OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2021-22 onwards
(For the batch admitted in Academic year 2018-19)
SEMESTER-VII

PAPER I (701) INORGANIC CHEMISTRY-III

Teaching hours-4/week **Credits 4**

Bonding Group Theory and its Applications

Unit IX: Group Theory, Normal mode analysis and Spectral Activity
Unit X: MOT of Metal Complexes
UnitXI: Electronic Spectroscopy of Metal Complexes
Unit XII: IR and Raman Spectroscopy

Unit IX: Group Theory, Normal Mode Analysis and Spectral Activity

Properties of a Group-Closure rule, Identity rule, associative rule, inverse rule, Abelian and Non-abelian groups. Classes of Symmetry Elements of a Group: Similarity transformation, properties of conjugate elements, salient features about Classes, Classes of C_{2V}, C_{2h} and C_{3V}. Matrix Representation of Symmetry Elements: Simple Matrices, Matrix addition, subtraction and multiplication, Block-Factorization. Matrix Representation of *E, Cn, Sn*, i and σ Elements. Great Orhogonality Theorem: Reducible and Irreducible Representations, Properties of Irreducible Representations, Construction of Character Tables for C2V, C2hand C3V. Mulliken Symbolism for Irreducible Representations - Standard Reduction Formula. Use of Character tables for IR & Raman spectroscopy, symmetry based selection rules for IR and Raman activity. Type and Symmetry of Normal Modes and IR and Raman activity of molecules: Cartesian coordinate method of analysis for C_{2V} (eg. H_2O, SF_4), C_{3V} (NH_3, $POCl_3$), C_2h (trans-N_2F_2), D_3h (BF_3), Td(SO_4^{2-}), Oh (SF_6). Internal coordinate method of analysis for C_2V (H_2O), C_3V (NH_3), Td (SO_4^{2-}).

Unit X: Molecular Orbital Theory of Metal Complexes:

Limitations of Crystal Field Theory,Adjustments to the Crystal Field Theory to allow for covalence -Experimental evidences for Metal -Ligand orbital overlap. The Adjusted Crystal Field Theory. Introduction to Molecular Orbital Theory.Symmetry Classification of Metal and Ligand Group Orbitals in Cubic and Non-Cubic Environments: Octahedral, Tetrahedral, Square Planar, Square Pyramidal, Trigonal Bipyramidal Geometries – Concept of Ligand Group Orbitals – Construction of Molecular Orbital Energy Level Diagrams -Octahedral Metal Complexes with (i) Sigma (σ), (ii) sigma(σ) &Pi (π) and (iii) sigma (σ), Pi (π) and Pi* (π*) bonding contribution from the Ligands - Tetrahedral Metal Complexes with (i) Sigma (σ) and (ii) sigma(σ) &Pi(π), and Square Planar Metal Complexes with (i) Sigma (σ) and (ii) sigma(σ) &Pi (π) bonding contribution from the ligands - Molecular orbital electron configurations and calculation of Magnetic Moments.

Unit XI: Electronic Spectroscopy of Metal Complexes

Classification of Electronic Spectra for Metal Complexes, Selection Rules: Electric Dipole Transitions, Magnetic Dipole Transitions, Orbital Selection Rules, Spin Selection Rules, Relaxation in Selection Rules. Nature of Electronic Spectral Bands: Band Widths, Band Intensities. Factors Influencing Band Shapes: Jahn-Teller Effect, Spectrochemical Series, Nephelauxetic Effect. Orgel Diagrams for d^1-d^9 Configurations, Crystal Field Spectra of Oh and Td Metal Complexes of 3d Metals. Charge Transfer Spectra. Strong Field Configurations: The Method of Descending Symmetry, Correlation Diagrams and Tanabe-Sugano Diagrams for d^2 and d^8 Configurations. Calculation of 10Dq Values, Racah Parameter (B) and Nephelauxetic Ratio (β).

Unit XII: Infrared and Raman Spectroscopy

Conditions for Infrared and Raman Spectroscopies, Direct product – symmetry requirements for overtones, binary and ternary combination bands. Partial Normal mode analysis-Structure Fitting, Determination of Coordination Sites and Linkage Isomers(NO_2^- , SCN^-), Assigning Denticity of Ligands (SO_4^{2-}, CO_3^{2-}), Prediction of Diagnostic Fundamentals in Isomers of Metal Complexes and Distinguishing Isomers of Metal Complexes. Effect of Coordination on Ligand Vibrations: Examples involving Mono, Bi and/or Polydentate Ligands of Oxygen, Nitrogen, Carbon and Halogen Donors (NH_3, H_2O, Glycine, Carbonyl and halides). Raman effect and molecular structure- CO, HCN, CO_2, N_2O, H_2O.Principles of Resonance Raman Spectroscopy. Application of Resonance Raman Spectroscopy to Structural Elucidation of the active Sites of Heme and Non-Heme Oxygen Carriers.

SUGGESTED BOOKS

1. Symmetry and Spectroscopy of Molecules, K. Veera Reddy, Second Edition, New Age International
(P) Limited Publishers (2009)
2. Chemical Applications of Group Theory, F. A. Cotton, 3rd edition, Wiley NY (1990)
3. Symmetry and Group Theory In Chemistry, Mark Ladd, Harwood Publishers, London (2000)
4. Symmetry Through the Eyes of a Chemist, I. Hargittai and M. Hargittai, 2nd Edition, Plenum Press,
NY (1995)
5. Molecular Symmetry and Group Theory, Robert L. Carter, John Wiley & Sons (1998)
6. Group Theory for Chemists, G. Davidson, Macmillan Physical Science Series (1991)
7. Molecular Symmetry, Schoenland
8. Electronic Spectroscopy, A. B. P. Lever
9. Introduction to Ligand fields, B. N. Figgis
10. Infrared and Raman Spectroscopy of Inorganic and Coordination Compounds, K. Nakamoto
11. Infrared spectroscopy of Inorganic Compound, Bellamy.

(For the batch admitted in Academic year 2018-19)

SEMESTER-VII

PAPER II (702) ORGANIC CHEMISTRY-III

Teaching hours-4/week **Credits 4**

Synthetic Reagents, Conformational Analysis and ORD, Carbohydrates

Unit-IX: Synthetic Reagents-I
Unit-X: Synthetic Reagents-II
Unit-XI: Conformational analysis (Cyclic systems) & ORD
Unit-XII: Carbohydrates

Unit-IX: Synthetic Reagents-I **15 Hrs**

i) Protecting groups: a) Protection of alcohols by ether, silyl ether and ester formation b) Protection of 1,2-diols by acetal, ketal and carbonate formation c) Protection of amines by benzyloxycarbonyl, t-butyloxycarbonyl, fmoc and triphenyl methyl groups. d) Protection of carbonyls by acetal, ketal and thiolacetal (Umpolung)groups. e) Protection of carboxylic acids by ester and ortho ester (OBO) formation.

ii) Organometallic Reagents: Preparation and application of the following in organic synthesis: 1) Organolithium 2) Organo copper reagents3) Organoboranes in C-C bond formation 4) Organo silicon reagents: reactions involving β-carbocations and α-carbanions, utility of trimethylsilyl halides, cyanides and triflates.

iii) Carbonyl methylenation:a) Phosphorousylide mediated olefination 1) Witting reaction, 2) Horner-Wordsworth-Emmons reaction.b) Titanium- Carbene mediated olefination 1) Tebbe reagent, 2) Petasis reagent 3) Nysted reagent.

iv) Carbene insertions: Rh based carbene complexes, cyclopropanations.

v) C-H Activation: Introduction, Rh catalysed C-H activation.

Unit-X: Synthetic Reagents II **15 Hrs**

i) Oxidations: a) Oxidation of active C-H functions: DDQ and SeO2.b) Alkenes to diols: Prevost and Woodward oxidation c) Alcohol to carbonyls: CrVI oxidants (Jones reagent, PCC, PDC) IBX, DMP, CAN, TEMPO, TPAP, Swern oxidation d) Oxidative cleavage of 1,2-diols: Periodic acid and Lead tetra acetate.

ii) Reductions: a) Catalytic hydrogenation: Homogenous (Wilkinsons's catalytic hydrogenation)and heterogeneous catalytic reduction. b) Non-metallic reductions: Diimide reduction c) Dissolving metal reductions: Birch reduction. d) Nucleophilic metal hydrides: $LiAlH_4$, $NaBH_4$, and their modifications. e) Electrophilic metal hydrides: BH_3, AlH_3 and DIBAL. f) Use of tri-n-butyl tin hydride: Radical reductions.

Unit-XI: Conformational analysis (Cyclic systems) & ORD **15 Hrs**

Conformational analysis (Cyclic systems): Study of conformations of cyclohexane, mono, di and tri substituted cyclohexanes, (1,3,5-trimethylcyclohexanes and Menthols), cyclohexanone

(2-alkyl and 3 -alkyl ketone effect), 2-halocyclohexanones, cycloheptane . Stereo chemistry of bicyclo[3,3,0]octanes, hydrindanes, decalins and perhydroanthracenes. Conformational structures of piperidine, NMethylpiperidine, tropane, tropine, pseudotropine, decahydroquinoline and quinolizidine. Factors governing the reactivity of axial and equatorial substituents in cyclohexanes. (oxidation, SN2 reaction, rearrangements, Ester hydrolysis) Stereochemistry of addition to the carbonyl group of a rigid cyclohexanone ring.

Optical Rotatory Dispersion (ORD) and CD Spectroscopy: Optical rotation, circular birefringence, circular dichroism and Cotton effect. Plain curves and anomalous curves. Empirical and semiempiricalrules-The axial haloketone rule, the octant rule, Helicity rule, Exciton chirality method. Application of the rules to the study of absolute configuration and conformations of organic molecules.

Unit-XII: Carbohydrates **15 Hrs**

Introduction to the importance of Carbohydrates. Types of naturally occurring sugars. Deoxy sugars, amino sugars, branched chain sugars methyl ethers and acid derivatives of sugars. Determination of configuration and determination of ring size of D-glucose and D-Fructose. Conformational analysis of monosaccharides. 4C1 and 1C4 conformations of D-glucose. Reactions of six carbon sugars: Ferrier, Hanesian reaction and Ferrier rearrangement. Synthesis of amino, halo and thio sugars. Structure, ring size determination of sucrose and maltose. Conformational structures of sucrose, lactose, maltose, cellobiose and gentobiose. Structure and biological functions of starch, cellulose, glycogen and chitin. Role of sugars in cell to cell recognition, blood groups.

Recommended Books:

1. Some modern methods of organic synthesis by W. Carruthers
2. Guidebook to organic synthesis, by R K Meckie, D M Smith & R AAtken
3. Organic Synthesis by O House
4. Organic synthesis by Micheal B Smith
5. Reagents for organic synthesis, by Fieser&Fieser, Vol 1-11 (1984)
6. Organic synthesis by Robert E Ireland
7. Handbooks of reagents for organic synthesis by Reich and Rigby, Vol-I-IV
8. Organic chemistry by Jonathan Clayden, Nick Greeves and Stuart Warren
9. Organic Reactions and their mechanisms by P.S.Kalsi
10.Organic reaction mechanisms by V.K.Ahulwalia and Rakesh Kumar Parashar
22. Stereochemistry of organic compounds — Principles & Applications by D Nasipuri
23. Stereochemistry of Carbon compounds by Ernest L Eliel& Samuel H. wilen
24. Stereochemistry: Conformation & Mechanism by P S Kalsi
25. The third dimension in organic chemistry, by Alan Bassendale
26. Stereo selectivity in organic synthesis by R S Ward.
27.Advanced organic chemistry. Part A Structure & Mechanism by Francis A. Corey and Richard J. Sundberg
28. Optical rotatory dispersion by C Djerassi
29. Optical rotatory dispersion and circular dichroism by P Crabbe

30. Mechanism and Structure in Organic chemistry by S Mukherjee
31. Organic Chemistry Vol.I and Vol.II by I.L.Finar
32. Carbohydrate Chemistry by Barton Volumes
33. Carbohydrate chemistry by G.J.Boons
34. The chemistry of natural products:vol.V - carbohydrates by S.F.Dyke
35. Organic Chemistry by McMurry

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SEMESTER-VII

PAPER III (703) PHYSICAL CHEMISTRY-III

Teaching hours-4/week **Credits 4**

Unit-IX: Applications of Schrödinger equation
Unit- X: Chemical kinetics – II
Unit- XI: Electrochemistry – II
Unit- XII: Statistical Thermodynamics

Unit-IX: Applications of Schrödinger equation (15 hrs)

Systems with discontinuity in the potential field. A simple potential barrier. A potential barrier with a finite thickness. Quantum mechanical tunneling – examples - α-particle emission, inversion of NH_3 , hydrogen transfer reactions. The harmonic oscillator – detailed treatment. Wave functions and energies. Vibration of a diatomic molecule – harmonic oscillator model. The rigid rotator – detailed treatment. Wave functions and energies. Spherical harmonics. Rigid rotator as model for a rotating diatomic molecule. The hydrogen atom – detailed treatment. Angular and radial functions. Atomic orbitals. Measurability of the ground-state energy of hydrogen atom. Orthonormal nature of hydrogen-like wave functions. Probability calculations. Atomic and molecular term symbols. Atoms in external field, Zeeman and anomalous Zeeman effect.

Unit- X: Chemical kinetics – II: (15hrs)

Reactions in solution: Factors affecting reaction rates in solution. Effect of pressure on rate ofreaction. Diffusion controlled reactions. Influence of dielectric constant and ionic strength on ion-ion, ion-dipole and dipole-dipole reactions. Primary and secondary salt effects. Kinetic isotope effects: Primary and secondary isotope effects. Solvent isotope effects.

Fast reactions: Flow methods and the stopped-flow technique. The fluorescence technique. Shock tube method. Relaxation methods (T-jump and P- jump). Kinetic equations for chemical relaxation.

Enzyme kinetics: Michaelis - Menten mechanisms of enzyme catalyzed reactions involving one and two intermediates. Steady-state approximation. Derivation of kinetic equations. Evaluation of kinetic parameters. Enzyme- substrate complex: Fischer's lock and key and Koshland's induced fit hypotheses. Specificity of enzyme-catalyzed reactions. Discussion of the various types of forces involved in the formation of E-S complex. pH dependence of enzyme-catalyzed reactions – the kinetics and the equations involved.

Unit- XI: Electrochemistry – II (15 hrs)

The electrode-electrolyte interface: The electrical double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model. Quantum aspects of charge transfer at the interfaces. Tunneling.

Electrodics: Charge transfer reactions at the electrode-electrolyte interface. Exchange current density and overpotential. Derivation of Butler-Volmer equation. High field approximation. Tafel equation - low field - equilibrium, Nernst equation. The symmetry factor and its significance.

Corrosion: Electrochemical corrosion.Short-circuited energy producing cell. The definition and final expression of corrosion current and corrosion potential. Homogeneous theory of corrosion.Evans diagrams. Potential-pH (Pourbaix) diagrams of iron. Methods of corrosion rate

measurement. Mechanism of anodic dissolution of iron. Protection against corrosion. Corrosion inhibition by organic molecules.

Unit- XII: **Statistical Thermodynamics** **(15 hrs)**

Concepts of distribution and probability. Estimation of probability and the most probable distribution. Systems composed of noninteracting particles. Derivation of Boltzmann distribution law. The molecular partition function. Systems composed of interacting particles. The concept of ensemble and canonical ensemble. Canonical partition function and its relation to molecular partition function. The factorization of molecular partition function – translational, rotational, vibrational and electronic partition functions. Derivation of expressions for translational, rotational (diatomic) and vibrational partition functions. Relationship between partition functions and thermodynamic functions. The relationship between partition functions and thermodynamic functions. Law of equipartition energy. Specific heats of solids – Einstein equation of heat capacity of solids – derivation. Explanation of heat capacity at very low and very high temperatures – Dulong and Petits Law. Debye theory. The entropy of a monoatomic ideal gas. The Sackur-Tetrode equation- derivation. Mean translational and vibrational energies. The relation between equilibrium constant and partition function- derivation. Basic ideas of Bose-Einstein statistics and Fermi-Dirac statistics and comparison of these with Maxwell-Boltzmann statistics.

Books suggested:

1. Quantum Chemistry, Ira N. Levine, Prentice Hall
2. Introduction to Quantum Chemistry, A. K. Chandra, Tata McGraw Hill
3. Elementary Quantum Chemistry, F. L. Pilar, McGraw Hill
4. Molecular Quantum Mechanics, P. W. Atkins & R. S. Friedman, Oxford University Press
5. Coulson's Valence, R. McWeeny, ELBS
6. Elements of Statistical Thermodynamics, L. K. Nash, Addison – Wesley
7.. Introduction to Statistical Thermodynamics, T. L. Hill, Addison Wiley
8. Statistical Thermodynamics, M. C. Gupta, New Age International
9. Atkin's Physical Chemistry, P. Atkins & Julio de Paula, Oxford University Press
10. Molecular Thermodynamics, D. A. McQuarrie & J. D. Simon, University Science Books
11. Text book of Biochemistry by Stryer, W.H.Freeman & Co Ltd
12. Advanced physical chemistry by Gurtu and Gurtu, Pragati Edition
13. Physical chemistry by Puri and Sharma, Vishal Publishing Co.
14. Chemical Kinetics, K. J. Laidler, McGraw Hill
15. Kinetics and Mechanism, A. A. Frost & R. G. Pearson, John Wiley & sons
16. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman & J. Kuriacose, McMillan
17. Chemical Kinetics and Reaction Mechanisms, J. H. Espenson, McGraw Hill
18. Physical Organic Chemistry, N. S. Isaacs, ELBS
19. The Physical basis of Organic Chemistry, Howard Maskill, Oxford University Press
20. Modern Electrochemistry, J. O. M. Bockris & A. K. N. Reddy, Plenum.
21. Modern Electrochemistry 2B, Bockris & Reddy, Plenum.
22. Introduction to Electrochemistry, S. Glasstone, EAST-WEST Press Pvt. Ltd, New Delhi

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SEMESTER-VII

PAPER IV (704) ANALYTICAL TECHNIQUES AND SPECTROSCOPY-III

Teaching hours-4/week **Credits 4**

UNIT-IX : ^{13}C NMR and 2D NMR spectroscopy
UNIT –X : Diffraction Methods
UNIT XI: Thermal Methods
UNIT XII: Advanced Mass spectrometry

UNIT-IX : ^{13}C NMR and 2D NMR spectroscopy **15 Hrs**

i) ^{13}C NMR spectroscopy: Introduction**,** Types of ^{13}Cnmr spectra: undecoupled, proton decoupled and off-resonance decoupled (ORD) spectra. ^{13}C chemical shifts, factors affecting the chemical shifts, chemical shifts of organic compounds. Calculation of chemical shifts of alkanes, alkenes and alkynes. Homonuclear (^{13}C, ^{13}C J) and heteronuclear (^{13}C,^{1}H J and ^{13}C, ^{1}H J) coupling. Applications of ^{13}C-NMR spectroscopy: Structure determination, stereochemistry, reaction mechanisms and dynamic processes in organic molecules. ^{13}CNMR spectral editing techniques: principle and applications of APT, INEPT and DEPT methods.

ii) 2D-NMR spectroscopy: Principles of 2D NMR, Classification of 2D-experiments. Correlation spectroscopy (COSY) HOMOCOSY (1H-1H COSY) , TOCSY (Total Correlation Spectroscopy), HeteroCOSY (^{1}H, ^{13}C COSY,HMQC), long range -^{1}H, ^{13}C COSY (HMBC), Homonuclear and Heteronuclear 2D-J-resolved spectroscopy, NOESY and 2D INADEQUATE experiments and their applications.

UNIT –X: Diffraction Methods **15 Hrs**

X – ray Diffraction : X –rays and their generation – choice of radiation ; Miller indices, Braggs equation, Experimental methods – Powder and single crystal methods, Indexing the reflections, Systematic absences, Electron density studies by X – rays – Platinum phthalocyanine complex, Silylacetate, Tetraalkylbiphosphate ; Advantages and limitations of X – ray Diffraction.

Electron Diffraction by gases :Principles , Radial distribution curves- Interpretation of results for $PBrF_2S$, PF_3S, PF_2HS, $HClO_4$, Silylmonothioacetate and Germylmonothioacetate and HgCl2 molecules, Advantages and Limitations.

Neutron Diffraction: Principle, Application in Hydrogen bonding studies, combined use of X – ray and Neutron diffraction studies, Advantages and limitations.

UNIT XI: Thermal Methods **15 Hrs**

Thermogravimetric analysis (TGA): Principle, Instrumentation, working function of each component, applications of TGA, Study of oxalates, nitrates and chromates by TGA. Determination of carbon black in polythene.

Differential thermal analysis (DTA): Principle, Instrumentation, Methodology, applications. Differential thermogram of sulphur. TG and DTA of manganese phosphine monohydrate.

Differential scanning calorimetry (DSC): Principle, instrumentation, power compensated DSC instruments and Heat flow DSC instruments, Methodology, DSC experiment calibration and data analysis. Applications determination Glass transition temperatures and heat capacities, problems based onThermal Techniques:

Thermometric titrations: Principle, apparatus, applications to acid base, precipitation, complexometric, redox and non-aqueous titrations.

Combined thermal instruments: Introduction to TGA/MS and TGA/FTIR, High resolution TGA, Microthermal analysis.

UNIT XII: Advanced Mass spectrometry **15 Hrs**

Mass Analyzers: Quadruple, Ion traps, Time of flight (TOF) mass analyzers

Mass Spectrometry / Mass Spectrometry: Tandem Mass Spectrometry, Instrumentation, Applications.

Hyphenated Techniques: GC-MS Principle, instrumentation, Interfaces- Direct coupling interface and open split interface. Application based on gas chromatography/mass spectrometry-Analysis of metabolite of drug Imipramine. **LC-MS-** principle, Instrumentation – Interfaces-Moving belt interface, particle beam interface, thermospray interface, Electrospray interface, atmospheric pressure chemical ionizationinterface.**ICP – MS** - Principle Instrumentation, and Applications.

Matrix-assisted laser desorption/ionization-Time of flight Mass spectrometry (MALDI-TOF-MS):Principle, Matrix, Sample Preparation for MALDI-MS - Dried droplet Crystallization, Thin layer method, Sandwich Crystallization, Instrumentation, Applications.

SUGGESTED BOOKS

1. Analytical Chemistry, Gary Christian, VI Ed, John Wiley & Sons Inc, New York.
2. Instrumental Methods of Chemical Analysis, H. Kaur.
3. Vogel's Text Book of Quantitative Chemical Analysis, 6th Ed, Pearson EducationLtd.
4. Principles of Instrumental Analysis, Skoog, Holler and Nieman.
5. Instrumental Techniques for Analytical Chemistry, Frank Settle.
6. Principles of Analytical Chemistry, M. Valcarcel.
7. Solid State Chemistry and its Applications, *West.*
8. Introduction to Solids, Azaroff.
9. Solid State Chemistry, D.K. Chakrabarthy
10. Physical Methods in Advanced Inorganic Chemistry, Hill and Day.
11. Instrumental Methods of Analysis, Sixth edition, CBS Publishers, Willard, Merrit, Dean,and Settle.
12. Mass spectrometry for Chemists and Biochemists, Robert A.W Johnstone and Molcolm. E.Rose,second Edn.
13. Physical methods for Chemists, Russell S. Drago second edition, Saunders Collegepublishing 1992.
14. Structural methods in Inorganic Chemistry, E.A.V. Ebsworth, D.W.H Rankin and S.Craddeck, ELBS.
15. Mass Spectrometry Basics, Herbert, Christopher G.; Johnstone, Robert A.W., CRC Press.
16. Mass Spectrometry-A Textbook by Jürgen H. Gross, © Springer-Verlag Berlin Heidelberg 2004,Printed in Germany.
17. Matrix-assisted laser desorption/ionization - https://en.wikipedia.org/wiki/Matrixassisted_ laser_desorption/ionization

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SEMESTER VII

PAPER - V (705) Skill Enhancement Course (SEC V)

Chemistry of Drugs and Pharmaceuticals

Unit — III: General Characteristics of Drugs

Introduction: Diseases — causes of diseases, Drug — definition and sources.
ADME of drugs (brief) — Absorption, distribution, drug metabolism (in liver), elimination (brief). Toxicity.
Examples (i) Zintac (Ranitidine, antacid) (ii) Paracetamol (antipyretic) (iii) Benadryl (Cough syrup). Characteristics of an ideal drug.
Nomenclature of Drugs: chemical name — generic name — trade name. Trade names for the given generic names — (i) Aspirin (ii) Amoxycillin (iii) Ciprofloxacin (iv) Paracetamol

(v) Mebendazole.
Drug formulations: Definition — need for conversion of drug into pharmaceutical (drug formulations) — Additives — diluents, binders, lubricants, antioxidants, flavourants, sweeteners, colourants, coating agents.

Classification of Drug formulations: oral, parenterals and topical dosage forms - advantages and disadvantages.

(i) **Oral Dosage forms**: Tablets (Aspirin — analgesic; Ciprofloxacin - antibacterial). Capsules (Amoxycillin — antibiotic; Omeprazole-antacid). Syrups (B-complex syrup; Benadryl-Cough syrup).
(ii) **Parenterals (Injection forms)**: Propranolol (antihypertensive), Heparin (anticoagulant)
(iii) **Topical dosage forms**: Creams and Ointments
(iv) **Antiallergic**: Aclometasone (Aclovate), Betamethasone valerate(2%) Multiple purposes,
(v) **Anti-itching**: Doxepin Zonalon), Antifungal: Miconozole (Dactarin, Neomicol), Ketoconazole, (Nizoral Cream), Fluconazole, Anesthetic-Lidocaine, (Lidocaine ointment) and Antiseptic: Boro Plus Cream, For burns-Iodine ointment.

Unit — IV: Classification of Drugs

Classification of drugs based on therapeutic action-Chemotherapeutic agents, Pharmacodynamic agents and drugs acting on metabolic processes.

Brief explanation for the following :

(i) **Chemotherapeutic agents**: Antimalarials-Chloroquine; Antibiotic-Amoxicillin; Antitubercular drugs – isoniazide; Antiprotozoals-metronidazole.

(ii) **Pharmacodynamic agents :**
   a) Drugs acting on CNS: Diazepam (CNS depressant), General anesthetic (Thiopental sodium), antipyretic and analgesic (Iburofen)
   b) Drugs acting on PNS: local anasthetics (Benzocaine)

c) Drugs acting on cardiovascular system: Metaprolol (antihypertensive agents), Nefidipine antianginal and antihypertensive agent).
d) Drugs acting on renal system: Diuretics (Acetazolamide).

(iii) **Drugs acting on metabolic processes :**

a) Vitamins: Common name, source, deficiency, vitamin A, B2, B6, C, D, E and K – remedy
b) Hormones: Function (brief) – deficiency of hormones (Insullin, Testosterone and Oesterone).

Recommended Text Books and Reference Books:

1. An Introduction to Medicinal Chemistry by Graham L. Patrick, Oxford University Press, New York,1995.
2. Drugs by G.L. David Krupadanam, D. Vijaya Prasad, K. Varaprasad Rao, K.L.N.Reddy, C. Sudhakar, Universities Press (India) Limited 2007.
3. Introduction to drug design by R Silverman
4. Biochemical approach to medicinal chemistry. by Thomas Nogrady.
5. Pharmaceutical Chemistry and Drug synthesis by Roth and Kleeman
6. Medicinal Chemistry By Ashtoshkar
7. Principles of medicinal chemistry. By William O. Foye etal.
8. Medicinal chemistry An introduction By Gareth Thomas.

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SEMESTER-VII Practicals

PAPER V 751 INORGANIC CHEMISTRY-III

Teaching hours-6/week **Credits 2**

Synthesis and Characterization of Metal Complexes and Separation methods

1. Laboratory preparation and characterization of 3d transition metal complexes
   - i. $VO(acac)_2$
   - ii. $CoCl_2(Py)_2$
   - iii. $Na[Cr(NH_3)_2(SCN)_4]$
   - iv. $K_3[Cr(C_2O_4)_3]\ 3H_2O$: UV, IR, TGA and estimation of oxalate.
   - v. *Trans*-bis(glycinato)copper(II): IR, estimation of Cu by iodometry
   - vi. $Fe(acac)_3$: FTIR
   - vii. MnO_2 nano particles; SEM, TEM

2. Separation Methods
   - i. Separation of Fe^{3+} and Ni^{2+} using tri-n-butyl phophite (TBP) from HCl medium (Solvent extraction)
   - ii. Determination of cations by paper chromatography; Co(II), Ni(II) and Cu(II)
   - iii. Separation of Fe(III) and Al(III) by column chromatography
   - iv. Determination of capacity of an ion exchange resin.
   - v. Separation of Fe^{3+} and Ni^{2+} using strongly basic anion resin.
   - vi. Separation of Zinc and Magnesium on an anion exchange resin and estimation of Mg^{2+} and Zn^{2+} ions.

Suggested Books :

1. Practical Inorganic Chemistry, G. Marr and B. W. Rockett.
2. Practical Inorganic Chemistry by G.Pass H.Sutchiffe, 2nd edn John Wiley & Sons.
3. Experimental Inorganic/Physical Chemistry, M. A. Malati, Horwood Publishing, Chichester, UK (1999)
4. Analytical Chemistry Theory and Practice by R.M. Verma 3rd Edn.CBS Publishers &Distrbutors1994.
5. Comprehensive Experimental Chemistry by V.K. Ahluwalia et.al New Age Publications 1997.

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SEMESTER-VII Practicals

PAPER VI (752) ORGANIC CHEMISTRY-III

Teaching hours-6/week **Credits 2**

Synthesis of organic & drug molecules & TLC

Organic Synthesis:

2-Phenyl indole (Fischer indole synthesis), 2,5-Dihydroxy acetophenone (Fries reaction), Benzilic acid from benzil (Benzillic acid rearrangement), Benzpinacol (photochemical reaction), 7-hydroxy coumarin (Pechman synthesis), Photo-dimerization of maleic anhydride, benzophenone (Friedel-Crafts reaction), Benzanilide (Beckmann rearrangement), Vanillyl alcohol from vanillin ($NaBH_4$ reduction),

Drug Synthesis:

Paracetamol, Phenytoin, Benzocaine, 6-Methyluracil, Chloritone,FIuorescien, 4-Aminobenzene sulfonamide, antipyrineand phenothiazine

Purity of the all the synthesied compounds monitered by TLC

(A) Laboratory synthesis of the following compounds: 2- and 4-nitrophenols (nitration and separation by steam distillation), Acridone from Phthalic anhydride.

(B) Isolation of the following natural products: Caffeine from tea leaves (solvent extraction), Piperine from pepper (Soxhlet extraction), Eucalyptus oil from leaves (steam distillation), Lycopene from tomatoes.

(C)Thin layer chromatography: Thin layer chromatography: Determination of purity (All the above preparations), monitoring the progress of chemical reactions (any of the four above preparations), identification of unknown organic compounds by comparing the Rf values of known standards.

