S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FIRST SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT11) Paper-I: GENERAL CHEMISTRY – I

UNIT-I

Basic Quantum Chemistry-I: Wave equation - interpretation of wave function-properties of wave function - Normalization and Orthogonalisation, Postulates of quantum mechanics; Operators - linear, non-linear and commutators of operators – Eigen functions and eigen values - Hermitian operator- Eigen values and Eigen functions of Hermitian operator; Unitary operator - setting up of operators to observables; position, linear momentum, energy and angular momentum – Eigen values of angular momentum operator.

UNIT-II

Basic Quantum Chemistry-II: Wave mechanics of simple systems with constant potential energy, particle in one- dimensional box, wave equation, quantized energies, zero point energy, normalized wave function, characteristics of wave function - factors influencing color - transition dipole moment integral - Symmetry arguments in deriving the selection rules - the concept of tunneling - particle in three-dimensional box, calculations using wave functions of the particle in a box- Wave mechanics of Rigid rotor, Hamiltonian operator - Wave mechanics of rigid rotator.

UNIT-III

Basic Quantum Chemistry-III: Wave mechanics of systems with variable potential energy - simple harmonic oscillator - solution of wave equation - characteristics of wave function - derivation of selection rules for simple harmonic oscillator - Hydrogen atom - Construction of Hamiltonian operator - Separation of variables in Schrodinger wave equation - solution of R(r), Φ (ϕ) and Θ (θ) equations. Probability density in 1S atomic orbital - shapes of orbitals.

UNIT-IV

Molecular Spectroscopy-I: Microwave and IR- Spectroscopy- Rotational spectra of diatomic molecules- Rigid rotor-Selection rules- Calculations of bond length- Isotopic effect in rotational spectra - Second order stark effect and its applications. Infrared spectra of diatomic molecules - harmonic and anharmonic oscillators - Selection rules - Calculation of force constant, anharmonicity constant and zero point energy - Overtones- Combination bands - Fermi resonance - simultaneous vibrational-rotational spectra of diatomic molecules.

UNIT- V

Molecular Spectroscopy-II: Raman and Electronic Spectra - Classical and quantum mechanical explanations - Rotational Raman spectra - Vibrational Raman spectra - Rotational fine structure of Raman spectra of diatomic molecules - Electronic spectra of diatomic molecules - Types of electronic transitions - Born Oppenheimer approximation - Vibrational Coarse structure - intensities of spectral lines - Franck-Condon principle - applications, Rotational Fine structure - band origin, band head and band shading, Charge transfer spectra.

References/ Text books

1. Fundamentals of Molecular spectroscopy: by C. N. Banwell
2. Molecular spectroscopy: by B. K. Sharma
3. Molecular spectroscopy: by Aruldas
4. Introductory quantum mechanics: by A. K. Chandra
5. Quantum chemistry: by R. K. Prasad

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FIRST SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT12) Paper- II: INORGANIC CHEMISTRY-I

UNIT- I

Structure & Bonding: Applications of VSEPR, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules- role of p and d orbitals in π-bonding. Application of MO theory to Tetrahedral $[CoCl_4]^{2-}$, Square planar ($[PtCl_4]^{2-}$) and Octahedral complexes ($[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$). Classification of ligands based on π-bonding using MO theory.

UNIT-II

Inorganic cage and ring compounds – preparation, structure and reactions of boranes, carboranes, metallocarboranes. Electron counting in boranes – Wades rules (Polyhedral skeletal electron pair theory).

Heterocyclic inorganic ring systems: Boron–Nitrogen ($H_3B_3N_3H_3$), Phosphorus–Nitrogen ($N_3P_3Cl_6$) and Sulphur-Nitrogen (S_4N_4, $(SN)_x$) cyclic compounds.

UNIT-III

Coordination compounds: Crystal field theory - crystal field splitting patterns in octahedral, tetrahedral, tetragonal, square planar, square pyramidal and trigonal bipyramidal geometries. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies – Spectrochemical series – Jahn – Teller effect, nephelauxetic effect – ligand field theory.

UNIT- IV

Term symbols – Russell – Sanders coupling – Hund's Rules – Hole Formalism, derivation of term symbols for p^1 –p^6 and d^1 – d^9 configurations of p and d orbitals. Spectroscopic ground states.

Magnetic properties of transition and inner transition metal complexes – spin and orbital moments –spin-orbit coupling and magnetic moments - Quenching of orbital momentum by crystal fields in complexes.

UNIT- V

Electronic spectra of transition metal complexes: Types of electronic transitions – d-d transitions - Selection rules, break down of selection rules – Orgel and Tanabe-Sugano diagrams for d^1 –d^9 octahedral and tetrahedral transition metal complexes of 3d series – Calculation of Dq, B and β parameters. Charge transfer spectra.

Reference books& Text books:

1. Advanced Inorganic Chemistry by F.A. Cotton and G. Wilkinson, IV Edition, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III Edition, Harper International Edition, 1983.
3. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press pvt. Ltd., New Delhi.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999).
5. Inorganic Chemistry 5th Edition by Gary L. Miessler et al, Pearson Publications.

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FIRST SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT13) Paper –III: ORGANIC CHEMISTRY -I

UNIT – I

Nature of bonding in organic molecules and Aromaticity 15 Hrs

(A) *Electronic Effects and Reactive intermediates:*-Inductive effect, Mesomeric effect (Resonance), Hyperconjugation, Steric effect, Tautomerism, Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and arynes

(B) *Criteria of Aromaticity:*- Concept of Aromaticity, Huckle`s rule, aromaticity in benzenoid non-benzenoid compounds, Aromaticity in Fused-Ring Systems, Hetero-aromatic Systems, anti-aromaticity and homo-aromaticity and Pseudo aromaticity. *Annulenes:* Cyclobutadiene, Benzene,1,3,5,7-Cyclooctatetraene, [10] Annulenes, [12], [14], [16] and [18] annulenes,

UNIT – II

Stereo Chemistry &Molecular representation of organic molecules 12 Hrs

Molecular Symmetry and Chirality: Symmetry elements: Plane of Symmetry, Axis of Symmetry and Centre of Symmetry Definition and classification of Stereoisomers, Enantiomer, Diastereomer, Invertomers, Homomers, Epimers, Anomers, Configuration and Conformation Configurational nomenclature: D,L and R, S nomenclature, Molecules with a single chiral center, Molecules with two chiral centers; constitutionally unsymmetrical and symmetrical molecules.

UNIT – III

12 Hrs

(A) Geometrical Isomerism and Conformations of Cyclic Systems:- Cis-trans, E, Z- and Syn & anti nomenclature, Methods of determining configuration of Geometrical isomers using physical, spectral and chemical methods, Stability, Cis-trans inter conversion.Conformations of cyclobutane, cyclopentane, cyclohexane, mono and disubstitutedcyclohaxanes.

(B)Stereoisomerism in molecules without chiral Center -Axial chirality Allenes, Alkylidene cycloalkanes, spiranes, nomenclature. *Atropisomerism:* Biphenyl derivatives, nomenclature.

UNIT – IV

Heterocyclic compounds: 11 Hrs

Importance of heterocyclic compounds as drugs. Nomenclature of heterocyclic systems based on ring size,number and nature of hetero atoms. Chemistry of heterocyclic compounds, synthesis and reactivity of the following systems: Quinoline, Isoquinoline, Indole, Pyrazole, Imidazole, Oxazole, Isoxazole, Pyridazine, pyrimidine and Pyrazine.

UNIT - V

Chemistry of some typical natural products (Alkaloids and Terpenoids) 10 Hrs

A study of the following compounds involving their isolation, structure elucidation, synthesis and biogenesis of

Alkaloids; Atropine, Nicotine, and Quinine.

