VIKRAMA SIMHAPURI UNIVERSITY::NELLORE
DEPARTMENT OF CHEMISTRY

Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

DEPARTMENT OF CHEMISTRY
VIKRAMA SIMHAPURI UNIVERSITY
NELLORE – 524324

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The mission and vision of the organization help in preparation of strategic plan.

Mission:

- To develop the researcher and scientist in chemical science through post-graduate education and research programme.
- To develop the competent manpower with technology based experimentation methodologies and value based practices for business and industries.
- To provide student centric learning facilities for the development of overall personality of learner.

Vision:

- A global teaching – learning and research, nationally and internationally in the area of chemical sciences, by providing competitive trained chemists which will assist the chemical world and industries.

Program Educational Objectives (PEOs)

- The purpose of the postgraduate chemistry program at the University level is to provide the key knowledge base and laboratory resources to prepare students for careers as professionals in the field of chemistry.
- To develop various skills in planning, performing and handling modern techniques, equipment, laboratory experiments and various softwares.
- Students will learn foundation in the fundamentals and advanced topics in the major fields of organic, inorganic, physical and analytical chemistry to improve their confidence levels to excel in teaching and research fields.
- Students will be encouraged to improve their skills to design molecules using retro synthetic analysis based on their theoretical understanding of the chemical sciences.
- Students are motivated to pursue higher studies in the chosen field.

Program Specific Outcomes (PSOs)

After the successful completion of M.Sc. chemistryprogram, the students will be able to

PSO-1: Core competency: The chemistry graduates are expected to gain knowledge of thefundamental concepts of chemistry and applied chemistry through theory and practical. Thesefundamental concepts would be reflected in the latest understanding of the field to keepcontinues its progression.

PSO-2: Critical thinking: Chemistry graduates are expected to achieve critical thinking abilityto design, carry out, record and analyze the results of chemical reactions. They can have thatmuch potential and confidence that they can overcome many difficulties with the help of theirsharp scientific knowledge and logical approaches.

PSO-3: Analytical skill development and job opportunity: Chemistry graduates are expected to possess sufficient knowledge how to synthesize a chemical compound and perform necessary characterization and analysis in support of the formation of the product by using modern analytical tools and advanced technologies. Because of this course curriculum chemistry graduates have lot of opportunity to get job not only in academic and administrative field but also in industry.

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Program Outcomes (POs)

PO-1: Knowledge and skill: A graduate student is expected to be capable of demonstrating comprehensive knowledge and understanding both theoretical and practical knowledge in all disciplines of Chemistry. Students can solve their subjective problems very methodically, independently and finally draw a logical conclusion. Further, the student will be capable of applying modern technologies, handling advanced instruments and Chemistry related soft-wares for chemical analysis, characterization of materials and in separation technology.

PO-2: Problem solver: Identify, formulate, design, carryout, record and analyse the results of chemical reactions. Students will be able to apply evidence based comparative chemistry approach to explain chemical synthesis and analysis.

PO-3: Design/Development of solutions: The students will develop and design solutions for the target molecules to meet the specific needs for public health and environmental considerations.

PO-4: Sense of inquiry: It is expected that the course curriculum will develop an inquisitive characteristics among the students through appropriate questions, planning and reporting experimental investigation..

PO-5: Modern Techniques :Create, Select,andapply appropriate experimental techniques , resources and modern methods and modelling to complex problems with an understanding of the limitations.

PO-6: Ethical awareness :A post graduate student requires understanding and developing ethical awareness or reasoning which is adequately provided through the course curriculum. Students can also create an awareness of the impact of chemistry on the environment, society, and also on scientific community.

PO-7: Individual and Team work : Function effectively as an individual by contributing in laboratory, as a member or leader in diverse teams, and in multi disciplinary settings.

PO-8 : Skilled Communicator :The course curriculum incorporates basics and advanced training in order to make a graduate student capable of expressing the subject through technical writing as well as through oral presentation.

PO-9 Enterpreneur and Development : Demonstrate knowledge and understanding of the chemistry and management principles and apply these to once own work, and as amember and leader in a team, to manage projects as Enterpreneur in muti disciplinary environments.

PO-10 : Lifelong learning : The course curriculum is designed to inculcate the habit of learning continuously through use of advanced ICT techniqueand other available e-Techniques, e-books and e-journals for personal academic growth.

