling mistakes or grammatical errors. If the project contains such mistakes the student will have to resubmit their project after the necessary corrections. The project should be bound in hard black mounted cover. Project with spiral binding and paper cover will not be accepted. The students are expected to prepare 4 copies of the project one of which should be submitted to the Department.

The project will carry 75 marks. Assessment of the project will be done at the end of the semester. Students have to appear for Power Point presentation and viva based on project work. In the presentation, students are expected to describe their project problem, the data they are going to analyze, and the objectives of their project. In addition to this, they should also mention their methodology. Students will have to submit their project at the time of final project evaluation examination. The project report as well as presentation will be evaluated by an Examiner (as per norms) appointed by the institute. When an external examiner is not available, the Head may appoint an external examiner from the Department with the prior permission of the Director.

Distribution of Marks (Project/ Dissertation)		**Maximum Marks: 150**
1.	Introduction & Review of literature	**15M**
2.	Presentation of Work (PPT)	**10M**
3.	Reasoning Capability	**10M**
4.	Subject Knowledge	**10M**
5.	Interpretation of Results	**10M**
6.	Project Viva:	**20M**
7.	**Project/Dissertation Marks (ESE)** (Evaluated jointly by External & Internal Examiner)	**75M**
8.	Internal Assessment (CIE) (Evaluated by Internal Examiner)	**75M**
9.	**Total Marks**	**150M**