Reference books:

1. Practical organic chemistry by Mann & Saunders.
2. Text book of practical organic chemistry by Vogel.

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PAPER VII 753 PHYSICAL CHEMISTRY-III

Teaching hours-6/week **Credits 2**

(A) Chemical Kinetics

I) $K_2S_2O_8$-KI reaction by colorimetry

(i) Overall order of the reaction
(ii) Order with respect to $K_2S_2O_8$ using initial rate method
(iii) Order with respect to KI using initial rate method
(iv) Order with respect to KI using isolation method

II) $K_2S_2O_8$-KI clock reaction

(i) Overall order of the reaction
(ii) Order with respect to $K_2S_2O_8$ using initial rate method
(iii) Order with respect to KI using initial rate method
(iv) Order with respect to KI using isolation method

(B)Instrumentation - Potentiometry

I) Acid –Base titrations

(i) Strong acid vs Strong base
(ii) Weak acid vs Strong base
(iii) Mixture of strong and weak acids vs strong base
(iv) Dibasic acid vs strong base
(v) Tribasic acid vs strong base

(II) Redox titrations

(i) Fe(II) vs $K_2Cr_2O_7$
(ii) Fe(II) vs $KMnO_4$
(iii) Fe(II) vs Ce(IV)
(iv) KI vs KMnO4
(v) Fe(II)+V(V) vsCe(IV)

(III) Precipitation titrations

(i) KCl vs $AgNO_3$
(ii) KI vs $AgNO_3$
(iii) KSCN vs $AgNO_3$
(iv) KCl + KI vs $AgNO_3$
(v) KI+KSCN vs $AgNO_3$

(IV) Complexometric titrations

(i) Fe(III) vs EDTA

References:

1. A textbook of practical organic chemistry by A I Vogel, Vol 1&2.
2. Senior practical physical chemistry. B. D. Khosla, V.C. Garg, AdarshGulati
3. Experimental Physical Chemistry: V. Athawale and P. Mathur.
4. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
5. Practical in Physical Chemistry: P.S. Sindhu
6. Advanced Practical Physical chemistry: J.B.Yadav

OSMANIA UNIVERSITY
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SEMESTER-VIII
Paper-I (801) INORGANIC CHEMISTRY-IV

Teaching hours-4/week **Credits 4**

Bioinorganic Chemistry

UNIT-XIII: Metal ions Interactions with Nucleic acids and their constituents
UNIT-XIV: Transport of Electrons and Metal ions
UNIT-XV: Metallo-Enzymes of Iron, Zinc and Nickel
UNIT-XVI: Metallo-Enzymes of Cobalt, Copper, Molybdenum and Manganese

UNIT-XIII: Metal ions Interactions with Nucleic acids and their constituents

Nucleic Bases, Nucleosides and Nucleotides. Proton Binding Sites of Nucleic Acid Constituents-Purineand Pyrimidine Bases, Nucleosides and Nucleotides. The covalent structure of polynucleotides, secondary structure of DNA: The double helix anti and syn conformations of nucleotides. B, A, & Z forms of DNA. General Factors that influence Metal Ion Binding Sites in Solution – Specific Metal Ion Binding to Nucleic Bases, Nucleotides and Nucleosides in Solution: Stability of Phosphate- Metal ion complexes, Metal binding Metal Ion Complexes, Metal Binding Sites in Nucleosides, Nucleotide - Metal Ion Interactions – Intra-molecular Equilibrium Constant KI, Percentage of Closed Isomers - Outer Sphere and Inner Sphere Isomers of M-ATP Complexes and Metal Ion Nucleic Base Interactions. *Metal-DNA and RNA Interactions*: Potential Binding Sites (Elementary Treatment) – Influence of Metal Ions on Stability of Nucleic Acids.

UNIT-XIV: Transport of Electrons and Metal ions

Transport of Electrons: Iron-Sulphur Proteins: Rubredoxins and Ferredoxins (2Fe,3Fe, 4Fe, 8Fe Proteins)-High Potential Iron-Sulphur Proteins – Structural and Spectral features of Iron-Sulphur Proteins -Electron-transport by Cytochromes, Azurin and Plastocyanin - Importance of Structures of Azurin and Plastocyanin in facilitating Rapid Electron Transport, acotinase- Fe-S enzyme.
Transport and Storage of Metal Ions: Iron-Transport by Transferrin and Siderophores – Ferritin in IronStorage - Transport of Na^+ and K^+ across Cell Membranes by Na^+- K^+ ATPase - Transport of Calciumacross Sarcoplasmic Reticulam by Ca^{2+}-ATPase.

UNIT-XV: Metallo-Enzymes of Iron, Zinc and Nickel

Iron Enzymes: Structural and Mechanistic Aspects of Cytochrome P450, Cytochrome oxidase,Catalaseand Peroxidase - Role of the Metal Ion.
Zinc Enzymes: Structural and Mechanistic Aspects of Carbonic Anhydrase, CarboxyPeptidase,Leucin –aminopeptidase, Thermolysin, Alcohol Dehydrogenase - Role of Zinc.
Nickel Enzymes: Urease, Hydrogenase and Factor F430: Reactions Catalyzed, MechanisticAspects.

UNIT-XVI: Metallo-Enzymes of Cobalt, Copper, Molybdenum and Manganese

Cobalt Enzymes: Cobalt in Vitamin B12 - Structural Features of Vitamin B12 with reference tocoordination of Cobalt - Different Oxidation States of Cobalt - Various forms of Vitamin B12 and ActiveEnzyme forms - Types of Reactions Catalysed by i) Methyl Cobalamin

ii)DeoxyadenosylCobalamin -Mechanism of the Methyl Malonyl CoA conversion to Succinyl CoA - Role of the Apoenzyme – Uniquefeatures of Cobalt to suit Vitamin B12.
Copper Enzymes: Types of Copper in Biological Systems - Structural and Mechanistic Aspects ofSuperoxide Dismutase, Laccase and Galactose oxidase.
Molybdenum Enzymes: Biological Roles and Mechanistic Aspects of Nitrogenase, Xanthineoxidase andSulfite oxidase.
Manganese Enzymes: Arginase, Water – oxidase.

SUGGESTED BOOKS

1. Biochemistry - Geoffrey L. Zubay.
2. Biochemistry - Mary K. Campbell. (added these books)
3. Bioinorganic Chemistry, Bertini, Gray, Lippard and Valentine, University ScienceBooks, CaliforniaUSA 1994.
4. Principles of Bioinorganic Chemistry, S.J. Lippard and M.Berg University ScienceBooks, California1994.
5. Biological Chemistry of Elements, J.J.R. Franstodasilva and R.J.P. Williams OxfordUniversity Press1991.
6. Metal Ions in Biological Systems (Series), Ed. H. Sigel Marcel Dekkar, New York
7. Inorganic Biochemistry, J.A. Cowan, VCH publishers 1993.
8. Advances in Inorganic Biochemistry, edited by G.L.Eichorn&Marzilli
9. Bioinorganic Chemistry, Vol-I edited by G.L.Eichorn.
10. Interactions of metal ions with nucleotides and nucleic acids and their constituents Helmut SigelChem. Soc. Rev., 1993,22, 255-267.

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SEMESTER-VIII
Paper-II (802) ORGANIC CHEMISTRY-IV

Teaching hours-4/week **Credits 4**

Modern Organic Synthesis

Unit XIII: Asymmetric synthesis
Unit XIV: Synthetic strategies
Unit XV: New Synthetic reactions
Unit XVI: New techniques and concepts in organic synthesis

Unit XIII: Asymmetric synthesis **15 Hrs**

Introduction: Brief revision of classification of stereo selective reactions

Prostereoisomerism: Topicity in molecules Homotopic, stereoheterotopic (enantiotopic and diastereotopic) groups and faces- symmetry criteria.

Prochiral nomenclature: Pro chiraility and Pro-R, Pro-S, Re and Si. Conditions forstereoselectivity: Symmetry and transition state criteria, kinetic and thermodynamic control. Methods of inducing enantioselectivity.

Analytical methods: % Enantiomeric excess and diastereomeric ratio. Determination of enantiomeric excess: specific rotation, Chiral NMR; Chiralderivatizing agents, Chiral solvent, Chiral shift reagents and Chiral HPLC.

Chiral Substrate controlled asymmetric synthesis: Nucleophilic additions to chiral carbonyl compounds. 1, 2- asymmetric induction, Cram's rule and Felkin-Anh model.

Chiral auxiliary controlled asymmetric synthesis: α-Alkylation of chiral enolates, Evan's oxazolidinone, 1, 4-Asymmetric induction and Prelog's rule.

Chiral reagent controlled asymmetric synthesis: Asymmetric reductions using BINAL-H. Asymmetric hydroboration using IPC2 BH and IPCBH2.

Chiral catalyst controlled asymmetric synthesis: Sharpless epoxidation. Asymmetric hydrogenations using chiral Wilkinson biphosphincatalyst.

Asymmetric aldolreaction: Diastereoselectivealdol reaction (achiral enolate & achiral aldehydes) its explanation by Zimmerman-Traxelmodel.

Unit XIV: SyntheticStrategies **15 Hrs**

Introduction: Terminology, Target, synthon, synthetic equivalent, functional group interconversion (FGI), functional group addition. Criteria for selection of target. Linear and convergent synthesis. Retrosynthetic analysis and synthesis involvingchemoselectivity, regioselectivity, reversal of polarity and cyclizations. .

Order of events: S-Salbutamol, Propoxycaine..

One group C-C and C-X disconnections: Introduction .One group C-C disconnections in alcohols and carbonyl compounds. One group C-X disconnections in Carbonyl compounds, alcohols,ethers and sulphides.

Two group C-C and C-X disconnections : Introduction .Two group C-X disconnections in 1,1-difunctionalised, 1,2-difunctionalised and 1,3-difunctionalised compounds.

Two group C-C disconnections: Diels-Alder reaction, 1,3-difunctionalised compounds, 1,5-difunctionalised compounds, Michael addition and Robinson annulation.

Control in carbonyl condensations:oxanamide and mevalonic acid.

Strategic bond: definition, guidelines for disconnection; disconnection of C-X bonds, disconnect to greatest simplification, using symmetry in disconnection, disconnection corresponding to known reliable reaction, high yielding steps and recognizable starting materials. Retrosynthesis of Retronecene, longifoline.

Unit XV: New Synthetic reactions **15 Hrs**

1. Metal mediated C-C and C-X coupling reactions: Suzuki, Heck, Stille, Sonogishira crosscoupling, Buchwald-Hartwig and Negishi-Kumada coupling reactions.

2. C=C Formation Reactions: Shapiro, Bamford-Stevens, McMurrey reactions,Julia-Lythgoe olefination and Peterson's stereoselective olefination.

3. Multicomponent Reactions: Ugi,Passerini, Biginelli, Bergman and Mannichreactions.

4. Ring Formation Reactions: Pausan-Khand reaction, Nazerov cyclisation.

5. Click Chemistry: Click reaction, 1,3-dipolar cycloadditions.

6.Metathesis: Grubb's 1st and 2nd generation catalyst, Olefin cross coupling Metathesis (OCM), ring closing metathesis (RCM), ring opening metathesis (ROM), applications.

7. Other important synthetic reactions: Baylis-Hilman reaction, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction,Stork-enamine reaction and Michael reactions.

Unit XVI: New techniques and concepts in organic synthesis **15 Hrs**

1. Techniques in peptide synthesis: Solid phase peptide synthesis, commonly used resins (Rink resin, Wang resin and Ellmanresin, synthesis of cross linked Merrifield resin and drawbacks of solid phase synthesis.

2. Solid phase oligodeoxynucleotidesynthesis: Phosphotriester, phosphatetriester and phosphoramidite pathway

3. Oligosaccharide synthesis: Glycosidation**:** cylicoxocarbenium ion, glycosyl donors and glycosyl acceptors, Kahneglycosidation, convergent and linear oligosaccharide synthesis.

4. Phase Transfer catalysis: Onium and crwon ethers as PTC.

5. Tandem synthesis: Tandem reactions; conjugate addition-aldol reaction, polymerization cyclisation, elctrocylic-Diels Alder reaction.

6. Baldwin Rules: Exo and Endo cyclisation, tetrahedral, trigonal and diagonal systems, favoured and disfavoured cyclisations.

7.Chiron approach in organic synthesis: Nature's chiral pool, carbohydrates, amino acids, hydroxy acids, terpenes as chiral precursors. Synthesis of shikimic acid from D-arabinose, furanonycin from D-glucose, S-(-)-ipsenol from S-leucine.

8) Determination of absolute configuration: Mosher's method.

Reference Books:

1. Asymmetric synthesis by Nogradi
2. Asymmetric organic reactions by J D Morrison and H S Moschcr
3. Principles in Asymmetric synthesis by Robert E. Gawley&Jeffreyaube
4. Stereo differentiating reactions by Izumi
5. Some modern methods of organic synthesis by W Carruthers
6. Guidebook to organic synthesis, by R K Meckie, D M Smith & R AAtken

7. Organic synthesis by Michael B Smith
8. Organic Synthesis-The disconnection approach by S Warren
9. Organic Synthesis by C Willis and M Willis
10. Problems on organic synthesis by Stuart Warren
11.Organic chemistry Jonathan Clayden, Nick Greeves and Stuart Warren
12.The logic of chemical synthesis by Elias James Corey and Xue-Min Cheng
13. Name reactions by JieJacj Li

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SEMESTER-VIII
Paper-III (803) PHYSICAL CHEMISTRY-IV

Teaching hours-4/week **Credits 4**

Unit XIII: Angular momentum and approximate methods
Unit XIV: Polymerization and Kinetics of polymerization
Unit XV: Non-equilibrium Thermodynamics
Unit XIII: Angular momentum and approximate methods

Unit XIII: Angular momentum and approximate methods (15 hrs)

Angular momentum operators. Commutation relations of angular momentum operators and their consequence. Eigen functions of L 2 and L z and the eigen values. Magnitude and orientation of angular momentum vectors. Electron spin. Spin operators. Pauli principle and the Pauli exclusion principle.

Approximate methods- The variation method. Construction of variation function by the method of linear combinations. H and He atom. Perturbation theory (first order and nondegenerate). Wave function and energy corrections. Application of perturbation theory to the helium atom.

Time- dependent perturbation theory. Interaction of radiation and matter. Allowed and forbidden transitions. Multielectron atoms. The Hartree-Fock self-consistent field method. Basis functions. Slater-type orbitals (STOs).

Unit XIV: Polymerization and Kinetics of polymerization (15 hrs)

Classification of polymers. Types of polymerization. Kinetics and mechanism of free radical polymerization. Degree of polymerization, kinetic chain length and chain transfer coefficient – Trommsdorff effect. Effect of pressure and temperature on chain polymerization.

Kinetics and mechanism of cationic, anionic polymerization, coordination polymerization, linear stepwise polymerization. copolymerization reactions and copolymer composition. Reactivity ratios and their determination.

Alfrey and Price Q-e scheme for monomer and radical reactivity. Block and graft copolymers.

Polymerization in homogeneous and heterogeneous systems. Techniques of polymerization-Bulk, solution, suspension and emulsion polymerizations.

Unit XV: Non-equilibrium Thermodynamics (15hrs)

Thermodynamic criteria for non-equilibrium states. Entropy production in irreversible processes. Entropy production in heat flow and entropy production in material flow. Fluxes and forces. Linear flux-force relations. Phenomenonological equations and coefficients. Microscopic reversibility. Onsager reciprocal relations. Application of Onsager relations to electrokinetic phenomena – electroosmotic pressure and streaming current. The Onsager relations and the principle of detailed balance. Liquid junction potentials – derivation of equation for liquid junction potential in terms of transport numbers using Onsager relations. Steady states. Principle of minimum entropy production. Irreversible thermodynamics as applied to biological systems - examples. Application to thermoelectric circuits. Seebeck and Peltier effect.

Unit XVI: Bonding in molecules (15 hrs)

Born-Oppenheimer approximation. MO theory of H_2^+ ion. Calculation of MOs and their energies. Evaluation of the overlap integral. Probability curves and enegy diagram. MO theory of H_2 molecule. Calculation of energy. MO theory of polyatomic molecules (general ideas). MO treatment of H_2O. Symmetry-adapted linear combinations. MOs of H_2O. Concept of hybridization

– sp, sp^2 , and sp^3 hybrid orbitals. Semiempirical MO methods. The Huckel theory of conjugated systems. HMO calculations on ethylene, allyl system, butadiene, cyclopropenyl system and benzene. π–electron charges and bond orders. Simplification of secular determinants of cyclopropenyl system, cyclobutadiene and benzene using molecular symmetry.
Introduction to extended Huckle Theory, extension of the Huckle's approach to molecules containing heteroatoms.
Orbital symmetry and reactivity: $H_2 + F_2 \rightarrow 2HF$ reaction. $2NO \rightarrow N_2 + O_2$ reaction.

SUGGESTED BOOKS

1. Elements of Statistical Thermodynamics, L. K. Nash, Addison – Wesley
2. Introduction to Statistical Thermodynamics, T. L. Hill, Addison Wiley
3. Statistical Thermodynamics, M. C. Gupta, New Age International
4. Atkin's Physical Chemistry, P. Atkins & Julio de Paula, Oxford University Press
5. Molecular Thermodynamics, D. A. McQuarrie & J. D. Simon, University Science Books
6. Text book of Biochemistry by Stryer, W.H. Freeman & Co Ltd
7. Advanced physical chemistry by Gurtu and Gurtu, Pragati Edition
8. Physical chemistry by Puri and Sharma, Vishal Publishing Co.
9. Textbook of Polymer Science, F. W. Billmeyer Jr, John Wiley & sons
10. Polymer Science, V. R. Gowarikar, N. V. Viswanathan & J. Sreedhar, Wiley Eastern
11. Contemporary Polymer Chemistry, H. R. Alcock & F. W. Lambe, Prentice Hall
12. Physics and Chemistry of Polymers, J. M. G. Cowie, Blackie Academic and professional
13. Materials science and engineering an introduction by William D Callister, Jr. Wiley Publ
14. The Chemical Bond, J. N. Murrel, S. F. A. Kettle & J. M. Tedder, John Wiley
15. Valency Theory, J. N. Murrel, S. F. A. Kettle & J. M. Tedder, ELBS
16. Chemical Applications of Group Theory, F. A. Cotton, John Wiley & Sons
17. Symmetry and Group Theory In Chemistry, Mark Ladd, Harwood Publishers, London 2000).
18. Symmetry Through the Eyes of a Chemist, I. Hargittai and M. Hargittai, 2nd Edition, Plenum Press, NY (1995).
19. Coulson's Valence, R. McWeeny, ELBS

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SEMESTER-VIII

PAPER IV 804 ANALYTICAL TECHNIQUES AND SPECTROSCOPY-IV

Teaching hours-4/week **Credits 4**

UNIT-XIII : AAS, AES, ICP-AES
UNIT-XIV : Multinuclear NMR
UNIT-XV : Mossbauer and Nuclear Quadrupole Resonance Spectroscopy
UNIT-XVI : Green Chemistry

UNIT-XIII: AAS, AES, ICP-AES **15 Hrs**

Atomic Absorption Spectroscopy (AAS): Principles of AAS, Instrumentation – flame AAS and furnace AAS, resonance line sources, sensitivity and detection limits in AAS, interferences – chemical and spectral, evaluation methods in AAS and application in qualitative and quantitative analysis.

Atomic Emission Spectroscopy (AES): Principles of AES, Instrumentation, interferences, evaluation methods, Application in quantitative analysis.

Flame Photometry: Principle, Theory, Instrumentation and Applications

Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES): Limitations of AES, Principles of plasma spectroscopy, plasma as an excitation source. Inductively coupled plasma source, ICP-AES – Instrumentation. Application of ICP-AES, Comparison with AAS.

UNIT-XIV: Multinuclear NMR and ESR of Transition metal complexes 15Hrs

Virtual Coupling and its importance in study of Metal Complexes $[Pd\{P(CH_3)_3\}_2I_2]$. Spin Dilute Systems-Satellites in Pt(II) Complexes cis-$[Pt(PEt_3)_2Cl_2]$, $Sn(CH_3)_4$. NMR Time Scale and its use in studying Stereo chemical Non–rigidity (PF_5, $[Rh(PR_3)_5]^+$, $[Fe\{Cp\}_2(CO)_2]$) - ΔR, the Ring Contribution to ^{31}P Chemical Shifts –Metal and Chelate size on ΔR.

Applications of ^1H, ^{13}C, ^{19}F, ^{31}P and ^{15}N to simple inorganic and Coordination Compounds

(1) **^{1}H-NMR**: $PtHCl(PEt_3)_2$, $Pt(NH_3)_3(CH_3)_3$, BH_4^-, NH_4^+, CH_3CN, $[6h\text{-}C_7H_8Mo(CO)_3]$, $[7h\text{-}C_7H_7Mo(CO)_3]^+$, B_2H_6; $^{29}SiH_3SiH_3$, (2) **^{19}F**: BF_4^-, H_2PF_3 (3) **^{31}P**: $Mo(CO)_3(PPh_3)_3$, $[Rh(PPh_3)_3Cl]$, trans-$[PtCl_4(PEt_3)_2]$, $^{31}PF_2H(^{15}NH_2)_2$ (4) **^{13}C**; $[4hC_8H_8Ru(CO)_3]$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$, $FeICp(CO)_{12}$, $[^{13}C^{15}NCo(DH)_2Pyridine]$. $^{13}C\{^1H\}$ NMR spectrum of σ-bonded C_6H_5 ligand.

Applications of ESR to Metal Complexes: ESR Spectra of d^1–d^9 Transition Metal Complexes with examples. Interpretation of g in cubic, axial and rhombohedral geometries. Factors affecting g values. Calculation of g values with simple examples. Intensities of 'g ∥ and g ⊥ peaks. Evidence for Metal-Ligand Bond Covalency- Cu(II)- Bis –Salicylaldimine. $[(NH_3)_5CoO_2Co(NH_3)_5]^{5+}$, Cu(II)-diethyldithiophosphinate, Vanadyldithiophsphinate, Copper(II) tetraphenylporphyrin, Co(II)-phthalocyanine, $K_2[IrCl_6]$. Interpretation of 'g' and 'A' values from ESR spectral data in - i) MnF_6^{4-}, ii) CoF_6^{4-} and CrF_6^{3-}. ESR spectra of dinuclear Cu(II) complexes.

UNIT-XV : Mossbauer and Nuclear Quadrupole Resonance Spectroscopy 15Hrs

Mossbauer Spectroscopy: Principle, Experimental Considerations and Presentation of the Spectrum -Isomer Shifts – Quadrupole splitting and Magnetic hyperfine splitting - Selection Rules.

Applications:

Iron Compounds: Low-spin and High-spin Fe(II) and Fe(III) Complexes - π-bonding Effects in Iron complexes - Study of High-spin Low-spin Cross-over c) Diamagnetic and Covalent Compounds -Structural aspects of Iron Carbonyls and Iron-Sulfur Proteins.

Tin Compounds: Tin Halides and Organotin Compounds.

Iodine Compounds: Isomer Shifts of ^{127}I and ^{129}I - Applications to Alkali metal iodides and Molecular Iodine. Mossbauer spectra of IF_6^- and IF_6^+

Nuclear Quadrupole Resonance Spectroscopy: Principle, nuclear quadrupole resonance experiment, Structural information from NQR spectra- $PFCl_4$, PCl_4Ph, $Ga_2Cl_7^-$ and $TeCl_4$ Interpretation of nuclear quadrupole coupling constants.

UNIT-XVI: Green Chemistry

Principles and concepts of green chemistryIntroduction, sustainable development and green chemistry, atom economy, atom economic reactions,rearrangement reactions, addition reactions, atom uneconomic reactions- substitution reactions,elimination reactions, Wittig reactions.Reducing toxicity, measuring toxicity.Organic solvents: Environmentally benign solutions: Organic solvents and volatile organic compounds,solvent free systems, super critical fluids- supercritical carbon dioxide and supercritical water. Water as areagent solvent, water based coatings.Industrial case studies: A brighter shade of green – greening of acetic acid, Vitamin C synthesis –enzymeroutes. Polythene manufacture-metallocene catalysis.

SUGGESTED BOOKS

1. Instrumental Techniques for Analytical Chemistry, Frank Settle.
2. Principles of Analytical Chemistry, M. Valcarcel.
3. NMR in chemistry - A multinuclear introduction by William Kemp
4. Spectroscopic identification of organic compounds by P S Kalsi
5. Introduction to organic spectroscopy by Pavia
6. Carbon-13 NMR for organic chemists by GC Levy and O L Nelson
7. Nuclear Magnetic Resonance Basic principles by Atta-ur-Rahman
8. Basic one and two-dimensional NMR spectroscopy by Horst Friebolin
9. NMR spectroscopy by H.Gunther
10. Structural Methods in Inorganic Chemistry, E. A. V. Ebsworth, D. W. H. Rankin and S. Craddock, ELBS.
11. Physical Methods in Chemistry, R. S. Drago, W.B. Saunders Co., 1977.
12. Physical Methods for Chemists, Russell S. Drago Second edition, SaundersCollege Publishing, 1992.
13. Principles of Mossbauer spectroscopy, T. C. Gibb, Chapman and Hall, London, 1976.
14. Mossbauer Spectroscopy, N. N. Greenwood and T. C. Gibb, Chapman and Hall, London,1971.
15. Principles of Instrumental Analysis, Skoog, Holler and Nieman.
16. Physical Methods in Advanced Inorganic Chemistry, Hill and Day
17. Magneto Chemistry, Dutta &Shyamal Oxford Chemistry Primers, Vol 62 A.S. Matlack:
18. Introduction to Green Chemistry, Marcel Deckkar, (2001).
19. M.C. Cann & M.E. Connely: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
20. M.A. Ryan & M. Tinnesand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
21. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers
22. P.T. Anastes& J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (1998).

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SEMESTER VIII

PAPER V (805) Skill Enhancement Course (SEC VI)

Teaching hours-2/week **Credits 2**

Intellectual Property Rights

Unit I: Introduction to IPR
Unit II: Patent Search and IP Reports Generation

Unit I: Introduction to IPR **15 Hrs**

Introduction : Legal Rights and obligations, Concept of Property, Kinds of Property, General concept and Significance of Intellectual Property (IP), Intellectual Property Rights (IPR), Intellectual property, Introduction to IPR, contents of IPR and their protection, Recent Developments, IP Organizations.

Introduction to Patents, Trademarks, Copyrights, Trade secrets, Industrial designs and Geographical indications.

International organizations & treaties: introduction to various conventions and organizations, Paris Convention, World Trade organization (WTO)

Unit II: Patent Search and IP Reports Generation **15Hrs**

What is a patent search. Who needs a patent search. Patent Search Types and Methodologies, Novelty Searches, Validity Searches, Infringement Searches, State-of-the-art searches.

Searching in Patent Databases:

Free search databases: USPTO, EPSPACE, WIPO, FreePatentsOnline, FreshPatents and JSPTO, Paid search databases: Micropat, Delphion, DialogPro, Patent Optimiser, Aureka and PatentCafe, Patent Filing and Drafting, Patent filing procedures, Indian patent act, patent drafting, PCT applications, provisional and complete specifications.

References

1. Fundamentals of Jurisprudence by Dhyani, Allahabad Publication, Central Law.
2. Jurisprudence of Legal Theory by Dwivedi S.P. Allahabad Central Law Agency.
3. Text Book on Jurisprudence by Hilari WC Cobrey, Oxford Publications.
4. Treaties on Intellectual Property Rights by Blackstone
5. W.T.O. by Myneni, Asia Law House.
6. W.T.O. by Vasudeva, Minerva Publications, Delhi.
7. Law of Practice of Intellectual Property in India by VikasVashistha, Bharat Law Publications, Delhi.
8. Intellectual property rights by B L Wadhera, Universal Law Publications.
9. Trade Marks Act by Mittal, Eastern Book Company.
10. Patent Law by Narayana P, Eastern Book Company.
11. Intellectual Property Rights by Cornish, Universal Publications.

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SEMESTER-VIII Practicals

PAPER V 851 INORGANIC CHEMISTRY- IV

Teaching hours-6/week **Credits 2**

Spectroscopic methods of Analysis

I Spectrophotometry

1. Determination of Manganese in steel
2. Determination of chromium
3. Determination of Manganese and chromium simultaneously.
4. Determination of composition of Complex by Job's Method and Mole ratio Method in the following:

(i) Cu (II)-EDTA
(ii) Fe (II) – o-Phen

5. Determination of Fluoride by Zirconium Alizarin Method

II Colorimetry

1. Determination of blood cholesterol
2. Determination of Glucose
2. Determination of Paracetamol

III Fluorimetry

1. Determination of Riboflavin

IV Flame photometry

1. Determination of Na
2. Determination of K

Suggested books:

1. Chemistry Experiments for Instrumental Methods, Donald T Sawyer William R.Hememanet. JohnWiley & Sons 1984.
2. A Text Book of Quantitative Inorganic Analysis by A.I. Vogel 3rd Edition, Elbs Publication 1969.
3. Vogel's Text Book of Quantitative Inorganic Analysis Jeffery etal 4th edition, ElbsPublications 1988.
4. Vogel's Text Book of Quantitative Chemical Analysis, 6th edition. Pearson Education Ltd 2002.
5. Analytical Chemistry Theory and Practice by R.M. Verma 3rd Edn.CBS Publishers &Distrbutors1994.
5. Comprehensive Experimental Chemistry by V.K. Ahluwalia et.al New Age Publications 1997.
7. Laboratory hand Book of Instrumental Drug Analysis.by B.G. Nagavi 2 nd edn. 1996.
8. A Text Book of Quantitative Inorganic Analysis by A.I. Vogel 3rd EdnElbs Publication 1969.
9. Quantitative Analysis by Day and Underwood Prentice Hall (India) VI Edn.
10. Analytical Chemistry Theory and Practice by R. M. Verma 3rd Edn.CBS Publishers &Distrbutors1994.
11. Practical Pharmaceutical Chemistry, A.H. Beckett and J.B. Stenlake 4thedn. CBS publishers, 2001
12. Medical Laboratory Technology – Mukherjee,McGraw Hills, 1988.

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SEMESTER-VIII Practicals

PAPER VI (852) ORGANIC CHEMISTRY- IV

Teaching hours-6/week **Credits 2**

Paper CH (O) 352P: Separation and identification of organic compounds & Column chromatography

Separation of two component mixtures by chemical methods and their identification by chemical reactions — separation by using solvent ether, 5 % aqueous sodium bicarbonate, 5% sodium

hydroxide and dil. hydrochloric acid, checking the purity of the two components by TLC, identification of the compounds by a systematic study of the physical characteristics (mp/bp), extra elements (nitrogen, halogens and sulfur), solubility, functional groups, preparation of crystalline derivatives and identification by referring to literature. A minimum of **09** mixtures should be separated and analyzed by these procedures.

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CBCS- with effect from Academic year 2021-22 onwards
SEMESTER-VIII Practicals

PAPER VII 853 PHYSICAL CHEMISTRY-IV

Teaching hours-6/week **Credits 2**

Kinetics and Instrumentation

(A) Acetone – Iodine reaction by volumetry

(i) Order with respect to iodine

(ii) Order with respect to acetone

(iii) Order with respect to H^+

(B) Acetone – Iodine reaction by spectrophotometry

(i) Order with respect to iodine

(ii) Order with respect to acetone

(iii) Order with respect to H^+

(C) Saponification of ethyl acetate by volumetry

(D) Saponification of ethyl acetate by conductometry

(i) Overall order of the reaction

(ii) Order with respect to ethyl acetate

(iii) Order with respect to NaOH

pH-metry

(1) Strong acid vs Strong base

(2) Weak acid vs Strong base

(3) Mixture of strong and weak acids vs strong base

(4) Dibasic acid vs strong base

(5) Tribasic acid vs strong base

(6) Determination of dissociation constants of monobasic/dibasic acids by Albert- Serjeant method

(7) Determination of dissociation constant of acetic acid in DMSO, acetone and dioxane

(8) Determination of pKa and pKb of glycine

(9) Determination of stability constant of metal complex

References:

1. A textbook of practical organic chemistry by A I Vogel, Vol 1&2.

2. Senior practical physical chemistry. B. D. Khosla, V.C. Garg, AdarshGulati

3. Experimental Physical Chemistry: V. Athawale and P. Mathur.

4. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.

5. Practical in Physical Chemistry: P.S. Sindhu

6. Advanced Practical Physical chemistry: J.B.Yadav

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
Semester III
General English (301)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Prescribed Textbook for Semesters III & IV: *English in Use*. Eds. T Vijay Kumar, K DurgaBhavani, YL Srinivas. Published by Macmillan.

UNIT I	1) Poem: Charlotte Brontë "Life" 2) Short Story: Rabindranath Tagore "A Wrong Man in Workers' Paradise" 3) Vocabulary: Synonyms, Antonyms 4) Grammar: Prepositions (including Prepositional Phrases)
UNIT II	1) Poem: Kamala Das "Punishment in Kindergarten" 2) Essay: RK Narayan "Toasted English" 3) Vocabulary: British/American English Common Words 4) Grammar: Voice
UNIT III	1) Poem: Langston Hughes "As I Grew Older" 2) Speech: BR Ambedkar "Grammar of Anarchy" (Excerpt) 3) Vocabulary: Phrasal Verbs 4) Grammar: Concord
UNIT IV	Writing-I (Essay Writing) 1) Discursive Essay 2) Argumentative Essay 3) Vocabulary: Idioms 4) Grammar: Connectives
UNIT V	Writing-II (Report Writing) 1) Business Reports 2) Media Reports 3) Vocabulary: Technical Vocabulary (Business, Media) 4) Grammar: Reported Speech (Including Reporting Verbs)

Osmania University, Hyderabad.

CBCS Pattern of B.A., B.Sc., B.Com., & B.B.A.,

Syllabus

Telugu (Second Language) - Paper - 3

3rd Semester

ప్రాచీన పద్యభాగం

1. ధర్మజుని వాక్చాతుర్యం ... తిక్కన
2. విభీషణ శరణాగతి ... గోన బుద్ధారెడ్డి
3. గుణనిధి కథ ... శ్రీనాథుడు

ఆధునిక పద్యభాగం

1. రైతు ప్రశస్తి ... వానమామలై జగన్నాథాచార్యులు
2. గురుదక్షిణ ... అంబటి లక్ష్మీనరసింహరాజు
3. గుడిసెలు కాలిపోతున్నై ... డా॥ బోయి భీమన్న

వచన విభాగం (నాటకం)

చలిచీమలు (సాంఘిక నాటకం) ... పి.వి. రమణ

అలంకారాలు

శబ్దాలంకారాలు : వృత్త్యనుప్రాస, ఛేకానుప్రాస, లాటానుప్రాస, అంత్యానుప్రాస, యమకం, ముక్తపదగ్రస్తాలంకారాలు.