*Terpenoids:*α- Terpeneol, α-Pinene and Camphor.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and structure, Jerry March, 6th Ed. (John Wiley & Sons).
2. Organic Chemistry, Paula YurkanisBruice, 4th Ed. (Printice Hall)
3. Organic chemistry-Clayden J. (Oxford)
4. Organic Chemsitry, Wade, L.G. Jr. 5th Ed. (Pearson)
5. Advanced Organic Chemistry: Reactions and mechanisms, Miller Bernard & Other, 2nd Ed. (Pearson)
6. Mechanism and Theory in Organic Chemistry, Thomas H. Lowry, Kathleen S. Richardson, Harper & Row, (Publishers, Inc.).
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, 6th Ed., (Longman).
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, 2nd Ed. (New Age International).
9. Organic Chemistry, R. T. Morrison and R. N. Boyd (Prentice-Hall)
10. Stereochemistry to Organic Compounds, E.L. Eliel (John Wiley).
11. Stereochemistry, P.S. Kalsi, 5th Ed. (New Age International).
12. Organic Chemistry Structure and Reactivity, EgeSeyhan, 3rd Ed. (AITBS)
13. Heterocyclic Chemistry, J.A.Joule, K. Kills and G. F. Smith, Chapman and Hall
14. Heterocyclic Chemistry, T.L.Gilchrist, Longman Scientific Technical
15. Heterocyclic Chemistry, Raj.K. Bansal.
16. An Introduction to the Heterocyclic Compounds, R. M. Acheson, John Wiley.

REFERENCE BOOKS:

1. Chemistry of Natural Products, K.W.Bentley
2. Stereochemistry of carbon compounds by E.Eliel, John Wiley & Sons, Inc.
3. Stereochemistry to Organic Compounds, D. Nasipuri, 2nd Ed. (New Age International).
4. Chemistry of Natural products by R.S. KalsiKalyani Publishers. 1983.

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FIRST SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT14) Paper – IV: PHYSICAL CHEMISTRY-I

UNIT-I

Thermodynamics-I: Concepts of partial molar properties – partial molar volume and its significance; Determination of partial molar volume: Graphical method, intercept method and apparent molar volume method. Partial molar free energy, chemical potential, Variation of chemical potential with T and P. Gibbs-Duhem equation-derivation and significance. Phase equilibrium - Derivation of phase rule from the concept of chemical potential. *Ideal solutions* - Thermodynamics of mixing of liquids (ΔG_{mix}, ΔH_{mix}, ΔS_{mix}) - Thermodynamic properties of ideal solutions - Raoult's law; Thermodynamic properties of ideally dilute solutions - Henry's law. *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 non-volatile solutes using Gibbs-Duhem equation - Chemical equilibrium- effect of temperature on equilibrium constant - Van't-Hoff equation.

UNIT-II

Micelles and Macro molecules: Surface active agents, classification of surface active agents, micellization, hydrophobic interaction, Critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization - phase separation and mass action models, Micellar solubilization, micro emulsion, reverse micelles.

Polymer- definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of free radical polymerization. Molecular mass- Number and mass average molecular weight, molecular weight determination- Osmometry, viscometry, ultracentrifugation and light scattering methods.

UNIT-III

Chemical Kinetics: Theories of reaction rates- Collision theory- Limitations, Transition state theory, Thermodynamic formulation of transition state theory. Effect of ionic strength on rates of reactions - Debye Huckel theory - Primary and secondary salt effects; Effect of dielectric constant on rates of reactions, Effect of substituent - Linear free energy relationships - Hammett equation-limitations, Taft equation; Kinetics of Consecutive reactions, parallel reactions, opposing reactions (Uni molecular steps only, no derivation).

UNIT-IV

Specific and general acid-base catalysis; Skrabal diagram; Steady state approximation - Protolytic and Prototropic mechanism - Enzyme catalysis- Michaelis -Menten mechanism. Derivation of Kinetic equation and Kinetic parameters. Lock and Key hypothesis - pH dependence of enzyme catalyzed reactions. Fast reactions, different methods of studying fast reactions- Flow methods: Continuous flow method and Stopped flow method - Relaxation methods: Shock tube method, temperature jump and pressure jump methods.

UNIT-V

Photochemistry: Electronic transitions in molecules, Franck-Condon principle. Electronically excited molecules - singlet and triplet states, spin-orbit interaction. Quantum yield and its determination; Actinometry - ferrioxalate and uranyl oxalate actinometers. Derivation of fluorescence and phosphorescence quantum yields. Quenching effect- Stern-Volmer equation. Photochemical equilibrium - Delayed fluorescence: E-type and P-type delayed fluorescence. Photochemical primary processes, types of photochemical reactions - Photodissocoation, Photoaddition and Photoisomerisation reactions with examples.

Books:

1. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford UniversityPress.
2. Physical Chemistry by G.W. Castellon, Narosha PublishingHouse
3. Physical Chemistry by W.J.Moore, PrenticeHall
4. Thermodynamics for Chemists, SamuelGlasstone
5. Chemical Kinetics by K.J.Laidler, McGraw HillPub.
6. Photochemistry, R.P. Kundall and A. Gilbert, ThomsonNelson.
7. Polymer Chemistry byBillmayer
8. Introduction to Polymer Science, V.R. Gowriker, N.V.Viswanadhan and J. Sreedhar., WileyEaster.
9. Micells, Theoretical and applied aspects, V.Morol, Plenumpublishers.

LABORATORY WORK (6 hrs/week)

(19CHEP11) Practical-1: INORGANIC CHEMISTRY - I

I. Inorganic Synthesis: Preparation of

(i) Tetraamminecopper(II) sulphate

(ii) Potassium tris-oxalato ferrate(III) trihydrate

(iii) Tris-thiourea copper(I) sulphate

II. Semi micro qualitative analysis of six radical mixtures

(One interfering anion and one less familiar cation for each mixture)

Anions: CO^{2-}, S^{2-}, SO^{2-}, Cl^{-}, Br^{-}, I^{-}, NO_3^{-}, SO_4^{2-}, CH_3COO^{-}
C_2O^{2-}, $C_4H_4O_6^{2-}$, PO_4^{3-}, CrO_4^{2-}, AsO_4^{3-}, F^{-}, BO_3^{3-}

Cations : Ammonium (NH_4^{+})
1st group: Hg, Ag, Pb, Tl, W
2nd group: Hg, Pb, Bi, Cu, Cd, As, Sb, Sn, Mo
3rd group: Fe, Al, Cr, Ce, Th, Ti, Zr, V, U, Be
4th group: Zn, Mn, Co, Ni
5th group: Ca, Ba, Sr
6th group: Mg, , Li

Reference books:

Vogel's textbook of semimicro qualitative analysis, 5th Edition by G. Svehla.

(19CHEP12) Practical-2: ORGANIC CHEMISTRY -I

Preparation, recrystallization, and determination of melting point & yield of the following compounds:

(i)	Aspirin,	(ii)	Nerolin,	(iii)	Chalcone,
(iv)	*p*-Nitro acetanilide,	(v)	2,4,6- Tribromoaniline,	(vi)	*m*-Dinitrobenzene,
(vii)	Phthalimide,	(viii)	Diels-Alder adduct.		

Books Suggested

1. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J. D. Barnes and M. J. Thomas, 4th & 6th Ed. (Pearson Education Asia).

2. Vogel's Text Book of Practical Organic Chemistry, B.S. Furniss, A.J. Hannaford, P.W.G. Smith, A.R. Tatchell, 5 Ed. (Longman Scientific & Technical)

Practical -3: Physical Chem: Pr-1

1. Determination of critical solution temperature of phenol-water system.
2. Effect of added electrolyte on the CST of phenol-water system.
3. Conductometric titration of Strong acid versus Strong base
4. Conductometric titration of Weak acid versus Strong base
5. Determination of cell constant
6. Dissociation constant of weak acid (CH_3COOH) by conductometric method.
7. Adsorption of acetic acid on animal charcoal.
8. Acid-catalyzed hydrolysis of methyl acetate

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SECOND SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT21) Paper- I: GENERAL CHEMISTRY-II

UNIT-I

Approximation methods- Perturbation theory - Time independent perturbation theory (only first order perturbation is to be dealt with) - application to ground state energy of Helium atom - Variation principle – applications - calculation of zero-point energy of hydrogen atom and harmonic oscillator - many electron atom, Hamiltonian operator - Hartee's self-consistent field method - Hartee-Fock self-consistent field method.