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Course Structure:

FIRST SEMESTER							
S.No	**Course code**	**Course Title**	**Hours/ week**	**Credits**	**Internal assessment marks**	**University assessment marks**	**Max. Marks**
1	20RMSCOC101	Inorganic Chemistry- I	4	4	30	70	100
2	20RMSCOC102	Organic Chemistry - I	4	4	30	70	100
3	20RMSCOC103	Physical Chemistry -I	4	4	30	70	100
4	20RMSCOC104	General Chemistry- I	4	4	30	70	100
5	20RMSCOC105	Inorganic Chemistry Lab-I	6	2	0	67	67
6	20RMSCOC106	Organic Chemistry Lab-I	6	2	0	67	67
7	20RMSCOC107	Physical Chemistry Lab-I	6	2	0	66	66

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SECOND SEMESTER							
S.No	**Course code**	**Course Title**	**Hours/ week**	**Credits**	**Internal assessment marks**	**University assessment marks**	**Max. Marks**
1	20RMSCOC201	Inorganic Chemistry- II	4	4	30	70	100
2	20RMSCOC202	Organic Chemistry - II	4	4	30	70	100
3	20RMSCOC203	Physical Chemistry –II	4	4	30	70	100
4	20RMSCOC204	General Chemistry- II	4	4	30	70	100
5	20RMSCOC205	Inorganic Chemistry Lab-II	4	2	0	67	67
6	20RMSCOC206	Organic Chemistry Lab-II	4	2	0	67	67
7	20RMSCOC207	Physical Chemistry Lab-II	4	2	0	66	66

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THIRD SEMESTER							
S.No	**Course code**	**Course Title**	**Hours / week**	**Credits**	**Internal assessment marks**	**University assessment marks**	**Max. Marks**
1	20RMSCOC301	Organic Synthesis - I	4	4	30	70	100
2	20RMSCOC302	Organic Synthesis – II	4	4	30	70	100
3	20RMSCOC303	Bioinorganic and Physical Chemistry	4	4	30	70	100
4	20RMSCOC304	Organic Spectroscopy and Its applications	4	4	30	70	100
5	20RMSCOC305	Practical –I (Multistep Synthesis)	6	4	0	100	100
6	20RMSCOC306	Practical –II (Estimations)	6	4	0	100	100

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FOURTH SEMESTER							
S.No	**Course code**	**Course Title**	**Hours/ week**	**Credits**	**Internal assessment marks**	**University assessment marks**	**Max. Marks**
1	20RMSCOC401	Organic Synthesis - III	4	4	30	70	100
2	20RMSCOC402	Heterocyclic Compounds and Natural products	4	4	30	70	100
3	20RMSCOC403	Bio Medicinal Chemistry	4	4	30	70	100
4	20RMSCOC404	General Organic Chemistry	4	4	30	70	100
5	20RMSCOC405	Practical –I (Spectral Problems)	6	4	0	100	100
6	20RMSCOC406	Practical –II (Dissertation (Inorganic/Organic/Physical)	6	4	0	100	100

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FIRST SEMESTER

20RMSCOC101:INORGANIC CHEMISTRY – I

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
I	20RMSCOC101	INORGANIC CHEMISTRY–I	4	60	4

UNIT – I: CO-ORDINATION COMPLEXES **15 hrs**

Introduction to Crystal field theory, Types of ligands, Spectrophotochemical series, Salient features of CFT, CFSE and its calculation, Pairing Energy, Splitting of d orbital's in octahedral, square planar, tetrahedral, square pyramidal and trigonal bipyramidal geometries. High spin and low spin octahedral complexes. Factors affecting the magnitude of crystal field splitting. Jahn-Teller effect, Applications of CFT, OSSE, site selection in spinels and limitations of CFT.

UNIT - II: REACTION MECHANISMS OF METALCOMPLEXES **15 hrs**

Reactivity of metal complexes, Inert and Labile complexes - Concept of labile and inert complexes in terms of Valence bond and crystal field theories. Taube's classification of complexes as labile and inert complexes. Dissociative (D) and Dissociative interchange Mechanism (Id) & Associative (A) and Associative interchange Mechanism (Ia). Substitution reactions in octahedral complexes, Acid hydrolysis and factors affecting acid hydrolysis. Base hydrolysis, conjugate base mechanism, Anation reactions, Substitution reactions in square planar complexes - Trans effect, Mechanisms of trans effect, Theories of trans effect - Polarization theory and π-bonding theory. Electron transfer reactions - Inner sphere and outer sphere mechanisms, Marcus theory.

UNIT – III: CHEMISTRY OF NON TRANSITION ELEMENTS **15 hrs**

General characteristics of non transition elements, Special features of individual elements, Synthesis, Properties and structure of their halides and oxides, Polymerization of Carbon, Phosphorous and Sulphur. Synthesis, Properties and Structure of Boranes, Carboranes, Borazines, Silicates, Carbides, Sulphur-Nitrogen Compounds. Electron counting in Boranes, Wades rules (Polyhedral skeletal electron pair theory), Isopropyl and Hetero poly acids.

UNIT – IV: METAL CARBONYLS AND NITROSYLS **15hrs**

Metal Carbonyls – Synthesis of metal carbonyls, Structure of metal carbonyls of the types M(CO)n (M = Cr, Fe, Ni; n = 4-6), $M_2(CO)n$ (M = Co, Fe, Mn; n = 8-10), $M_3(CO)_{12}$ (M = Fe, Ru and Os), $M_4(CO)_{12}$ (M = Co, Rh, Ir). IR spectra of metal carbonyls – (i) Detection of bridging CO ligand, (ii) Determination of molecular symmetry and (iii) Determination of

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bond angles in metal carbonyls, Synergistic effect, EAN and 18- electron rule as applied to metal carbonyls, Electron counting methods – (i) Oxidation State method and (ii) Neutral Atom method.