అర్థాలంకారాలు : ఉపమ, ఉత్ప్రేక్ష, రూపక, స్వభావోక్తి, ఉల్లేఖ, అర్థాంతరన్యాస, శ్లేష, దృష్టాంతాలంకారాలు.

పరీక్షా పద్ధతి

ఎ. ఇంటర్నల్ ఎసెస్‌మెంట్	20 మార్కులు
బి. సెమిస్టర్ పరీక్ష	80 మార్కులు

FACULTY OF SCIENCE

M.Sc. Chemistry 5 Years Integrated 3rd SEMESTER EXAMINATIONS

TELUGU (Second Language) - PAPER - 3

TIME: 3 HOURS **MARX: 80**

★సూచన: అన్ని ప్రశ్నలకు సమాధానాలు రాయండి

విభాగం - ఎ (5 X 4 = 20 మార్కులు)

(సంక్షిప్త సమాధానాలు)

1. శ్రీనాథుడి కావ్యాలు
2. ధర్మజుని వాక్చాతుర్యం పాఠ్యభాగ సందర్భం
3. జానాయి
4. విశాలాక్షి
5. బోయి భీమన్న

విభాగం - ఆ (4 X 15 = 60 మార్కులు)

(వ్యాసరూప సమాధానాలు)

6. ధర్మజుని వాక్చాతుర్యాన్ని వివరించండి.

లేదా

రైతు ప్రశస్తి పాఠ్యభాగ సారాంశాన్ని రాయండి.

7. విభీషణుడి గురించి వివరించండి.

లేదా

గురుదక్షిణ పాఠ్యభాగ సారాంశాన్ని రాయండి.

8. గుడిసెలు కాలిపోతున్నై పాఠ్యభాగం ఇచ్చే సందేశం ఏమిటి?

లేదా

గుణనిధి గురించి రాయండి.

9. శబ్దాలంకారాల గురించి సోదాహరణంగా వివరించండి.

లేదా

అర్థాలంకారాల గురించి సోదాహరణంగా రాయండి.

10. గోవిందయ్య స్వభావం ఎటువంటిది?

లేదా

చలిచీమలు నాటకం ఇచ్చే సందేశం ఏమిటి?

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
Semester III
Hindi (Second Language) (302H)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Name of The Book : KavyaNidhi (Pub : Telugu Academy,Hyderabad)

1) The Following Poems are recommended

1. KabeerkeDohe : Kabirdas
2. Baal Leela : Soordas
3. TulsikeDohe : Tulsidas
4. Navyuvakon Se : MaithilisharanGupt
5. PhoolAurKanta : AyodhyasinghUpadhyaya"Hariaudh"
6. Bharat : Jaishankar Prasad
7. JeevanKaAdhikar : Sumitranandan Pant

(It is Resolved to Delete Poem MeraNayaBachpan :SubhadraKumariChauhan "by the members of BOS)

2) Hindi SahityKaItihas (History Of Hindi Literature)
- **A) RitiKaal – ParisthitiyanEvamPravruttiyan**
- **B) Bhakti Kaal – ParishthitiyanEvamPravruttiyan**

3) RachnakaronKaParichay (Introduction of Writers)
1)Chanbardai 2) Kabirdas 3) Tulsidas 4) Soordas 5) Jai Shanker Prasad 6) Sumitranandan Pant 7) Ramdhari Singh Dikar

4) Essay
5) Translation

SEMESTER III
Hindi (Second Language)
Practical Model Paper

Time: 3 hrs(20M for internals + 80M External Exam) **Max. Marks : 80**

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1) **किसी 1 (एक) कविता का सारांश लिखिए :--** **16 अंक**

(काव्य निधि की कबीर के दोहे,बाल लीला,तुलसी के दोहे,नवयुवकों,फूल और काँटा,भारत,जीवन का अधिकार में से 2(दो) दिए जायेंगे,एक का सारांश लिखना होगा)

2) **किन्हीं 2 (दो) की संदर्भ सहित व्याख्या कीजिये:--** **8 X 2 =16 अंक**

(काव्य निधि के उपरोक्त दोहों/कविताओं में से 4 (चार) अंश दिए जायेंगे)

3) **किसी 1 (एक) प्रश्न का उत्तर लिखिए :--** **20अंक**

(हिंदी साहित्य के आदिकाल एवं भक्तिकाल की परिस्थितियों/प्रवृतियों पर आधारित 2(दो)प्रश्न दिए जायेंगे)

4) (**किसी एक कवि का परिचय दीजिये :--** **8अंक**

(चंदवरदाई,कबीर,तुलसीदास,सूरदास,भारतेंदु हरिश्चंद्र,मैथिलीशरण गुप्त,जयशंकर प्रसाद,सुमित्रानंदन पन्त, रामधारीसिंह दिनकर में से 2 कवि दिए जायेंगे)

5) **किसी एक विषय पर निबंध लिखिए:--** **10अंक**

(निम्नलिखित विषयों में से 2 (दो) निबंध दिए जायेंगे

1.साहित्य और समाज,

2.विद्यार्थी और राजनीति,

3.विज्ञान:वरदान या अभिशाप,

4.समाज में नारी का स्थान

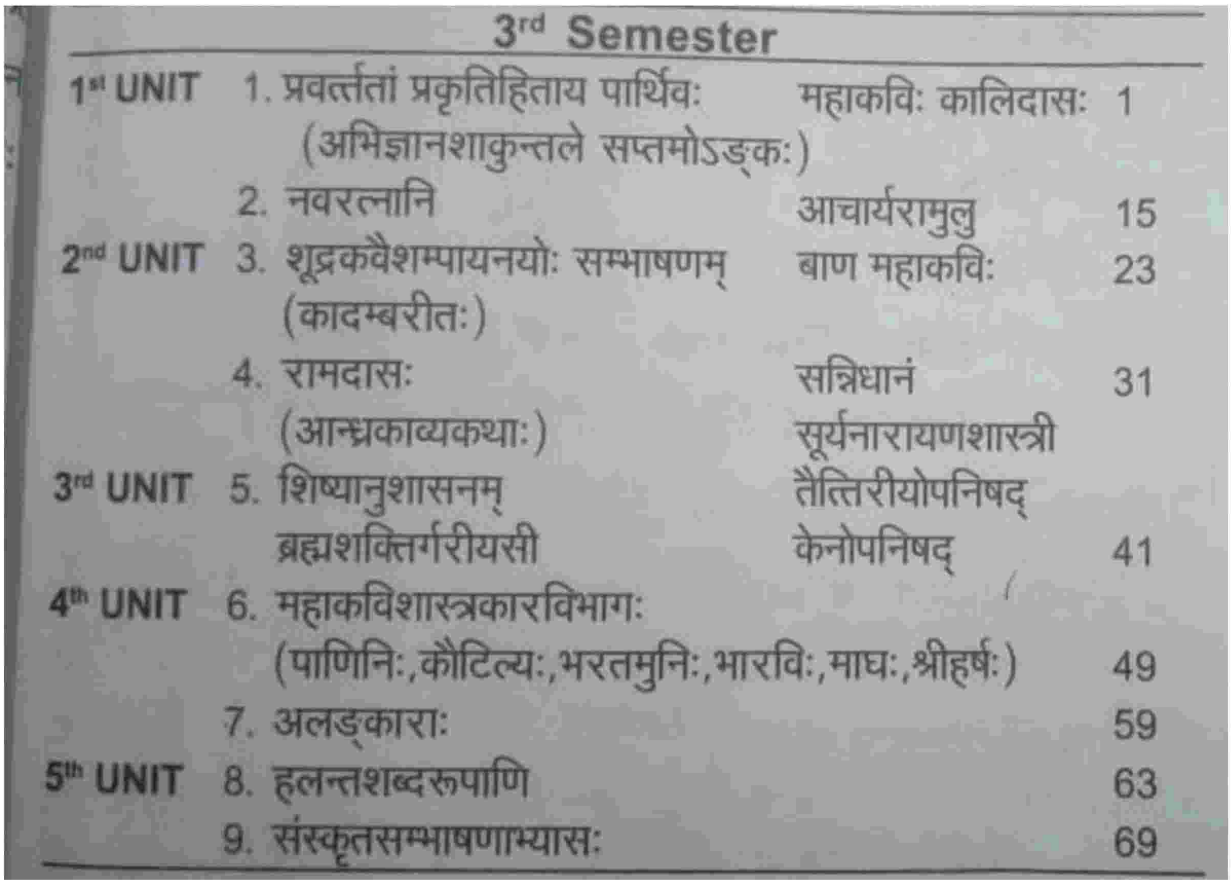
5.आधुनिक शिक्षा और नारी,

6.जीवन में स्वच्छता का महत्त्व

6) अनुवाद (अंग्रेजी या तेलुगु के अंश का हिंदी में अनुवाद करना होगा):-- **10 अंक**

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
Semester III
Sanskrit (Second Language) (302S)

Total Instruction hours per week are 4 (60hrs) **Credits 4**



3rd Semester

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
Semester III
Skill Enhancement Course- I (SEC-I) (303)

Total Instruction hours per week are 2 (30hrs) **Credits 2**

SEC: **Safety Rules in Chemistry Laboratory and Lab Reagents**

Unit I: **Laboratory Safety Rules and Regulations**.

General rules and regulations for lab safety: Minimizing Risks of Hazards, Personal Protective Equipment (PPE) - Hair, Dressing for the Laboratory, Eye Protection, Eye-wash fountain, Gloves, Laboratory Protocols, Labeling Chemicals, Careful reading of labels Prevention of Inhaling Harmful Chemicals, Guide to Chemical Hazards, Chemical Spills etc,. Accidents use of fire extinguisher and first aid kit in the laboratory, safety symbols- Preparation of the charts by the students and display of chats in chemistry labs. Calibration of fractional weights, calibration of glass ware - burette, pipette, standard flask, Normality/Molarity and specific gravity of concentrated acids – Preparation of dilute solutions (Numerical problems). Precautions to be taken in the preparation of dilute acids and bases and bases. Preparation of stock solutions of salts with specific examples.Properties of primary standard salt and preparation of standard solution. Good laboratory practices-maintenance of observation book record.

UNIT 2: **Preparation of Lab Reagents**:

Preparation of indicators and use of indicators in volumetric analysis- acid base titrations, redox titrations, precipitation titrations and complexometric titrations.Role of an indicator in detecting end point (Phenolphthalein, Methyl orange, Methyl-red, Potassium Chromate, Diphenylamine, EBT, Murexide, etc). Preparation of buffers – pH 10 ammonicalbuffer and acetate buffer solutions. Preparation of commonly used reagents : Ammonium hydroxide solution, Ammonium molybdate reagent, Ammonium hydrogen phosphate solution, Bayer's reagent, Benedict's solution, Bromine water, Dimethyl glyoxime reagent, 2,4-Dinitrophenyl hydrazine reagent, Eriochrome black-T reagent Fehling solution, Ferric chloride solution, Ferrous sulphate solution, Iodine solution, Molisch's reagent, Nessler's reagent, Neutral FeCl3, Schiff's reagent, Silver nitrate solution, Sodium carbonate solution , Sodium hydroxide(Caustic soda) solution, Starch solution, Tollen's reagent. (reference work and submission of assignments). Charts preparation depicting course content.

RECOMMENDED BOOKS :

1. Vogel's Text Book of Quantitative Chemical Analysis, 5 th edition.
2. Vogel's Text Book of macro and semimicro qualitative inorganic analysis. G. Svehla, 5 th edition.
3. Chemistry Reagent Manual Prepared by Chemistry Department, SGTB Khalsa College under DBT's Star College Scheme, University of Delhi (Available: online)
4. American Chemical Society Safety in Academic Chemistry Laboratories 8 th edition.

[Course objectives (CO)]

- To improve the skills of students in the application of theory and practical knowledge.
- To fill the gap between theory and practicals.
- To train the students in understanding laboratory safety rules and to improve the skills in preparation of laboratory reagents.

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-III
MATHEMATICS – III (304A)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Real Analysis

Objective: The course is aimed at exposing the students to the foundations of analysis which will be useful in understanding various physical phenomena.

Outcome: After the completion of the course students will be in a position to appreciate beauty and applicability of the course.

Unit- I

Sequences: Limits of Sequences- A Discussion about Proofs-Limit Theorems for Sequences-Monotone Sequences and Cauchy Sequences -Subsequences-Lim sup's and Lim inf's-Series-Alternating Series and Integral Tests .

Unit- II

Continuity: Continuous Functions -Properties of Continuous Functions -Uniform Continuity - Limits of Functions

Unit- III

Differentiation: Basic Properties of the Derivative - The Mean Value Theorem - L'Hospital Rule - Taylor's Theorem.

Unit- IV

Integration : The Riemann Integral - Properties of Riemann Integral-Fundamental Theorem of Calculus.

Text:

Kenneth A Ross,Elementary Analysis-The Theory of Calculus

References:

S.C. Malik and SavitaArora, Mathematical Analysis, Second Edition, Wiley Eastern Limited, New Age International (P) Limited, New Delhi, 1994.
William F. Trench, Introduction to RealAnalysis
Lee Larson, Introduction to Real Analysis
Shanti Narayan and Mittal, Mathematical Analysis
Brian S. Thomson, Judith B. Bruckner, Andrew M. Bruckner; Elementary Real analysis ;
Sudhir R., Ghorpade, Balmohan V., Limaye; A Course in Calculus and Real Analysis

SEMESTER-III

MATHEMATICS – III PRACTICALS (351A)

Total Instruction hours per week are 3 (45hrs) **Credits 1**

Maximum Marks: 50 **(10M for continuous evaluation + 40M External Exam)**

UNIT-I

1) List the first five terms of the following inductively defined Sequences.

(i) $s_n = \frac{1}{n^2+2}$ (ii) $s_1 = 1,\ s_n = 3s_n + 1$; (iii) $s_1 = 1, s_2 = 2,\ s_{n+2} = \frac{s_{n+1} + s_n}{s_{n+1} - s_n}$;

2) Check whether the following Sequences Convergent . Find the Limit/ Limit Point of the Sequences, g.l.b, l.u.b if exists

(i) $\left\{\frac{1}{n}\right\}$ (ii) $\left\{\sqrt[3]{n+1} - \sqrt[3]{n}\right\}$ (iii) $(-1)^n$

3) Show that the following Sequences are bounded and check for theconvergence.

(a) $\left\{\frac{n+2}{n^2++2n+2}\right\}$, (b) $\left(1+\frac{1}{n}\right)^n$

4) Check for the convergence of the following Sequences by using appropriate methods.

$(a)\ s_n = 1+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+.....+\frac{1}{n}$ $(b)\ s_n = \frac{1}{n^2+1}+\frac{1}{n^2+2}+.....+\frac{1}{n^2+n}$

$(C)\ s_n = 1+\frac{1}{2!}+\frac{1}{3!}+\frac{1}{4!}+.....+\frac{1}{n!}$ $(d)\ s_n = \frac{1}{1.2}+\frac{1}{2.3}+\frac{1}{3.4}+.....+\frac{1}{n.(n+1)}$

5)Show that the following Sequences converges.

(a) $s_1 = \sqrt{3},\ s_{n+1} = \sqrt{3s_n}$ *converges to* 3.

(b) $s_1 = 1,\ s_{n+1} = \sqrt{5+s_n}$ *converges to positive root of* $x^2 - x - 5 = 0$

6) Find the limits of (i) $s_n = \frac{1}{(n!)^{1/n}}$ (ii) $s_n = \left(\frac{2^n}{(n!)}\right)^{1/n}$

7) Check for the Convergence of the following Series by Using appropriate Tests.

$(a)\sum\left(\frac{n+1}{2n+5}\right)^n$ (b) $\sum\left(1+\frac{1}{n}\right)^{-n^2}$ (c) $\sum\left(\frac{n^2}{3^n}\right)$ (d) $\sum\frac{x^n}{n}\ ; x > 0$

8)Convergence and Test for Absolute Convergence of the following Series.

(a) $1-\frac{1}{2^p}+\frac{1}{3^p}-\frac{1}{4^p}+.....,\ p > 0.$ (b) $\sum\frac{(-1)^n}{n}$; (c) $\sum\frac{\cos nx}{n^2}$

9)If $(s_n) = (0,1,2,1,0,1,2,1,0,1,2,1,0\ldots\ldots\ldots\ldots)$ $(t_n) = (2,1,1,0,2,1,1,0,2,1,10\ \ldots\ \ldots\ \ldots\ .)$find

a)liminf(s_n)+ lim inf (t_n)***b***) lim inf(s_n)+ lim sup (t_n)

c) Lim sup(s_n)+ lim sup (t_n)**d)** limsup$((s_n + t_n)$

10) Prove lim sup$|s_n| = 0$ if and only if lim$s_n = 0$

UNIT-II

1)Find the Limits of the following functions if exists.

$$f(x)=\begin{cases} x-[x] & when\,[x]\neq 0 \\ 0 & when\,[x]=0 \end{cases}$$

2)If $f:\Re-\{0\}\to\Re$ is defined as $f(x)=x\left(\dfrac{e^{1/x}-1}{e^{1/x}+1}\right)$ show that $\lim\limits_{x\to 0} f(x)=0$.

3) Find $\lim\limits_{x\to 0} f(x)$ if $f(x)=\dfrac{e^{1/x}-e^{-1/x}}{e^{1/x}+e^{-1/x}}$

4) If $f(x)=\begin{cases} x \ \ if\ x\ is\ rational \\ -x\ if\ x\ is\ irrational \end{cases}$ show that $\lim\limits_{x\to 0} f(x)$ exists only at $x=0$

5)Verify whether the given functions are continuous at given point. If not find the type of discontinuity.

(a) $f(x)=\begin{cases} 1\ if\ x\ is\ rational \\ -1\ if\ x\ is irrational \end{cases}$ at all Real Numbers.

6) $f(x)=x^m\sin\dfrac{1}{x}$ $at\ x=0$ (c) $f(x)=\begin{cases} \left(\dfrac{e^{1/x}-e^{-1/x}}{e^{1/x}+e^{-1/x}}\right) & if\ x\neq 0 \\ 1 & if\ x=0 \end{cases}$

7) Define Uniform Continuity. Check the following functions are uniform continuous ? $f(x)=\dfrac{1}{x}$ $on(0,1]$

8) Check the following functions are uniform continuous ? $f(x)=x^2$ $on[-1,1]$ and on R

9) Prove that the function f defined on R^+ as $f(x)=\sin\dfrac{1}{x}$ $\forall x>0$, is continuous but not uniformly continuous on R^+

10) Examine the Continuity and Uniform Continuity of f defined by $f(x)=\lim\limits_{n\to\infty}\dfrac{x^n}{1+x^n e^x}$ $\forall\ x\geq 0$, $n>0$.

UNIT-III.

1) Check the following functions are differential at a given points

.

(a) $f(x)=|x|+|x-1|+|x-2|$ $at\ x=0,1,2$

(b) $f(x)=\begin{cases} 5x-4\ if\ \ 0\leq x\leq 1 \\ 4x^2-3x\ if\ \ 1\leq x\leq 2 \\ 3x+4 \ \ if\ x\geq 2 \end{cases}$ at $x=1,2$

2)Find the value of m such that $f(x)=\begin{cases} x^m\sin\dfrac{1}{x} & if\ x\neq 0 \\ 0 & if\ x=0 \end{cases}$ is differentiable at

3) Define Rolle's Theorem and discuss the applicability for the following Functions.

(a) $f(x)=x^3-6x^2+11x-6$ $on\ [1,3]$ (b) $f(x)=\sin x$ $on\ [0,\pi]$

4) Define Lagrange's Mean Value Theorem discuss the applicability for the following functions.

(a) $f(x)=\frac{1}{x}\ on[-1,1]$ (b) $f(x)=\log x\ on\ [1,e]$

(c) $f(x)=1+x^2\ on[1,2]$

5)Define Cauchy's Mean Value Theorem. If

$f(x)=\frac{1}{x^2}, g(x)=\frac{1}{x}$ *then show that 'c' is the Harmonic Mean of* a,b *where* $0<a<b.$

6)Define Taylor's Theorem and Mc Lauren's Theorem and find the Taylor's Series/ Mc Lauren's Series to the following functions.

(a) $\sin x$ *at* $x=0, x=\frac{\pi}{2}$ (b) $\cos x$ *at* $x=0, x=\frac{\pi}{4}$

7)Let f be a function defined on $\Re$ and $f(x+y)=f(x)+f(y), \forall x, y\in R$ then show that (i) f is continuous then $f(x)=x.f(1), \forall x\in R$

8)By using L'Hospital Rule find the following Limits.

(a) $\lim_{x\to 0}\left(\frac{\sin x}{x}\right)^{1/x^2}$

(9) $Lim_{x\to\infty}\frac{x^3}{e^x}$

(10) $Lim_{x\to 0^+}\left(\frac{1}{x}-\frac{1}{\sin x}\right) on\left(0,\frac{\pi}{2}\right)$

UNIT-IV

1). Define Upper Riemann Sum, Lower Riemann Sum, Oscillatory sum, Lower Riemann Integral, Upper Riemann Integral.

2)Find Upper Riemann Sum, Lower Riemann sum, Oscillatory sum for the following functions.

(a) $f(x)=2x-1\ on\ [0,1]\ with\ P=\left\{0,\frac{1}{4},\frac{2}{4},\frac{3}{4},1\right\}$

(b) $f(x)=\sin x\ \ on[0,\pi]$, $with\ P=\left\{0,\frac{\pi}{3},\frac{2\pi}{3},\pi\right\}$

3)Check whether the following functions are Riemann Integrable or not by finding Upper and Lower Riemann Integrals and also find Riemann Integral if it exits.

(a) $f(x)=3x-1\ on\ [1,2]$

(4) $f(x)=\begin{cases}1\ if\ x\in Q\\ -1\ if\ x\in R\setminus Q\end{cases} on[a,b]\subseteq R$

(5) $f(x)=\begin{cases}2\ if\ 0\le x\le 1\\ 1\ if\ 1\le x\le 2\end{cases} on[0,2]\subseteq R$

(6) $f(x)=\frac{1}{a^{n-1}}\ if\ \frac{1}{a^n}\le x\le\frac{1}{a^{n-1}}, a>1 and\ f(0)=0.$

(7) $f(x)=\begin{cases}2rx, \frac{1}{r+1}<x\le\frac{1}{r}\ on[0,1], r\in N.\\ 0\ \ if\ \ x=0\end{cases}$

8)Find the following by using appropriate theorems (First Mean Value Theorem etc…)

(a) $\frac{\pi}{4} \le \int_0^{\pi/4} \sec x\,dx \le \frac{\pi}{2\sqrt{2}}$ (b) $4 \le \int_1^3 \sqrt{3+x^3}\,dx \le 2\sqrt{30}$

Find the following Infinite Limits.

(9) $\underset{n\to\infty}{Lt}\left(\frac{1}{n}+\frac{n^2}{(n+1)^3}+\frac{n^2}{(n+2)^3}+\ldots\ldots\ldots\ldots\ldots+\frac{1}{8n}\right)=\frac{3}{8}$

(10) $\underset{n\to\infty}{Lt}\frac{1}{n^2}\sum_{r=0}^{n-1}\sqrt{n^2-r^2}$

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-III
BOTANY – III (304B)
Total Instruction hours per week are 4 (60hrs) Credits 4
ANGIOSPERMS TAXONOMY, PLANT ANATOMY AND EMBRYOLOGY

UNIT – I

1. Introduction: Principles of plant systematics, Types of classification: Artificial, Natural and Phylogenetic; Systems of classification: Salient features of Bentham & Hooker and Engler&Prantle. An introduction to Angiosperm Phylogeny Group (APG).
2. Current concepts in Angiosperm Taxonomy: Embryology in relation to taxonomy, Cytotaxonomy and Chemotaxonomy.
3. Nomenclature and Taxonomic resources: An introduction to *International Code of Nomenclature for algae, fungi, and plants* (ICN), *Shenzhen Code* -2018 a brief account. Herbarium: Concept, techniques and applications.

UNIT-II

4. Systematic study and economic importance of plants belonging to the following families: Polypetalae : Annonaceae, Capparidaceae, Rutaceae, Fabaceae (Faboideae/papilionoideae, Caesalpinioideae, Mimosoideae), Cucurbitaceae
5. Gamopetalae: Apiaceae, Asteraceae, Asclepiadaceae, Lamiaceae
6. Monochalmydeae: Amaranthaceae, Euphorbiaceae, Monocotyledons: Orchidaceae and Poaceae.

UNIT-III

7. Meristems: Types, histological organization of shoot and root apices and theories.
8. Tissues and Tissue Systems: Simple, complex and special tissues.
9. Leaf: Ontogeny, diversity of internal structure; stomata and epidermal outgrowths.
10. Stem and root anatomy: Vascular cambium - Formation and function.
11. Anomalous secondary growth of Stem - *Boerhaavia*, *Dracaena*; Root– *Beta vulgaris*

UNIT - IV

12. Anther structure, Microsporogenesis and development of male gametophyte.
13. Ovule structure and types; Megasporogenesis; types and development of female gametophyte.
14. Pollination - Types; Pollen - pistil interaction. Fertilization.
15. Endosperm - Development and types. Embryo - development and types.
16. Palynology- Pollen morphology, NPC system and application of Palynology.

References:

- Stace, C. A. 1989. Plant Taxonomy and Biostatistics (2nd Ed.).
- Edward Arnold, London. Singh, G. 1999. Plant Systematics: Theory and Practice. Oxford and IBH, New Delhi.
- Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.
- Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy.
- Oliver and Boyd, London. Heywood, V. H. 1965 . Plant Taxonomy.
- ELBS , London. Heywood, V. H. and D. M. Moore (Eds). 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
- Jain, S. K. and V. Mudgal. 1999. A Handbook of Ethnobotany. Bishen Singh Mahendra Pal Singh, Dehradun.
- Jeffrey, C. 1982. An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge
- Bhattacharya et. al. 2007. A textbook of Palynology, Central, New Delhi.
- Bhojwani, S. S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House, Delhi.
- M.R.Saxena- A textbook of Palynology.
- Vashista- A textbook of Anatomy.
- P.K.K.Nair- A textbook of Palynology.
- Esau, K. 1971. Anatomy of Seed Plants.
- John Wiley and Son, USA. Johri, B. M. 1984. Embryology of Angiosperms.
- Springer-Verleg, Berlin. Kapil, R. P. 1986. Pollination Biology. Inter India Publishers, New Delhi.
- Maheswari, P. 1971. An Introduction to Embryology of Angiosperms.
- McGraw Hill Book Co., London. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press.

SEMESTER-III

BOTANY – III PRACTICALS (351)B

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

1. Systematic study of locally available plants belonging to the families prescribed in theory syllabus (Minimum of one plant representative for each family)
2. Demonstration of herbarium techniques.
3. Candidate have to submit at least 30 herbarium sheets
4. Demonstration of double staining technique.
5. Tissue organization in root and shoot apices using permanent slides
6. Preparation of double stained Permanent slides Primary structure: Root - Cicer, Canna; Stem – Tridax, Sorghum
7. Secondary structure: Root – Tridax sp.; Stem –Pongamia Anomalous secondary structure: Examples as given in theory syllabus.
8. Stomatal types using epidermal peels.
9. Microscopic study of wood in T.S., T.L.S. and R.L.S.
10. Structure of anther and microsporogenesis using permanent slides.
11. Structure of pollen grains using whole mounts - Hibiscus, Acacia and Grass).
12. Pollen viability test using Evans Blue – Hibiscus
13. Study of ovule types and developmental stages of embryosac.
14. Structure of endosperm (nuclear and cellular); Developmental stages of dicot and monocot embryos using permanent slides.
15. Isolation and mounting of embryo (using Cymopsis / Senna / Crotalaria)

SEMESTER III BOTANY-3

ANGIOSPERM TAXONOMY,PLANT ANATOMY AND EMBRYOLOGY

Practical Model Paper

Time: 3 hrs(10M for continuous evaluation + 40M External Exam) Max. Marks : 50

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1. Technical description of the given plant twig " **A** " **1x10=10M**
2. Prepare a double stained permanent mount of transverse section of given material " **B** " **1x6=6M**
3. Prepare a temporary mount of epidermal peel of the given leaf material " **C** " and identify the stomatal type. **1X4=4M**
4. Conduct pollen viability test for the given pollen material "**D**". **1X5=5M**
5. Identify and describe the specimens / slides with well labeled diagrams (i) Embryology – "**E**" (ii) Palynology – "**F**" (iii) Anatomy – "**G**" **3x3=9M**
6. Record and Herbarium **2x3=6M**

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-III
PHYSICS – IV (305A)
Total Instruction hours per week are 4 (60hrs) **Credits 4**

Electromagnetism and Electronics

Unit — I **(15hrs)**

Electrostatics& Dielectrics: Gauss law and its application, electric field due to uniformly charged sphere, Mechanical force on a charged conductor; Electric potential- potential due to a charged spherical conductor, electric dipole. An atomic view of dielectrics, potential energy of a dipole in an electric field, Polarization and charge density.

Dielectrics and Gauss's law.Relation between D, E, and P - Dielectric constant and susceptibility.Capacitance: Capacity of concentric spheres, capacity of parallel plate condenser with and without dielectric. Electric energy stored by a charged condenser- force between plates of condenser.

Unit — II **(15hrs)**

Magneto statics: Magnetic shell, potential due to magnetic shell, field due to magnetic shell, magnetic induction (B) and field (H), permeability and susceptibility, Dia. Para and ferro-magnetic materials (qualitative), concepts of magnetic domains, Hysteresis loop, B-H curve-theory and experiment.

Moving Charge in Electric and Magnetic Fields: Force on a current carrying conductor, force and torque on current loop, Biot-Savart's law and calculation of B due to long straight wire, circular current loop and solenoid. Hall-Effect, Cyclotron, Synchrocyclotron and Synchrotron.

Unit — III **(15hrs)**

Electromagnetic Induction: Faraday's law, Lenz's law, expression for induced e.m.f. Electromotive force — time varying magnetic fields, Betatron, Ballistic galvanometer- Theory and damping correction, self and mutual inductance, coefficient of coupling, calculation self-inductance of long solenoid and toroid, energy-stored in magnetic field- principles and construction of transformer.

Maxwell's Equations: A review of basic laws of electricity and magnetism, displacement current, Maxwell's equations in differential form, Maxwell's wave equation.

Unit — IV **(15hrs)**

Semiconductor devices: P-N junction diode, Zener diode, Half wave and Full wave rectifiers.PNP and NPN transistors.Current components in a transistor, Input and output characteristics of transistor in CE configurations.

Digital Principles: Binary arithmetic, Logic gates, Boolean algebra, OR, AND, NOT gates, truth tables, DeMorgan's theorems: statements and proof logic gates using discrete components, Universal gates;half and full adders; parallel adder circuits.

Suggested text Books

1. Electricity and Magnetism: Berkeley physics series, The McGraw Hill companies.
2. Third year physics, Telugu Academy
3. Electricity and Magnetism: Brijlal and Subramaniam.
4. Electricity and Magnetism: C. J. Smith, Edward Arnold Ltd
5. Electricity and Magnetism: C. J. Smith and.Rangawala. . ‘
6. Electricity and Magnetism with Electronics: K.K.Tewari (R. Chand).
7. Electricity and magnetism, D C Tayal, 1998, Himalaya publishing house
8. Introduction to Electrodynamics, D.J. Griffiths, 3rdEdn., 1998, Benjamin Cummings
9. Electromagnetics, B B Laud, New age international publishers
10. Electronic devices and circuits, S. Salivahanan and N.Suresh Kumar, 2012, Tata Mc-Graw Hill.
11. Digital Principles & Applications, A.P.Malvino, D.P.Leach7th Ed.,2011, Tata McGraw Hill publication.
12. Electronic devises and circuits- Milllman and Halkias, Mc, Graw Hill publication

SEMESTER-III

PHYSICS – IV PRACTICALS (352A)

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Electricity& Magnetism Lab

1. Determination of M and H – Vibration Magnetometer
2. Magnetic Field along the axis of a coil carrying current – Stewart and Gee's Galvanometer
3. Hysteresis Loop – Magnetometer Method (or) I-H Curve
4. Carey Foster's Bridge
5. Potentiometer – Comparison of Low Resistances
6. Constant **'K'** of a Ballistic Galvanometer by using Standard Condenser
7. Verification of Logic gates AND, OR, NOT, X-OR and NAND gates
8. Verification of De-Morgan's Laws
9. R.C. Coupled Amplifier
10. Determination of ac-frequency-sonometer.
11. CR or RC circuit (Frequency response i.e. as a High or a Low Pass Filter)
12. RC circuit (Charging & Discharging of a Capacitor)
13. LCR circuit (Frequency response)

Note: *Minimum of eight experiments should be performed.*

Suggested Text Books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (VaniPublishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (PragatiPrakashan, Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, AnchalSrivastava
5. B.Sc Practical Physics, C L Arora- S Chand & Co.
6. A text book of practical physics, M.N. Srinivasan, Chand & Co
7. Practical physics, M. Arul Thakpathi, Complete pulishers
8. Via voce in advanced physics, R C Gupta, and P N Saxena, PragathiPrakashan, Meerut

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-III
ZOOLOGY – IV (305B)
Total Instruction hours per week are 4 (60hrs) Credits 4

Cell & Molecular Biology, Genetics & Evolution

UNIT – I **(15 Periods)**

1. Cell Biology & Molecular Biology

1.1. Differences of Prokaryotic and Eukaryotic cells, Ultrastructure of Animal cell
1.2. Structure and functions of Plasma membrane, Endoplasmic reticulum, Golgi body, Ribosomes, Mitochondria andNucleus
1.3 Chromosomes – Structure, types, Cell Division(Mitosis, Meiosis)
1.4.DNA (Deoxyribo Nucleic Acid) & RNA (Ribo Nucleic Acid) – Structure & types
1.5. DNA Replication & Protein Synthesis

UNIT – II **(15 Periods)**

2. Genetics

2.1 Mendals laws of Inheritance and Non-Medelian Inheritance, Incomplete dominance Codominance and Epistasis
2.2 Linkage and Crossing over
2.3.Sex determination in Human beings and sex-linked inheritance
2.4 Chromosomes structure. Mutations -Types
2.5. Gene mutations- Induced and Spontaneous Mutations.