UNIT-II

Bonding in molecules: Valence-Bond (VB) method application to H_2 molecule – Molecular Orbital theory - LCAO Approximation - Construction of trail function by the method of linear combinations. Variation parameters, secular equations and secular determinant - Application of MO theory to H_2^+ ion, The variation integral for H_2^+ ion, calculation of wave functions and energies for the bonding and anti-bonding MOs, Physical picture of bonding and anti-bonding wave functions, Energy diagram. Application of MO theory to H_2 molecule - Directed valence - Quantum mechanical concepts of SP^3, SP^2 and SP hybridisation.

UNIT-III

Molecular symmetry and Group Theory in Chemistry-I: Basic concepts of symmetry and Group theory - Symmetry elements, symmetry operations - Matrix representations for symmetry operations - point groups- Schoenflies symbols - Classification of molecules into point groups – Identification of point groups of molecules, linear, planar and three dimensional molecules - Axioms of Group theory - Group multiplication tables for C_{2v} and C_{3v} point groups -

UNIT-IV

Molecular symmetry and Group Theory in Chemistry-II: Similarity transformations and classes – Representations: reducible and irreducible representations, Mullikan symbols, Orthogonality theorem and its consequence – Properties of irreducible representations - Character table and its anatomy (need not to derive Character table) - Application of group theory to IR, Raman spectroscopy and transition metal complexes.

UNIT-V

Treatment of analytical data: Accuracy and precision - Classification of errors - Determination of Indeterminate errors - Minimization of errors - Absolute and Relative errors, propagation of errors - Distribution of Indeterminate errors - Gaussian distribution - Measures of central tendency - Measures of precision - Standard deviation - Standard error of mean- student's t- test - Confidence interval of mean - Testing for significance - Comparison of two means - F-test - Criteria of rejection of an observation - Significant figures and computation rules.

References/ Text books:

1. Introductory Quantum chemistry: by A. K. Chandra
2. Group theory for Chemistry: by A. K. Bhattacharya
3. Introductory Group theory for chemists : by George Davidson
4. Vogel's text book of quantitative analysis by Vogel
5. Fundamentals of Analytical chemistry: by Skoog and West
6. Quantum Chemistry: by N. Levine.

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SECOND SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT22) Paper- II: INORGANIC CHEMISTRY-II

UNIT-I

Metal cluster compounds - definition – evidences for existence of M-M bonds - conditions favorable for formation of M-M bonds – preparation, structure and bonding of the following metal cluster compounds.

$Re_2Cl_8^{2-}$, $Mo_2Cl_8^{4-}$, $Re_2(RCOO)_4X_2$, $Mo_2(RCOO)_4(H_2O)_2$, $Cr_2(RCOO)_4(H_2O)_2$, $Cu_2(RCOO)_4(H_2O)_2$, $Cr_2Cl_9^{3-}$, $Mo_2Cl_9^{3-}$, $W_2Cl_9^{3-}$, Re_3Cl_9, $Re_3Cl_{12}^{3-}$, $Mo_6Cl_8^{4+}$, $Nb_6X_{12}^{2+}$ and $Ta_6X_{12}^{2+}$.

UNIT-II

Organometallic compounds - 16 and 18 electron rules. Isoelectronicrelationship - Synthesis, structure, bonding and reactions of carbon monoxide, dinitrogen and nitric oxide complexes.Isolobal relationship – H, Cl, CH_3, $Mn(CO)_5$; S, CH_2, $Fe(CO)_4$; P, CH, $Co(CO)_3$. Synthesis, structure, bonding and reactions of metallocenes with special reference to ferrocene. Catalysis by Organometallic compounds

UNIT-III

Metal Ligand equilibria in solution: Stepwise and overall formation constants and their interaction– trends in stepwise constants – factors affecting the stability of metal complexes– Pearson's theory of hard and soft acids and bases (HSAB), chelate effect and its thermodynamic origin, determination of stability constants of complexes–spectrophotometric method and pH–metric method.

UNIT- IV

Inorganic Reaction Mechanisms: Reactivity of metal complexes–inert and labile complexes.Explanation of lability on the basis of VBT & CFT. Substitution reactions of metal complexes – D, Id, Ia and A mechanisms – Ligand replacement reactions of octahedral complexes – Acid hydrolysis – factors affecting acid hydrolysis – Anation and Base hydrolysis of Cobalt(III) complexes. Ligand displacement reactions of square planar complexes of platinum (II). Factors affecting square planar substitution – trans effect (theories).

UNIT- V

Bio-Inorganic Chemistry & Electron transfer reactions : Metalloporphyrins with special reference to Haemoglobin& Myoglobin. Biological role of alkali and alkaline earth metal ions with special reference to Ca^{2+}.Biological and abiological Nitrogen Fixation.

Electron transfer reactions of complexes – concept of complementary and non-complementary reactions with examples.Inner and outer sphere mechanisms.

Text books:

1. Advanced Inorganic Chemistry by F.A. Cotton and R.G. Wilkinson, IV Edition, John, John Wiley and Sons, New York, 1980.
2. Inorganic Chemistry by J.E. Huheey, III edition, Harper International Edition, 1983.
3. Organometallic Chemistry-A unified approach by A. Singh and R.C. Mehrotra, Wiley Eastern Ltd.
4. Inorganic Chemistry by Shriver and Atkins, Oxford University Press (1999)
5. Theoretical Inorganic Chemistry, II Edition by M.C. Day and J. Selbin, Affiliated East-West press Pvt. Ltd., New Delhi.
6. Mechanisms of Inorganic reactions in solution by D.Benson, MCgraw Hill, London, 1968.

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SECOND SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

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(23OCHT23) Paper-III: ORGANIC CHEMISTRY-II

UNIT-I

Reaction Mechanism **10 Hrs**

Aliphatic Nucleophilic Substitution and Nucleophilic Aromatic substitution:

Stereochemistry of S_N2 and S_N1 mechanisms, Neighboring Group Participation (Anchimeric assistance), NGP by O, S, N: Aromatic Nucleophilic substitution: SN2 (Ar) (Addition – Elimination), SN1(Ar) and benzyne mechanisms (Elimination - Addition); evidence for the structure of benzyne. Von Richter Sommelet-Hauser and Smiles rearrangements.

UNIT-II **10 Hrs**

Elimination Reactions:Type of elimination reactions, mechanisms, Stereochemistry and Orientation, Hofmann and Saytzeff rules, Syn elimination versus anti-elimination, competition between elimination and substitution, dehydration, dehydrogenation, dehalogenation, decarboxylative eliminations and pyrolytic eliminations

UNIT-III

Addition Reactions **15 Hrs**

(A) Addition to Carbon – Carbon Multiple Bonds:Mechanistic and stereo chemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, region and chemo selectivity, orientation and reactivity, Hydrogenation of double and triple bonds, hydrogenation of aromatic rings, Hydroboration.

(B) Addition to Carbon-Hetero Multiple Bonds: Steric course of addition reactions to C=O and C=N, Aldol, Cannizzaro, Perkin, Knoevenagel, Claisen-Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations, Reformatsky reaction, Tollen's reaction, Prins reaction: Wittig, Grignard, Mannich, and Michael reaction, Hydrolysis of Carbon-Nitrogen bond, Isocyanates and isothioyanates.