Metal Nitrosyls: Synthesis of metal Nitrosyls, Bonding, Electron donation by nitric oxide, Principles of Stoichiomerty, Modes for NO bonding – (i) Covalent model and (ii) Ionic models, Structures of Metal nitrosyls (1) $[IrCl(PPh_3)(CO)(NO)]^+$, (2) $[RuCl(PPh_3)_2(NO)_2]^+$, (3) $[(Cp)CrCl(NO)_2]$, (4) $[(Cp)_2Cr_2Cl(NO)_4]$, Applications of Metal Nitrosyls.

Books suggested

1. Inorganic Chemistry, J. E. Huheey, E. A. Keiterand R. L. Keiter, 4th edition, Harper Collins College Publishers.
2. Concepts and models of Inorganic Chemistry, B.E. Douglas, D.H. McDaniel and J.J. Alexander, 3rd edition, John-Wiley.3. Inorganic Chemistry, D.F. Shriver and P.W. Atkins, 3rd edition, Oxford.
3. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, 6th edition, Wiley Interscience.
4. Inorganic Chemistry, G.L. Miessler and D.A. Tarr, 3rd edition, Low Price edition.
5. Inorganic Chemistry, K.F. Purcell and J.C. Kotz, Holt – Saunders International Edition.
6. Coordination Chemistry, F. Basolo and R. Johnson, Benzamin Inc.
7. Concise Inorganic Chemistry, J. D. Lee, Blackwell Science.
8. Metal complexes in aqueous solutions, A.E. Martell and R.D. Hancock, Plenum Press.
9. Chemistry of complex equilibria, M.R. Beck, Von Nostrand Reinhold.
10. Homogeneous catalysis by metal complexes, Volumes I & II, M.M. Taquikhan and A.E. Martell, Academic Press.
11. Coordination Chemistry, D. Banerjea.
12. Metal ions in reaction mechanisms, K. Veera Reddy, Golgotia Publications (P) Ltd.

	Description of CO	Knowledge
CO1	Discuss the properties of Coordination complexes, Categorize types of Coordination complexes and splitting of "d" orbitals, summarize the applications of CFT.	K_2, K_5, K_2
CO2	Explain the properties of Inert and labile complexes, Review to the reaction mechanisms of ,etal complexes, Discuss the theories of trans effect and Marcus theory	K_2, K_2, K_2
CO3	Generalized characteristics features of non-transition elements, Prepare Boranes, Silicates and Carbides, Distinguish the Closo,Nido and Arachno Boranes.	K_5, K_4 ,K_2
CO4	Classify types of Carbonyls and Nitrosyls, Synthesize metal carbonyls and Nitrosyls, Differentiate Effective Atomic Number(EAN) and 18 electron Rule	K_5, K_4, K_2

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	-	-	-	-	-	1	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC102: ORGANIC CHEMISTRY – I

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
I	20RMSCOC102	ORGANIC CHEMISTRY – I	4	60	4

UNIT-I: AROMATICITY **15hrs**

Huckle's rule and the concept of aromaticity, aromaticity in benzenoid and non benzenoid compounds, alternant and non-alternant hydrocarbons. Metallocenes-preparations and properties of ferrocene, azulenes, annulenes, fulvenes. Anti-aromaticity, pseudo-aromaticity, homo-aromaticity.

UNIT-II: REACTION MECHANISMS-I (Substitution Reactions) 15hrs

Aliphatic Nucleophilic Substitutions: The S_N2, S_N1, mixed S_N1 and S_N2, Definition and types of ambident nucleophiles, SET mechanisms. The neighbouring group mechanism, neighbouring group participation by σ and π- bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions, norbornyl system, common carbocation rearrangements–primary,secondary and tertiary. The S_Ni mechanism, Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate, attacking nucleophile, leaving group and reaction medium.

Aromatic Nucleophilic Substitution: The S_NAr, S_N1, benzyne mechanisms. The von Richter, Sommelet-Hauser and Smiles rearrangements.

UNIT-III: REACTIVE INTERMEDIATES **15 hrs**

Types of reactions and mechanisms, thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and arynes.

UNIT-IV: HETEROCYCLIC COMPOUNDS **15hrs**

Introduction and importance. Replacement and systematic nomenclature (Hantzsch-Widman) for three, four, five, six membered, fused and bridged heterocycles.

Three and four membered heterocycles: Synthesis and reactions of aziridines, oxiranes, thiiranes, azetidines, oxetanes and thietanes.