UNIT – III **(15 Periods)**

3. Evolution

3.1. Theories of Evolution – Lamarckism and Neo-Lamarckism, Darwinism and Neo-Darwinism, Modern synthetic theory of organic evolution
3.2. Evidences of Evolution and Hardy Weinberg Law.
3.3. Forces of Evolution – Mutation, Genetic drift, Natural selection and Migration
3.4. Isolation & mechanisms
3.5. Speciation: Concept of species, Methods of Speciation

UNIT – IV **(15 Periods)**

4. Biomolecules & Metabolism

4.1 Carbohydrate metabolism - Glycolysis, Krebs cycle, , Electron transport system
4.2 Protein Metabolism - Transamination and Urea Cycle
4.3 Lipid Metabolism – Classification of lipids & Biological significance
4.4 Enzymes: Definition & Classification,
4.5 Concept of Homeostasis

Suggested readings

1. **Lodish, Berk, Zipursky, Matsudaria, Baltimore, Darnel**l *'Molecular Cell Biology'* W.H. Free man and company New York..
2. **Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008).** *Principles of Genetics*.VIII Edition. Wiley India.
3. **Snustad, D.P., Simmons, M.J. (2009).** *Principles of Genetics*.V Edition.John Wiley and Sons Inc.
4. **Klug, W.S., Cummings, M.R., Spencer, C.A. (2012).** *Concepts of Genetics*. X Edition. Benjamin Cummings.
5. **Russell, P. J. (2009).** *Genetics- A Molecular Approach.*III Edition. Benjamin Cummings.
6. **Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.** *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
7. **Ridley, M. (2004).** *Evolution*.III Edition. Blackwell Publishing
8. **Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007).** *Evolution*. Cold Spring, Harbour Laboratory Press.
9. **Hall, B. K. and Hallgrimsson, B. (2008).** *Evolution*.IV Edition. Jones and Bartlett Publishers
10. **Campbell, N. A. and Reece J. B. (2011).** *Biology*. IX Edition, Pearson, Benjamin, Cummings.
11. **Douglas, J. Futuyma (1997).** *Evolutionary Biology*.Sinauer Associates.
12. **Minkoff, E. (1983).** *Evolutionary Biology*.Addison-Wesley.
13. **James D. Watson, Nancy H. Hopkins** '*Molecular Biology of the Gene'*
14. **Jan M. Savage**. *Evolution*, 2nd ed, Oxford and IBH Publishing Co., New Delhi.
15. **Gupta P.K**., 'Genetics'
16. Nagabhushanam, Comparative Animal Physiology
17. Veer BalRastogi, Text Book of Animal Physiology

SEMESTER-III
ZOOLOGY – IV PRACTICALS (352B)

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Cell& Molecular Biology, Genetics & Evolution

I. Cytology

1. Preparation and Identification of slides of Mitotic divisions with onion root tips
2. Identification and study of the following slides/photographs/figures.
   i). Different stages of Mitosis and Meiosis

II. Genetics

1. Problems on Genetics - Mendelian inheritance

III. Evolution

1. Museum Study of Fossil animals: *Peripatus, Coelacanth Fish, Dipnoi fishes, Sphenodon, Archeopteryx*.

IV. Biomolecules & Metabolism

1.Effect of pH and Temperature on salivary amylase activity.

2. Study of permanent histological sections of Mammalian Endocrine glands - Pituitary, Thyroid, Pancreas, Adrenal gland.

- **Laboratory Record work shall be submitted at the time of practical examination**
- An **"Album"** containing photographs, cut outs, with appropriate write-up about Genetics and Evolution.

Suggested manuals

Manual of laboratory experiments in cell biology Edward, G.

Tortora, G.J. and Derrickson, B.H. (2009).*Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.

Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill

Guyton, A.C. and Hall, J.E. (2011).T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).*Biochemistry*.VI Edition. W.H Freeman and Co.

Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009).*Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.

Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). *Harper's Illustrated Biochemistry*. XXVIII Edition. Lange Medical Books/Mc Graw3Hill

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-III
CHEMISTRY – IV (306)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Unit-I (Inorganic Chemistry) **15h (1 h/week)**

S3-IV-I-1: Coordination Compounds-I **7 h**

Simple inorganic molecules and coordination complexes. Nomenclature – IUPAC rules,
1.Brief review of Werner's theory,Sidgwick's electronic interpretation, EAN rule and their limitations. Valence bond theory (VBT) – postulates and application to (a) tetrahedral complexes $[Ni(NH_3)_4]^{2+}$, $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ (b) square planar complexes $[Ni(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[PtCl_4]^{2-}$ (c) octahedral complexes $[Fe(CN)_6]^{4-}$, $[Fe(CN)_6]^{3-}$, $[FeF_6]^{4-}$, $[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$. Limitations of VBT.2. Coordination number, coordination geometries of metal ions, types of ligands. 3. Isomerism in coordination compounds, stereo isomerism – (a)geometrical isomerism in (i) square planar metal complexes of the type$[MA_2B_2]$, $[MA_2BC]$, $[M(AB)_2]$, [MABCD]. (ii) Octahedral metal complexes of the type $[MA_4B_2]$, $[M(AA)_2B_2]$, $[MA_3B_3]$ using suitable examples, (b) Optical isomerism in (i). tetrahedral complexes [MABCD], (ii). Octahedral complexes $[M(AA)_2B_2]$, $[M(AA)_3]$ using suitable examples. Structural isomerism: ionization, linkage, coordination ligand isomerism using suitable examples.

S3-IV-I-2:Organometallic Chemistry **4h**

Definition, nomenclature and classification of organometallic compounds.Methods of preparation, properties and applications of alkyl and aryl compounds of Li, Mg &Al. Preparation and properties of ferrocene.

S3-IV-I-3: Metal carbonyls and related compounds **4h**

18 valence electron rule, classification of metal carbonyls: $Ni(CO)_4$, $Fe(CO)_5$, $Fe_2(CO)_9$, $Fe_3(CO)_{12}$ and $Cr(CO)_6$, Preparation and properties of Ni(CO)4.

UNIT - II (Organic chemistry) **15 h (1 hr/week)**

S3-IV-O-1: Carboxylic acids and derivatives **8h**

Nomenclature, classification and methods of preparation a) Hydrolysis of Nitriles, amides and esters. b) Carbonation of Grignard reagents. Special methods of preparation of Aromatic Acids.Oxidation of the side chain of Arenes.Hydrolysis of benzotrichlorides.Kolbe reaction. Physical roperties- hydrogen bonding, dimeric association, acidity – strength of acids with the examples of trimethyl acetic acid and trichloro acetic acid, Relative differences in the acidity of Aromatic, aliphatic acids& phenols. Chemical properties – Reactions involving H, OH and COOH groups -salt formation, anhydride formation, Acid halide formation, Esterification (mechanism) & Amide formation. Reduction of acid to the corresponding primary alcohol – via ester or acid chloride.Degradation of carboxylic acids by Huns Diecker reaction, Schmidt reaction (Decarboxylation).Arndt – Eistert synthesis, Halogenation by Hell – Volhard - Zelensky reaction.Carboxylic acid Derivatives – Reactions of acid halides, Acid anhydrides, acid amides and esters (mechanism of ester hydrolysis by base and acid).

S3-IV-O-2:Nitro hydrocarbons: **7 h**

Nomenclature and classification of nitro hydrocarbons.Structure.Tautomerism of nitroalkanes leading to aci and keto form.Preparation of Nitroalkanes. Reactivity - halogenation, reaction with HNO_2 (Nitrous acid), Nef reaction, Mannichreaction,Michael addition and reduction. Aromatic Nitro hydrocarbons: Nomenclature, Preparation of Nitrobenzene by Nitration. Physical properties, chemical reactivity – orientation of electrophilic substitution on nitrobenzene.Reduction reaction of Nitrobenzenes in different media.

Unit – III (Physical Chemistry) **15 hr(1h/week)**

S3-IV-P-1: Electrochemistry & EMF **15 h**

Electrical transport – conduction in metals and in electrolyte solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of specific and equivalent conductance with dilution. Migration of ions and Kholrausch's law, Arrhenius theory of electrolyte dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only). Transport number, definition and determination by Hittorf's method for attackable electrodes. Applications of conductivity measurements: Determination of degree of

dissociation, determination of Ka of acids, determination of solubility product of a sparingly soluble salt, conductometric titrations. Electrolyte and Galvanic cells – reversible and irreversible cells, conventional representation of electrochemical cells.EMF of a cell and its measurement.Computation of EMF.Types of reversible electrodes- the gas electrode, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions, Nernst equation, cell EMF and single electrode potential, standard Hydrogen electrode – reference electrodes (calamel electrode) – standard electrode potential, sign conventions, electrochemical series and its significance. Applications of EMF measurements, Calculation of thermodynamic quantities of cell reactions (G, H and K). Determination of pH using hydrogen electrode, glass electrode and quinhydrone electrode, Solubility product of AgCl.Potentiometric titrations.

Unit-IV (General Chemistry) **15h (1 h/week)**

S4-IV-G-1: Molecular spectroscopy

Introduction to electromagnetic radiation, interaction of electromagnetic rations with molecules, various types of molecular spectra.

Rotational spectroscopy (Microwave spectroscopy)

Rotational axis, moment of inertia, classification of molecules (based on moment of inertia), rotational energies, selection rules, determination of bond length of rigid diatomic molecules
eg. HCl.

Infra red spectroscopy

Energy levels of simple harmonic oscillator, molecular vibration spectrum, selection rules. Determination of force constant.Qualitative relation of force constant to bond energies.Anharmonic motion of real molecules and energy levels.Modes of vibrations in polyatomic molecules.Characteristic absorption bands of various functional groups.Finger print nature of infrared spectrum.

Electronic spectroscopy:

Bonding and antibonding molecular orbitals,electronic energy levels of molecules (σ, π, n),types of electronic transitions:σ-σ*, n-σ*, n-л*, л-л* with suitable examples.Selectionrules,Terminology of chromophore, auxochrome, bathochromic and hypsochromicshifts.Absorption of characteristicsofchromophones: diene, enone and aromatic chromophores.
Representation of UV-visible spectra.

Proton Magnetic Resonance Spectroscopy

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals – spin-spin coupling, representation of proton NMR spectrum – Integrations.^{1}H NMR spectrum of – ethyl bromide, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate and acetophenone.

Referances:

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rd edn Van Nostrand Reinhold Company (1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rd edn
Wiley Publishers (2001).
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,E.A. Keiter and R.L. Keiter 4th edn. (2006)
5. Chemistry of the elements by N.N.Greenwood and A. EarnshawPergamon Press(1989).
6. Inorganic Chemistry by Shriver and Atkins 3rd edn Oxford Press (1999).
7. Textbook of Inorganic Chemistry by R Gopalan(Universities Press(2012)
8. College Practical chemistry by V K Ahluwalia, SunithaDhingra and AdarshGulati Universities Press (India) Limited(2012)

Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; Twenty Ninthedition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh. New Age Publishers PvtLtd (2008)
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)

4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by BruiceYuranisPowla. (2012)
6. Text book of organic chemistry by C N pillai CRC Press (2012)

Unit III

1. Principles of physical chemistry by Prutton and Marron. The MacmillanCompany; 4th edition (1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand &sons(2011)
3. Text Book of Physical Chemistry by Puri and Sharma. S. Naginchand and Co.(2017)
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Colloidal and surface chemistry, M. Satake, Y. Hayashi, Y.Mido, S.A.Iqbal andM.S.sethi, Discovery Publishing Pvt.Ltd (2014)
6. Material science by Kakani&Kakani, New Age International(2016)

Unit IV

1. Fundamentals of molecular spectroscopy: Banwell
2. Fundamentals of molecular spectroscopy: P.S. Sindhu
3. Elementary Organic Spectroscopy: Y.R.Sharma
2. Organic spectroscopy, William Kemp, Palgrave Macmillan; 2nd revised edition(1 February 1987)

SEMESTER-III
CHEMISTRY – IV PRACTICALS (353)

Total Instruction hours per week are 3 (45hrs) Credits 1
Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

1. (Organic Chemistry)
1. Synthesis of Organic compounds:
Acetylation: Acetylation of salicylic acid, Benzoylation of Aniline.
Aromatic electrophilic substitution: Nitration: Preparation of nitro benzene and m-dinitro benzene.
Halogenation: Preparation of p-bromo acetanilide, Preparation of 2,4,6-tribromo phenol
Oxidation: Preparation of benzoic acid from benzyl chloride.
Esterification: Preparation of n-butyl acetate from acetic acid. Methylation: Preparation of - naphthyl methyl ether.
Condensation: Preparation of benzilidine aniline and Benzaldehyde and aniline.
Diazotisation: Azocoupling of β-Naphthol.

2. Physical Chemistry
A. Potentiometry:
a) Determination of redox potential of $Fe^{2+}/Fe^{3+}$by potentiometric titration of ferrous ammoniumsulphate vs. potassium dichromate.
b) Precipitation titration of KCl vs. $AgNO_3$ -Determination of given concentration of silver nitrate.
c) Strong acid Vs Strong base;
B. Conductometry:
a) Determination of cell constant of conductivity cell.
b) Determination ofdissociationconstant (Ka) ofaceticacidbyconductivity measurements
c. Conductometry titrations:
i) Strong acid Vs Strong base;
ii) Weak acid Vs Strong base.
C. pH metry:
a) pH metric titration of strong acid (HCl) vs. strong base- Determination of the concentration of the given acid.

CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-III
CHEMISTRY –V (307)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Unit-I (Inorganic Chemistry)

S3-V-I-1: Coordination compounds –II

Crystal field theory (CFT)- Postulates of CFT, splitting patterns of d-orbitals in ctahedral, tetrahedral, square planer with suitable examples. Crystalfield stabilization energies and its calculations for various d^nconfigurations in octahedral complexes.High Spin Low Spin complexes.
Magnetic properties of transition metal complexes- para, dia, ferro, anti ferromagnetic properties, determination of magnetic susceptibility (Guoy method), spin only formula, calculations of magnetic moments.
Electronic spectra of metal complexes – colour of transtion metal aqua complexes– d-d transitions.Detection of complex formation - basic principles of various methods- change in chemical properties, solubility, colour, pH, conductivity, magnetic susceptibility. Thermodynamic and kinetic stability of transition of metal complexes .Stability of metal complexes –stepwise and overall stability constant andf their relationship.Factors effecting the stability constants. Chelate effect, determination of composition of complex by Job's method and mole ratio method.

Applications of coordination compounds
Applications of coordination compounds a) in quantitative and qualitative analysis with suitable examples b) in medicine for removal of toxic metal ions and cancer therapy c) in industry as catalysts polymerization – Ziegler Natta catalyst d) water softening.

Unit-II (Organic Chemistry) **15h (1 h/week)**

S3-V-O-1: Amines, Cyanides and Isocyanides **9h**

Amines:

Nomenclature, classification into 1^0, 2^0, 3^0Amines and Quarternary ammonium compounds.Preparative methods – 1.Ammonolysis of alkyl halides 2. Gabriel synthesis
3. Hoffman's bromamide reaction (mechanism). Reduction of Amides and Schmidt reaction.
Physical properties and basic character – Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amine and aniline- comparative basic strength of aniline, N-methylaniline and N,N- dimethyl aniline (in aqueous and non- aqueous medium), steric effects and substituent effects. Use of amine salts as phase transfer catalysts. 4. Chemical Properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation. 5. Reaction with Nitrous acid of 1^0, 2^0, 3^0(Aliphatic and aromatic amines).
Electophilic substitutions of Aromatic amines – Bromination and Nitration, oxidation of aryl and 3^0Amines, diazotisation. 6. Diazonium salts: Preparation with mechanism. Synthetic importance – a) Replacement of diazonium group by – OH, X (Cl)-Sandmeyer and Gatterman reaction, by luorine (Schiemann's reaction), by iodine, CN, NO_2, H and aryl groups. Coupling Reaction of diazonium salts. i) with phenols ii) with anilines. Reduction to phenyl hydrazines.
Cyanides and isocyanides:
Nomenclature (aliphatic and aromatic) structure.Preparation of cyanides from a) Alkyl halides b) from amides c) from aldoximes.Preparation of isocyanides from Alkyl halides and Amines. 2. Properties of cyanides and isocyanides, a)hydrolysis b) addition of Grignard reagent iii) reduction iv) oxidation.

S3-V-O-2: Heterocyclic Compounds
6 h

Introduction and definition: Simple 5 membered ring compounds with one hetero atom Ex.Furan. hiophene and pyrrole. Importance of ring systems – presence in important natural products like emoglobin and chlorophyll.Numbering the ring systems as per Greek letter and Numbers.romatic character – 6- electron system (four-electrons from two double bonds and a pair of non-bonded electrons from the hetero atom). Tendency to undergo substitution reactions.
Resonance structures: Indicating electron surplus carbons and electron deficient hetero atom. Explanation of feebly acidic character of pyrrol, electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions. Reactivity of furan as 1,3- iene, Diels Alder reactions (one example). Sulphonation of thiophene purification of Benzene obtained rom coal tar). Preparation of furan, Pyrrole and thiophene from 1,4,- dicarbonylompounds only, Paul-Knorr synthesis, structure of pyridine, Basicity – Aromaticity– Comparison with pyrroleone method of preparation and properties –Reactivity towards Nucleophilic substitution reaction chichibabin reaction.

Unit-III(Physical Chemistry) **15h (1 h/week)**

S3-V-P-1: Chemical Kinetics

Introduction to chemical kinetics, rate of reaction, variation of concentration with time, rate laws and rate constant. Specific reaction rate.Factors influencing reaction rates: effect of concentration of reactants, effect of temperature, effect of pressure, effect of reaction medium, effect of radiation, effect of catalyst with simple examples, order of reaction. First order reaction, derivation of equation for rate constant. Characteristics of first order reaction.Units for rate constant.Half- life period, graph of 1storder reaction, examples.Decomposition of H_2O_2 and decomposition of oxalic acid.
Pseudo first order reaction, Hydrolysis of methyl acetate, inversion of cane sugar, problems.
Second order reaction, derivation of expression for 2ndorder rate constant, examples- Saponification of ester, $2O_3 \rightarrow 3O_2$, $C_2H_4 + H_2 \rightarrow C_2H_6$. Characteristics of second order reaction, units for rate constants, half- life period and second order plots.
Zero order reaction: derivation of rate expression, examples i)combination of H_2 and Cl_2 to form HCl, ii) thermal decomposition of HI on gold surface characteristics of Zero order reaction units of k, half-life period and graph, problems.
Determination of order of reaction: i) method of integration, ii) half life method, iii) Vant-Hoff differential m ethodiv) Ostwald's isolation method. Problems Kinetics of complex reactions (first order only): opposing reactions, parallel reactions, consecutive reactions and chain reactions. Problems.Effect of temperature on reaction rate, Arrhenius equation.Temperature coefficient.Concept of energy of activation, determination of energy of activation from Arrhenius equation and by graphical method, problems.Simple collision theory based on hard sphere model explanation of frequency factor, orientation or steric factor.The transition state theory (elementary treatment).

Unit-IV (General Chemistry) **15h (1 h/week)**

S3-V-G-1: Mass Spectrometry 4 h

Electron Impact Mass: Basic principles, Nitrogen rule, types of ions: Molecular ion, fragment ion and isotopic ions, representation of mass spectrum, types of peaks (molecular ion, fragment and isotopic ion peaks). Determination of molecular weight Mass spectrum of ethyl chloride, ethyl bromide and acetophenone.

Chromatography I **11Hrs**

S5-E-A-I: Solvent Extraction- Principle, Methods of extraction: Batch extraction, continuous extraction and counter current extraction. Application – Determination of Iron (III).
Chromatography: Classification of chromatographic methods, principles of differentialmigration, adsorption phenomenon, nature of adsorbents, solvent systems.
Thin layer Chromatography (TLC): Advantages, preparation of plates, development of the

chromatogram, Detection of the spots, factors effecting Rf values and applications.
Paper Chromatography: Principle, choice of paper and solvent systems, development of chromatogram – ascending, descending, radial and two dimensional chromatography and applications.
Column Chromatography- Principle, Types of stationary phases, Column packing – Wet packing technique, Dry packing technique. Selection criteria of mobile phase solvents for eluting polar, non-polar compounds and its applications.

References:

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rdedn. Van Nostrand Reinhold Company(1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rdedn Wiley Publishers (2001).Chem.
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,E.A. Keiter and R.L. Keiter 4thedn. (2006)
5. Chemistry of the elements by N.N.Greenwood and A. EarnshawPergamon Press(1989).
6. Inorganic Chemistry by Shriver and Atkins 3rdedn Oxford Press (1999).

Unit- II

1. Text book of organic chemistry by Soni. Sultan Chand & Sons; TwentyNinth edition (2012)
2. General Organic chemistry by Sachin Kumar Ghosh.New Age Publishers PvtLtd (2008)
3. Text book of organic chemistry by Morrison and Boyd. Person(2009)
4. Text book of organic chemistry by Graham Solomons. Wiley(2015)
5. Text book of organic chemistry by BruiceYuranisPowla. (2012)

Unit III

1. Principles of physical chemistry by Prutton and Marron. The MacmillanCompany; 4th edition (1970)
2. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand &sons.(2011).
3. Text Book of Physical Chemistry by Puri,SharmaandPattania. chand andCo.(2017)
4. Physical Chemistry by Atkins & De Paula, 8thEdition
5. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
6. Physical Chemistry through problems by S.K. Dogra. (2015)
7. Text Book of Physical Chemistry by R.P. Verma.
8. Elements of Physical Chemistry byLewisGlasstone. Macmillan (1966)

Unit IV

1. Fundamentals of molecular spectroscopy: Banwell
2. Fundamentals of molecular spectroscopy: P.S. Sindhu
3. Elementary Organic Spectroscopy: Y.R.Sharma
4. Analytical Chemistry by David Krupadanam, Universities Press (India) Limited.
5. D.A. Skoog, F.J. Holler, T.A. Nieman, Principles of Instrumental Analysis, Engage earning India Ed.
6. D. A. Skoog, D.M. West, F.J. Holler, Fundamentals of Analytical Chemistry 6thEd.,Saunders College Publishing, Fort worth (1992).

7. Willard, H.H., Merritt, L.L., Dean, J. &Settoe, F.A. Instrumental Methods of Analysis. 7thEd.Wadsworth Publishing Co. Ltd., Belmont, California, USA, 1988.
8. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7th Ed., Prentice Hall.
9. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Prentice Hall.

11. Analytical Chemistry 7th edition by Gary D. Christian (2004).
13. M.N Sastry, Separation Methods, Paperback (2004), Himalaya Publications.

SEMESTER-III
CHEMISTRY –V PRACTICALS (354)

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Qualitative and Spectral Analysis of Organic Compounds:

Qualitative analysis: 20M

Identification of an Organic compound through the functional groupanalysis, determination of melting points/boiling points, functional group tests and preparation of
suitable derivatives of the following:
Carboxylic acids, phenols, amines, urea, thiourea, carbohydrates, aldehydes, ketones, amides,nitro hydrocarbons, ester and naphthalene.

Spectral analysis 10M

Determination of structures from combined spectral data (IR, ^{1}H-NMR andMass): Minimum of five problems.

Organic Laboratory Techniques: 10M

MP,BP, Distillation, TLC (2-Nitro aniline, 4- Nitro aniline, Acetophenone and Ethyl Benzoate), column (Mixture seperation 2-Nitro aniline & 4- Nitro aniline, Anthracene + ethyl benzoate) of Chromatography, crystallisation.

CBCS- with effect from Academic year 2019-20 onwards

Semester IV

General English (401)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Prescribed Textbook for Semesters III & IV: *English in Use*. Eds. T Vijay Kumar, K DurgaBhavani, YL Srinivas. Published by Macmillan.

UNIT VI	1. Poem: "The Flower" *Alfred Tennyson* 2. Prose: "The Kitemaker" *Ruskin Bond* 3. Vocabulary: Commonly Confused Words 4. Grammar: Determiners
UNIT VII	1. Poem: "Ecology" *AK Ramanujan* 2. Prose: What's the Language of the Future? *Henry Hitchings* 3. Vocabulary: Indianisms 4. Grammar: Framing Questions (Including Tag Questions)
UNIT VIII	1. Poem: "Television" *Roald Dahl* 2. Prose: "The Fringe Benefits of Failure, and the Importance of Imagination" *JK Rowling* 3. Vocabulary: One-word Substitutes 4. Grammar: Relative Clauses
UNIT IX	1. Review writing: Film Review, Book Review 2. Vocabulary: Technical Vocabulary (Film, Literature) 3. Grammar: Conditionals
UNIT X	1. CV Writing: Chronological CV, Functional CV 2. Vocabulary: Appropriacy 3. Grammar: Common Errors

M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
Hindi (Second Language) – IV (402H)

Total Instruction hours per week are 4 (60hrs) Credits 4

Name of The Book :KavyaNidhi

1. **The following Poets Prescribed : -**
   1) **MeeraBaiMeeraKe Pad**
   2) **RaheemRaheemkeDohe**
   3) **BihaariLalBihariKeDohe**
   4) **SooryakantTripathi"Nirala" BhagwanBuddhkePrati**
   5) **MahadeviVarmaVeMuskaatePhoolNahin**
   6) **RamdhariSingh"Dinkar" KalamAurTalwaar**
   7) **HarivanshRaiBacchan Too Kyonbaithgayaahai path par**

   (It is resolved to Delete Poem "AnubhavParipakva" from "KavyaNidhi")

2. **Hindi SahityakaItihas (History of Hindi Litrature)**
   A) **Ritikaal: Naamkaran, Paribhashayan**
   B) **Adhunikkaal: Naamkaran, Paribhashayan, Pravruttiyan**

3. **Hindi SahityakaItihas: Brief Study of the following Authors and Poets**
   1. **MeeraBai 2. Raheem 3. BihaariLal 4. SooryakanthTripathiNirala**
   4. **MahadeviVarma 6. Ramdhari Singh Dinkar 7. HarivamshRaiBacchan**
   8. **Agyeya 9. Premchand**

4. **General Essay on Socio-Political &Literaray Subjects/Topics from the following**
   1. **VidhyarthiaurAnushasan**
   2. **AajkeeShikshaNeeti**
   3. **Barat meinBerozgarikiSamasya**
   4. **PariyavaranaurPradushan**
   5. **Bharat mein Badhtihuyi Janasankhya**
   6. **Bharatiya Samskruti**

5. **Translation (English or Telugu to Hindi)**

Practical Model Paper

Time: 3 hrs(20M for Internals + 80M External Exam) **Max. Marks : 80**

I. किन्हीं 2 (दो) की संदर्भ सहित व्याख्या कीजिये:-- **8 X 2 = 16 अंक**

(काव्य निधि के उपरोक्त दोहों/कविताओं में से 4 (चार) अंश दिए जायेंगे)

1) मीरा के पद 2) रहीम के दोहे 3) बिहारी के दोहे 4) भगवान बुध्द के प्रति

5) वे मुस्कराते फूल नहीं 6) कलम और तलवार 7) तू क्यों बैठ गया है पाठ पर?

II. किसी 1 (एक) कविता का सारांश लिखिए :-- **16 अंक**

(काव्य निधि पाठों में से 2(दो) दिए जायेंगे,एक का सारांश लिखना होगा)

III. किसी 1 (एक) प्रश्न का उत्तर लिखिए :-- **20अंक**

(हिंदी साहित्य काइतिहास के रीतिकाल और आधुनिक काल में से 2(दो)प्रश्न दिए जायेंगे)

IV. (किसी एक रचनाकार का परिचय दीजिये :-- **8 अंक**

(आधुनिक काल के रचनाकारों में से 2 कवि दिए जायेंगे)

1) मीराबाई 2) बिहारीलाल 3) रहीम 4) महादेवी वर्मा 5) अज्ञेय 6) महावीर प्रसाद व्दीवेदी

7) सूर्यकांत त्रिपाठी निराला 8) हरिवंशराय बच्चन 9) प्रेमचंद

V. किसी एक विषय पर निबंध लिखिए:-- **10अंक**

(निम्नलिखित विषयों में से 2 (दो) निबंध दिए जायेंगे)

1) विद्यार्थी और अनुशासन 2) आज की शिक्षा नीति 3) भारत में बेरोजगारी की समस्या

4) पर्यावरण और प्रदूषण 5) भारत में बढ़ती हुई जनसंख्या 6) भारतीय संस्कृति

6) अनुवाद कीजिये:-- **10 अंक**

(पाँच वाक्य दिए जायेंगे)

Osmania University, Hyderabad.

CBCS Pattern of B.A., B.Sc., B.Com., & B.B.A.,

Syllabus

Telugu (Second Language) - Paper - 4

4th Semester

ప్రాచీన పద్యభాగం

1. నారద గానమాత్సర్యం ... పింగళి సూరన
2. వాగ్దాన భంగం ... ఆసూరి మరింగంటి వేంకట నరసింహాచార్యులు
3. నారసింహ శతకం ... ధర్మపురి శేషప్ప

ఆధునిక పద్యభాగం

1. నరుడ నేను, నరుడ నేను ... కాళోజీ
2. ఆర్తగీతం ... దేవరకొండ బాలగంగాధర తిలక్
3. దేవరకొండ దుర్గం ... డా॥ ముకురాల రామారెడ్డి

వచన విభాగం

1. అర్ధరాత్రి అరుణోదయం ... దాశరథి రంగాచార్య
2. సి.పి.బ్రౌన్ సాహిత్య సేవ ... జానమద్ది హనుమచ్ఛాస్త్రి
3. మన గ్రామ నామాలు ... డా॥ కపిలవాయి లింగమూర్తి
4. నివురు తొలగిన నిప్పు ... పోల్కంపల్లి శాంతాదేవి
5. కొండమల్లెలు ... ఇల్లిందల సరస్వతీదేవి

ఛందస్సు

పాఠ్యగ్రంథము లోనివి

సామాజిక వ్యాసం

పరీక్షా పద్ధతి

ఎ. ఇంటర్నల్ ఎసెస్‌మెంట్ 20 మార్కులు

బి. సెమిస్టర్ పరీక్ష 80 మార్కులు

FACULTY OF SCIENCE

M.Sc. Chemistry 5 Years Integrated 4th SEMESTER EXAMINATIONS

TELUGU (Second Language) - PAPER - 4

TIME: 3 HOURS **MARX: 80**

★సూచన: అన్ని ప్రశ్నలకు సమాధానాలు రాయండి

విభాగం - ఎ (5 X4 = 20 మార్కులు)

(సంక్షిప్త సమాధానాలు)

1. ధర్మపురి శేషప్ప
2. కాళోజీ
3. సీసం
4. చంపకమాల
5. పోల్కంపల్లి శాంతాదేవి

విభాగం - ఆ (4 X15 = 60 మార్కులు)

(వ్యాసరూప సమాధానాలు)

6. తుంబురుణ్ణి అధిగమించడానికి నారదుడు పడిన పాట్లు ఏవి?

లేదా

నరుడ నేను, నరుడ నేను పాఠ్యభాగం ఇచ్చే సందేశం ఏమిటి?