UNIT-IV

Molecular Rearrangements **12 Hrs**

Types of molecular rearrangements, migratory aptitude;

(A) Rearrangements to electron deficient carbon: Pinacol-pinacolone, Wagner-Meerwein, , Dienone – Phenol, Arndt-Eistert synthesis;

(B) Rearrangements to electron deficient nitrogen: Beckmann, Hofmann, Curtius, Schmidt and Lossen rearrangements.

(C) *Rearrangements to electron deficient oxygen:* Baeyer-villiger, Hydro peroxide rearrangement and Dakin rearrangements; Neber rearrangement, Benzil-Benzilic acid and Favorskii rearrangements

UNIT-V

Spectroscopy: Basic principles and importance of UV, IR, NMR and Mass. **13 Hrs**

(A) UV Spectroscopy: Introduction, Absorption Laws (Lambert's Law and Beer's Law), Chromophore, Auxo Chrome,

(B) IR Spectroscopy: Introduction, Finger Print Region

(C) NMR Spectroscopy: Introduction, Nuclear Spin, Nuclear Resonance, Shielding, Deshielding and Chemical Shift

(D) Mass Spectroscopy: Introduction, Fragmentation pattern of Aldehydes and Ketones.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and structure, Jerry March, 6th Ed. (John Wiley & Sons).
2. Modern Organic Reactions, H. O. House (Benjamin)
3. Structure and Mechanism in Organic Chemistry, C.K. Inglod (Comell University Press).
4. Organic Chemistry, Paula YurkanisBruice, 4th Ed. (Printice Hall)
5. Organic Chemistry, Salmons, P.W. & Others, 8th Ed. (John Wiley & Sons)
6. Advanced Organic Chemistry: Reactions and mechanisms, Miller Bernard & Other, 2nd Ed. (Pearson)
7. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, 6th Ed., (Longman).
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, 2nd Ed. (New Age International).
9. Stereochemistry to Organic Compounds, E.L. Eliel (John Wiley). 13. Stereochemistry to Organic Compounds, Nasipuri, 2nd Ed. (New Age International).
10. Stereochemistry, P.S. Kalsi, 5th Ed. (New Age International). Organic Chemistry Structure and Reactivity, Ege Seyhan, 3rd Ed. (AITBS)
11. Spectroscopic Methods in Organic Chemistry- Forth Edition, D.H. Williams and I. Fleming Tata - McGraw Hill, New Delhi, 1990.
12. Organic Spectroscopy- Second Edition, W. Kemp, ELBS Macmillan, 1987.
13. Applications of absorption spectroscopy of Organic Compounds J.R.Dyer,Prentice Hall of India, New Delhi, 1984.
14. Spectrometric identification of Organic Compounds-Fourth Edition, R.M. Silverstein: G.C.Vassiellr and T.C. Merill, Johne Willey, Singapore, 1981.

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SECOND SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

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(23OCHT24) Paper – IV: PHYSICAL CHEMISTRY-II

UNIT-I

Physical methods of molecular structural elucidation: Magnetic susceptibility – Gouy balance method for measuring magnetic susceptibility - NMR: Principle and theory, Nature of spinning particle and its interaction with magnetic field - Chemical shift and its origin. Spin-Spin interaction, Application of NMR to structural elucidation: Structure of ethanol, dimethylformamide, styrene and acetophenone – NMR instrumentation.

UNIT-II

Electron Spin Resonance: Principle and theory - g-factor, presentation of ESR spectra, line shapes and line widths - hyperfine interactions, H atom, D atom and CH_3 radical – Reference used in ESR and determination of g-factor - Applications of ESR studies to the structure of free radicals and metal complexes - zero field splitting, Kramer's degeneracy – ESR instrumentation.

UNIT -III

Thermodynamics-II- Brief review on entropy; entropy changes accompanying specific process – expansion, phase transition, heating or cooling - Nernst heat theorem, limittions; Third law of thermodynamics - Determination of the absolute entropy of solids, liquids and gases - Apparent exceptions to Third law of thermodynamics.

Statistical Thermodynamics: Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles. Thermodynamic probability, Most probable distribution, Maxwell-Boltzmann distribution Law – Partition Function, (Definition and significance): Molar and molecular partitions - translational, rotational, vibrational and electronic partition functions - Relation between thermodynamic functions (E, H, S, G and C_v) and the partition functions.

UNIT-IV

Electrochemistry I: Electrochemical cell- Galvanic and electrolytic cell. Concentration cell with and without transference, Effect of complexation on redox potential – ferricyanide / ferrocyanide couple, Iron (III) phenonthroline / Iron (II) phenonthroline couple. Determination of standard potential, activity coefficients and solubility product from EMF data.

Bjerrum theory of ion association (elementary treatment) - 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. Effect of dilution on equivalent conductance of electrolytes - Anomalous behavior of strong electrolytes. Debye Huckel-Onsagar equation – verification and limitations, Fuel Cells.

UNIT-V

Electrochemistry II: The electrode-electrolyte interface. The electric double layer. The Helmholtz-Perrin parallel-plate model, the Gouy-Chapman diffuse-charge model and the Stern model.

Electrodics: Charge transfer reactions at the electrode-electrolyte interface. Exchange current density and over-potential. Derivation of Butler-Volmer equation, High field approximation, Tafel equation, Low field equilibrium, Nernst equation. Voltametry - Concentration polarization, experimental techniques.

Books:

1. Text book of Physical Chemistry by Samuel Glasstone, McMillanPub.
2. Physical Chemistry by W.J.Moore, PrenticeHall
3. Physical Chemistry by G.W. Castellon, Narosha PublishingHouse
4. Physical Chemistry by Peter Atkins and Julio de Paula, Oxford UniversityPress.
5. Modern Electrochemistry, 2A & 2B, JOM Bockris&A.K.N.Reddy, Plenumpublishers
6. Introduction to Electrochemistry,S.Glasstone.
7. Fundamentals of Molecular Spectroscopy,Banwell
8. Spectroscopy by Straw &Walker.
9. Statistical thermodynamics ,M.C.Gupta
10. Statistical Thermodynamics,M.Dole

Practical-1: INORGANIC CHEMISTRY PRACTICAL –II

Quantitative analysis:

Volumetric:

1. Determination of Ferric iron by photochemicalreduction
2. Determination of Nickel by EDTA
3. Determination of Calcium and Magnesium in a mixture byEDTA
4. Determination of Ferrocyanide by Cericsulphate
5. Determination of Copper(II) in presence ofiron(III)

Gravimetric:

6. Determination of Zinc as Zincpyrophosphate
7. Determination of Nickel from a mixture of Copper andNickel.

Reference books:

Vogel's textbook of quantitative chemical analysis, 5th edition by G.H. Jeffery et al.

(19OCHP26) Practical-2: ORGANIC CHEMISTRY PRACTICALS –II

Systematic qualitative analysis of an organic mixture containing two compounds

Identification of method of separation and the functional group(s) present in each of them and preparation of one solid derivative for the conformation of each of the functional group(s).

(19OCHP27)Practical-3: PHYSICAL CHEMISTRY PRACTICALS –II

1. Distribution of iodine between $CHCl_3$ andwater
2. Distribution of I_2between $CHCl_3$ and aq.KI solution- calculation of equilibriumconstant and concentration of given KI solution.
3. Determination of Coordination number of cuprammoniumcation.
4. Titration of mixture Strong acid and weak acid versus Strong base byconductometry.
5. Titration of Strong acid Vs Strong Base – pH –metry.
6. Titration of mixture of ($NaHCO_3$ + Na_2CO_3) VsHCl – pH-metry.
7. Titration of Fe^{+2}Vs $K_2Cr_2O_7$ –potentiometry
8. Verification of Beer-Lambert's law by Iron-thiocyanate system–colorimetry.