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Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, JohnWiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International
9. Heterocyclic chemistry Vol. 1-3, R.R. Gupta, M.Kumar and V. Gupta, Springer Verlag.
10. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
11. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
12. An Introduction to the Heterocyclic Compounds, R.M. Acheson, Jonn Wiley.
13. Text book of Organic Chemistry, Fessendon and Fessendon.
14. Text book of Organic Chemistry, T.W. Solomon,
15. Organic Chemistry, Vol I, I.L.Finar, ELBS Eds.
15. A primer to mechanism in organic chemistry, Peter Sykes, PSN Education.
16. Mechanism and theory in organic chemistry, Thomas H Lowry, Addison Wesly Longman
17. Introduction to organic chemistry, Andrew Streitwieser, and Elaton H Heath cock, Prentice Hall
18. Advanced Organic Chemistry : Reactions and mechanisms, Bernord Miller.
19. Chemistry for changing times, 8th ed. John W. Hill, Doris K. Kolb. Printice Hall.
20. Principles of Modern Heterocyclic Chemistry, L.A. Paquett.

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	Description of CO	Knowledge
CO1	Explain the structural and electronic criteria of aromaticity and its applications in benzenoid & non-benzenoid, alternant and non-alternant hydrocarbon.	K1
CO2	Discuss the basics of reaction mechanism of the S_N1, S_N2, SET, S_Ni and S_NAr reactions and their applications through the name reactions Distinguish the reaction mechanisms of aliphatic and aromatic nucleophilic substitution reactions and their applications via the name reactions.	K1, K2, K3
CO3	Outline detailed knowledge on reactive intermediates like carbocations carbanions etc. To learn the physical parameters and potential energy diagrams of transition states and intermediates of organic reactions.	K1, K2, K3, K4, K5
CO4	Explain the basic knowledge on Hantszschwidmann nomenclature of different heterocycles and synthesis & properties of three and four membered heterocycles	K1, K3, K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	-	-	-	-	-	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	3	1	2
CO3	2	2	-	1	-	-	-	-	-	-	3	2	2
CO4	3	-	1	3	-	-	-	-	-	1	3	2	2

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC103: PHYSICAL CHEMISTRY – I

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
I	20RMSCOC103	PHYSICAL CHEMISTRY – I	4	60	4

UNIT I: THERMODYNAMICS-1

15hrs

Thermodynamic system-Surroundings-Types of systems-Thermodynamic variables (or) State variables.Thermodynamicprocess.Exact and inexact differentials.

Internal energy- Nature of work and heat- Zeroth law of Thermodynamics-First law of Thermodynamics- Mathematical formulation of the first law of Thermodynamics. Heat changes- Heat content (Enthalpy) – Heat Capacity- Heat Capacity at constant volume and Heat capacity at constant Pressure. Applications of first law of Thermodynamics : C_p-C_v = R derivation – Maxwell Relations – chemical potential – derivation of Gibb's Duhem equation – Fugacity and its determination

UNIT II: QUANTUM CHEMISTRY-I

15hrs

Photoelectric effect-black-body radiation- Plank's equation- wave particle duality and uncertainty principle- Hydrogen emission spectrum- Bohr's model of the atom.

Operators Algebra operator Addition- subtraction-multiplication operators. Commutator operator- Commutative property of operator linear operator- operator's∇ and ∇^2 – derivation of Schrodinger wave equation - Eigen values and Eigen functions-Hermitian property of operators- properties of Hermitian operator- derivation of operator for momentum and energy - well behaved functions-Normalized function- orthogonality condition-degeneracy.

UNIT-III: CHEMICAL KINETICS- I

15hrs

Rate- Rate laws – order of reaction- molecularity of reaction- difference between order of reaction and molecularity. Theories of reaction rates: Collision Theory of bimolecular reactions- Collision Theory of unimolecular reactions.

Theories of absolute reaction rates- Translate state theory- mathematical treatment of transition state theory, Lindemen's Theory of unimolecular reactions, RRKM theory.

Chain reactions: Reaction kinetics of hydrogen-bromine reaction- reaction kinetics of Hydrogen- chlorine reactions. H_2O_2 explosion reactions.

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UNIT-IV: ELECTROCHEMISTRY-I

15hrs

Thermodynamic and kinetic derivation of Nernst equation-chemical and concentration cells with and without transference- liquid junction potential- derivation of the expression liquid junction potential- it's determination and elimination- Applications of conductance Measurements (i) solubility product(ii) pH determination (iii) potentiometric titrations, Conductance, resistance, specific conductance and conductometric titrations. Classification of electrochemical cells. Selection and characterization of electro chemical cells.

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Books suggested

1.Thermodynamics for Chemists by Glasstone.
2. An introduction to Thermodynamics by Rastogi and Misra.
3. Thermodynamics for students of chemistry by J.Kuriakose and Rajaram.
4. Basic Thermodynamics by Gupta.
5. Chemical Kinetics by K. J.Laidler.
6. Kinetics and mechanisms of Chemical transformations by J.Kuriakose and Rajaram.
7. Introduction to Electrochemistry by S. Glasstone.
8. Modern Electrochemistry by J.O.M.Bockris and A.K.N.Reddy.
9. Soviet Electrochemistry by C.Ansvipov.
10. Quantum Chemistry by A.K.Chandra.