7. సి.పి.బ్రౌన్ తెలుగు సాహిత్యానికి చేసిన సేవను తెలియజేయండి.

లేదా

ఆర్తిగీతం పాఠ్యభాగ సారాంశాన్ని రాయండి.

8. నారసింహ శతకంలోని భక్తి భావనను వివరించండి.

లేదా

దేవరకొండ వైభవాన్ని వర్ణించండి.

9. గ్రామనామాల అధ్యయన ప్రయోజనాలను తెలపండి.

లేదా

కొండమల్లెలు పాఠ్యభాగ సారాంశాన్ని రాయండి.

10. పర్యావరణ కాలుష్యం గురించి ఒక వ్యాసం రాయండి.

లేదా

సమాజంపై మీడియా ప్రభావాన్ని వివరిస్తూ ఒక వ్యాసం రాయండి.

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
Sanskrit (Second Language) – IV (402S)
Total Instruction hours per week are 4 (60hrs) **Credits 4**

4th Semester

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
Skill Enhancement Course – II (403A)
(Interdisciplinary Course: For the students with Mathematics background)
Total Instruction hours per week are 2 (30hrs) Credits 2

Cell Biology

Periods: 30

Unit-I **(15 Periods)**

1. **Cell Biology**

1.1. Ultra structure of Animal cell, Differences of Prokaryotic and Eukaryaotic cells
1.2. Structure and functions of Plasma membrane.
1.3. Structure and functions of cell organelles – Endoplasmic reticulum, Golgi body, Ribosomes, Lysosomes, Centrosomes, Mitochondria and Nucleus
1.4. Chromosomes - Structure and types.
1.5. Cell Division - Mitosis, Meiosis.

Unit-II **(15 Periods)**

2. **Molecular Biology**

2.1. DNA (Deoxyribo Nucleic Acid) – Structure and functions.
2.2. RNA (Ribo Nucleic Acid) Structure, types and functions.
2.3. DNA Replication.
2.4. Protein Synthesis – Transcription and Translation
2.5. Gene Expression – Genetic Code; operation concept

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
Skill Enhancement Course – II (403B)
(Interdisciplinary Course: For the students with Biology background)
Total Instruction hours per week are 2 (30hrs) Credits 2

Unit I Limits and Continuity & Differentiation :

Intervals and neighborhoods. Limits, Standard Limits, Continuity, Derivative of a function. Elementary Properties. Trigonometric, Inverse Trigonometric, Hyperbolic, Inverse Hyperbolic Function – Derivatives, Methods of Differentiation, Second Order Derivatives.

Unit II Integration :

Integration as the inverse process of differentiation- Standard forms – properties of integrals. Method of substitution- integration of Algebraic, exponential, logarithmic, trigonometric and inverse trigonometric functions.Integration by parts.

Unit III Vectors :

Classification of vectors, Addition of vectors, Scalar multiplication. Angle between two non zero vectors, Linear combination of vectors. Component of a vector in three dimensions, Vector equations of line and plane including their, Cartesian equivalent forms.

Text:

TELUGU ACADAMY –INTER FIRST YEAR

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
MATHEMATICS – IV (404)A

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Algebra

Objective: The course is aimed at exposing the students to learn some basic algebraic structures like groups, rings etc.

Outcome: On successful completion of the course students will be able to recognize algebraic structures that arise in matrix algebra, linear algebra and will be able to apply the skills learnt in understanding various such subjects.

Unit- I

Groups: Definition and Examples of Groups- Elementary Properties of Groups-Finite Groups - Subgroups - Terminology and Notation -Subgroup Tests - Examples of Subgroups.

Cyclic Groups: Properties of Cyclic Groups - Classification of Subgroups Cyclic Groups.

Unit- II

Permutation Groups: Definition and Notation -Cycle Notation-Properties of Permutations -A Check Digit Scheme Based on D_5. Isomorphisms ; Motivation- Definition and Examples -Cayley's Theorem Properties of Isomorphisms -Automorphisms-Cosets and Lagrange's Theorem Properties of Cosets - Lagrange's Theorem and Consequences-An Application of Cosets to Permutation Groups -The Rotation Group of a Cube and a Soccer Ball.

Unit- III

Normal Subgroups and Factor Groups: Normal Subgroups-Factor Groups -Applications of Factor Groups - Group Homomorphisms - Definition and Examples -Properties of Homomorphisms -The First Isomorphism Theorem.

Unit- IV

Introduction to Rings: Motivation and Definition -Examples of Rings -Properties of Rings – Subrings**;**Integral Domains: Definition and Examples - Fields - Characteristics of a Ring.Ideals and Factor Rings: Ideals -Factor Rings -Prime Ideals and Maximal Ideals.

Text Book

Joseph A.Gallian, Contemporary Abstract Algebra (9th edition)

References:

Bhattacharya, P.B Jain, S.K.; and Nagpaul, S.R,Basic Abstract Algebra
Fraleigh, J.B, A First Course in Abstract Algebra.
Herstein, I.N, Topics in Algebra.

SEMESTER-IV

BOTANY – IV PRACTICALS (451A)

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Algebra

Unit-I

1. Show that the set(1,2,34) is a group under multification modulo 5

2. Let G be a group with the property that for any x, y, z in the group, xy =zximplies y = z. Prove that G is Abelian.

3. Find the Normal sub groups of (i) $(G,.)=\{1,-1,i,-i\}$.(ii) $(\mathbb{Z}^{*}_{7},\times_{7})$.

is a group under multiplication.

4.Let G be the group of polynomials under addition with coefficients from Z_{10}. Find the ordersof

$f(x) = 7x^2+ 5x + 4$, $g(x) = 4x^2+ 8x + 6$, and $f(x)+ g(x)$

5.IfaisanelementofagroupGand|a|=7,showthataisthecubeofsomeelementofG.

6. Find the generators of the cyclic group of order n where $n = 6,10, 25,19,30$

7.How many subgroups does Z_{20}have? List a generator for each of thesesubgroups.

8.Consider the set (4,8,12,16) Show that this set is a group under multiplication modulo 20 by constructing its Cayley table. What is the identity element? Is the group cyclic? If so, find all of itsgenerators.

9. Prove that a group of order 4 cannot have a subgroup of order3.

10. If $S=\left\{\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix} / a,b \in \mathbb{R} \text{ and } ab \neq 0\right\}$ is a Subgroup of the set of all 2×2 non-singular matrices with respect to matrix multiplication.

Unit-II

1. Find all of the left cosetsof {1, 11} inU (30)

2.Determinewhetherthefollowingpermutationsareevenorodd.

a.(135) b.(1356) c. (13567) d. (12)(134)(152) e. (1243)(3521)

4.Let G = U(16),H=(1, 15) andK=(1,19) . Are H and K isomorphic? Are G/H andG/K isomorphic?

5.SupposethatfisahomomorphismfromZ30toZ30andKerf=(0,10,20)If f (23) = {9, } determineallelementsthatmapto9.

6.How many Abelian groups (up to isomorphism) arethere

a. of order6?
b. of order15?
c. of order42?

d. of order pq, where p and q are distinctprimes?
e. oforderpqr,wherep,q,andraredistinctprimes?

7). Find the regular permutation Group isomorphic to $(G,.)=\{1,-1,i,-i\},(\square_5,\times_5)$

8) Classify whether the following permutations are even or odd if $f=(1234)(567)(235)$,

$g=\begin{pmatrix}1&2&3&4&5&6&7\\7&5&6&4&3&1&2\end{pmatrix}$ in S_7

9)Find the generators of the cyclic group of order n where $n=6,10,25,19,30$

10) Find the order of the permutations $f=(1\,2\,3\,5)(2\,3\,5\,4)(1\,5\,3)$, $g=(1\,2\,3\,5)(2\,3\,5)(1\,5)$ in a group $(S_5,\circ)$.

UNIT-III

1. Show that the mapping f (a + bi)=a-I b isanautomorphismofthegroupofcomplexnumbers underaddition.

2.Find the Normal sub groups of (i) $(G,.)=\{1,-1,i,-i\}$.

Consider the following maps:

(3) $f:(Z,+)\to(G,.)$ *defined as* $f(x)=i^x$ where $(G,.)=\{1,-1,i,-i\}$

(4) $f:(Z,+)\to(Z,+)$ *defined as* $f(a)=a+1$

(5) $f:(R,+)\to(R^+,.)$ *defined as* $f(x)=e^x$

(6) $f:(R^+,+)\to(R^+,.)$ *defined as* $f(x)=x^2$

(7) $f:(R^+,.)\to(R,+)$ *defined as* $f(x)=\log x$

Check whether the above maps are isomorphism or not? Find also their kernels.

8. H=$\begin{pmatrix}a&b\\0&d\end{pmatrix}$ IS H a normal subgroup of GL(2,R) ?

9)Supposethatfisahomomorphismfrom$Z30$to$Z30$and$Kerf$=(0,10,20).If $f(23)=9$, determineallelementsthatmapto9.

10)What is the order of the factorgroup$\frac{Z_{60}}{|5|}$

h5i

Unit-IV

1) Show that the sets $(Z(\sqrt{2}),+,.),(Q(\sqrt{2}),+,.),(Z[i],+,.)(C,+,.)$ are Rings.

2) The set of Real Continuous functions defined on (0, 1) with respect to Addition and Multiplication of functions.Is a Ring

3) The set of 2×2 matrices is of the form $\begin{bmatrix} a & b \\ -\bar{b} & \bar{a} \end{bmatrix}$ is forms a ring with respect to matrix addition and matrix multiplication.

4) The set of all the real polynomials forms a Ring with respect to the addition and multiplication of Polynomials.

5) Find the zero divisors, and units of rings $(Z_6,+_6,\times_6)$, $(Z_7,+_7,\times_7)$, $(Z_{12},+_{12},\times_{12})$, $(Z_{20},+_{20},\times_{20})$, $(Z_p,+_p,\times_p)$

6)Which of the following sets

(i) $U=\left\{A=\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}/\ a,b\in R\right\}$

7) $I=\left\{A=\begin{bmatrix} a & b \\ 0 & 0 \end{bmatrix}/\ a,b\in R\right\}$, (iii) $I=\left\{A=\begin{bmatrix} a & 0 \\ b & 0 \end{bmatrix}/\ a,b\in R\right\}$

8) $U=\left\{A=\begin{bmatrix} a & b \\ c & 0 \end{bmatrix}/\ a,b\in R\right\}$,

9) $U=\left\{A=\begin{bmatrix} a & b \\ 0 & c \end{bmatrix}/\ a,b\in R\right\}$ are Sub rings or ideals of the Ring of all 2×2 real matrices.

10) Find the Principal ideals, Prime ideals and maximal ideals of the rings $(Z_6,+_6,\times_6)$, $(Z_7,+_7,\times_7)$, $(Z_{12},+_{12},\times_{12})$, $(Z_{20},+_{20},\times_{20})$.

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
BOTANY – IV (404B)

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Plant Physiology

UNIT - I

1. Plant-Water Relations: Importance of water to plant life, physical properties of water, diffusion, imbibition, osmosis; waterosmotic and pressure potentials; absorption.
2. Transport of water, Ascent of sap; Transpiration; Stomatal structure and movements.
3. Mineral Nutrition: Essential macro and micro mineral nutrients and their role; symptoms of mineral deficiency.

UNIT-II

4. Translocation of organic substances: Mechanism of phloem transport.
5. Enzymes: Nomenclature, Characteristics, Classification.
6. Mechanism and regulation of enzyme action, factors regulating enzyme activity.
7. Photosynthetic pigments, absorption and action spectra; Red drop and Emerson enhancement effect;
8. Concept of two photosystems; mechanism of photosynthetic electron transport and evolution of oxygen; Factors effecting Photosynthesis, Photophosphorylation.

UNIT-III

9. Carbon assimilation pathways: C3, C4 and CAM.
10. Nitrogen Metabolism: Biological nitrogen fixation, nitrate reduction, ammonia assimilation, (GS-GOGAT, transamination)
11. Respiration: Aerobic and Anaerobic; Glycolysis, Krebs cycle; electron transport system, mechanism of oxidative phosphorylation, pentose phosphate pathway.

UNIT-IV

12. Growth and Development: Physiological effects of phytohormones–Auxins, gibberellins, cytokinins, ABA, ethylene and Brassinosteroids.
13. Physiology of flowering and photoperiodism. Role of Phytochrome in flowering.
14. Stress physiology: Concept of water, salt and temperature stresses and plant responses.

References:

1. Hopkins, W. G. 1995. Introduction to Plant Physiology. John Wiley & Sons Inc., New York, USA
2. Jain, J.L., S. Jain and Nitin Jain. 2008. Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.
3. Pandey, B. P. 2007. Botany for Degree Students: Plant Physiology, Biochemistry, Biotechnology, Ecology and Utilization of Plants. S. Chand & Company Ltd., New Delhi.
4. Salisbury, F. B. and C. W. Ross. 1992. Plant Physiology. 4th edn. (India Edition), Wordsworth, Thomson Learning Inc.,USA.
5. Taiz, L. and E. Zeiger. 1998. Plant Physiology (2nd Ed.). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
6. Dutta A.C. 2016. Botany for Degree Students. Oxford University Press

SEMESTER-IV

BOTANY – IV PRACTICALS (451B)

Total Instruction hours per week are 3 (45hrs) **Credits 1**

Maximum Marks : 50 **(10M for continuous evaluation + 40M External Exam)**

Plant Physiology Practical Syllabus

1. Determination of osmotic potential of vacuolar sap by Plasmolytic method using leaves of Rheodiscolor / Tradescantia.
2. Determination of rate of transpiration using Cobalt chloride method
3. Determination of stomatal frequency using leaf epidermal peelings / impressions
4. Determination of catalase activity using potato tubers by titration method
5. Separation of chloroplast pigments using paper chromatography technique
6. Estimation of protein by Biurette method
7. Mineral deficiency- Detail study of Micronutrients and Macro nutrients
8. Identification of C3, C4 and CAM plants

SEMESTER IV BOTANY-4

Plant Physiology Practical Model paper

Practical Model Paper

Time: 3 hrs(10M for continuous evaluation + 40M External Exam) **Max. Marks : 50**

I. Major Experiment: **(16 marks)**

1. Determination of Osmotic potential of vascular sap- plasmolytic method.
2. Determination of Catalase activity – Potato, tubers by titration method.
3. Separation of Chloroplast pigments by paper chromatography.
4. Estimation of proteins by Biuret Method.

II. Minor Experiment: **(8 marks)**

1. Determination of Stomatal frequency using leaf epidermal peel/impressions.
2. Determination of Rate of transpiration by Cobalt chloride method.

III. Identify and Comment on: A, B & C **(3x4=12 Marks)**

1. Micronutrient Deficiency
2. Macronutrients Deficiency
3. C3, C4 and CAM plants.

IV. Record **(4marks)**

OSMANIA UNIVERSITY
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SEMESTER-IV
MATHEMATICS – V (405)A

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Numerical Analysis

Objective: Students will be made to understand some methods of numerical analysis. Outcome: Students realize the importance of the subject in solving some problems of algebra and calculus.

Unit- I

Errors in Numerical Calculations - Solutions of Equations in One Variable: The Bisection Method - The Iteration Method - The Method of False Position-Newton's Method - Muller's Method - solution of Systems of Nonlinear Equations.

Unit- II

Interpolation and Polynomial Approximation: Interpolation - Finite Differences - Differences of Polynomials - Newton's formula for Interpolation - Gauss's central differences formulae - Stirling's and Bessel's formula - Lagrange's Interpolation Polynomial - Divided Differences - Newton's General Interpolation formula - Inverse Interpolation.

Unit- III

Curve Fitting: Least Square Curve Fitting: Fitting a Straight Line-Nonlinear Curve Fitting.

Numerical Differentiation and Integration: Numerical Differentiation - Numerical Integration: Trapezoidal Rule-Simpson's 1/3rd-Rule and Simpson's 3/8th-Rule - Boole's and Weddle's Rule - Newton's Cotes Integration Formulae.

Unit- IV

Numerical Solutions of Ordinary Differential Equations: Taylor's Series Method - Picard's Method - Euler's Methods - RungeKutta Methods.

Text:

Richard L. Burden and J. Douglas Faires,Numerical Analysis (9e)

S.S.Sastry,Introductory Methods of Numerical Analysis, PHI

References:

M K Jain, S R K Iyengar and R K Jain, Numerical Methods for Scientific and Engineering computation

B.Bradie , A Friendly introduction to Numerical Analysis

SEMESTER-IV

MATHEMATICS –V PRACTICALS (452)A

Total Instruction hours per week are 3 (45hrs) **Credits 1**

Maximum Marks : 50 **(10M for continuous evaluation + 40M External Exam)**

NUMERICAL ANAYLSIS

UNIT-I

1) Define Absolute Error, Relative Error, Percentage Error. If $\pi = \frac{22}{7}$ is Approximated as 3.14 then find E_A, E_R & E_P .

2) If $f(x, y, z) = 10x^3y^2z^2$ find the general error if $x = 1, y = 2, z = 3$, $\Delta x = 0.01, \Delta y = 0.02, \Delta z = 0.03$.

(3) If $e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots\ldots$, *absolute error* $\in = 0.001$, then find $n = the\ number\ of\ terms\ if\ x = 1.$

4) Bi-Section Method and Iteration method.

(a) $x^3 - 4x - 9 = 0$

5) Regula- falsi / Method of false position.

(a) $x^3 + x^2 + x + 7 = 0$

6). $2xe^{-x} - \sin x = 0$, $x_0 = 1$ Newton-Rap son Method .

7) $x^3 - x - 4 = 0$, $x_0 = 0$ Newton-Rap son Method.

8) $x + \log x = 3, x_0 = 1$

9)Generalized Newton's Method Double root of $x^3 - 3x + 2 = 0,\ x_0 = 0.7$

10)MullersMethod(a) $x^3 - x - 1 = 0$

UNIT-II

1. Compute the following: $\Delta^3(x^3 + 2x + 1)$, $\Delta^2(\sin x + \cos x)$, $\nabla^2((x+1)(x+2))$,
2. Find the relations between $E, \Delta, \nabla, \delta, \mu$ operators.
3. Using Newton's Forward and Back word differences find $f(0.54)$ if

x	0.1	0.2	0.3	0.4	0.5	0.6	0.7
$f(x)$	2.631	3.328	4.097	4.944	5.875	6.896	8.013

4.Find the Interpolation Polynomial by using Newton's forward and Back ward difference formula

x	0	1	2	3
$f(x)$	1	8	27	64

5. By using Gauss Central Forward/ Backward difference formulae and Stirling formulae compute $f(1.22)$ if

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
$f(x)$	2.7183	2.8577	3.0042	3.1582	3.3201	3.4903	3.6693

6. Using Lagrange's Interpolation / Newton's divided difference formulae find the interpolating polynomial.

x	-2	-1	2	3
$f(x)$	-12	-8	3	5

7. Find the cubic polynomial by using Lagrange's Interpolation formula for

x	0	1	3	4
y	-1	1	17	43

8. By using Newton's Forward difference formulae find $f(3.5)$ if

x	1	2	3	4	5	6	7
$f(x)$	2.631	3.328	4.097	4.944	5.875	6.896	8.013

9).Define Forward difference operator and find $\Delta^2(\sin x + x^2)$.

1. By using Newton's Backward difference formulae find $f(8.5)$

x	0	2	4	6	8	10
$f(x)$	1	1	9	25	49	81

UNIT-III

1) Find the first and second derivative of the function at given points by using below tables.

X	1.0	1.1	1.2	1.3	1.4	1.5	1.6
Y	7.989	8.403	8.781	9.129	9.451	9.750	10.031

at $x = 1.3,\ and\ x = 1.6$

2) The distance travelled by a vehicle at various time intervals during the initial running is given by

Time t (s)	5	6	7	8	9
DistanceTravelled(km)	10.0	14.5	19.5	25.5	32.0

Evaluate the velocity and acceleration of the vehicle at time $t = 5, 7 \& 9$ secs.

3)The population of a certain town is shown in the following table

X(yr)	1931	1941	1951	1961	1971
Y(population)	40.62	60.80	79.95	103.56	132.65

Find the rate of growth of population in 1961.

4)Solve the following functions By Trapezoidal Rule, Simson's $\frac{1}{3}$ rd Rule, Simson's $\frac{3}{8}$ th Rule for $n = 4,6,8,10$ and apply Romberg's Integration any one.

(i) $\int_0^1 \frac{1}{1+x}dx$ (ii) $\int_0^2 \frac{1}{1+x^2}dx$

5) $\int_0^{\pi/2} \cos x\,dx$ By Trapezoidal Rule, Simson's $\frac{1}{3}$ rd Rule

6)Solve the following by Weddle's and Boole's formulae.i) $\int_4^{5.2} \log x dx$ (ii) $\int_0^2 \frac{1}{1+x+x^3}dx$

7. Using Lagrange's Interpolation / Newton's divided difference formulae find $f(302)$ if $(x, f(x))$ is given by $(300, 2.4771), (304, 2.4829), (305, 2.4843), (307, 2.4871)$.

8. Fit the following data in a Straight Line

(1, 2.4),(2, 3.1), (3, 3.5), (4, 4.2), (6, 5.0), (8, 6.0)

9. Fit the following data in a quadratic polynomial.

(0, 1), (1, 0) (2, 3),(3, 10), (4, 21)

10. Fit the following data in $y = ae^{bx}$ (1, 40.17), (1.2, 73.196), (1.4, 133.372), (1.6, 243.02)

UNIT-IV

1)If (i) $\frac{dy}{dx} = x - y^2$, $y(0) = 1$ by Taylor's Series Method.

2) (ii) $y'' - xy' - y = 0$, $y(0) = 1, y'(0) = 0$ find $y(0.2)$ by Taylor's Series Method.

3)Solve by Picard's sucessiveitertation method $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$

Hence find y(0.1), y(0.2).

4)Find y(0.5) if $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$, $h = 0.1$ by Euler's Method and Modified Euler's Method.

5)Solve for $y(0.5)$ by Runge-Kutta Method (i) $\frac{dy}{dx} = \frac{x^2 + y^2}{10}$ if $y(0) = 1, h = 0.1$

6) $\frac{dy}{dx} = x^2 - y$; $y(0) = 1, h = 0.1$. byRunge-Kutta Method

7) By using Picard $\frac{dy}{dx} = \frac{x^2 + y^2}{10}$, $y(0) = 1, h = 0.1$ for y(0.1),

8) Solve the equation $\frac{dy}{dx} = x^2 - y$, $y(0) = 1$, $h = 0.1$ by Runge – Kutta fourth order.

9) Solve $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$, $h = 0.1$ by Euler's method also find $y(0.5)$

10)Solve $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$, $h = 0.1$ by Taylor method also find $y(0.2)$

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
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SEMESTER-IV
BOTANY –V (405)B

Total Instruction hours per week are 4 (60hrs) **Credits 4**

Cell Biology and Genetics

Unit - I:

1. Principles of Microscopy: Light Microscope and Electron Microscope.
2. Plant cell envelops: Ultra structure of cell wall, molecular organization of cell membranes.
3. Nucleus: Ultra structure, Nucleic acids - Structure of DNA, types and functions of RNA.
4. Prokaryotic and Eucaryotic ribosome organization

Unit-II

5. Chromosomes: Morphology, organization of DNA in a chromosome with reference to nucleosome model.
6. Euchromatin and Heterochromatin, Karyotype. Special types of chromosomes: Lampbrush and Polytene chromosomes.
7. Extra nuclear genome: Mitochondrial DNA and Plastid DNA, Plasmids.
8. Cell division: Cell cycle and its regulation; mitosis, meiosis and their significance, Apoptosis.

Unit-III

9. Mendelism: Laws of inheritance. Genetic interactions – Epistasis- 12:3:1, 9:3:4, 9:7, Complementary, Supplementary and inhibitory genes.
10. Linkage: A brief account and theories of Linkage. Crossing over: Mechanism and theories of crossing over.
11. Genetic maps: Construction of genetic maps with Two point and Three point test cross data.

Unit - IV

12. Mutations: Chromosomal aberrations - structural and numerical changes; Gene mutations, Transposable elements: ACDS elements.
13. Gene Organization- Structure of gene, Genetic code, Process of DNA Replication with Polymerase enzyme.
14. Mechanism of transcription in Prokaryotes and Eukaryotes, processing of Eucaryotic m-RNA.
15. Regulation of gene expression in prokaryotes (Lac and Trp. Operons).

References:

1. Sharma, A. K. and A. Sharma. 1999. Plant Chromosomes: Analysis, Manipulation and Engineering. Harward Academic Publishers, Australia.
2. Shukla, R. S. and P. S. Chandel. 2007. Cytogenetics, Evolution, Biostatistics and Plant Breeding. S.Chand& Company Ltd., New Delhi.
3. Singh, H. R. 2005. Environmental Biology. S. Chand & Company Ltd., New Delhi.
4. Snustad, D. P. and M. J. Simmons. 2000. Principles of Genetics. John Wiley & Sons, Inc., U S A.
5. Strickberger, M. W. 1990. Genetics (3rd Ed.). Macmillan Publishing Company.
6. Verma, P. S. and V. K. Agrawal. 2004. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd., New Delhi.

SEMESTER-IV

BOTANY –V PRACTICALS (452B)

Total Instruction hours per week are 3 (45hrs) Credits 1
Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Cell Biology and Genetics

1. Demonstration of cytochemical methods: Fixation of plant material and nuclear staining for mitotic and meiotic studies.
2. Study of various stages of mitosis using cytological preparation of Onion root tips.
3. Study of various stages of meiosis using cytological preparation of Onion flower buds.
4. Solving genetic problems related to monohybrid, dihybrid ratio incomplete dominance and interaction of genes (minimum of six problems in each topic).
5. Construction of linkage maps; two and three point test cross.
6. Study of ultra-structure of cell organelles using photographers. Chloroplast, Mitochondria, Nucleus, Ribosomes, Endoplasmic reticulum, and Golgi complex.
7. Study of Special types of Chromosomes (Polytene chromosome and Lampbrush chromosomes- Permanent slide).

SEMESTER IV BOTANY-5

Cell Biology and Genetics
Practical Model paper

Time: 3 hrs(10M for continuous evaluation + 40M External Exam) **Max. Marks : 50**

1. Prepare a cytological slide of given material "**A**" and identify & describe any two stages with well labeled diagrams. **(16M)**
2. Solve genetic problems "**B**" related to dihybrid ratio or incomplete dominance. **(8M)**
3. Solve the genetic problem "**C**" related to interaction of genes. **(6 M)**
4. Slides "**D**"-Cell organelles "**E**"-Chromosomes (Polytene Chromosome) **(2x3=6 M)**
5. Record **(4M)**

OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2019-20 onwards
SEMESTER-IV
PHYSICS –V (406A)
Total Instruction hours per week are 4 (60hrs) **Credits 4**

Modern Physics

Unit –I **(15 hrs)**

Quantum Mechanics: Planck's theory of blackbody radiation; Photoelectric effect; Einstein's photoelectric theory; Compton effect (quantitative); wave particle duality; de-Broglie matter waves; electron diffraction; Davison and Germer Experiment, Heisenberg's uncertainty principle; Bohr's principle of correspondence.

Unit — II **(15hrs)**

Postulates of Quantum Mechanics: Schrodinger's wave equation, time – dependent, time-independent form, properties of wave function; preparation of wave functions; concept of stationary states. Applications of Schrodinger's equation: particle in a box, potential step, potential barrier and potential square well.

Unit – III **(15 hrs)**

General properties of Atomic nucleus: Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, semi-empirical mass formula and binding energy. Quantum properties of nuclear states, particle groups, nuclear resonances, liquid drop model, shell model, collective model.

Unit – IV **(15 hrs)**

Radioactivity: Stability of nucleus; Law of radioactive decay; Mean life & half-life; α decay; β decay - energy released, spectrum and Pauli's prediction of neutrino; γ-ray emission.

Fission and fusion: - Mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons. Nuclear reactor: slow neutrons interacting with Uranium 235; Fusion and thermonuclear reactions

Suggested text Books

1. Third year Physics, Telugu Academy

2. Quantum Mechanics: Mathews and Venkateshan P

3. Introduction to Quantum Mechanics: Pauling and Wilson.

4. Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill

5. Modern Physics, John R.Taylor, Chris D.Zafiratos, Michael A.Dubson,2009, PHI Learning

6. Six Ideas that Shaped Physics:Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill

7. Quantum Physics, Berkeley Physics Course Vol.4. E.H. Wichman, 2008, Tata McGraw-Hill Co.

8. Modern Physics, R.A. Serway, C.J. Moses, andC.A.Moyer, 2005, Cengage

9. Introduction to modern physics, Rictmyer, Kannard, Cooper, TMH edition.

10. Nuclear Physics: D C Tayal, Himalaya publishing house

SEMESTER-IV

PHYSICS –V PRACTICALS (453)A

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Modern Physics Lab

1. To determine work function of material of filament of directly heated vacuum diode.
2. To determine value of Planck's constant using LEDs of at least 4 different colors.
3. To determine the ionization potential of mercury.
4. To determine the wavelength of H-alpha emission line of Hydrogen atom.
5. e/m of an electron by Thomson method
6. Characteristic of GM counter
7. Study of absorption of β and γ rays
8. Determination of Planck's constant
9. Characteristics of a solar cell
10. Characteristics of a photodiode

Note: *Minimum of eight experiments should be performed*

Suggested Text Books

1. D.P. Khandelwal, "A laboratory manual for undergraduate classes" (VaniPublishing House, New Delhi).
2. S.P. Singh, "Advanced Practical Physics" (PragatiPrakashan,Meerut).
3. Worsnop and Flint- Advanced Practical physics for students.
4. "Practical Physics" R.K Shukla, AnchalSrivastava
5. B.Sc Practical Physics, C L Arora- S Chand & Co.
6. A text book of practical physics, M.N. Srinivasan, Chand & Co
7. Practical physics, M. Arul Thakpathi, Complete pulishers
8. Via voce in advanced physics, R C Gupta, and P N Saxena, PragathiPrakashan, Meerut
9. Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House.
10. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
11. A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11thEdition, 2011, KitabMahal, New Delhi.

OSMANIA UNIVERSITY
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SEMESTER-IV
ZOOLOGY –V (406B)
Total Instruction hours per week are 4 (60hrs) **Credits 4**

Physiology and Immunology

UNIT – I **(15 Periods)**

1.1 Digestion: Digestion Absorption and Assimilation of carbohydrates, Proteins and lipids.
1.2 Role of Gastrointestinal hormones in digestion
1.3 Respiration: Respiratory Pigments; Transport of oxygen, Oxygen dissociation curves. Bohr's effect. Transport of CO_2 – Chloride shift
1.4 Circulation: Structure of Mammalian Heart, Types of hearts – Neurogenic and Myogenic; Heart function, Regulation of Heart rate
1.5 Excretion: Structure and function of Nephron. Urine formation, Counter current mechanism

UNIT – II **(15 Periods)**

2.1 Muscle contraction: Types of Muscles. Ultra structure of skeletal muscle fibre
2.2 Nerve impulse: Structure of Neuron. Nerve impulse - Resting potential and Action potential
2.3 Neurotransmiters types and functions, Synapse, types of synapses
2.4 Endocrine glands - Structure, secretions and functions
2.5 Male and Female Hormones, Hormonal control of Menstrual cycle in humans.

UNIT – III **(15 Periods)**

3.1 Immunology: Definition of immunology, cells and organs of immune system
3.2 Types of Immunity – Innate and acquired, Humoral and Cell Mediated
3.3 Structure, function and types of antibodies, epitopes, haptens, and adjuvants.
3.4 Types of hyper sensitivity.
3.5 Introduction to Vaccines and types of Vaccines

UNIT – IV **(15 Periods)**

4.1 History, Definition and Scope of Transplantation.
4.2 Genetic barriers between donor and recipient, Immunological recognition of variation
4.3 Acute and Chronic Rejection, Mechanism of Graft Rejection, Manifestation of the rejection
4.4 Stem Cells & stem cell therapy & limitations
4.5 Concepts of autoimmunity

Suggested Readings:

Sherwood, Klandrof, Yanc, *Human Physiology*, Thompson Brooks/Coole, 2005.
Knut Scmidt-Nielson, *Animal Physiology***,** 5th ed, Cambridge Low Price Edition.
Roger Eckert and Randal, *Animal Physiology***,** 4th ed, Freeman Co, New York**.**
Singh. H.R, Text Book of Animal Physiology and Biochemistry
Nagabhushanam, Comparative Animal Physiology

Veer BalRastogi, Text Book of Animal Physiology
Arthur C. Guyton MD, ***A Text Book of Medical Physiology,*** **Eleventh ed., John E. Hall, Harcourt Asia Ltd.**
Knut Scmidt-Nielson, ***Animal Physiology*****, 5th ed, Cambridge Low Price Edition.**
Richard A. Glodsby, Thomas J Kind, Barbara A. Osborne, Janis Kuby, ***Immunology,*** **5th ed, Freeman and Co. New York**
Ivan Roitt, ***Immunology*****, 4th ed, JohanthanBrostoff, Moshy, London.**
Thomas C. Chung, ***General Parasitology*****, Hardcourt Brace and Co ltd. Asia. New Delhi.**
Gerard D. Schmidt and Larry S Roberts, ***Foundations of Parasitology*****, McGraw Hill**
Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition.Immunology. W.H. Freeman and Company.
Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006).XI Edition.Roitt's Essential Immunology, Blackwell Publishing.
ArunIngale (2012): Basic Immunology; Published by New Central Book Agency (P) Ltd. London

SEMESTER-IV
ZOOLOGY –V PRACTICALS (453B)

Total Instruction hours per week are 3 (45hrs) Credits 1

Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

Physiology and Immunology

1. Physiology

1. Qualitative tests for identification of carbohydrates, proteins and lipids.
2. Qualitative tests for identification of ammonia, urea and uric acid (Nitrogenous excretory products)
3. Estimation of Haemoglobin by Sahlis method.