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT31) Paper-I: ORGANIC REACTION MECHANISMS-I & PERICYCLIC REACTIONS

12 Hrs

UNIT – I

Aliphatic Nucleophilic Substitution: Neighboring group participation by Bromine, Phenyl group, Non–Classical carbocations, NGP by Pi bond, Sigma bond and Cyclopropyl group, SN at Allylic carbon (allylic rearrangements), SN at Aliphatic trigonal carbon, SN at Vinylic carbon, Ambident nucleophiles, Hydrolysis of esters (B_{AC}^2 Ac^2,A_{AC}^1,A_{AL}^1,B_{AL}^1), Mechanism of esterification of carboxylic acid with an alcohol using DCC, Mayers Synthesis of aldehydes, ketones and carboxylic acids Mitsunobu reaction, Von–Braun reaction

12 Hrs

UNIT – II

Aliphatic Electrophilic Substitution: Mechanisms of SE^2, SE^1, SE^i, *Hydrogen as electrophile*: Hydrogen exchange; Migration of double bonds, *Halogenelectophiles.* Mechanism of Halogenation of aldehydes and ketones; HVZ reaction; Halogenation of Sulphoxides & Sulphones, *Nitrogen Electrophiles*: Aliphatic diazo coupling, Diazo transfer reaction, *Carbon as Leaving groups*: Decarboxylation of Aliphatic Acids; Dakin – West reaction; Haller–Bauer reaction.

12 Hrs

UNIT – III

Principles of asymmetric synthesis: Introduction and terminology: Topicity in molecules Homo topic, stereo hetero topic (enantiotopic and diastereotopic) groups and faces, symmetry, substitution and addition criteria. Prochirality nomenclature: Pro-R, Pro-S, Re and Si. Stereo selective reactions: Substrate stereo selectivity, product stereo selectivity, enantio selectivity and dia stereo selectivity. Conditions for stereo selectivity: Methods for inducing enantio and dia stereo selectivity. Analytical methods: % Enantiomeric excess, enantiomeric ratio, optical purity,% diastereomeric excess and diastereomeric ratio. Techniques for determination of enantiomeric excess, specific rotation, Chiral NMR; Chiral derivatizing agents, chiral solvent, chiral shift reagents and Chiral HPLC.

12 Hrs

UNIT – IV

Pericyclic Reactions-I: Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3 Butadiene, 1, 3, 5- Hexatriene, allyl system, classfication of pericyclic reactions FMO

approach, Woodwrd- Hoffman correlation diagram method and perturbation of molecular (PMO) approach for the explanation of pericyclic reactions under thermal and photochemical conditions. Electrocyclic Reactions: Conrotatory and disotatory motions (4n) and (4n+2), allyl systems Cycloadditions: Antarafacial and suprafacial additions, notation. of cycloadditions, (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+4) - cycloadditions, (2+2) - additions of ketenes and chelotropic reactions.

UNIT-V **12 Hrs**

Pericyclic Reactions-II: FMO approach and perturbation of molecular (PMO) approach for the explanation of sigma tropic rearrgements under thermal and photochemical conditions. Suprafacial and antarafacial shifts of H Sigmatropic shift involving carbon moieties,retention and inversion of configurations, (3, 3) and (5, 5) sigmatropic rearrangements detailed treatment of Claisen and Cope rearrangements, aza-Cope rearrangement and Barton reaction.

Text Books and Reference Books:

1. Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, Mc.Graw Hill and Kogakush.
2. Molecular reactions and Photochemistry by Charles Dupey and O. Chapman, Prentice Hall.
3. Pericyclic reactions by S.N. Mukharji, Mcmilan.
4. Mechanisms and Theory in Organic Chemistry by T. H. Lowery and K.S. Rich gardson.
5. The modern structural theory in Organic Chemistry by L. N. Ferguson, Pretice Hall
6. Physical Organic Chemistry by jack Hine, Mc. Graw Hill
7. Advanced Organic Synthesis, Part B-Reactions and Synthesis, Francis A. Carey and Richard J. Sudenburg, Fourth edition, Kluwer academic publishers, New York
8. Organic Synthesis, Christine Willis and Martin Willis, Oxford Chemistry primers.
9. Principles of Organic Synthesis, ROC Norman and JM Coxon, third edition, CBS, Publisher, Delhi.
10. Organic Synthesis, M. B. Smith, Mc Graw Hill, International Edition.
11. Organic Chemistry, Clayden, Greeves and Stuwart Warren.
12. Modern Organic Synthesis-an introduction by George S. Zweifel and Michael H. Nantz, W. H. Freeman & company, New York.
13. Pericyclic Reactions — a problem solving approach, Lehr and Merchand
14. Conservation of Orbital Symmetry by Woodward and Hoffmann.

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THIRD SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT32) Paper- II: ORGANIC SPECTROSCOPY-I

UNIT-I **12 Hrs**

UV-Visible spectroscopy:

A) Introduction - Instrumentation-Energy transitions - Absorption shifts (Bathochromic, Hypsochromic, Hyper chromic and Hypo chromicshifts) UV absorption of Alkenes-Poly enes unsaturated cyclic systems.

B) UV absorption of carbonyl compounds: α,β-unsaturated carbonyl systems-UV absorption of aromatic systems-geometrical isomerism. Calculation of λ max values using Woodward Fieser – rules.

UNIT-II **12 Hrs**

Infrared spectroscopy:

A) Introduction – Instrumentation - Fundamental modes of vibrations (stretching and bending vibrations) - Factors effectingVibrational frequency - Hydrogen bonding.

B) Typical group frequencies for –C - H,-OH, N-H, C - C, -C = O and aromatic systems-Application in structural determination of simple problems.

UNIT-III **12 Hrs**

Nuclear Magnetic Resonance Spectroscopy (^{1}HNMR):

A) Introduction: Basic principle of NMR - Relaxations-Instrumentation.

B) Shielding and deshielding of magnetic nuclei-chemical shift and its measurements, factors influencing chemical shift –spin-spin interactions

UNIT-IV **12 Hrs**

Coupling Constants in ^{1}HNMR and ^{13}C NMR Spectroscopy:

A) Coupling Constant (J_1) , Geminal Constant (J_2) ,Vicinal Constant (J_3) and Karplus equation

B) ^{13}C NMR Spectroscopy: Similarities and Differences between PMR and CMR, Chemical shift (aliphatic alkanes, olefinis, alkyne, and aromatic compounds)

UNIT-IV **12 Hrs**

Mass spectrometry

A) Introduction: Basic principles of Mass Spectroscopy – Instrumentation of Mass Spectrometer – Isotopic Abundance – Ion production-EI, CI, ES, MALDI and FAB

B) Classification of Mass spectral fragmentation of organic compounds, molecular ion peak, Meta stable peak. Nitrogen Rule, Mc Laffety rearrangement and Problems on Mass spectral fragmentation of simple organic compounds.

Suggested Books:

1. Spectroscopic Methods in Organic Chemistry- Forth Edition, D.H. Williams and I.Fleming Tata McGraw Hill, New Delhi, 1990.
2. Organic Spectroscopy- Second Edition, W.Kemp, ELBS Macmillan, 1987.
3. Applications of absorption spectroscopy of Organic Compounds J.R.Dyer, Prentice Hall ofIndia, New Delhi, 1984.
4. Spectrometric identification of Organic Compounds-Fourth Edition, R.M. Silverstein: G.C.Vassiellr and T.C. Merill, Johne Willey, Singapore, 1981.
5. Introduction to spectroscopy-D.L.Pavia, G.M.Lampman, G.S.Kriz, 3rd Ed. (Harcourt college publishers).
6. Absorption spectroscopy of organic molecules-V.M.Parkih.
7. Nuclear Magnetic Resonance-Basic principles-Atta-Ur-Rehman, Springer-Verlag, 1986.