	Description of CO	Knowledge
CO1	Acquire in depth knowledge in quantum mechanics, quantum chemistry, chemicalkinetics thermodynamics and electrochemistry.	K1
CO2	Describe the principles and applications of plank's equation,bohr'smodel,Schrodinger wave equation - Eigen values and Eigen functions.	K1, K3, K4
CO3	Illustrate the classification and characterization of electro chemical cells.	K1, K3
CO4	Apply the knowledge to calculate conductance measurements.	K3, K4, K6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	-	1	2	-	-	-	-	-	1	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	2	1	-	-	-	-	-	2	2	-
CO4	3	2	-	2	2	-	-	1	1	-	2	2	1

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC104: GENERAL CHEMISTRY-I

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
I	20RMSCOC104	GENERAL CHEMISTRY-I	4	60	4

UNIT I : MATHEMATICAL CONCEPTS AND COMPUTERS

(A) Mathematical Concepts

Logarithmic relations, curve sketching, linear graphs and calculation of slopes, differentiation of functions like k_x, e^x, x^n, sin x, log x; maxima and minima, partial differentiation and reciprocity relations. Integration of some useful/relevant functions; permutations and combinations. Factorials. Probability.

(B) **Computers**

General introduction to computers, different components of a computer, hardware and software, input-output devices; binary numbers and arithmetic; introduction to computer languages. Programming, operating systems.

UNIT II : POLYMERS

Classification based upon polymerization mechanism- classification based upon polymer structure-Thermoplastics and Thermo sets- polymerization techniques: Bulk polymerization, solution polymerization and suspension polymerization, emulsion polymerization and plasma polymerization. The management of plastics in the environment: (1) Recycling (2) Incineration (3) Biodegradation- conductive polymers- photoconductive polymers in Biomedical Engineering and drugs delivery- kidney dialysis- Applications in Electronics.

UNIT-III : ELECTRO CHEMICAL BATTERIES

Introduction- primary batteries- secondary batteries lead storage batteries- dry-cell batteries Nickel- Cadmium batteries- Nickel-metal hydride batteries Lithium and Lithium –ion batteries and its Applications. Fuel-cells-H_2-O_2 Fuel cell- Direct methanol fuel cell Proton Exchange Membrane (PEM) fuel cells and its applications. Solar- cells.

UNIT IV : SOLID STATE CHEMISTRY

Introduction to solid state materials –bonding in solids-Ionic,covalent,metallic,hydrogen and wander Waals(molecular) bondings-cohesive energy –defects in crystals-imperfections in solids-line defects-surface imperfections-twin boundary volume defects, crystal systems and X- ray diffraction. Electrode potential –oxidation and reduction potential-electrolyte –electrolysis-catalyst

Physical Vapour Deposition, chemical bath deposition -advantages-limits-DSSCs(dye-sensitized solar cells)-Organic solar cell, XRD (X-ray diffraction) –principal-application-Optical absorption spectroscopy –Raman and IR spectroscopy –XPS (X-ray Photo electron Spectroscopy) –SEM(Scanning Electron Microscopy).

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Books Suggested

1. Physical Methods in Chemistry.- Russell S Drago, Reinhold Publications Co ,1965
2. Chemical Structure and Bonding.- R.L.Decock and H.B Gray.
3. Fundamentals of Molecular Russell S Drago –C.N.Banwell& E.A. Mc Cash, 4th Ed.
4. Molecular Structure and Spectroscopy – G. Aruldhas.
5. Co ordination Chemistry ; Experimental Methods –K.Burger, London Butter Worths, 1973.
6. Physical Methods in Chemistry; Russell S Drago, W.B. Saunders, Co 1997.
7. Modern Spectroscopy-J.M.Hoilas, John Willey.
8. Introduction to Molecular Spectroscopy – G.M. Barrow, Mc Graw Hill.

	Description of CO	Knowledge
CO1	Describe functions, differential equations, probability, vectors, matrices and determinants To learn about the introduction to the computer and computer languages.	K1, K2, K3, K6
CO2	Enriching and appreciating the basic concepts and polymers and understand the significance of co-polymerization, coordination and conducting polymers and molecular weight concept of polymers and its determination.	K1, K3, K5
CO3	Application of batteries especially for primary and secondary batteries,dry cells, fuel cells and solar cells.	K1, K2, K3
CO4	Explain the structural aspects of materials in solid sate by XRD, XPS and SEM Describe the fundamental principles of molecular spectroscopy including IR, and Raman spectroscopies and various rules involved.	K1, K3, K4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	2	-	-	-	-	-	-	-	1	-	-
CO2	3	2	-	2	2	-	-	-	-	2	2	-	2
CO3	2	-	2	-	1	-	-	-	1	2	2	2	2
CO4	3	-	2	-	-	-	-	-	-	-	2	2	1

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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VIKRAMA SIMHAPURI UNIVERSITY::NELLORE
DEPARTMENT OF CHEMISTRY

Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

20RMSCOC105: INORGANIC CHEMISTRY LAB - I

Course Objectives:

The main objectives of this course are:

Gain knowledge on preparation and estimation of Inorganic complexes.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

Train students to improve skills in preparation and processing of inorganic complexes.