2. Immunology

1. Identification of Blood groups
2. Histological study of spleen, thymus and lymph nodes (through prepared slides)
3. Enumeration of RBC & WBC from a given blood sample
4. Identification of Autoimmune disease through charts.

Laboratory Record work shall be submitted at the time of practical examination

Suggested manuals

Tortora, G.J. and Derrickson, B.H. (2009).*Principles of Anatomy and Physiology*, XII Edition, John Wiley & Sons, Inc.

Widmaier, E.P., Raff, H. and Strang, K.T. (2008) *Vander's Human Physiology*, XI Edition., McGraw Hill

Guyton, A.C. and Hall, J.E. (2011).T*extbook of Medical Physiology*, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company

Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006).*Biochemistry*.VI Edition. W.H Freeman and Co.

Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009).*Principles of Biochemistry*. IV Edition. W.H. Freeman and Co.

Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company.

David, M., Jonathan, B., David, R. B. and Ivan R. (2006). Immunology, VII Edition, Mosby, Elsevier Publication.

Abbas, K. Abul and Lechtman H. Andrew (2003.)Cellular and Molecular Immunology.V Edition.Saunders Publication.

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SEMESTER-IV
CHEMISTRY –VI (407)
Total Instruction hours per week are 4 (60hrs) Credits 4

Unit-I (Inorganic Chemistry) 15h (1 h/week)
S4-VI-I-1.Hard and soft acids bases (HSAB) 2h
Classification, Pearson's concept of hardness and softness, application of HSAB principles – Stability of compounds / complexes, predicting the feasibility of reaction
S4-VI-I-2.Metallurgy
General Methods involved in extraction of metals: 5Hrs
Minerals and ores, ore concentration – electromagnetic separation, gravity separation – wilfley table, hydraulic classifier, leaching, froth flotation, Calcination and roasting. Acid and alkali digestion.
Reduction – of oxides, carbonates, halides, sulphides, sulphates – smelting, flux, auto reduction, alumino – thermic reduction, hydrometallurgy, electrolytic reduction.
Purification of impure metals – liquation, fractional distillation, zone refining, oxidative process, cupellation, bassemerisation, pudding, poling, thermal decomposition, Amalgamation and Electrolysis.
S4-VI-I-3. Alloys 3Hrs
Classification, substitutional solid solutions, interstitial alloys, intermetallic compounds, Hume – Rothery rules. Preparation of alloys – fusion, electro deposition, reduction and compression Uses – ferrous and non-ferrous alloys
Unit -II (Organic Chemistry) 15h (1 h/week)
S4-VI-O-1.Diseases: Common diseases, infective diseases–insect borne, air-borne, water-borne and hereditary diseases.
S4-VI-O-2.Terminology in Medicinal Chemistry: Drug, Pharmacology, Pharmacophore, Pharmacodynamics,
Pharmacokinetics, metabolites, anti metabolites and therapeutic index.
S4-VI-O-3.Drugs: Nomenclature: Chemical name, Generic name and Trade names with examples; Classification: Classification based on structures and therapeutic activity with examples.
ADME: a) Absorption: Definition, absorption of drugs across the membrane – active and passive absorption, routes of administration of drugs. b) Distribution: definition and effect of plasma protein binding. c) Metabolism: definition, phase I and phase II reactions. d) Elimination: definition and renal elimination.
Synthesis and Therapeutic Activity of Drugs 12Hrs
Introduction, synthesis and therapeutic activity of Chemotherapeutics**:** Sulphanilamide, dapsone, Pencillin-G (semi synthesis), Chloroquin, Isoniazid, Cisplatin and AZT.

Unit-III(Physical Chemistry) 15h (1 h/week)
S4-VI-P-1.Thermodynamics- II 4 h
Entropy: Definition from Carnot's cycle. Entropy as a state function.Entropy as a measure of disorder. Sign of entropy change for spontaneous and non- spontaneous processes & equilibrium processes. Entropy changes in i). Reversible isothermal process, ii).Reversible adiabatic process, iii).phase change, iv). reversible change of state of an ideal gas. Problems.Entropy of mixing inert

perfect gases. Free energy Gibb's function (G) and Helmholtz's function (A) as thermodynamic quantities. Concept of maximum work and net work ΔG as criteria for spontaneity.Derivation of equation ΔG =ΔH – TΔS. significance of the equation. Gibbs equations and the Maxwell relations.Variation of G with P, V and T.

S4-VI-P-2.Photochemistry 4 h

Introduction to photochemical reactions, Difference between thermal and photochemical reactions, Laws of photo chemistry- Grotthus - Draper law, Stark – Einstein's Law of photo chemical equivalence. Quantum yield.Examples of photo chemical reactions with different quantum yields. Photo chemical combinations of H_2 – Cl_2 and H_2 – Br_2 reactions, reasons for the high and low quantum yield. Problems based on quantum efficiency, Consequences of light absorptions. Singlet and triplet states.Jablonski diagram Explanation of internal conversion, inter-system crossing, Phosphorescence, fluorescence.

Unit-IV (General Chemistry) 15h (1 h/week)

S4-VI-G-1.Colorimetry and Spectrophotometry

General features of absorption – spectroscopy, transmittance, absorbance, and molar absorptivity. Beer Lambert's law and its limitations, difference between Colorimetry and Spectrophotometry. Instruments – Single beam UV- Visible Spectrophotometer, Double beam UV- Visible Spectrophotometer. Lamps used as energy sources. Verification of Beer's law. Estimation of iron in water samples by thiocyanate method. Estimation of (i) Chromium and (ii) Manganese in steel.

S4-VI-G-2.IR Spectrophotometer: Principle, Sources of Radiations, Sampling, Block diagram of FT-IRSpectrophotometer.

References:

Unit- I

1. Principles of Inorganic Chemistry by Puri, Sharma and Kalia Vishal Publications(1996).
2. Concise Inorganic Chemistry by J.D. Lee 3rdedn. Van Nostrand Reinhold Company(1977)
3. Basic Inorganic Chemistry by F.A.Cotton, G.Wilkinson and Paul.L. Gaus 3rdedn Wiley Publishers (2001).Chem.
4. Inorganic Chemistry Principles of structure and reactivity by James E.Huhey,E.A. Keiter and R.L. Keiter 4thedn. (2006)
5. Chemistry of the elements by N.N.Greenwood and A. EarnshawPergamon Press(1989).
6. Inorganic Chemistry by Shriver and Atkins 3rdedn Oxford Press (1999).

Unit – II

1. G.L. Patrick: Introduction to Medicinal Chemistry, Oxford University Press, New York. 2013.
2. Thomas Nogrady, Medicinal Chemistry, Oxford Univ. Press, New York.2005.
3. David William and Thomas Lemke, Foye's Principles of Medicinal Chemistry, Lippincott Williams & Wilkins, 2008.
4. AshutoshKar Medicinal Chemistry, New Age International, 2005.
5. O.D.Tyagi&M.Yadav Synthetic Drugs by, Anmol Publications,1998.
6. Medicinal Chemistry by Alka L. Gupta, PragatiPrakashan.
7.G. L. David Krupadanam, D.Vijaya Prasad, K.VaraprasadRao, K. L. N. Reddy, C. Sudhakar, Drugs, Universities Press (India) Ltd. 2012.

Unit – III

1. Text Book of Physical Chemistry by Soni and Dharmahara. Sulthan Chand &sons.(2011).

2. Text Book of Physical Chemistry by Puri,Sharmaand Pattania. chand andCo.(2017)
3. Physical Chemistry by Atkins & De Paula, 8thEdition
4. Text Book of Physical Chemistry by K. L. Kapoor. (2012)
5. Physical Chemistry through problems by S.K. Dogra. (2015)
6. Text Book of Physical Chemistry by R.P. Verma.
7. Elements of Physical Chemistry byLewisGlasstone. Macmillan (1966)
8. Thermodynamics by Rajaram, Vishal Publishing Co, (2013).
9. Photochemistry by Gurdeep Raj, Goel publishing house, 5th edition

Unit IV

1. Fundamentals of molecular spectroscopy: Banwell
2. Fundamentals of molecular spectroscopy: P.S. Sindhu
3. Elementary Organic Spectroscopy: Y.R.Sharma
2. Organic spectroscopy, William Kemp, Palgrave Macmillan; 2nd revised edition(1 February 1987)

SEMESTER-IV
CHEMISTRY –VI PRACTICALS (454)

Total Instruction hours per week are 3 (45hrs) Credits 1
Maximum Marks : 50 (10M for continuous evaluation + 40M External Exam)

(Physical Chemistry) 45hrs (3 h / w)

1. Distribution law

a) Determination of distribution coefficient of iodine between water and carbon Tetrachloride/determination of molecular status and partition coefficient of benzoic acid in Toluene and water.

b) Determination of distribution coefficient o f acetic acid between n-butanol and water.

2. Kinetics

a) Determination of specific reaction rate of the hydrolysis of methyl acetate catalyzed by hydrogen ion at room temperature.

b) Determination of rate of decomposition of hydrogen peroxide catalyzed by $FeCl_3$.

3. Colorimetry

Beer'slaw using $KMnO_4$

Verification of and determination of the concentration of the given solution.

4. Adsorption

Adsorption of acetic acid on animal charcoal, Verification of Freundlich adsorption isotherm.

5. Physical constants

Surface tension and viscosity of liquids.

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Semester V

Course Type	Courses	Hours per week	Duration of Exam Hrs	Marks			No. of Credits
				Internal	External	Total	
SEC	Basic Computer Skills	2	2	10	40	50	2
CC Theory	Inorganic Chemistry -1 (501)	4	3	20	80	100	4
	Organic Chemistry -1 (502)	4	3	20	80	100	4
	Physical Chemistry -1 (503)	4	3	20	80	100	4
	General Chemistry -1 (504)	4	3	20	80	100	4
CC Practicals	Inorganic Chemistry -1 (551)	6	4		75	75	2
	Organic Chemistry -1 (552)	6	4		75	75	2
	Physical Chemistry -1 (553)	6	4		75	75	2
	Seminar				25	25	1
	Total	36				650	25

Semester VI

Course Type	Courses	Hours per week	Duration of Exam Hrs	Marks			No. of Credits
				Internal	External	Total	
SEC	Computational Chemistry and Drug Designing	2	2	10	40	50	2
CC Theory	Inorganic Chemistry -2 (601)	4	3	20	80	100	4
	Organic Chemistry -2 (602)	4	3	20	80	100	4
	Physical Chemistry -2 (603)	4	3	20	80	100	4
	General Chemistry -2 (604)	4	3	20	80	100	4
CC Practicals	Inorganic Chemistry -2 (651)	6	4		75	75	2
	Organic Chemistry -2 (652)	6	4		75	75	2
	Physical Chemistry -2 (653)	6	4		75	75	2
	Seminar				25	25	1
	Total	36				650	25

CC: Core Course

23/1/2021

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OSMANIA UNIVERSITY
M.Sc. Five Year Integrated Course in Chemistry
CBCS- with effect from Academic year 2020-21 onwards
SEMESTER-V
Paper I (501):INORGANIC CHEMISTRY-I

Teaching hours-4/week **Credits 4**

Unit I: Symmetry of molecules
Unit II: Bonding in Metal Complexes-I
Unit III: Coordination equilibria
Unit IV: Ligational aspects of diatomic molecules

Unit I: Symmetry of Molecules: **15hrs**

Concept of Symmetry in Chemistry – Symmetry Operations – Symmetry Elements: Rotational Axis of Symmetry and Types of Rotational Axes, Plane of Symmetry and types of Planes, Improper Rotational Axis of Symmetry , Inversion Center and Identity Element – More about Symmetry Elements – Molecular Point Groups: Definition and Notation of Point Groups, Classification Molecules in to C_1, C_s, C_i, C_n,C_{nv}, C_{nh}, $C_{\infty v}$, D_n, D_{nh}, D_{nd}, $D_{\infty h}$, S_n (n=even), T_d, O_h, I_h, K_h Groups. Descent in Symmetry with Substitution – Exercises in Molecular Point Groups – Symmetry and Dipole moment – Symmetry criteria for Optical activity.

Unit II: Bonding in metal complexes–I: **15hrs**

Crystal Field Theory: Salient features of CFT. d-orbital splitting patterns in regular Octahedral, tetragonally distorted octahedral, Jahn-Tellar theorem , trigonalbipyramidal, trigonal planar, Pentagonal bipyramidal, and linear geometries. Concept of weak field and strong fields. - Calculation of crystal field stabilization energies (CFSE's) in six and four coordinatecomplexes.Types of magnetic behaviour – magnetic susceptibility – calculation of magnetic moment from magnetic susceptibility spin only formula ,- Quenching of orbital angular momentum – Determination of magnetic moment from Guoy's method.. Applications of magnetic moment data for the determination of oxidation states, bond type and stereochemistry. Spin crossover: High spin, low spin cross over phenomenon in $[Fe(Ophen)_2(NCS)_2]$ and $[Fe(R_2NCS_2)_3]$. Spinels.

Unit III:CoordinationEquilibria: **15 hrs**

Solvation of metal ions- Metal complex formation in solution-Binary metal complexes. Stability constants (types and relationships between them). – Factors influencing the stability constants: (i) Metal ion effects (charge/size, IP, crystal field effect, John-Teller effect, Pearson theory of hard and soft acids and bases (HSAB), elecronegativity and hardness and softness, symbiosis. (ii) Ligand effects (Basicity , Substituent effect, Steric , Chelate(size and number of chelate rings), Macrocyclic andCryptate effects- crown ethers, crypton, size match selectivity or concept of hole size, limitations, Macrocycles with pendent groups– Methods used for the determination of Stability constants (Basic Principles only): pH metric, Spectrophotometric and Polarographicmethods.Ternary Metal Complexes – definition – Formation of ternary metal complexes – Step-wise and simultaneous equilibria with simple examples.

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Unit IV: Ligational AspectsofDiatomic molecules **15hrs**

Metal Carbonyls:- Carbon monoxide as a ligand – Molecular orbitals of CO - Donor and Acceptor molecular orbitals of CO; Bonding modes of CO- Terminal and Bridging; Evidence for multiple bonding from Bond lengths and Stretching frequencies; 18 Valence electron rule and itsapplication.

Metal Nitrosyls: - NO as a ligand – Molecular orbitals of NO – Donor and Acceptor components; Bonding modes of NO – Terminal (Linear, Bent) and Bridging; Structural aspects of $[IrCl(PPh_3)_2(CO)(NO)]^+$ and$[RuCl(PPh_3)_2(NO)_2]^+$.

Stereo chemical control of valence in $[Co(diars)_2(NO)]^{2+}$ and $[Co(diars)_2(NO)(SCN)]^+$.

Metal Dinitrogen complexes: - N_2 as aligand – Molecular orbitals of N_2; Bonding modes – Terminal and Bridging; Stretching frequencies; Structures of Ru (II) and Os(II) dinitrogen complexes; Chemical fixation of dinitrogen.

Suggested References:

1. Symmetry and Group theory in Chemistry, Mark Ladd, Marwood Publishers, London (2000).
2. Molecular Symmetry and Group Theory, Robert L.Carter, John Wiley &Son(1998).
3. Symmetry and Spectroscopy of Molecules. K.Veera Reddy, New Age International (P) Limited(1999).
4. Advanced Inorganic Chemistry. F.A.Cotton, G.Wilkinson, C.A.Murillo and M.Bochmann, 6th Edition, Wiley Interscience, N.Y(1999
5. Inorganic Chemistry, J.E. Huheey, K.A.Keiter and R.L.Keiter 4 th Edition Harper Cottens College Publications(1993).
6. Homogeneous Catalysis by Metal complexes Vol I, M MTaqui Khan and A E Martell, Academic Press NY(1974).
7. Inorganic Chemistry, Keith F.Purcell and John C.Kotz, Holt-Saunders International Editions, London(1977).

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SEMESTER-V

Paper II (502): ORGANIC CHEMISTRY-I

Teaching hours-4/week Credits 4

Unit I:Stereochemistry
Unit II: Reaction mechanism-1
Unit III: Conformational analysis (Acyclic systems)
Unit IV: Heterocyclic compounds & Natural products

Unit I:Stereochemistry **15 hrs**

Molecular representations: Wedge, Fischer, Newman and Saw-horse formulae, their description and interconversions.
Molecular Symmetry & Chirality: Symmetry operations and symmetry elements (Cn&Sn). Criteria for Chirality.Desymmetrization.
Axial, planar and helical chirality: Axially chiral allenes,spiranes,alkylidene cycloalkanes, chiral biaryls, atropisomerism, planar chiral ansa compounds and trans- cyclooctene, helically chiral compounds and their configurational nomenclature
Relative and absolute configuration: Determination of configuration by chemical correlation methods.
Racemisation and resolution techniques: Racemisation, resolutions by direct crystallization, diastereoisomer salt formation chiral chromatography and asymmetric transformation.
Determination of configuration in E, Z-isomers: Spectral and Chemical methods of configuration determination of E,Z isomers. Determination of configuration in aldoximes and ketoximes.

Unit II:Reaction mechanism-I **15 hrs**

Electrophilic addition to carbon carbon double bond: Stereoselective addition to carbon carbon double bond; *anti* addition- Bromination and epoxidation followed by ring opening. *Syn*addition of OsO_4 and $KMnO_4$,
Elimination reactions Elimination reactions E2, E1, E1CB mechanisms. Orientation and stereoselectivity in E2 eliminations. Pyrolytic*syn*elimination and α-elimination, elimination Vs substitution.
Determination of reaction mechanism: Determination of reaction mechanism: Energy profiles of addition and elimination reactions, transition states, product isolation and structure of intermediates, use of isotopes, chemical trapping and crossover experiments. Use of IR and NMR in the investigation of reaction mechanism.

Unit III: Conformational analysis(acyclicsystems) **15hrs**
Conformational isomerism: Introduction to the concept of dynamic stereochemistry. Conformational diastereoisomers and conformational enantiomers .Study of conformations in ethane and 1,2-disubstituted ethane derivatives like butane, dihalobutanes, halohydrin, ethylene glycol, butane-2, 3-diol amino alcohols and 1,1,2,2-tetrahalobutanes. Klyne-Prelog terminology for conformers and torsionangles

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Conformations of unsaturated acyclic compounds: Propylene, 1-Butene, Acetaldehyde Propionaldehyde and Butanone.
Factors affecting the conformational stability and conformational equilibrium: Attractive and repulsive interactions. Use of Physical and Spectral methods in conformational analysis.
Conformational affects on the stability and reactivity of acyclic diastereoisomers: Steric and stereoelectronic factors-examples.Conformation and reactivity. The Winstein-Holness equation and the Curtin – Hammett principle

Unit IV: Heterocyclic compounds&Naturalproducts **15 hrs**

Heterocyclic compounds: Introduction, Nomenclature Synthesis and reactivity of indole, quinoline, isoquinoline, carbazole and acridine
Natural products : Importance of natural products as drugs.
Terpenoids: Generalmethodsinthestructuredeterminationofterpenes. Isoprene rule. Structure determination and synthesis of β-carotene, α-terpeniolandcamphor.
Alkaloids: General methods of structure determination of alkaloids. Structure determination and synthesis of papaverine

References:

1.Stereochemistry of carbon compounds by Ernest L.Eliel and Samuel H.Wilen
2. Stereochemistry of organic compounds- Principles and Applications by D.Nasipuri
3.Heterocyclic Chemistry, T.L. Gilchrist, Longman UK Ltd, London (1985).
4.Benzofurans A. Mustafa, Wiley-Interscience, New York(1974).
5.HeterocyclicChemistry,3rd EdnJ.A.Joule, K.Mills and G..F.Smith, Stanley ThornesLtd,UK, (1998)
6.The Chemistry of Indole, R.J. Sunderberg, Academic Press, New York(1970).
7.An introduction to the chemistry of heterocyclic compounds, 2ndEdn.R.M.Acheson, Interscience Publishers, New York, 1967.
8.Advanced Organic Chemistry by JerryMarch
9.Mechanism and Structure in Organic Chemistry S.Mukerjee

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SEMESTER-V

Paper III (503): PHYSICAL CHEMISTRY -I

Teaching hours-4/week **Credits 4**

Unit I: Thermodynamics-I
Unit II: Electrochemistry-I
Unit III: Quantum Chemistry-I
Unit IV: Chemical Kinetics-I

Unit I: Thermodynamics-I 15 hrs

Brief review of I and II Laws of thermodynamics. Concept of Entropy, Entropy as a function of V and T, Entropy as a function of P and T. Entropy change in isolated systems- Clausius inequality. Entropy change as criterion for spontaneity and equilibrium. Third law of thermodynamics. Evaluation of absolute entropies from heat capacity data for solids, liquids and gases. Standard entropies and entropy changes of chemical reactions. Thermodynamic relations. Gibbs equations. Maxwell relations. Gibbs equations for non-equilibrium systems. Material equilibrium. Phase equilibium. Clausius-Clapeyron equation Conditions for equilibrium in a closed system. Chemical potential of ideal gases. Ideal-gas reaction equlibrium-derivation of equilibrium constant. Temperature dependence of equilibrium constant-the van't Hoff equation.

Unit II:Electrochemistry-I 15 hrs

Electrochemical Cells: Derivation of Nernst equation – problems. Chemical and concentration cells (with and without transference). Liquid junction potential (LJP) – derivation of the expression for LJP – its determination and elimination. Types of electrodes. Applications of EMF measurements: Solubility product, potentiometric titrations, determination of pH using glass electrode, equilibrium constant measurements. Decomposition potential and its significance. Electrode polarization – its causes and elimination. Concentration over-potential. Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient. Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law (derivation not required). Calculation of mean ionic activity coefficient. Limitations of Debye-Huckel theory. Extended Debye-Huckel law. Theory of electrolytic conductance. Derivation of Debye-Huckel-Onsager equation – its validity and limitations. Concept of ion association – Bjerrum theory of ion association (elementary treatment)-ion association constant – Debye-Huckel-Bjerrum equation.

Unit III: QuantumChemistry-I 15 hrs

A brief review of Black body radiation-Planck's concept of quantization-Planck's equation, average energy of an oscillator (derivation not required), Wave particle duality and uncertain principle-significance of these for microscopic entities. Emergence of quantum mechanics. Wave mechanics and Schrödinger wave equation. Operators- Operator algebra. Commutation of operators, linear operators. Complex functions. Hermitian operators. Operators ∇ and ∇^2. Eigen functions and eigen values. Degeneracy. Linear combination of eigen functions of an operator. Well behaved functions. Normalized and orthogonal functions. Postulates of quantum mechanics: Physical interpretation of wave function. Observables and Operators. Measurability of operators.

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Average values of observables. The time dependent Schrodinger equation. Separation of variables and the time-independent Schrodinger equation. Theorems of quantum mechanics. Real nature of the eigen values of a Hermitian operator- significance. Orthogonal nature of the eigen values of a Hermitian operator-significance of orthogonality. Expansion of a function in terms of eigen values. Eigen functions of commuting operators-significance. Simultaneous measurement of properties and the uncertainty principle. Particle in a box- one dimensional and three dimensional. Plots of Ψ and Ψ^2-discussion. Degeneracy of energy levels. Calculations using wave functions of the particle in a box- orthoganality, measurability of energy, position and momentum, average values and probabilities. Application to the spectra of conjugated molecules.

Unit IV: Chemical Kinetics- I **15 hrs**

Theories of reaction rates: Collision theory, steric factor. Transition state theory. Thermodynamic formulation of transition state theory. Application to reaction between atoms and molecules. Limitations of transition state theory. Potential energy surface diagram, Reaction coordinate, Activated complex. Activation parameters and their significance. The Eyring equation. Unimolecular reactions and Lindamann's theory. Complex reactions- Opposing reactions, parallel reactions and consecutive reactions (all first order type). Chain reactions-general characteristics, steady state treatment. Example- H_2-Br_2 reaction. Derivation of rate law.□Effect of structure on reactivity- Linear free energy relationships. Hammett and Taft equations-substituent (σ and σ^*) and reaction constant (ρ and ρ^*) with examples. Deviations from Hammett correlations, reasons-Change of mechanism, resonance interaction. Taft four parameter equation. Correlations for nucleophillicreactions. The Swain – Scott equation and the Edward equation. Reactions in solutions: Primary and secondary salt effects. The reactivity-selectivity principle – Isokinetic temperature -Isoselectivty rule, Intrinsic barrier and Hammond's postulate.

References:

1. Atkin's Physical Chemistry, Peter Atkins and Julio de Paula, Oxford University press.
2. Physical Chemistry, Ira N. Levine, McGraw Hill.
3. Physical Chemistry-A Molecular approach, D.A. McQuarrie and J.D. Simon, Viva Books Pvt. Ltd.
4. Molecular Thermodynamics, D.A. McQuarrie and J.D. Simon, University Science Books.
5. Quantum Chemistry, Ira N. Levine, Prentice Hall.
6. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
7. Chemical Kinetics, K.J. Laidler, McGraw Hill.
8. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
9. Introduction to Electrochemistry, S. Glasstone.
10. Modern Electrochemistry, J. O. M. Bockris& A. K. N. Reddy, Plenum.
11. Principles of physical chemistry, Samuel H. Maron and Carl F. Prutton, Oxford& IBH.
12. The Physical Basis of Organic Chemistry by Howard Maskill, Oxford University Press. (New York)
13. Chemical Kinetics and Reaction Mechanisms, J. H. Espenson, McGraw Hill.
14. Physical Organic Chemistry, N. S. Isaacs, ELBS.
15. Elementary Quantum Chemistry, F. L. Pilar, McGraw Hill.
16. Quantum Chemistry – D.A. Mcquarri Viva Publications.

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SEMESTER-V

Paper IV (504): ANALYTICAL TECHNIQUES AND SPECTROSCOPY- I

Teaching hours-4/week **Credits 4**

Unit I: Techniques of Chromatography
Unit II: NMR spectroscopy-I (^{1}H NMR)
Unit III: Rotational and Vibrational spectroscopy
Unit IV: Electronic spectroscopy

Unit I: Techniques of Chromatography 15 hrs

i. Introduction, Classification of chromatographic techniques, differential migration rates, partition ratio, retention time, relation between partition ratio and retention time, capacity factor, selectivity factor. Efficiency of separation- resolution, diffusion, plate theory and rate theory.

ii. **GC:** Principle, instrumentation, detectors- TCD, FID, ECD. Derivatization techniques, PTGC.

iii. **HPLC:** Principle, instrumentation, detectors- UV detectors, Photodiode array detector, fluorescence detector.

iv. **Applications**: Methods of quantization for GC and HPLC: GC analysis of hydrocarbons in a mixture, GC assay of methyl testosterone in tablets, atropine in eye drops. HPLC assay of paracetamol and aspirin in tablets.

Unit II: NMR spectroscopy-I (^{1}H-NMR) 15 hrs

^{1}H NMR spectroscopy: Magnetic properties of nuclei, Principles of NMR Instrumentation, CW and pulsed FT instrumentation, equivalent and non equivalent protons, enantiotopic and diastereotopic protons, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

Applications of ^{1}H NMR spectroscopy: Reaction mechanisms (cyclic bromonium ion, electrophilic and nucleophilic substitutions, carbocations and carbanions), E, Z isomers, conformation of cyclohexane and decalins, keto-enol tautomerism, hydrogen bonding, proton exchange processes (alcohols, amines and carboxylic acids), C-N rotation. Magnetic resonance imaging (MRI). ^{1}H NMR of organic molecules and metal complexes: ethyl acetate, 2- butanone, mesitylene, paracetamol, asprin, ethylbenzoate, benzyl acetate, 2-chloro propionic acid, $[HNi(OPEt_3)_4]^+$, $[HRh(CN)_5]$ (Rh I=1/2), $[Pt(acac)_2]$.

Unit III: Rotational, Vibrational and Raman spectroscopy 15 hrs

a) Microwave Spectroscopy: Classification of molecules based on moment of inertia. Diatomic molecule as rigid rotator and its rotational energy levels. Selection rules (derivation not required). Calculation of bond lengths from rotational spectra of diatomic molecules. Isotope effect on rotational spectra. Calculation of atomic mass from rotational spectra. Brief description of microwave spectrometer.

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b) Vibrational Spectroscopy. Vibrational energy levels of diatomic molecules, selection rules (derivation not required). Calculation force constant from vibrational frequency. Anharmonic nature of vibrations. Fundamental bands, overtones and hot bands, Fermi Resonance. Vibration rotation spectra diatomic molecules. Vibrations of poly atomic molecules. Normal modes of vibration, concept of group frequencies. Characteristics of vibrational frequencies of functional groups; Stereochemical effects on the absorption pattern in carbonyl group, cis-trans isomerism and hydrogen bonding. Isotopic effect on group frequency. IR spectra of metal coordinated NO_3^-, SO_4^{2-} and CO_3^{2-} ions.

c) Raman Spectroscopy- Classical and Quantum theories of Raman effect. Rotational Raman and Vibrational Raman spectra, Stokes and anti- Stokes lines. Complementary nature of IR and Raman spectra.

Unit IV: Electronic spectroscopy **15 hrs**

Electronic spectroscopy: Electronic spectra: Elementary energy levels of molecules-selection rules for electronic spectra; types of electronic transitions in molecules. Chromophores: Congugated dienes, trienes and polyenes, unsaturated carbonyl compounds, Benzene, mono substituted derivative (Ph-R), di substituted derivative (R-C_6H_4-R′) and substituted benzene derivatives (R-C_6H_4-COR′), Woodward-Fieser rules. Polynuclear aromatic compounds (Biphenyl, stilbene, naphthalene, anthracene, phenanthrene and pyrene). Heterocyclic systems. Absorption spectra of charge transfer complexes. Solvent and structural influences on absorption maxima, stereochemical factors. Cis-trans isomers, and cross conjugation. Beer's law application to mixture analysis and dissociation constant of a weakacid.

References:

1. Fundamentals of Molecular Spectroscopy, Banwell and McCash.
2. Introduction to Molecular Spectroscopy, G.M.Barrow.
3. Absorption Spectroscopy of Organic Compounds, J.R. Dyer.
4. Biochemistry: Hames and Hooper.
5. Introduction to Spectroscopy, Pavia Lampman Kriz.
6. Pharmaceutical analysis, Watson
7. NMR in Chemistry- A multinuclear introduction, William Kemp.
8. Organic Spectroscopy, William Kemp.
9. Atomic Structure and Chemical bond: including Molecular Spectrodcopy, Manas Chanda,
10. Spectroscopy of organic compounds, P.S. Kalsi.
11. Structural methods in Inorganic chemistry, E.A.V Ebsworth.
12. Organic Spectroscopy, LDS Yadav
13. Organic Spectroscopy, Y.R.Sharma
14. Molecular Spectroscopy –Arhuldas
15. Vibrational spectroscopy – D.N. Satyanarayana

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SEMESTER-V
Paper V (505): Skill Enhancement Skill III (SEC-III)

Basic Computer Skills

Credits 2

Teaching hours-2/week

Unit I: Introduction to Computers & Fundamentals of an operating system: **(8Hrs)**
Introduction to computers: History of computers, Block diagram of a computer – CPU –memory- ROM, RAM, Input / Output Devices.
Operating System: Introduction. What is an OS? Types of OS, OS concepts, Structure of OS, Functions of OS.

Unit II: Introduction to UNIX operating System **(8Hrs)**
Introduction to UNIX operating System: Salient features of UNIX – UNIX system organizations, UNIX commands. UNIX system organizations – Types of Shells – sh, ksh, rsh, csh – UNIX commands.

Unit III: Introduction to C Programming Language: **(8Hrs)**
Introduction to C Programming Language- Historical development, what is c, where c stands for C preprocessor, features of C preprocessor.
C Programming Language concepts- character set, variables and constants, data types, Arithmetic, relational and logical operators and their hierarchy and associativity – expression and statements. Control statements – if-else and else-if. Switch. Loops – while, for, do-while.