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S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT33)Paper –III: MODERN ORGANIC SYNTHESIS–I

12 Hrs

UNIT-I

Formation of C-C single bonds

A) Organo Sulphur chemistry: Corey Seebach Reaction, Sulphurylides: dimethyl sulphoniummethylide, dimethyloxosulphoniummethylide preparations and their syntheticapplications

B) Organo Palladium Chemistry: Heck Reaction, Stille coupling, Suzuki coupling, Sonogashira coupling, Negeshicoupling, Wacker Oxidation

C) Organo copper chemistry: Gilman's reagent and synthetic applications; BaylisHilman reaction.

12 Hrs

UNIT-II

Formation of Carbon-Carbon double bonds

A) Stereochemistry of E_1 and E_2 reactions, Saytzeff rule, Hofmann rulesand Bredt's rule; Pyrolytic Syn eliminations (focus should be given on stereochemistry of syn eliminations of amine oxides, xanthates and esters of acyclic and cyclic molecules); Sulphoxide-Sulphenate rearrangement (Mislow-Evans rearrangement)

B) Wittig reaction, Wittig-Horner reaction; Shapiro reaction, Claisen rearrangement of allyl vinyl ethers, Julia Lythgoe olefination, Mc Murray coupling, Peterson Olefination, Tebbes reagent and its application,

12 Hrs

UNIT-III

Reactions of Unactivated C-H bonds and Polymers, Metathesis & Click Chemistry

A) The Hoffmann - Loeffler- Freytag reaction (HLF), Barton reaction and Photolysis of organic hypohalites.

B) Metathesis: Grubbs 1st and 2nd generation catalysts, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis.

C) Click chemistry: criterion for click reaction, Sharpless azide cyclo additions

12 Hrs

UNIT-IV

Organoboranes: Organoboranes: Preparation of Organobornaesviz hydroboration with BH_3-THF, disiamyl borane, thexyl borane, 9- BBN, mono isopino camphenyl, borane ($IPCBH_2$) and diisopinocamphenyl borane (IPC_2BH). Functional group ransformations of Organo

boranes - Oxidation, protonolysis and isomerization. Formation of carbon-carbon bonds viz carbonylation and cyanidation.

UNIT-V **12 Hrs**

Simple applications of Microwave and Ultrasound assisted reactions

1. Microwave Technology: Microwave assisted reactions in organic solvents- Esterification reactions, Fries rearrangement, Ortho Ester Claisen rearrangement, Diels- Alder reaction, Decarboxylation.
2. Ultrasound assisted reactions: Introduction, Substitution reactions, Coupling reactions, Oxidation, Reduction reactions.
3. Synthetic applications of PTC and Crown ethers

Textbooks and Books for Reference Books:

1) Some Modern Methods of Organic Synthesis W. Carruthers, Third & Fourth Edition, Cambridge University Press,Cambridge, 1988.
2) Modern Organic Synthesis-an introduction by George S.Zweifel and Michael H. Nantz, W. H. Freeman & company, NewYork.
3) Advanced Organic Synthesis, Part B-Reactions and Synthesis, Francis A. Carey and Richard J. Sudenburg, Fourthedition, Kluwer academic publishers, New York
4) Organic Synthesis, Christine Willis and Martin Willis, Oxford Chemistry primers.
5) Principles of Organic Synthesis, ROC Norman and JM Coxon, third edition, CBS, Publisher, Delhi.
6) Organic Synthesis,M. B. Smith, McGraw Hill, International Edition.
7) Organic Chemistry, Clayden, Greeves and Stuwart Warren.
8) Guide Book to Organic Synthesis (3rd edition), R. Mackie, D. M. Smith and Aitken.
9) Organo Boranes and Silanes,Thomson, Oxford Chemistry primers.
10) Strategic applications of named reactions in organic synthesis, Laszlo Kurti and Barbara Czako.
11) Modern Synthetic Reactions, Herbet O. House, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
12) Organic Synthesis viz Boranes, Herbet C. Brown Gray, W. Kramer Alan B. Levy and M. Mark Midland John Wiely&Sons, New York, 1975.
13) Organic Synthesis: Special Techniques, V. K. Ahluwalia and Renu Agarwal.
14) Organic Synthesis, Jagadamba Singh and Dr. A. Yadav, Pragati Edition.

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S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2013-24 Admitted batch)

(23OCHT34) Paper – IV: CHEMISTRY OF NATURAL PRODUCTS -I

UNIT–I: **12 Hrs**

Alkaloids: Introduction, isolation, general methods of structure elucidation and physiological action, classification based on nitrogen heterocyclic ring, structure, stereochemistry, synthesis of morphine, strychnine, colchicine and reserpine.

UNIT–II: **12 Hrs**

Terpenoids: Occurrence, isolation, general methods of structure determination, isoprene rule. Structure determination, stereochemistry, synthesis of Farnesol, Zingiberene, Forskolin and Azadirachtin

UNIT–III: **12 Hrs**

Steroids: Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and its stereochemistry. Isolation, structure determination and synthesis of cholesterol (total synthesis not expected), androsterone, testosterone and progesterone.

UNIT–IV: **12 Hrs**

Flavonoids: Occurrence, nomenclature and general methods of structure determination, Isolation, structure elucidation and synthesis of Kaempferol, Quercetin, Cyanidin, Genestein and Butein

UNIT–V: **12 Hrs**

Pigments: Introduction structure elucidation and synthesis of quinones-Polyporic acid. Chlorophyll and haemin.

Books Suggested:

1. Natural Products: Chemistry and Biological Significance, J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthrope and J. B. Hatrbnome, Longman, Essex.
2. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
3. Chemistry of Organic Natural Products, O. P. Agrawal, Vols. 1 &2, Goel Pubs.
4. Natural Products Chemistry K. B. G. Torssell, John Wiley, 1983
5. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M. I. Choudhary, Harwood Academic Publisher.
6. Chemistry of Natural products P. S. Kalsi, Kalyani Publishers

7. Biosynthesis of steroids, terpenes and acetogenins, J. H. Richards & J. R. Hendrieson.
8. The biosynthesis of secondary metabolites, R. D. Herbert, Chapman & Hall
9. The Biosynthesis of Secondary Metabolite, R. D. Herbert, Second edn, Chapman and Hall 1984.
10. Chemical aspects of Biosynthesis, John Mann, Oxford University Press, Oxford, 1996.

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S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

THIRD SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2024-25 Admitted batch)

LABORATORY WORK (6 Hrs/week)

(23OCHP35) Practical-1: Multistep Synthesis of Organic Compounds **100 Marks**

The experiments should illustrate the use of organic reagents:

1. Beckmann rearrangement: Benzanilide from Benzophenone

   Benzophenone → Blenzophenone oxime → Benzanilide

2. Benzilic acid rearrangement: Benzilic acid from benzoin

   Benzoin → Benzil → Benzilic acid

3. P-Bromo Aniline from Aniline :

   Aniline → Acetanilide → P-Bromo Acetanilide → P-Bromo Aniline

4. Symmetrical Tribromo Benzene from aniline:

   Aniline → Tribromoaniline → Tribromobenzene

5. 2,4,6-trimethylquinoline from p-toluidine

   p-toluidne → 4-(p-tolylamino) pent-3-ene-2-one → 2,4,6-trimethylquinoline

6. 2-phenylindole from phenylhydrazine

   phenylhydrazine → acetophenone phenylhydrazone → 2-phenylindole

(23OCHP36) Practical-2: Estimations and Chromatography **100 Marks**

1. Estimation of (a) Glucose (b) Phenol (c) Aniline (d) Acetone (e) Aspirin (f) Ibuprofen
2. Separation by column chromatography: Separation of a mixture of *ortho* and *para* nitroanilines using silica gel as adsorbent and benzene as the eluent. The column chromatography should be monitored by TLC.

Books Suggested

1. Modern Organic Synthesis in the Laboratory *A Collection of Standard Experimental Procedures,* Jie Jack Li, Chris Limberakis, Derek A. Pflum.
2. Practical organic chemistry by Mann & Saunders.
3. Text book of practical organic chemistry by Vogel.
4. Text book of practical organic chemistry including qualitative organic analysis by A.I. Vogel (Longman).