Gain knowledge in the quantitative analysis of inorganic complexes.

1. **Preparation of metal complexes**
   - (i) Hexaammine Nickel(II) chloride $[Ni(NH_3)_6]\ Cl_2$
   - (ii) TetraammineCopper(II) sulphate. monohydrate $[Cu(NH_3)_4]SO_4.H_2O$
   - (iii) Pentaamminechlorocobalt(III) chloride $[Co(NH_3)_5Cl]Cl_2$
   - (iv) Potassium trioxalatoferrate(III) $K_3[Fe(C_2O_4)_3]$

2. **Analysis of individual metal ions and inorganic mixture**
   - (i) Reactions of rare earth metals (Mo,V, Zr, W, Se, Ce, Te, Li)
   - (ii) Systematic semi micro qualitative analysis of an inorganic mixture - I
   - (iii) Systematic semi micro qualitative analysis of an inorganic mixture -II
   - (iv) Systematic semi micro qualitative analysis of an inorganic mixture - III
   - (v) Systematic semi micro qualitative analysis of an inorganic mixture - IV

Books suggested

1. Vogel's Text Book of Qualitative Inorganic analysis.
2. Inorganic semi micro qualitative analysis, V.V. Ramanujam, The National Publishing Company.
3. Practical Inorganic Chemistry, G. Marr and B.W. Rockett, Van Nostrand Reinhold Company.
4. Practical Inorganic Chemistry. G. Pass and H. Sutcliff, 2nd edition, John – Wiley & Sons.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	2	-	-	2	2	1	2	-	-	1	3	-	1

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Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

20RMSCOC106 : ORGANIC CHEMISTRY LAB - I

Course Objectives:

The main objectives of this course are:

- To understand the basic principles of purification methods such as recrystallization, sublimation and distillation.
- To understand the preparation, purification and identification of organic compounds through single step synthesis.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

- To attain hands on experience on the named reactions and simple organic synthetic methods like methylation, nitration, oxidation, reduction, condensation, addition etc.
- To attain hands on experience in the purification methods like recrystallisation.

A. Give a brief introduction on

(a) Recrystallization (b) Sublimation (c) Distillation (d) Melting point and boiling point

B. Single step preparations

1. Preparation of *p*-nitroacetanilide
2. Preparation of Aspirin
3. Preparation of Nerolin
4. Preparation of Phthaliimide
5. Preparation of chalcone
6. Preparation of *p*-bromoaniline

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)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	3	2	1	2	2	2	2	1	1	-	3	2	2

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Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

20RMSCOC107: PHYSICAL CHEMISTRY LAB - I

Expected Course Outcomes:

On the successful completion of the course, student will be able:

- To prepare the chemicals with statistical analysis of molar solutions
- To develop knowledge in the determination of eutectic composition and distribution coefficient.
- To interpret the experimental results by adsorption isotherms.
- Impart training in operating calibration of volumetric apparatus and find statistical data of various chemical compositions..

1. Preparation of Solutions (1M HCl, 1M acetic acid, 1M H_2SO_4, 1M NaOH) and Calibration of volumetric apparatus and statistical analysis of the data.
2. Preparation of reagents any five (Starch solution, Chromic acid, Schiff's reagent, Tollen's reagent, Fehling's solution, Phenolphthalein indicator)
3. Preparation of Standard solution: i). To prepare 0.05M solution of oxalic acid in 250ml of volumetric flask. ii). To prepare 0.05M standard sodium carbonate solution in 250ml volumetric flask.
4. Determination of Eutectic composition and temperature of binary system
5. Determination of distribution coefficient of benzoic acid between water and benzene.
6. Study the adsorption of acetic acid on charcoal and analysis of the data on the basis of Langmuir and Freundlich adsorption isotherms.
7. Determination of rate constant of acid hydrolysis of an ester and investigate the effect of catalyst concentration, reactant concentration and temperature.

Books suggested

1. Senior Practical Physical Chemistry – B.D.Khosla, G.C.Garg
2. Vogel's Textbook of Quantitative Chemical Analysis, Revised by G.H.Jeffery, J.Bassett, J.Mendham, R.C.Denney, ELBS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	3	2	1	1	-	-	2	-	1	-	2	-	-

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SECOND SEMESTER
20RMSCOC201: INORGANIC CHEMISTRY-II

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
II	20RMSCOC201	INORGANIC CHEMISTRY-II	4	60	4

UNIT – I: MAGNETOCHEMISTRY OF TRANSITION METAL COMPLEXES 15 hrs

Introduction to Magneto Chemistry, Magnetic Induction, Permeability, Types of magnetism - Dia, para, ferro and anti ferromagnetism, Curie law and Curie-Weiss law. BehaviourDia, para, ferro and antiferromagnetic substances with temperature. Temperature Independent Paramagnetism (TIP), Magnetic exchange behaviour in copper (II) acetate, Magnetic susceptibility and determination of magnetic susceptibility by Guoy's method.