Unit IV: HTML **(8Hrs)**
Introduction to HTML - HTML elements – tags and attributes - head, base, meta, title, script and styles – body of HTML – paragraph div, hr, br.
Lists: UL and OL. Nested lists, Images – Types of format – inserting images – attributes.
Tables: table rows, table data, cell and its attributes – table attributes – column span, row span, Style sheets, Hypertext anchors – links to objects.

Suggested Books:

1. Computer Organization and Architecture – Williams Stallings.
2. Operating System – Modern Operating System – Andrew.S. Tenenbaum.
3. UNIX- Shell Programming in UNIX - Yashwant Kanitker.
4. Programming with C – E. Blalaguruswamy (TMH)
5. Programming Using C Language – Byron Gottfried, McGraw Hill (Schaum's series)
6. HTML black book – Steven Holzner.

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SEMESTER-V Practicals:

Paper V (551): Inorganic Chemistry- I

Teaching hours-6/week **Credits 2**

I. Calibrations:
(i) Calibration ofweights.
(ii) Calibration ofpipettes.
(iii) Calibration of standardflasks.
(iv) Calibration ofburette.
II. EDTAback-titrations:
(i) Estimation of Ni^{2+}.
(ii) Estimation of Al^{3+}.
III. EDTA substitutiontitrations:
Estimation of Ca^{2+}.
IV. RedoxTitrations
(i) Estimation of Ferrocyanide and Ferricyanide in a mixture.
V. Preparation ofcomplexes:
(i). Hexaammine nickel (II) chloride.
(ii). Tris (acetylacetanato) manganese.
(iii). Tris (ethylenediamine) nickel (II) thiosulphate.
(iv). Mercury tetrathiocyanatocobaltate (II).
(v). Chloropentaammine cobalt (III)chloride
(vi). Tetrammine copper (II) sulphate and estimation of NH_3 and calculation of %purity.

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SEMESTER-V Practicals:

Paper VI (552): Organic Chemistry -I

Teaching hours-6/week **Credits 2**

Synthesis of the following compounds:
p-Bromoacetanilide,
p- Bromoaniline,
2,4,6- tribromoaniline,
1,3,5-tribromobenzene,
aspirin,
tetrahydrocarbazole,
7-hydroxy-4-methyl coumarin,
m-dinitrobenzene,
m-nitroaniline,
hippuric acid,
azlactone,
anthracene-maleic anhydride adduct,
Phthalimide,
2,4-dihydroxyacetophenone

References.
1. Text book of practical organic chemistry,Vogel
2. Text book of practical organic chemistry, Mann andSaunders.

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SEMESTER-V Practicals:
Paper VII (553): Physical Chemistry - I

Teaching hours-6/week **Credits 2**

A. Chemical Kinetics:
1. Stoichiometry of $K_2S_2O_8$ –KI reaction
2. Overall order of $K_2S_2O_8$ –KI reaction
3. Order with respect to $K_2S_2O_8$ using initial rate method
4. Order with respect to KI using initial rate method

B. Distribution:
5. Distribution of Iodine between n–hexane and water
6. Distribution of Iodine between n–hexane and aq. KI (Calculate equilibrium constant)
7. Distribution of succinic acid between water and ether / n- butanol

C. Polarimetry:
8. Determination of specific rotation of Sucrose, Glucose and Fructose
9. Acid catalyzed hydrolysis of Sucrose (Inversion of Sucrose)
10. Enzyme catalyzed hydrolysis of sucrose

D. pH-metry:
11. Calibration of a pH meter and measurement of pH of different solutions
12. Preparation of phosphate buffers
13. Titration of strong acid vs strong base

E. CST:
14. Determination of CST of of phenol-water system
15. Effect of added electrolyte on the CST of phenol-water system

References:

1. A textbook of practical organic chemistry by A I Vogel, Vol 1&2.
2. Senior practical physical chemistry. B. D. Khosla, V.C. Garg, AdarshGulati
3. Experimental Physical Chemistry: V. Athawale and P. Mathur.
4. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
5. Practical in Physical Chemistry: P.S. Sindhu
6. Advanced Practical Physical chemistry: J.B.Yadav

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SEMESTER-VI
Paper I – (601) INORGANIC CHEMISTRY-II

Credits 4

Teaching hours-4/week

Unit V: Reaction mechanisms of transition metalcomplexes
Unit VI: Bonding in metal complexes-II
Unit VII: Metal clusters
Unit VIII: Biocoordination chemistry

Unit V: Reaction mechanisms of transitionmetalcomplexes: **15hrs**

Ligand substitution reactions:
Energy profile of a reaction – Transition state or Activated Complex. Types of substitution reactions (SE, SN, SN^1, SN^2). Langford and Grey classification – A mechanism, D-Mechanism, I_a, I_d, and Intimate mechanism.

Ligand substitution reactions in octahedral complexes:
Aquation or Acid hydrolysis reactions, Factors effecting Acid Hydrolysis , Base Hydrolysis, Conjugate Base Mechanism, Evidences in favour of SN^1CB Mechanism.
Substitution reactions without Breaking Metal-Ligand bond. Anation reaction

Ligand Substitution reactions in Square-Planar complexes: Mechanism of Substitution in Square-Planar complexes- Trans-effect, Trans-influence, Grienberg's Polarization theory and Π - bonding theory – Applications of Trans-effect in synthesis of Pt (II) complexes.

Electron Transfer Reactions (or Oxidation-Reduction Reactions) in Coordination compounds: Mechanism of One-electron Transfer Reactions: Atom (or group) Transfer or Inner Sphere Mechanism, Direct electron Transfer or Outer Sphere Mechanism. Factors affecting direct electron transfer reactions, Cross reactions and Marcus-Hush theory.

Unit VI: Bonding in Metal Complexes–II: **15 hrs**

Free ion terms and Energy levels: Configurations, Terms, States and Microstates – Formula for the calculation of Microstates p^n and d^n configurations – L-S (Russel-Saunders) coupling scheme – j-j coupling scheme – Determination of terms for various p^n and d^n configurations of metal ions. Hole formalism – Energy ordering of terms (Hund's rules) Inter – electron repulsion Parameters (Racah parameters) – Spin-Orbital coupling parameters. Effect of weak cubic crystal fields on S,P,D and F terms- Orgel Diagrams.

Unit VII: MetalClusters: **15 hrs**

Carbonyl clusters: Factors favouring Metal-Metal bonding – Classification of Clusters – Low Nuclearity Clusters : M_3 and M_4 clusters , structural patterns in $M_3(CO)_{12}$ (M=Fe,Ru,Os) and $M_4(CO)_{12}$ (M=Co,Rh,Ir) Clusters. Metal carbonyl scrambling – High Nuclearity clusters M_5, M_6, M_7, M_8 and M_{10} Clusters-, Polyhedral skeletal electron pair theory and Total Electron Count theory – Capping rule – Structural patterns in $[Os_6(CO)_{18}]^{2-}$, $[Rh_6(CO)_{16}]$, $\{Os_7(CO)_{21}\}$, $\{Rh_7(CO)_{16}\}^{3-}$, $[Os_8(CO)_{22}]^{2-}$, $[Os_{10}C(CO)_{24}]^{2-}$ and $[Ni_5(CO)_{12}]^{2-}$.

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Metal Halide clusters: Major structural types in Dinuclear Metal-Metal systems – Edge sharing Bioctahedra, Face sharing Bioctahedra, Tetragonal prismatic and trigonal antiprismatic structures -. Structure and bonding in $[Re_2Cl_8]^{2-}$ and Octahedral halides of $[Mo_6(Cl)_8]^{4+}$ and $[Nb_6(Cl)_{12}]^{2+}$. Trinuclear halides of Re(III). Hoffman's Isolobal analogy and its Structural implications. Boranes, carboranes, STYX Rule. Stereo chemical non-rigidity in $[Rh_4(CO)_{12}]$ and $[Fe_2(Cp)_2(CO)_4]$.

15 hrs

Unit VIII: Bio-coordination chemistry:

Metal ions in Biological systems: Brief survey of metal ions in biological systems. Effect of metal ion concentration and its physiological effects. Basic principles in the biological selection of elements.

Oxygen transport and storage: Hemoglobin (Hb) and Myoglobin (Mb) primary, secondary, tertiary and quarternary structures and non-covalent bonds present in them. Oxygenation equilibria for Mb and Hb. Factors effecting oxygenation equilibria. Cooperativity and its mechanism. Spin state of iron. Spatial and electronic aspects of dioxygen binding. Allosteric models (T and R states). Role of globin. Transport of NO and CO_2. Hemocynin (Hc) and Hemerythrin (Hr): Introduction-structure of active sites with oxygen and without oxygen. Comparison of Hemerythrin and Hemocyanin with hemoglobin.

Photosynthesis: Structural aspects of Chlorophyll. Photo system I and Photo system II.

Vitamin B_6 model systems: Forms of vitamin B_6 with structures. Reaction mechanisms of (1) Transamination (2) Decarboxylation and (3) Dealdolation in presence of metal ions.

References:

1. Inorganic Reaction Mechanisms. M.L.Tobe and John Burgess, Addison Wesley Longman (1999).
2. Metal ions in Reaction Mechanisms. K.Veera Reddy. Golgotia Publications (P)Ltd
3. Mechanisms of Reactions in Transition Metal Sites. Richard A Henderson, Oxford Science Publications, London(1993).
4. Inorganic Reaction Mechanisms, F.Basolo and R.G.Pearson, New York(1967).
5. Advanced Inorganic Chemistry. F.A.Cotton, G.Wilkinson, C.A.Murillo and M.Bochmann, 6 Th Edition, Wiley Interscience, N.Y(1999
6. Inorganic Chemistry, J.E.Huheey ,K.A.Keiter and R.L.Keiter 4 th Edition Harper Cottens College Publications(1993).
7. Inorganic Biochemistry Edited by G.L.Eichorn, Volume 1 Elsevier (1982).
8. The Chemistry of Metal Cluster Complexes. D.F.Shriver, H.D.Kaerz and R.D.Adams (Eds), VCH, NY(1990).
9. Inorganic Chemistry, Keith F.Purcell and John C.Kotz, Holt-Saunders International Editions, London(1977).
10. Bioinorganic Chemistry, I.Bertini, H.B.Gray, S.J. Lippard and S.J. Valentine, Viva Low-Priced Student Edition, New Delhi(1998).
11. Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, W. Kaim and B.Schwederski, John Wiley and Sons, NY(1999).

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SEMESTER-VI
Paper II –(602) ORGANIC CHEMISTRY-II

Teaching hours-4/week **Credits 4**

Unit V: Reaction mechanism-II
Unit VI: Pericyclic reactions-I
Unit VII: Photochemistry
Unit VIII: Reactive intermediates and molecular rearrangements

Unit V:Reaction mechanism-II **15 hrs**

Nucleophilic Aromatic substitution: Aromatic Nucleophilic substitution: $S_N1(Ar)$, S_N2 (Ar), and benzyne mechanisms; evidence for the structure of benzyne. Von Richter rearrangement. Definition and types of ambident nucleophiles.

Neighbouring group participation : Criteria for determining the participation of neighbouring group. Enhanced reaction rates, retention of configuration, isotopic labeling and cyclic intermediates. Neighbouring group participation involving Halogens, Oxygen, Sulphur, Nitrogen, Aryl, Cycloalky l groups , σ and π- bonds. Introduction to nonclassicalcarbocations.

Electrophilic substitution at saturated carbon and single electron transfer reactions. Mechanism of aliphatic electrophilic sustitution. S_E1, S_E2, and S_Ei. SET mechanism.

Unit VI: Pericyclic reactions **15 hrs.**

Introduction, Classification of pericyclic reactions,

Electrocyclic reactions: con rotation and dis rotation. Electrocyclic closure and opening in 4n and 4n+2 systems.

Cycloaddition reactions: suprafacial and antara facial additions in 4n and 4n+2 cycloadditions.

Sigmatropic reactions: [i, j] shifts- suprafacial and antarafacial shifts, Cope and Claisen rearrangement reactions.

Approaches for the interpretation of mechanism of pericyclic reactions: Aromatic Transition States (ATS)/Perturbation Molecular Orbitals (PMO) approach-Concept of Huckel –Mobius aromatic and antiaromatic transition states. Framing Woodward-Hofmann selection rules for all the pericyclic reactions by ATS approach. Solving problems based on ATS approach.

Molecular orbitals: ethylene, 1, 3-butadiene, 1, 3, 5-hexatriene, allylcation, allyl radical, pentadienylcation, pentadienyl radical.

Frontier Molecular Orbital (HOMO-LUMO) approach-concept: Framing Woodward-Hofmann selection rules for all the pericyclic reactions by Frontier Molecular Orbital (FMO) approach. Solving problems based on FMO approach.

Conservation of orbital symmetry: (Correlation Diagrams) approach- for electrocylic and cycloadditions &cycloreversions.

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Unit VII: Photochemistry 15hrs

Photochemistry: Photochemistry of π-π* transitions: Excited states of alkenes, cis-trans isomerisation, and photo stationary state. Photochemistry of 1,3-butadiene Electrocyclisation and sigmatropic rearrangements, di-π methane rearrangement. Intermolecular reactions, photocycloadditions, photodimeriastion of simple and conjugated olefins. Addition of olefins to α, β-unsaturated carbonyl compounds. Excited states of aromatic compounds, Photoisimerisation of benzene.

Photochemistry of (n-π*) transitions: Excited states of carbonyl compounds, homolytic cleavage of α-bond, Norrish type I reactions in acyclic and cyclic ketones and strained cycloalkane diones.

Intermolecular abstraction of hydrogen: photoreduction-influence of temperature, solvent, nature of hydrogen donor and structure of the substrate.

Intramolecular abstraction of hydrogen: Norrish type II reactions in ketones, esters and 1,2diketones, Addition to carbon-carbon multiple bonds, Paterno-Buchi reaction,

Photochemistry of nitrites-Barton reaction.

Unit VIII: Reactive intermediates and Molecular rearrangements 15 hrs

Reactive Intermediates: Generation, detection, structure, stability and reactions ofcarbocations, carbanions, carbenes, nitrenes and free radicals.

Molecular rearrangements: Definition and classification. Molecular rearrangements involving 1) electron deficient carbon: Wagner- Meerwein, Pinacol-Pinacolone, Allylic and Wolf rearrangement. 2) electron deficient Nitrogen: Hofmann, Lossen, Curtius, Schmidt and Beckmann rearrangements 3) electron deficient Oxygen: Baeyer-Villiger oxidation. 4) Base catalyzed rearrangements: Benzilic acid, Favourski, Transannular, Sommlett-Hauser and Smiles rearrangement

References :

1. Stereochemistry of Carbon compounds by Ernest L Eliel / Samuel H.Wilen
2. Stereochemistry of organic compounds – Principles and Applications by DNasipuri
3. The third dimension in organic chemistry, by AlanBassindale
4. Stereochemistry: Conformation and Mechanism by P SKalsi
5. Stereochemistry by V MPotapov
6. Advanced Organic Chemistry by JerryMarch
7. Mechanism and Structure in Organic Chemistry S.Mukerjee
8. Organic chemistry Vol.I and II byI.L.Finar
9. Comprehensive organic chemistry Vol.5 D.H.R.Barton andW.D..Ollis

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SEMESTER-VI
Paper III –(603) PHYSICAL CHEMISTRY-II

Teaching hours-4/week **Credits 4**

Unit V: Thermodynamics-II & Statistical Thermodynamics
Unit VI: Photochemistry-I
Unit VII: Quantum Chemistry-II
Unit VIII: Solid state chemistry

Unit V: Thermodynamics-II & Statistical Thermodynamics **15 hrs**

Partial molar poperties-significance. Relation between solution volume and partial molar volume. Measurement of partial molar volumes- slope and intercept methods. The chemical potential. Variation of chemical potential with T and P. Gibbs-Duhem equation-derivation and significance.
Ideal solutions. Thermodynamic properties of ideal solutions. Mixing quantities. Vapour pressure - Raoult's law. Thermodynamic properties of ideally dilute solutions. Vapour pressure- Henry's law.□Nonideal systems. Concept of fugacity, fugacity coefficeient. Determination of fugacity. Non ideal solutions. Activities and activity coefficients. Standard-state conventions for non ideal solutions. Determination of activity coefficients from vapour pressure measurements. Activity coefficients of nonvolatile solutes using Gibbs-Duhem equation. Multicomponent phase equilibrium: Vapour pressure lowering, freezing point depression and boiling point elevation

Unit VI: Photochemistry–I **15 hrs**

Electronic transitions in molecules. The Franck Condon principle. Electronically excited molecules-singlet and triplet states. Radiative life times of excited states-theoretical treatment. Measured life times. Quantum yield and its determination. Experimental set up of a photochemical reaction. Actinometry-ferrioxalate and uranyl oxalate actinometers – problems. Derivation of fluorescence and phosphorescence quantum yields. E-type & P-type delayed fluorescence- evaluation of triplet energy splitting (ΔEST). Photophysical processes- photophysical kinetics of unimolecular reactions. Calculation of rate constants of various photophysical processes-problems, State diagrams□Photochemical primary processes. Effect of light intensity on the rates of photochemical reactions. Photosensitization. Quenching-Stern-Volmer equation. Introduction to fast reactions-Principle of flash photolysis. Formation of excimers and exciplexes- their quantum yields

Unit VII: Quantumchemistry-II **15 hrs**

Cartesian, Polar and spherical polar coordinates and their interrelations.
Schrodinger equation for the hydrogen atom- separation into three equations. Hydrogen like wave functions. Radial and angular functions. Quantum numbers n, l and m and theirimportance. The radial distribution functions. Hydrogen like orbitals and their representation. Polar plots, contour pots and boundary diagrams.
Many electron systems. Approximate methods. The variation method-variation theorem and its proof. Trial variation function and variation integral. Examples of variational calculations. Paricle in a box. Construction of trial function by the method of linear combinations. Variation parameters. Secular equations and secular determinant.
Bonding in molecules. Molecular orbital theory-basic ideas. Construction of MOs by LCAO, H_2^+ ion.

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The variationan integral for H_2^+ ion. Detailed calculation of Wave functions and energies for the bonding and antibonding MOs. Physical picture of bonding and antibonding wave functions. Energy diagram. The MO wave function and the energy of H_2 molecule MO by LCAO method and Valence bond method (detailed calculations not required)-comparison of MO and VB models.

Unit VIII: Solid state chemistry **15 Hrs**

Electronic properties of metals, insulators and semi-conductors: Electronic structure of solids, Band theory, band structure of metals, insulators and semi-conductors. Electrons, holes and Excitons. The temperature dependence of conductivity of extrinsic semi-conductors. Photo conductivity and photovoltaic effect – p-n junctions.

Superconductivity: Occurrence of superconductivity. Destruction of superconductivity by magnetic fields – Meissner effect. Types of superconductors. Theories of super conductivity – BCS theory. High temperature superconductors: Structure of defect perovskites. High T_c superconductivity in cuprates. Phase diagram of Y-Ba-Cu-O system. Crystal structure of $YBa_2Cu_3O_{7-x}$. Prepartion of 1-2-3 materials. Origin of high T_c superconductivity.

Classification of solids based on magnetic properties: Paramagnetic, Diamagnetic, Ferro, antiferro, Langvien theory of diamagnetic materials.

References:

1. Atkin's Physical Chemistry, Peter Atkins and Julio de Paula, Oxford University press.
2. Physical Chemistry, Ira N. Levine, McGraw Hill.
3. Physical Chemistry-A Molecular approach, D.A. McQuarrie and J.D. Simon, VivaBooks Pvt Ltd.
4. Molecular Thermodynamics, D.A. McQuarrie and J.D. Simon, University Science Books.
5. Quantum Chemistry, Ira N. Levine, Prentice Hall.
6. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
7. Introduction to Solids, Leonid V. Azaroff, Tata McGraw Hill.
8. Solid state Chemistry, D.K. Chakrabarthy, New Age International.
9. Solid state Chemistry and its aplications, A.R. West, Plenum.
10. Fundamentals of Photochemistry, K.K.Rohtagi-Mukherji, Wiley-Eastern.
11. Molecular Photochemistry, N.J. Turro, Benjamin.
12. Photochemistry, R.P.Kundall and A. Gilbert, Thomson Nelson.
13. Essentials of Molecular Photochemistry by A. Gilbert and J. Baggott, Blackwell, Scientific Publications.
14. Organic Photochemistry by J.M.Coxon and B.Halton, Cambridge University press.
15. Introductory Photochemistry by A.Cox and T.J.Kemp. McGraw-Hill, London.
16. Principles of the Solid State, H. V. Keer, New Age International.
17. Elements of Physical Chemistry by Peter Atkins and Julio de Paula, Oxford University Press.
18. Quantum Chemistry, D.A. McQuarrie, Prentice Hall.
19. Elementary Quantum Chemistry, F. L. Pilar, McGraw Hill.
20. Nanostructured Materials and Nanotechnology, edited by Hari Singh Nalwa, Academic Press.
21. Self-Assembled Nanostructures, Jin Zhang, Zhong-lin Wang, Jun Liu, Shaowei Chen & Gan-Yu-Liu, Kluwer Academic/Plenum.
22. Introduction to Nanotechnology, Charles P. Poole Jr, F. J. Owens, Wiley India Pvt. Ltd.
23. The physics and chemistry of solids by Stephen Elliott, Wiley Publishers.
24. Introductory Photochemistry by A.Cox and T.J.Kemp. McGraw-Hill, London.
25. Solid State Chemistry, Gurtu-Gurtu, PragatiPrakashan, Meerut.

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SEMESTER-VI
Paper IV –(604) ANALYTICAL TECHNIQUES and SPECTROSCOPY - II

Teaching hours-4/week **Credits 4**

Unit V: Electro analytical Techniques.
Unit VI: NMR- II
Unit VII: Mass Spectroscopy
Unit VIII: Photoelectron & ESR spectroscopy

Unit V: Electro Analytical Techniques **15 hrs**

Types and Classification of Electro analytical Methods:

a) D.C Polarography:. Instrumentation - Dropping mercury electrode- -polarogram. Types of Currents: Residual, Migration, Limiting. Two and Three electrode assemblies. Ilkovic equation (derivation not necessary) and its consequences. Applications of polarography in qualitative and quantitative analysis. Analysis of mixtures. Application to inorganic and organic compounds. Determination of stability constants ofcomplexes.

b) Brief account of following techniques and their advantages over conventional d.c.polargraphy.

(i) A.C.polarography (ii) Square-wave polarography (iii) Pulse polarography (iv) Differential pulse polarography

c) Amperometric titrations: Principle, Instrumentation. Types and applications of amperometric titrations. Determination of SO_4^{2-}, metal ions viz., Mg^{2+}, Zn^{2+}, Cu^{2+} and other substances.

d) Cyclic Voltammetry: Principle, instrumentation, Applications. Cyclic voltammetric study of insecticideparathion.

Unit VI: NMR spectroscopy-II (^1H, ^{19}F and ^{31}PNMR) 15 hrs

^1H, ^{19}F, ^{31}P and solid state NMR spectroscopy: First order and non first order spectra e.g., AX, AX_2, AX_3, A_2X_3, AMX and AB, ABC. Simplification of complex spectra: increased field strength, deuterium exchange, Lanthanide shift reagents and double resonance techniques. Discrimination of enantiomers by use of chiral NMR solvents (CSAs), chiral lanthanide shift reagents and Mosher's acid. Nuclear Overhauser enhancement (NOE). Fluxional moleculesbullvalene, [η5-C_5H_5M], [η5-$(C_5H_5)_2$ Ti η1-$(C_5H_5)_2$] and [η4$C_8H_8Ru(CO)_3$].

^{19}F NMR spectroscopy: ^{19}F chemical shifts, coupling constants. Applications of ^{19}F NMR involving coupling with ^{19}F, ^1H and ^{31}P: 1,2 dichloro-1,1 difluoro ethane, BrF_5, SF_4, PF_5, ClF_3, IF_5,CF_3CH_2OH

^{31}P NMR spectroscopy: ^{31}P chemical shifts, coupling constants. Applications of ^{31}P NMR involving coupling with ^{31}P, ^{19}F, ^1H and ^{13}C: ATP, Ph_3PSe, P_4S_3, H_3PO_4, H_3PO_3, H_3PO_2, HPF_2, PF_6^-, PH3, $[Rh(PPh_3)Cl_3]$ (Rh I=1/2)

Introduction to solid state NMR: Magic angle spinning (MAS).Applications of solid state NMR.

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Unit VII: Mass spectrometry **15 hrs**

Origin of mass spectrum, principles of EI mass spectrometer. Types of fragments: odd electron and even electron containing neutral and charged species (even electron rule), Nitrogen rule, isotopic peaks, determination of molecular formula, metastable ion peaks. High resolution mass spectrometry. Salient features of fragmentation pattern of organic compounds including β-cleavage, Mclafferty rearrangement, retro Diels – Alder fragmentation and ortho effect. Principle of EI, CI, Fast Atom Bombardment (FAB), Secondary Ion Mass Spectrometry (SIMS), Electrospray (ESI) ionization and Matrix Assisted Laser Desorption Ionization (MALDI) methods. Introduction to principle and applications of Gas Chromatography-Mass Spectrometry (GC-MS) and Liquid chromatography-Mass Spectrometry (LC-MS) techniques.

Unit VIII: Photoelectron & ESR spectroscopy **15 hrs**

Photo electron Spectroscopy: Principle and Instrumentation, Types of Photoelectron Spectroscopy – UPS & XPS. Binding Energies, Koopman's Theorem, Chemical Shifts. Photoelectron Spectra of Simple Molecules: N_2, O_2, F_2 - Vibrational Structure of PES Bands, Potential energy curves, Interpretation of Vibrational spectral data for ionized (M^+) species, Prediction of Nature of Molecular Orbitals. ESCA in qualitative analysis, Principles of Auger electron spectroscopy.

Electron Spin Resonance: Introduction, principle, instrumentation, selection rules, interpretation of Lande's factor 'g'. Hyperfine and super hyperfine Coupling. Anisotropy in 'g' values and hyperfine coupling constants. Zero field splitting, Kramer's degeneracy and quadrupolar interactions. Study of free radicals and transition metal complexes. Evidence for covalency in complexes, ex. Cu(II) Bissalcylaldimine, Bis-acetylacetanatovanadyl(II) and hexachloroiridium(IV) complexes.

References:

1. Spectroscopic identification of organic compounds by R.M. Silverstein and F.X. Webster.
2. Organic spectroscopy by William Kemp
3. Mass Spectrometry for Chemists and biochemists by M. Rose and R.A. W.J ohnstone
4. Spectroscopic methods in organic chemistry by D.H. Williams and I. Fleming
5. Practical Pharmaceutical Chemistry by A. H. Beckett and J.B. Stenlake
6. Biological Mass Spectrometry by A.L. Burlingame
7. Principles and Practice of Biological Mass Spectrometry by Chhabil Das
8. Spectroscopic identification of organic compounds by R.M.Silverstein. C.Basslerand T.E. Morrill
9. NMR-A multinuclear introduction by William Kemp
10. Stereochemistry of Carbon compounds by Ernest L Eliel / Samuel H. Wilen
11. Principles of Polarography, Heyrovsky.
12. Principles of Polarography, Kapoor.
13. Modern Electroanalytical methods, edited by C.Charlot, Elsevier Company.
14. Principles of Instyrumental analysis, Skoog, Holler and Nieman, Harcourt Asia PTE Ltd.
15. Analytical Chemistry-An Introduction, Skoog, West, Holler and Crouch, Saunders college Publishing.
16. International series of Monographs, Vol. **53**: Photoelectron Spectroscopy, Edited by D. Beckerand D. Betteridge 1972.
17. Sructural methods in inorganic chemistry, E.A.V. Ebsworth

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SEMESTER-VI
Paper V (605): Skill Enhancement Skill III (SEC-IV)

Computational Chemistry and Drug Designing

Credits 2

Teaching hours-2/week

Unit I: Computational Chemistry
Unit II: Drug Designing

Unit I: Computational Chemistry

Introduction to Molecular Modeling, Single molecule calculations, assemblies of molecules and reactions of molecules - Co-ordinate systems, Cartisian and internal Co ordinates, Z-matrix, Potential energy surface - Conformational search - Global minimum, Local minima, Conformational analysis of ethane.

Force field - Features of Molecular Mechanics –Bonded and Non-bonded interactions. Bond Stretching – Angle Bending, Torsional Terms – Improper Torsions and out of Plane Bending Motions – Cross Terms. Non Bonded Interactions – Electrostatic Interactions - Van-der Waals interactions - Hydrogen Bonding, Miscellaneous interactions.

Force Field Equation in Energy minimization (Energy as function of r, θ, ω) and variation w.r.t ω only - Introduction to Derivative Minimization Methods – First Order Minimization – The steepest Descent Method – Conjugate Gradients Minimization – Conformational Search procedures - Geometry optimization procedures - Introduction to molecular dynamics.

Unit II: Drug Designing

Ligand Based

Lead Molecule - Structure Activity Relationship (SAR) –QSAR- Physicochemical parameters, Hydrophobicity, Electronic effects, Steric Factors: Molar refractivity, Verloop steric factor and other physicochemical parameters.

Methods used in QSAR studies- Correlation of Biological activity with physico chemical Parameters – Application of Hammet equation, Hansch analysis, significance of slopes and intercepts in Hansch analysis. QSAR- 2D

Linear Free Energy Relationship (LFER) - Craig plot - Topliss scheme - Bioisosteres - Free-Wilson approach - Molecular Descriptor analysis - Structure representation.

Structure Based.

Homology Modeling – Model Evaluation: Ramachandran Plot - Active site Identification - Docking - Docking Algorithms- Interactions-Scoring-Virtual Screening - Small molecule Building – De novo ligand design.

References:

1. Molecular Modelling: Principles and Applications, by Andrew Leach, Longman Publications.
2. Computational Chemistry, Guy H. Grant & W. Graham Richards, Oxford University Press.
3. Computational Chemistry: Introduction to the theory and Applications of Molecular and Quantum Mechanics, Errol Lewars, Springer Publications.

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4. Recent advances in Bioinformatics by I. A. Khan and A Khanum Ukaaz publications, 2003
5. Molecular modelling – Basic Principles and Applications by Hans Dieter Holtje and Gerd Folkers, Wiley-VCH, 1996
6. Introduction to Computational Chemistry by Jensen, Wiley Publishers, second edition.
7. Bioinformatics – A Primer by P. Narayanan, New Age International, (P) Ltd, 2005.
8. Introduction to Bioinformatics by Arthur M. Lesk, Oxford University Press (Indian. Edition), 2002
9. Principles of Medicinal Chemistry Vol. II by Dr. SS Kadam Pragati books Pvt. Ltd; 2007
10. Principles of Medicinal Chemistry, by Patrick
11. Bioinformatics: Methods : Genomics, Proteomics and Drug Discovery. S.C. Rastog,NamitaMendiratta, Parag Rastogi, PHI Larning Pvt.Ltd; 2006
12. Pharmacy Practice Vol.I and II by Remington.
13. Burger's Medicinal Chemistry and Drug Discovery, 5th Edition
14. Text book of Drug design and Vol.1 discovery 3rd Edition by POVL krogsgaard- larsen tommy liljefors and ULF madsen.

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SEMESTER-VI Practicals:
Paper V (651): Inorganic Chemistry -II

Teaching hours-6/week **Credits 2**

I One component gravimetric estimations
(i) Estimation of Zn^{2+}
(ii) Estimation of Ba^{2+} (as $BaSO_4$)

II Analysis of Two component mixtures:
(i). Separation of Ni^{2+} and Cu^{2+} in a mixture and estimation of Ni^{2+} (gravimetric) and Cu^{2+} (volumetric).

III Analysis of three component mixtures:
(i). Separation of (Ni^{2+} and Cu^{2+}) from Mg^{2+} in the given mixture and estimation of Mg^{2+} (Gravi).

IV Applied titrimetric analysis
(i) Determination of Iron and calcium in Cement
(ii) Determination of Calcium in calcium tablets
(iii)Determination of alkali content in antacid
(iv) Determination of Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^- in soil sample
(v) Determination of saponification value, Iodine number (5-6 samples and comparative study)
(vi) Determination of residual Chlorine in water by Iodometry.
(vii) Determination of Dissolved Oxygen in water sample

Suggested Books: (For both semesters).