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S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2013-24 Admitted batch)

(23OCHT41) Paper- I: ORGANIC REACTION MECHANISMS-II & ORGANIC PHOTO CHEMISTRY

UNIT – I: **12 Hrs**

Free Radical Reactions: Neighboring group assistance in free radical reactions; Reactivity for aliphatic substrates; Reactivity in aromatic substrates; Reactivity at bridge head; Allylic halogenations using NBS (Wohl – Ziegler bromination); Hydroxylation at aromatic carbonby Fentons reagent; Formation of hydroperoxides (autooxidation); Coupling of alkynes (Eglinton reaction and Glacer reaction); Arylation of Aromatic compounds by diazoinum salts (Gomberg – Bachman reaction); Mechanisms of Sandmeyer reaction, Hunsdiecker reaction, Reed reaction.

UNIT – II: **12 Hrs**

Rearrangements: Rearrangements: Classfication and general mechanistic treatment of nucleophilic, free radical and electrophilic rearrangements, Wagner - Meerwein and related reactions Tiffeman Demzanox rearrangement, a- ketone arrangement, Neber, Hofmann, Bayer- villiger, stevens, wittig rearrangements.

UNIT– III: **12 Hrs**

Methodologies in asymmetric synthesis

Strategies in Asymmetric Synthesis: l. Chiral substrate controlled, 2. Chiral reagent controlled and 3. Chiral catalyst controlled.

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

2. Chiral reagent controlled asymmetric synthesis: Asymmetric reductions using BINAL-H. Asymmetric hydroboration using IPC_2 BH and $IPCBH_2$.

3. Chiral catalyst controlled asymmetric synthesis: Sharpless and Jacobsen asymmetric epoxidations. Sharpless asymmetric dihydroxylation. Asymmetric hydrogenations using chiral Wilkinson biphosphine and Noyoricatalys. Enzymemediated enantioselective synthesis.

UNIT – IV **12 Hrs**

Photo Chemistry-I: Photochemical energy, Frank Condon Principle, Types of Electronic Excitation and Molecular orbital view of excitation, Jablonski Diagram, singlet and triplet

states, photosensitization, quenching, quantum efficiency and quantum yield. Photo Chemistry of Carbonyl Compounds: Norrish Type I reaction (alpha cleavage reaction), Norrish Type – II reaction, Paterno- Buchi reaction, Photo reduction & photo enolisation; photochemical Oxidations [Backstrom mechanism].

UNIT – V **12 Hrs**

Photochemistry-II: Di – Pi methane Rearrangement, Oxa di – Pi methane rearrangement; Aza di – Pi methane rearrangement; Photochemistry of Benzene and substituted benzene, 1, 2 , 1,3 ,& 1, 4-additions; Photo Fries rearrangement of Phenolic acetates and Anilides; Photochemistry of unsaturated systems, Cis- Trans Isomerisation of alkenes (Direct and sensitized) (Photoisomerisation of Stilbene), Photochemistry of Butadiene; Dimerisations of alkenes, Intramolecular dimerisation. Photochemical rearrangement of Cyclohexadienenones; Photochemistry of alpha, beta Unsaturated ketones (dimerisations and addition across the double bond); Photochemical rearrangement reactions of Cyclohexenone, Photorearrangements of Beta, gamma unsaturated systems (Mechanism of 1, 2& 1, 3 – acyl shifts); Photochemistry of Nitrite esters (Barton reaction).

Text Books and Reference Books:

1. Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, Mc. Graw Hill and Kogakush.
2. Molecular reactions and Photochemistry by Charles Dupey and O. Chapman, Prentice Hall.
3. Mechanisms and Theory in Organic Chemistry by T.H. Lowery and K.S. Rich gardson.
4. The modern structural theory in Organic Chemistry by L. N. Ferguson, Pretice Hall
5. Advanced Organic Synthesis, Part B-Reactions and Synthesis, Francis A. Carey and Richard J. Sudenburg, Fourth edition, Kluwer academic publishers, New York
6. Principles of Organic Synthesis, ROC Norman and JM Coxon, third edition, CBS, Publisher, Delhi.
7. Organic Synthesis, M. B. Smith, Mc Graw Hill, International Edition.
8. Organic Chemistry, Clayden, Greeves and Stuwart Warren.
9. Modern Organic Synthesis-an introduction by George S. Zweifel and Michael H. Nantz, W. H. Freeman & company, New York.
10. Organic Photochemistry by D Coyle.
11. Molecular Photochemistry by Gilbert & Baggo.
12. Organic Photochemistry by Turro.
13. Photochemistry by C. W. J. Wells.

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S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT42) Paper- II: ORGANIC SPECTROSCOPY-II

UNIT-I **12 Hrs**

Optical Rotatory Dispersion (ORD) and CD spectroscopy:

A) Optical Rotation, Circular birefringence, Circular Dichroism and Cotton effect.

B) Optical Rotatory Dispersion: Types of Optical Rotatory Dispersion and CD curves Similarities and difference between ORD and CDcurves. Applications of ORD curves

C) The α- halo keto rule - The octant rule-application in structural studies of absolute configuration and confirmations of organic molecules.

UNIT-II **12 Hrs**

A) Improving the PMR spectrum: Lanthanide shift reagents, Changing the Magnetization, Chemical and Magnetic Equivalence. Chemical exchange, First and Non-First Order Spectra and analysis of AB, AMX and ABX systems.

B) Nuclear Magnetic double resonance, Fourier transforms technique, Nuclear Over Hauser Effect (NOE), Deuterium Exchange, Resonance of other nuclei-^{19}F &^{31}P

UNIT-III **12 Hrs**

2D NMR spectroscopy:

2D - NMR spectroscopy: Definitions and importance of COSY, HETCOR, DEPT, INADEQUATE, INDOR, INEPT, HOM2DJ, HET2dJ, DQF. COSY.

UNIT-IV **12 Hrs**

Solution of structural problems by joint application of UV, IR, NMR (^{1}H & ^{13}C) and mass spectrometry.

UNIT-V **12 Hrs**

A) Separation Techniques: Solvent extraction chromatography-paper-thin layer-column Chromatography.

B) Instrumentation – Gas Chromatography, High performance Liquid Chromatography, X – Ray diffraction (XRD)

Suggested Books:

1. Spectroscopic Methods in Organic Chemistry- Forth Edition, D.H. Williams and I. Fleming Tata – McGraw Hill, New Delhi, 1990.
2. Organic Spectroscopy- Second Edition, W. Kemp, ELBS Macmillan, 1987.
3. Spectrometric identification of Organic Compounds-Fourth Edition, R.M. Silverstein: G. C. Vassiellr and T. C. Merill, Johne Willey, Singapore, 1981.
4. Introduction to spectroscopy-D. L. Pavia, G. M. Lampman, G. S. Kriz, 3rd Ed., (Harcourt college publishers).
5. "Applications of Optical rotation and Circular Dichroism", G. C. Barret, in "Elucidation of Organic structures by Physical and Chemical Methods" Part I (Eds) K.W. Bentley and G. W. Rirty John Wiley, 1972, Chapter VIII (only those aspects mentioned in the syllabus).
6. Instrumental methods of chemical analysis by H. Kaur, Pragati Prakasan, Meerut.
7. Separation Techniques by M. N. Sastri, Himalaya publishing House (HPH), Mumbai.

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FOURTH SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT43) Paper-III: MODERN ORGANIC SYNTHESIS–II

UNIT-I

12 Hrs

Organo Silanes

Synthetic applications of tri methyl silyl chloride, di methyl-t-butyl silyl chloride, tri methyl silyl cyanide, tri methy lsilyl iodide and tri methyl silyl triflate, synthetic applications of α-silyl carbanion and β-silyl carbonium ions. Nazarov cyclization, Synthetic conversion of α, β-epoxy silanes, Peterson Olefination, Brook rearrangement and Rubottom oxidation.