UNIT – II : ELECTRONIC SPECTROSCOPY OF TRANSITION METAL COMPLEXES

15 hrs

Free ion Terms and Energy Levels: Configurations, Terms, States and Microstates. Calculation of Microstates for p^2 and d^2 configurations, L-S (Russel-Sanders) Coupling Schemes, J-J Coupling Scheme, derivation of terms for p^2 and d^2 configuration. Hole formulation, Energy ordering of terms (Hund's rules), Selection rules: Laporte orbital selection rule, Spin selection rules, Splitting of energy levels and spectroscopic states. Orgel diagrams of d^1 to d^9 metal complexes. Interpretation of electronic spectra of aquo complexes of Ti(III), V(III), Cr(III), Mn(II), Fe(II), Fe(III), Co(II), Ni(II) and Cu(II). Tanabe-Sugano diagrams for d^2 and d^6 octahedral complexes. Charge transfer (L→M and M←L) spectra of metal complexes.

UNIT – III: MOSSBAUER AND NQR SPECTROSCOPY 15 hrs

Mossbauer spectroscopy – Principles and Instrumentation. Presentation of Mössbauer spectrum, Factors influencing absorption of γ-rays by nucleus – Isomeric shift, quadrupole interactions and magnetic interactions. Application of the technique in the study of iron and tin compounds with respect to a) spin nature b) structural elucidation c) nature of metal-ligand bonding d) oxidation states and e) electronegativity of groups.

Nuclear quadrupole resonance spectroscopy – Principle, Instrumentation, Quadrupole nuclei, Quadrupole moments, Electric field gradient and Applications.

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UNIT –I V: METAL – LIGAND EQUILIBRIA IN SOLUTION **15 hrs**

Stability of metal complexes-thermodynamic stability and kinetic stability. Types of stability constants - Concentration, conditional, stepwise and overall stability constants. Relation between stepwise and overall stability constants of a metal complex. Trends in step wise stability constants. Factors influencing the stability of metal complexes with reference to metal and the ligand. Chelate effect and Macrocyclic effect. HSAB rule and its application to stability of complexes and metal-ligand interaction in biological systems. Determination of stability constants of metal complexes by spectrophotometric and pH-metric methods.

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Books suggested

1. Inorganic Chemistry, J. E. Huheey, E. A. Keiterand R. L. Keiter, 4th edition, Harper Collins College Publishers.
2. Concepts and models of Inorganic Chemistry, B.E. Douglas, D.H. McDaniel and J.J. Alexander, 3rd edition, John-Wiley.
3. Inorganic Chemistry, D.F. Shriver and P.W. Atkins, 3rd edition, Oxford.
4. Advanced Inorganic Chemistry, F.A. Cotton and G. Wilkinson, 6th edition, Wiley Interscience.
5. Concise Inorganic Chemistry, J.D. Lee, Blackwell Science.
6. Magnetochemistry, R.L. Carlin, Springer-verlag.
7. Elements of magnetochemistry, R.L. Dutta and A. Syamal, Affiliated East-west.

	Description of CO	Knowledge
CO1	Outline the properties of dia and para magnetism, Describe the Curie law and Curie-Wiess Law, Explain the Temperature Independent Paramagnetism (TIP)	K_2, K_4, K_6
CO2	Write the principle of LS Coupling(Rusels Saunders),Compare the Leporte orbital selection rule and spin selection rule, Discuss the Charge Transfer of Metal Complexes	K_2, K_3, K_6
CO3	State the principles of Mossbauer and NQR spectroscopy, Illustrate the applications of Mossbauer and NQR spectroscopy, Discuss the Factors influencing absorbtion of Gamma rays nucleus.	K_1, K_2, K_3
CO4	Differentiate the stepwise and overall stability constants, state the HSAB principle, Demonstrate the stability constants of metal complexes by spectrophotometric and p^H metric methods.	K_1, K_3, K_4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	-	-	-	-	-	1	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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DEPARTMENT OF CHEMISTRY

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20RMSCOC202: ORGANIC CHEMISTRY – II

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
II	20RMSCOC202	ORGANIC CHEMISTRY – II	4	60	4

UNIT-I: REACTION MECHANISMS II (Addition and Elimination reactions) 15 hrs

Addition reactions : Stereoselective addition to carbon – carbon double bond, anti addition – Bromination and epoxidation followed by ring opening. Hydroboration. Michael reaction, Aldol condensation, Cannizaro reaction, Knoevenagel reaction and Dieckmann reaction.

Elimination reaction: E_1, E_2, E_{1CB} mechanisms, orientation and stereoselectivity in E_2 eliminations. Pyrolitic syn elimination and α - elimination, elimination vs substitution. Factors influencing the elimination reactions.

UNIT-II: STEREOCHEMISTRY 15 hrs

Optical isomerism: Molecular Symmetry and Chirality - Stereoisomers - Classification - Configuration - *R, S* - nomenclature - Axial Chirality - Stereochemistry of allenes, spiranes, biphenyl derivatives and atropisomerism - Planar chirality - Ansa compounds and *trans* - Cycloalkenes - Helicity.