1. (i). Text book of Quantitative Inorganic Analysis by A.I. Vogel, 3rd edition, ELBS 1969. (ii). Vogel's text book of Quantitative Inorganic analysis. Jeffery etal, 4th edition, ELBS 1988. (iii). Vogel's text book of Quantitative Inorganic Analysis. 6th edition, Pearson education ltd 2002.
2. Practical Inorganic chemistry By G.Marr and R.W.Rockett1972.
3. Experimental Inorganic/Physical Chemistry – An Investigative integrated approach to Practical Project work. By MounirA.Malati,1999.
4. Advanced experimental Inorganic chemistry by. AyodhyaSingh.
5. Practical Inorganic Chemistry by G. Pass & H. Sutchiffe, 2nd edn John Wiley &sons.
6. Comprehensive Experimental Chemistry by V.K. Ahluwalia et.al New Age Publications 1997.
7. Analytical Chemistry-Theory and Practice by R.M. Verma 3rd Ed. CBS Publishers & Distributors 1994

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SEMESTER-VI Practicals:
Paper VI (652): Organic Chemistry - II

Teaching hours-6/week **Credits 2**

Identification of organic compounds systematic qualitative analysis:
Physical data BP / MP, Ignition test, solubility classification, Extra elements-N,S& Halogens, (Lassagnine sodium fusion test, Beilstein test)
Functional groups tests, Preparation of crystalline derivative and determination of their m.p.s and reference to literature to identify the compounds
A minimum of **8** following compounds to be studied as unknown covering atleast one from each of the solubility classes
Glucose, benzoic acid, 2-chloro benzoic Acid, Anisic acid, p-Nitrobenzoic acid; p-Cresol, p-Chlorophenol, β-Naphthol; Aniline, o/m/p-Chloroanilines; N-Methyl aniline/N-Ethylaniline, N,N-Dimethylaniline,Benzamide, Benzaldehyde, Anisaldehyde, Acetophenone,benzophenone,Ethylbenzoate,methylbenzoate,Nitrobenzene, chlorobenzene, bromobenzene , naphthalene, biphenyl anthracene.

Identification of unknown organic compounds from their IR, UV, ^{1}H-NMR and MS:
Analysis of recorded spectra of 6 compounds belonging to i) aromatic carboxylic acid ii) alcohols and phenols iii) aldehydes and ketones iv) amides v) esters vi) alkenes and alkynes

References
1. Text book of practical organic chemistry,Vogel
2. Text book of practical organic chemistry, Mann andSaunders.
3. Spectral identification of organic compounds Bassler, Silverstein 5thEdition

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SEMESTER-VI Practicals:
Paper VII (653): Physical Chemistry Practicals

Teaching hours-6/week **Credits 2**

Kinetics and Instrumentation

(A) Chemical Kinetics

$K_2S_2O_8$-KI reaction

1. Order with respect to KI using isolation method
2. Effect of Ionic strength on reaction rate
3. Effect of temperature on reaction rate
4. Effect of solvent (Acetonitrile, Methanol and 1,4 dioxane) on reaction rate
5. Effect of Ionic strength on uncatalysed and Cu(II) –catalyzed reactions.

(B) Instrumentation – Conductometry

1. Strong acid vs Strong base
2. Weak acid vs Strong base
3. Mixture of strong and weak acids vs strong base
4. Mixture of strong and weak bases vs strong acid
5. Mixture of strong acid, weak acid and metal ions ($CuSO_4$, $ZnSO_4$, $MgSO_4$, $NiSO_4$) vs strong base
6. Mixture of halides (chloride + iodide) vs $AgNO_3$
7. Precipitation titration: K_2SO_4vs $BaCl_2$
8. Dissociation constants of weak acids
9. Effect of solvent (Acetonitrile, Methanol and 1,4 dioxane) on dissociation constant of acetic acid
10. Verification of Onsager equation for KCl, KBr and KI
11. Composition of Cu(II) – tartaric acid complex by Job's method

References:

1. A textbook of practical organic chemistry by A I Vogel, Vol 1& 2.
2. Senior practical physical chemistry. B. D. Khosla, V.C. Garg, AdarshGulati
3. Experimental Physical Chemistry: V. Athawale and P. Mathur.
4. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
5. Practical in Physical Chemistry: P.S. Sindhu
6. Advanced Practical Physical chemistry: J.B.Yadav

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Semester IX

Course Type	Courses	Hours per week	Duration of Exam Hrs	Marks			No. of Credits
				Internal	External	Total	
SEC	Research Methodology (905)	2	2	10	40	50	2
CC Theory	Inorganic Chemistry -5 (901)	4	3	20	80	100	4
	Organic Chemistry -5 (902)	4	3	20	80	100	4
	Physical Chemistry -5 (903)	4	3	20	80	100	4
	General Chemistry -5 (904)	4	3	20	80	100	4
CC Practicals	Inorganic Chemistry -5 (951)	6	6		100	100	2
	Organic Chemistry -5 (952)	6	6		100	100	2
	Physical Chemistry -5 (953)	6	6		100	100	2
	Seminar				25	25	1
	Total	36				775	25

CC: Core Course, SEC: Skill Enhancement Course

Semester X

Course Type/ code	Subject	Maximum marks	No. of Credits
Project work 1001	Bench work	200	8
	Project Dissertation	200	8
	Project Seminar	100	4
	Project Viva	100	4
	Total	**600**	**24**

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SEMESTER-IX
PAPER I (901) INORGANIC CHEMISTRY-V

Teaching hours-4/week **Credits 4**

Organo Metallic Chemistry of Transition Metal Complexes

UNIT-XVII: Mono,Di and Trihapto Complexes
UNIT-XVIII: Tetra, Penta, Hexa, Hepta and Octahapto Complexes
UNIT-XIX: Catalytic Role of OTMC-I
UNIT-XX: Catalytic Role of OTMC-II

UNIT-XVII: Mono, Di and Tri hapto Complexes

Nomenclature and Classification based on the number of Coordinated Carbons (hapticity) and number ofelectrons donated by the Ligand. 16 and 18 electron rules. Electron countingcovalentand ionic models. η1– Complexes : General methods of Preparation –Bonding of Ligand to Metal :αand βInteraction andagostic interaction– Stability and decomposition pathways –η1 Complexes –Tertiary Phosphine –Transition Metal Alkyl and Aryl Complexes of Pt – Ortho-effect – Bonding in Metal – CarbeneandCarbyne Complexes. η2 –Complexes: General methods of preparation of Metal – Alkene Complexes –Structure and Bonding in η2 Complexes-Zeises salt – Trans Effect – Rotation of Olefin around Metal-Olefin Bond. η3 - Complexes: Metal-Allyl Complexes – General Preparative Routes – Structure andBonding in η3 Allyl Complexes – Fluxionality.

UNIT-XVIII: Tetra, Penta,Hexa,Hepta and Octahapto Complexes

η4 Complexes: Structure and Bonding in η4 Complexes –Butadiene and Cyclobutadiene Complexes. η^5– Complexes: General methods of Preparation – Bis (η5-cyclopentadienyl) metal complexes(Metallocenes) – Ferrocene: Structure and Bonding –Reactions of Ferrocene – Mechanism of Electroplilic substitution – Friedel Crafts acylation, alkylation, nitration, halogenation and Metallation Reactions.η^6Complexes : Metal –Arene Complexes – Dibenzenechromium – Preparation, Structure and Bonding inBis(arene)-Metal Complexes – Reactions. η^7Complexes : Preparation , Structure and Reactions of η^7–C_7H_7 Complexes. η^8Complexes : C_8H_8 as a Ligand – Cyclooctatetraene Complexes – Preparation,Structure and Bonding in Uranocene.

UNIT-XIX: Catalytic Role of OTMC-I

Oxidative addition and Reductive Elimination: Stereochemistry and Mechanism of Oxidative Addition – Insertion Reactions – Hydrogenation of Olefins –Transfer Hydrogenation –Hydrosilation of Olefins – Isomerisation of Olefins – Ziegler –Natta Polymerization of Olefins – Oligomerization of ButadieneAlkene Metathesis. Dupont-1, 4-hexadiene synthesis.Oxidation of Olefins to Carbonyl Compounds –Oxidation of Hydrocarbons to Alcohols and Acids – Oxidation of Aldehydes, Cyclohexanol,Cyclohexanone, p-Xylene.

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UNIT-XX: Catalytic Role of OTMC- II

Reactions of Carbon monoxide and Hydrogen:Hydroformylation – Carbonylation –Syngas- Water gasshift Reaction (WGS) – Reactions of Syngas.Applications of Metal Clusters inCatalysis:Hydroformylation of Ethylene using $[HRu_3(CO)_{11}]$ – , Hydrogenation of Olefins. Use of$[Fe_4C(CO)14]$ as a model for Fischer – Tropsch process. Recent Developments in Homogenous Catalysis:Phase Transfer Catalysis (PTC) – Homogeneous Transition Metal Catalyzed Reactions under PhaseTransfer Conditions: Hydrogenation. Bio Catalysis : Enzyme Analogue Catalysis: Introduction, Examplesof Enzymatic Conversions, Reduction of >C=O and >C=C< bonds, Templates: Introduction, MetalCations as Templates, Covalent molecules as Templates, External and Internal Templates – Homogeneous Catalysts and theirHeterogenization or Immobilization by Aqueous Catalysis.

SUGGESTED BOOKS :

1. Organometallics-A Concise Introduction, Ch.Eischeinbroich and Salzer-VCH
2. Organotransition Metal Chemistry Fundamental Concepts and Applications, John AkioYamamato,Wiley& Sons.
3. Homogeneous Catalysis by Metal Complexes, M MTaqui Khan and A E Martel
4. Applied Homogenous Catalysis with Organo Metallic Compounds Vol I & II, Boy Cornillsand W A
5. Herrmann – VCH
6. Organometallic Compounds, G E Coates, M C H Green, K Wade vol II
7. Advanced Inorganic Chemistry, Cotton and Wilkinson, V & VI Ed
8. Symmetry and spectroscopy, K.Veera Reddy
9. Homogenous catalysis, G W Parshall, John Wiley & Sons, New York
10. Basic organometallic Chemistry, B.D. Gupta / A. J. Elias

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SEMESTER-IX

PAPER II (902) ORGANIC CHEMISTRY-V

Teaching hours-4/week **Credits 4**

Bioorganic and Heterocyclic Chemistry

Unit- XVII: Proteins, Nucleic acids and Lipids, introduction to metabolism
Unit- XVIII: Enzymes, Coenzymes and Vitamins
Unit- XIX: Heterocyclic Chemistry-I
Unit- XX: Heterocyclic Chemistry-II

UNIT-XVII: Proteins, Nucleic acids and Lipids, introduction to metabolism 15 Hrs

Proteins: Introduction. Peptide bond, classification and nomenclature of peptides. Amino acid sequence of polypeptides and proteins: terminal residue analysis and partial hydrolysis. Peptide synthesis by solution phase and solid phase synthesis methods. Proteins – Biological importance and classification - Primary, secondary and tertiary structure of proteins.

Nucleic acids: Retro synthetic analysis of nucleic acids - Nucleotides, Nucleosides, Nucleotide bases and Sugars. Structure and synthesis of nucleosides and nucleotides. Primary, secondary and tertiary structure of DNA. Types of mRNA, tRNA and rRNA. Replication, transcription and translation. Genetic code. Protein biosynthesis. DNA finger printing.

Lipids: Introduction and classification of lipids. Stereochemical notation in lipids. Chemical synthesis and biosynthesis of phospholipids and glycolipids. Properties of lipid aggregates, micelles, bilayers, liposomes and biological membranes.

Introduction to metabolism: Overview of metabolism, catabolic & anabolic processes, glycolysis citric acid cycle & oxidative phosphorylation.

UNIT-XVIII: Enzymes, Coenzymes and Vitamins 15 Hrs

Enzymes: Definition. Classification based on mode of action. Mechanism of enzyme catalysis - Lock and Key, Induced- Fit and three point contact models. Enzyme selectivity –chemo, regio, diastereo and enantio selectivity – illustration with suitable examples. Factors affecting enzyme catalysis. Enzyme inhibition- reversible and irreversible inhibition. Enzymes in organic synthesis. Immobilised enzymes.

Coenzymes: Introduction. Co-factors -cosubstrates -prosthetic groups. Classification — Vitamin derived coenzymes and metabolite coenzymes.Structure and biologicalfunctionsof coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate (PLP), oxidized and reduced forms of I) nicotinamide adenosine dinucleotide / their phosphates (NAD), NADH, NADP+ NADPH) ii) Flavin adenine nucleotide FAD, $FADH_2$ and iii) Flavin mononucleotide (FMN, $FMNH_2$) lipoic acid, biotin, tetrahydrofolate and ubiquinone. Adenosine triphosphate (ATP)and adenosine diphosphate (ADP), S-adenosyl methionine (SAM) and uridine diphosphosugars (UDP-sugars) Mechanism of reactions catalyzed by the above coenzymes.

Vitamins: Introduction, classification and biological importance of vitamins. Structuredetermination and synthesis of vitamins A, B_1, and B_2.Synthesis of vitamins - B_6, C, E andK. Structure of vitamin B_{12}.

UNIT-XIX Heterocyclic Chemistry - I

Nonaromatic & Aromatic heterocyclics&Aromaticity **15 Hrs**

Different types of strains, interactions and conformational aspects of nonaromaticheterocycles. Synthesis, reactivity and importance of the following ring systems.Azirines, Oxiranes, Thiiranes, Diazirenes, Oxaziridines, Oxetanes. Synthesis, reactivity, aromatic character and importance of the following heterocycles: Pyrazole, Imidazole, Oxazole, Thiazole, Isoxazole,

Aromaticity: Introduction, Aromatic and anti aromatic compounds. Criteria for aromaticity.Huckel's 4n+2 electron rule for benzene and non benzenoid aromatic compounds. Eg.Cyclopropenium ion, cyclopentadienyl ion, cycloheptatrienium ion, azulene and annulenes.

UNIT-XX: Heterocyclic Chemistry - II

Five and six membered heterocyclics with two and morethan two hetero atoms

Synthesis, reactivity, aromatic character and importance of the following heterocycles:Pyridazine, Pyrimidine, Oxazine, benzimidazole, benzoxazole and benzthiazole.Synthesis, reactivity, aromatic character and importance of the following Heterocycles: 1,2,3-triazoies,1,2,4-triazoles, Tetrazoles, 1,2,4-oxadiazole, 1 ,3,4-oxadiazole, 1,2,5- oxadiazole, 1,2,3-thiadiazoles, 1,3,4- thiadiazoles, 1,2,5- thiadiazoles, 1,2,3-triazine, 1,2,4-triazine, 1,3,5-triazine, tetrazines. Synthesis and importance of purines and pteridines.Syntheis of Caffeine, theobromine and theophylline.

Larger ring and other Heterocycles

Synthesis, structure, stability and reactivity ofAzepines, Oxepines and Thiepines. Synthesis ofDiazepines rearrangements of 1,2 - diazepines. Synthesis of Benzoazepines,Benzodiazepines, Benzooxepines, Benzothiepines, Azocines and Azonines.Synthesis of selenophenes, Tellerophenes,PhospholesandBoroles.

Reference Books:

1. Nucleic acids in Chemistry and Biology by G M Blackbum MI Gait
1. LehningerPrinciples of Biochemistry by D L Nelson and M MCoxon
2. Outlines of Biochemistry by Conn and Stumpf
3. Enzyme structure and mechanism by Fersht and Freeman
4. Enzymes for green organic synthesis by V.K.Ahluwalia
5. Biotransformations in Organic Chemistry by K Faber.
6. Principles of biochemistry by Horton &others.
7. Bioorganic chemistry - A chemical approach to enzyme action by Herman Dugasand
8. Christopher Penney.
9. Concepts in Biotechnology by D.Balasubramanian& others
10. Chemistry and physiology of the vitamins by H.R.Rosenberg.

11. Heterocyclic Chemistry, T.Gilchrist
12. An introduction to the Chemistry of heterocyclic compounds, R.M.Acheson
13. Heterocyclic Chemistry, J.A.Joule&K.Mills
14. Principles of Modern Heterocyclie Chemistry, A.Paquette
15. Heterocyclic Chemistry, J,A.Joule& Smith
16. Handbook of Heterocyclic Chemistry, A.R.Katritzky
17. The aromaticity III level, units 17-19 British open university volumes
18. Aromatic character and aromaticity by G.M.Badger

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SEMESTER-IX

PAPER III (903)PHYSICAL CHEMISTRY-V

Teaching hours-4/week **Credits 4**

Unit-XVII: Nanomaterials& Non Linear Optical materials
Unit-XVIII: Lasers in Chemistry
Unit-XIX: Phase-transfer catalysis (PTC)
Unit-XX: Corrosion and its control

Unit-XVII: Nanomaterials& Non Linear Optical materials **(15 hrs)**

Introduction to nanomaterials, Classification of nanomaterials: Zero Dimensional, 1D, 2,D 3D with examples. Preparation of nanomaterials: Top-down approach: Lithography, Ball Billing, Bottom Up: Physical Vopour deposition (PVD), Chemical Vopour Deposition (CVD) Sol-gel method, Characterization of nanoparticles: (a) powder X-ray diffraction (NaCl), Transmission electron microscopy (TEM) indexing of (hkl) values, Surface analysis: BET, BJH (derivation not required) with examples. Effect of particle size on optical properties of nanomaterials.Applications of nanonanomaterilas.

Techniques of single crystal growth – growth from solutions – growth from melts – growth fromvapour. Non-linear optical (NLO) behavior– basic concepts, second and third harmonic generation, examples of organic, inorganic and polymer NLO materials.

Unit-XVIII:Lasers in Chemistry: **(15 hrs)**

General principles of laser action.Stimulated emission.Rates of absorption and emission. Population inversion.Three-level and four-level laser systems.Pumping.Laser cavity – resonantmodes.Characteristics of laser light.Laser pulses and their characteristics.Pulse production, Qswitching.Pulse modification, mode-locking.

Practical lasers.Solid-state lasers, gas lasers, chemical and excimer lasers.Examples.Applications of lasers in chemistry: Femtochemistry. The pump-probe technique.Time-resolved spectroscopy.Photodissociation of ICN. Formation and dissociation of CO-hemoglobin complex. Conversion of ethylene to cyclobutane.Bond selectivity in chemical reactions – thereaction between hydrogen atoms and vibrationally excited HDO molecules.

Lasers and multiphoton spectroscopy – underlying principles.Two-photon spectra ofdiphenyloctatetraene.Lasers in fluorescence spectroscopy and Raman spectroscopy.

Unit-XIX:Phase-transfer catalysis (PTC): **(15 hrs)**

Principles of phase-transfer catalysis. PTC classification.Role of water in phase-transfer catalyzed reactions. Factors influencing the rate of PTC reactions.Inverse phase transfer catalysis.Mechanism of nucleophilicdisplacement reactions.

Crown ethers: Crown ethers as phase transfer catalysts(PTC) in the reaction of alkyl halides with super oxide. Permanganate oxidation of alkenes and phenols in presence of PTC's viz.,quarternary ammonium salts and crown ethers

Photo catalysis: Photocatalytic effect, metal semiconductor systems as photo catalysts, nature ofthe metal loaded, extent of metal loading, nature of semiconductor, doped semiconductors,coupled Semiconductors. Application of photocatalysisfor splitting of water by semiconductorparticles, removal of organic and inorganic pollutants, for oxidation and reduction of organic
compounds.

Unit-XX: Corrosion and its control: **(15 hrs)**

Magnitude of the problem, theories of corrosion, Chemical and electrochemical corrosion, corrosion reactions, factors affecting corrosion- nature of metal, purity of metal,electrochemical series, over voltage, nature of oxide film, nature of corrosion product, nature of environment, effect of temperature, effect of pH, effect of oxidant, humidity. Corrosion control methods design and material selection, cathodic protection, sacrificial anode, impressed current cathode.Surface coating methods: Surface preparation, metallic coatings.
Application of metal coatings: hot dipping, galvanizing, tinning, cladding, electroplating, chemical conversion coatings. Organic surface coatings-paints, constituents of paints and their functions, methods of application of paints, failure of paint films, varnishes, enamels, lacquers.

References:

1. Introduction to Nanoscience and Nanotechnology, K.K. Chattopadhyay, A. N. Banerjee, PHI Learning Private Limited.
2. Nanomaterials and Nanocomposites, Rajendra Kumar Goyal, CRC Press.
3. The physics and chemistry of solids. Stephen Elliot, John Wiley & Sons
4. Solid state chemistry and applications. A.R.West, John Wiley & Sons
5. Principles of the Solid State, H. V. Keer, New Age International
6. Phase Transfer Catalysis in Organic synthesis, W. P. Weber & G. W. Gokel, Springer
7. Hand book of phase transfer catalysisEdited by Y. Sasson and R. Neumann
8. Phase Transfer Catalysis, Fundamentals, Applications and Industrial perspective, C. M. Stark, C. Liotta& M. Halpern, Academic Press
9. Catalysis, Principles and applications, edited by B. Vishwanathan, S. Sivasanker& A. V. Rama Swamy, Narosa Publishing House
10. Engineering Chemistry by P.C. Jain & Monica Jain, Dhanpatrai publishing company, (2008)
11. Chemistry of Engineering Materials by C.V. Agarwal, C.P. Murthy & A. Naidu: BS publications
12. Chemistry of Engineering Materials by R.P. Mani & K.N. Mishra, CENGAGE learningApplied Chemistry – A text book of engineering and Technology – Springar(2005)

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SEMESTER-IX

Paper-IV (904) ANALYTICAL TECHNIQUES AND SUPRAMOLECULAR CHEMISTRY

Teaching hours-4/week **Credits 4**

UNIT-XVII: Data Handling
UNIT-XVIII: Surface Analysis Methods/ Microscopic analysis
UNIT-XIX: Advanced Separation Techniques
UNIT-XX: Supramolecular Chemistry

UNIT-XVII: Data Handling

Accuracy, Precision, Types of errors – determinate and indeterminate errors, minimization of determinateerrors, statistical validation- statistical treatment of finite data (mean, median, average deviation, standard
deviation, coefficient of variation and variance), significant figures – computation rules, comparison ofresults – student's t-test, F-test, statistical Q test for rejection of a result, confidence limit, regressionanalysis – method of least squares, correlation coefficient, detection limits. Calculations.

UNIT-XVIII: Surface Analysis Methods (Microscopic analysis)

Introduction, types of surface measurements.
Photon Probe Techniques: X-Ray Photoelectron spectroscopy - Principle, Instrumentation,applications.
Electron Probe Techniques: Scanning electron microscopy (SEM) – Principle, Instrumentation,applications. Transmission Electron Microscopy (TEM) - Principle, Instrumentation, applications. EnergyDispersive X-ray Spectroscopy (EDX) - Principle, Instrumentation, applications. Electron Probe X-rayanalysis (EPXMA) - Principle, Instrumentation, applications. Auger electron spectroscopy (AES) -Principle, Instrumentation, applications.
Ion Probe Techniques: Rutherford backscattering spectrometry (RBS) - Principle, Instrumentation,applications. Secondary ion mass spectrometry (SIMS) – Fundamental aspects of sputtering, Principle,Instrumentation (static & dynamic), applications
Scanning probe microscopy Techniques: Scanning Tunneling Microscopy – Principle, Instrumentation,applications. Atomic Force Microscopy - Principle, Instrumentation, applications.

UNIT-XIX: Advanced Separation Techniques

Separations by extractions: Solid phase extraction- Principle, methodology, applications. Solventextraction of flow injection analysis. Applications to extractions of metal ions by chelating agents(Dithiazone, 8-hydroxy quinoline and cupferron).Organic reagents in Inorganic analysis – Theoreticalbasis for the use of organic reagents in inorganic analysis. Extraction of

metal ions by the use of organicreagents – acetylacetone, thionyl-trifluoroacetone, tri-n-octyl phosphine oxide.

Affinity and chiral chromatography – Principle, technique, Instrumentation and applications.**Size Exclusion Chromatography** – Principles of gel – filtration Chromatography, Instrumentation,retention behavior, resolution, selection of gel type, applications, **Ion exclusion** – Principle andapplications.

Supercritical fluid chromatography (SFC) – Instrumentation of SFC, stationary and mobile phasesused in SFC, Detectors, Advantages of SFC. Technique and applications of SFC

UNIT-XX: Supramolecular Chemistry

Host – Guest chemistry: Definition and different types of host and guests with examples – types of noncovalentinteractions – binding constants of host guest complex and thermo dynamics involved in it –designing principles of host.

Cation guest binding – binding between metal cations and macro cycles – chelate and cryptate effects –relationship between cavity size of host and cation radius and stability of resultant complexes – binding ofmacro cycles having secondary binding sites.

Anion guest binding – different hosts for anionic guests capable of binding through electro staticinteractions, hydrogen bonds, lewis acidic hosts – enhancement of binding strength using more than noncovalentinteractions.

Neutral guest binding – binding of neutral guest using hydrogen bonding, π - π stacking, hydrophobiceffect and charge transfer interactions – simultaneous binding of cation and anion guests – cascadeapproach, individual binding sites and zwitter ions approach –present and future applications – phasetransfer agents – separation of mixtures – molecular sensors – switches and molecular machinery.

SUGGESTED BOOKS

1. Principles of Instrumental Analysis: Holler, Skoog and Ccrouch, 6th edition ,Cengage Learning 2007.
2. Instrumental methods of chemical analysis B.K. Sharma, Goel Publishing House.
3. Instrumental Methods of analysis, Willard Mersritt, Dean and Settle, 7th edition, CBS Publishers1986.
4. Analytical Chemistry – Gary D. Christian, 6 th ed., John Wiley and sons. Inc., New York 1994.
5. Instrumental methods of Analysis - Willard, Merit, Dean, 6 th ed., CBS Publishers & distributors, 1986.
6. Hand Book for Instrumental Techniques for Analytical Chemistry, Ed. Frank Settle, Prentice Hall, NewJersey, USA, 1997.
7. Vogel's Text book of Quantitative Analysis – GJ Jeffery, J Bassett et al, 5 th ed., Longmann, ELBSPublications, 2000.
8. Supramolecular Chemistry – concepts and perspectives by Jean-Marie Lehn
9. Principles and methods in Supramolecular chemistry, Hans-Jorg Schneider and A.Yatsimirsky, JohnWiley and Sons
10. Analytical Chemistry of Macrocyclic and Supramolecular Compounds, S.M.Khopkar, NarosaPublishing House

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SEMESTER IX

PAPER - (905) Skill Enhancement Course VII (SEC-VII)

Teaching hours-2/week **Credits 2**

Research Methodology

Unit I: Introduction to Research Methodology
Unit II: Chemical Information Sources and Searches

Unit I: Introduction to Research Methodology:
Definition,objectives of research, types of research- significance of research, research and scientific method, importance of knowing how research is done.
Research process -formulating the research problem, extensive literature survey, development of working hypotheses, preparing the research design, determining sample design, collecting the data, execution of the project, analysis of data, hypothesis-testing, generalizations and interpretation, preparation of the report or the thesis.
Criteria of good research, problems encountered by researchers in India.
Defining the research problem, selecting the problem, necessity of defining the problem.
Research design, need for research design, features of a good design, Basic principles of experimental designs

Unit II: Chemical Information Sources and Searches
Advantage/Limitation of computer searching strategies and tactics for searches
Types of Publications: Journals, technical reports, Patents, Conference Papers, Dissertations, Electronic Publications –
Types of databases – Public databases; NCBI, RCSB, CSD, SWISS-PROT and Paid databases CAT'STN and SciFinder -Computer searching of chemical abstracts – Web-based cross platform solutions for Cheminformatics and chemical communications(BLAST, ClustalW, RasMol, SAVES) – JChemBase – Keyword-based general bibliographic searches – Chemical connectivity and structure searches (2D) – Chemical structure, property and shape based searches(3D) – Searching for the synthesis (or) reactions of specific compounds or classes of compounds

Reference Books

1. Research Methodology- Methods and techniques, C. R. Kothari, New Age International (P) Ltd., Publishers.
2. Chemical Information Sources by Institute of Cheminformatics Studies.
3. Geer LY, Marchler-Bauer A, Geer RC, Han L, He J, He S, Liu C, Shi W, Bryant SH. The NCBI BioSystems database. Nucleic Acids Res. 2010
4. An Introduction to Computer Searching of Chemical Abstracts STN International Version
5. https://www.cas.org/products/scifinder.

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SEMESTER-IXPracticals

PAPER V 951INORGANIC CHEMISTRY-V

Teaching hours-6/week **Credits 2**

Electro-analytical techniques

I Potentiometry : Potentiometric Titrations and Calculation of End Point Potentials for the following systems:

1) Fe^{2+} and VO^{2+} Mixture vsCe^{4+}
2) Assay of sulphanilamide
3) Silver electrode for silver assay
4) Mixture of halide anions using Silver electrode

II pH-metry

1. Determination of CO_3^{2-} and HCO_3^- in a mixture
2. Determination of the dissociation constants of
   (i) Ethylenediamine (en)(H_2L) (ii) Glycine (HL)
3. Determination of binary constants of i) Cu(II)-en and (ii) Ni(II) – Gly Systems

III Conductometry:

1. Determination of the Composition of Cu(II)-oxine and Cu(II)-EDTA Complexes
2. Interaction of Pyrophosphate with Mg^{2+}, Ca^{2+} , Mn^{2+} and Cu^{2+}

SUGGESTED BOOKS:

1. A Text Book of Quantitative Inorganic Analysis by A.I.Vogel 3rd Edition Elbs Publication 1969.
2. Vogel's Text Book Of Quantitative Inorganic Analysis Jeffery etal 4th edition Elbs Publications1988.
3. Vogel's Text Book of Quantitative Chemical Analysis, 6th edition. Pearson Education Ltd 2002.
4. Determination and use of Stability Constants – Martell and Motekaitis VCH Publishers INC 1988.
5. Metal Complexes in Aqueous Solutions A.E.Martell and R.D. Handcock, Plenum Press, New York – 1996.
6. Analytical Chemistry by Gary D.Christian 6th EditionJohnWiley&SonsInc New York 1994.

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PAPER VI 952ORGANIC CHEMISTRY-V

Teaching hours-6/week

Credits 2

(A) Spectral Problems, drug analysis & isolations

Identification of unknown organic compounds by interpretation of IR, UV, ^{1}H -NMR, ^{13}C NMR, and mass spectral data(two examples with 2D-NMR). A minimum of 20representative examples should be studied.

(B) Estimation of the following drugs:

Aspirin (titrimetry), Ibuprofen (titrimetry), Analgin (titrimetry), Chloride in Ringer's lactate (argentometry), ascorbic acid Riboflavin(colorimetry), Ca+2 ions in Calcium gluconate injection(complexometry),

Isolation of caffeine from tea leaves, piperine from pepper, lycopene from tomatoes, curcumin from turmeric.

Reference books:

1. Practical organic chemistry by Mann & Saunders
2. Text book of practical organic chemistry by Vogel
3. The systematic identification of organic compounds by Shriner et.al
4. Analytical chemistry by G N David Krupadanam et.al
5. Advanced practical medicinal chemistry by Ashutoshkar
6. Pharmaceutical drug analysis by Ashutoshkar
7. Quantitative analysis of drugs in pharmaceutical formulations by P D Sethi
8. Practical pharmaceutical chemistry part-1 and part-2 by A H Beekett and J B Stenlake
9. Spectroscopic identification of organic compounds by R M Silverstein and F X Webster

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PAPER VII 953PHYSICAL CHEMISTRY-V

Teaching hours-6/week **Credits 2**

Kinetics

(A) H_2O_2 – I^- Clock reaction

(i) Over all order

(ii) Order with respect to Iodide

(iii) Order with respect to H_2O_2

(iv) Order with respect to acid

(B) Oxidation of alcohols using potassium dichromate by colorimetry

(i) Order with respect to acid

(ii) Order with respect to alcohol

(iii) Order with respect to potassium dichromate

(C) Kinetics of hydrolysis of t-butyl chloride by conductometry

Instrumentation spectrophotometry

(i) Estimation of Cu(II) using EDTA

(ii) Estimation of Fe(III) using thiocyanate

(iii) Estimation of Fe(II) using 1,10-phenanthroline

(iv) Estimation of Fe(III) in tap water using thiocyanate by standard addition method

(v) Simultaneous determination of dichromate and permanganate in a mixture

(vi) Composition of Cu(II) – EDTA complex by Job's method

(vii) Determination of composition and Gibbs energy of formation of Fe(III)–salicylic acid complex

References:

1. A textbook of practical organic chemistry by A I Vogel, Vol 1&2.
2. Senior practical physical chemistry. B. D. Khosla, V.C. Garg, AdarshGulati
3. Experimental Physical Chemistry: V. Athawale and P. Mathur.
4. Practical Physical Chemistry: B. Vishwanathan and P.S. Raghavan.
5. Practical in Physical Chemistry: P.S. Sindhu
6. Advanced Practical Physical chemistry: J.B.Yadav

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SEMESTER-X
PAPER I (1001)PROJECT WORK

Credits 4

Teaching hours-4/week

Pattern same as non-cbcs (to be copied)