12Hrs

UNIT-II

Organic Polymerization

Polymers – Polymerization - Types of Polymerizations (Addition, Coordination and Condensation Polymerizations), Isomerism of polymers and Tacticity (Isotactic, Syndio Tactic and Atactic polymers) – Copolymers and their Classification (Random, Alternative and Lader Copolymers)

UNIT-III

12Hrs

Oxidation

Synthetic applications of the following reagents: 1) Pb(OAC)4 2) HIO4 3) SeO2 4) Collins reagent, Jones reagent, PCC (Coreys reagent), PDC(Babler oxidation) 4) MnO2 5) KMnO4 6) OsO4 7) Swern oxidation, 8) Oxidations by using Bayer villager oxidation 10) Oxidation of alkenes using Woodward and Prevost reagents 11) Oxidation by using DDQ 12) Thallium nitrate

UNIT-IV

12Hrs

Reduction

(1) Reductions by using electrophilic nucleophilic metal hydrides: $LiAlH_4$, LAH, $NaBH_4$, $NaBH_3CN$, Tri alkyl Boro hydrides (Super Hydride and Selectride).

(3) Reductions by using electrophilic metal hydrides: BH_3, DIBAL

(4) Reductions by dissolving metals: Clemenson reduction, Acyloin condensation, Bouveault-Blanc reduction, Birch reduction

(5) Reductions by using Di - Imide and Wolf-Kishner Reduction

(6) Reductions by using tri n-butyl tin hydride.

UNIT-V

Retro Synthetic Analysis **12 Hrs**

1. Basic definitions of the following: a) Retro synthetic analysis b) Disconnection c) Target molecule d) Synthon e) Synthetic equivalent f) Functional Group Inter Conversion (FGI) g) Functional Group Addition (FGA)
2. Guidelines for the order of events - One Group C-X disconnections (Carbonyl derivatives, ethers, sulphides and alcohols) - Two group C-X disconnections (1,1-difunctionalised, 1,2-difunctionalised and 1,3-difunctionalised compounds) - Linear and convergent Synthesis.

Textbooks and Books for Reference:

1. Some Modern Methods of Organic Synthesis W. Carothers, Third Edition, Cambridge University Press, Cambridge, 1988.
2. Modern Organic Synthesis-an introduction by George S.Zweifel and Michael H. Nantz, W.H. Freeman & company, New York.
3. Advanced Organic Synthesis, Part B-Reactions and Synthesis, Francis A. Carey and Richard J. Sudenburg, Fourt edition, Kluwer academic publishers, New York.
4. Organic Synthesis, Christine Willis and Martin Willis, Oxford Chemistry primers.
5. Principles of Organic Synthesis, ROC Norman and JM Coxon, third edition, CBS, Publisher, Delhi.
6. Organic Synthesis, M. B. Smith, McGraw Hill, International Edition.
7. Organic Chemistry, Clayden, Greeves and Stuwart Warren.
8. Guide Book to Organic Synthesis (3rd edition), R. Mackie, D. M. Smith and Aitken.
9. Organo Boranes and Silanes, Thomson, Oxford Chemistry primers.
10. Strategic applications of named reactions in organic synthesis, Laszlo Kurti and Barbara Czako.
11. Organic Synthesis: The disconnection approach, S. Warrant John Wiley & sons, New York,1984.
12. Modern Synthetic Reactions, Herbet O. Horase, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.

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Ch. K. Prasad

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

(23OCHT44) Paper – IV: BIO-ORGANIC CHEMISTRY

12 Hours

UNIT-I

Biopolymers and Enzymes: Peptides: α-Amino acids, their general properties and synthesis, Synthesis of peptides by Merrified solid phasesynthesis. Chemistry of oxytocin and dolastain-10.Enzymes-Oxidoreductases, hydrolases, transferases, synthesis of ATP, Baker's Yeast. Enzyme models.

12 Hours

UNIT-II

Antimalarials: Chemotherapy, synthesis and activity of antimalarial drugs- quinoline group - quinine, acridine group quinacrine and guanidine group - paludrine.

12 Hours

UNIT-III

Antibiotics: General characteristics, structure- activity relationships, synthesis and activity of antibiotics: Pencillin G, Cephalosphorin-C and streptomycin.

12 Hours

UNIT-IV

Vitamins: Definition, occurance, structural formulae, physiological functions and synthesis of Vitamins: Structure determination and synthesis of Retinol (A), Thiamine (B1), Riboflavin (B2), Pyridoxine (B6) and Nicotininc acid.

12 Hours

UNIT-V

Nucleic Acids: Nucleic acids: Basic concepts of the structures of RNA and DNA and their hydrolysis products, nucleotides, nucleosides and heterocyclic bases, Genetic Code, Finger Print test. Application of recombinant DNA technology in production of pharmaceuticals, diagnosis of diseases, insect control, improved biological detergents, gene therapy-examples.

Reference Books and Material:

1. Chemical Aspects of Biosynthesis, John Man, Oxford University Press, Oxford, 1996.
2. Chemistry of Natural Products: A Unified Approach, N. R. Krishnaswamy, University Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.
3. Introduction to Organic Chemistry, A Streitweiser, CH Heathcock and E. M. Kosover IV Edition, Mc. Millan, 1992. (For Merrifield synthesis of peptides and also for other aspects of Unit IV)
4. Details of Primary literature: Nomenclature: Structure: Dolastatin-10: JACS, 1987, 109, 6883 (structure), ibdi, 1989,111, 5463, JCS, Parkin I, 1996, 859 (synthesis).

S. V. K. P. & Dr. K. S. RAJU ARTS & SCIENCE COLLEGE (A)

FOURTH SEMESTER M.Sc. ORGANIC CHEMISTRY SYLLABUS

(With effect from 2023-24 Admitted batch)

LABORATORY WORK (6 hrs/ week)

(23OCHP45) Practical-1: Chromatographic Separation and Isolation & identification of Natural Products **100 Marks**

1. Thin layer chromatography: Determination of purity of a given sample, monitoring the progress of chemical reactions, identification of unknown organic compounds by comparing the Rf values of known standards.
2. Isolation and identification of any five of following Natural Products.
   a) Isolation of caffeine from tea leaves
   b) Isolation of euginol from cloves
   c) Isolation of casein and lactose from milk
   d) Isolation of limonene from lemon peel
   e) Isolation of piperines from black pepper
   f) Isolation of lycopene from tomatoes
   g) Isolation of β-carotene from carrots

(23OCHP46) Practical-2: Spectral Identification of Organic Compounds **100 Marks**

Spectral Identification of Organic Compounds (UV, IR, ^{1}H- NMR, ^{13}C- NMR & MASS).

A minimum of 30 representative examples should be studied

Books Suggested:

1. Ikan, R. *Natural Products, A Laboratory Guide*, 2nd ed.; Academic Press: New York, 1991.
2. Adapted from *Introduction to Organic Laboratory Techniques: A Microscale Approach*. Pavia, Lampman, Kriz andEngel. (1999) Saunders College Publishing.
3. Pharmaceutical drug analysis by Ashutoshkar
4. Quantitative analysis of drugs in pharmaceutical formulations by P D Sethi
5. Practical pharmaceutical chemistry part-1 and part-2 by A H Beekett and J B Stenlake
6. Practical organic chemistry by Mann & Saunders.
7. Spectrometric Identification of organic compounds, R.M. Silverstein, F.X. Webster and D.J. Kiemle, 7th Ed.,(Wiley).

(23OCHP47) Project: Project Work & Viva **100 Marks**

Student has to submit Report on the Project work done after four weeks Training in Industry/ Chemical R&D/ Organization during summer vacation.

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PRINCIPAL
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