Geometrical isomerism: *E, Z* – nomenclature, Physical and Chemical methods of determining the configuration of geometrical isomers - Stereoisomerism in cyclic compounds.

Conformational analysis: Conformations of disubstituted cyclohexane - Compounds having intramolecular hydrogen bonding- Ethylene glycol, butane 2,3- diol, Amino alcohols, halohydrin.

UNIT- III :ALKALOIDS 15 hrs

Occurance, isolation, general methods of structural elucidation and physiological action, Classification based on nitrogen heterocycle ring, Structural elucidation and Synthesis of the following – Atropine, Papaverine and Quinine.

UNIT- IV: TERPENOIDS 15 hrs

Definition and classification – Occurrence, isolation and general methods of structural determination. Isoprene and special isoprene rule. Structural elucidation and Synthesis of the following – α- Terpinenol, Farnesol and Zingiberene.

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Books Suggested

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry C.K.Ingold, Cornell University Press.
5. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
6. Modern Organic Reactions, H.O. House, Benjamin.
7. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic & Professional.
8. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International
9. Stereochemistry to Organic Compounds, E.L. Eliel and others, John Wiley.
10. Stereochemistry to Organic Compounds, D. Nasipuri, New Age International.
11. Stereochemistry, P.S.Kalsi, Wiley Eastern.
12. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge University Press.
13. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
17. Introduction to Flavonoids, T.A. Geissman.
18. Chemistry of Natural Products P.S. Kalsi, Kalyani Publishers
19. Chemistry of Organic Natural Products, O.P. Agarwal, Vols., 1 & 2, Goel Pub
20. Natural Products Chemistry K.B.G. Torssell, John Wiley, 1983.

	Description of CO	Knowledge
CO1	Illustrate the mechanism and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals. Explain the mechanism and stereochemical aspects of variety of elimination reactions like E1, E2 and E1cB etc.	K_1, K_2
CO2	Describe the concept of axial chirality and planer chirality ansa compounds and healicity. Compare the different classification of stereo isomers Discuss conformation analysis of acyclic and alicyclic systems.	K_1, K_2, K_4
CO3	State the occurrence, isolation and classification of alkaloids	K_1, K_2
CO4	Define the isolation, isoprene rule and classification and synthesis of terpenoids	K_1, K_2

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2	-	1	-	-	2	-	2	1	3
CO2	3	2	2	2	-	-	-	-	-	-	2	1	-
CO3	2	2	-	-	-	-	1	-	-	-	2	2	1
CO4	3	2	-	-	-	-	1	-	-	-	2	2	1

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC203: PHYSICAL CHEMISTRY – II

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
II	20RMSCOC203	PHYSICAL CHEMISTRY – II	4	60	4

UNIT-I : STATISTICAL THERMODYNAMICS

Entropy, Probability- Relationship between entropy and probability, Thermodynamic probability- microstate-macro-state system-assembly and ensemble- classification of ensembles, configuration-distribution-Distribution number

Derivation of Boltzmann distribution law- partition function- physical significance of partition function. factoriztion of partition function-translation-rotational-vibrational and electronic and nucleus partition. Relation between patition function and Thermodynamic functions (internal energy, enthalpy, work function, entropy, equilibrium constant). The sacur-tetrode equation derivation.

UNIT-II: QUANTUM CHEMISTRY-II

Postulates of quantum mechanics: postulate-I(physical interpretation of wave function)-postulate-II(observables and operators)postulate-III(measurability of observables)-postulate-IV(average values of observables) postulates-V (Time dependent and independent Schrodinger equation).

Solution of Schrodinger wave equation to particle in one-dimensional box- three dimensional box, quantization of energy- Harmonic oscillator- zero point energy.

Application of Schrodinger wave equation to hydrogen atom - variation Theorem, Linear variation principle, perturbation Theory (first Order and non-degenerate).

UNIT-III: SYMMETRY AND GROUP THEORY

Definition of a group, rules that are set for a group, sub-group, order of a group, Relation between order of a finite group and its sub-group, conjugacy relation and class of a group, symmetry elements and symmetry operation.

Symmetry point group (MLS, MHS and MSS), Schoenflies symbols - Representation of groups by matrices (representation for C_n, C_{nv}, D_{nh} etc. groups to be worked out explicitly), character of a representation, group multiplication tables, reducible - irreducible representations The great orthogonality theorem (without proof) - character tables (H_2O,NH_3) and their use in spectroscopy, Mulliken character tables.

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UNIT-IV: ELECTROCHEMISTRY-II

Concept of activity –activity of a gas – concept of activity coefficient-activity and activity coefficient of solution-activity and activity coefficient of strong electrolytes
meanactivity and meanactivity coefficient- Debye- Huckel-limiting law-verification of Debye- Huckel-limiting law- Experimental determination of activity coefficient of electrolytes: solubility method- EMF method.
Corrosion and its examples- theories of corrosion, dry corrosion –wet corrosion-factors affecting corrosion-protection against corrosion–sacrificial anodic protection-Impressed current cathodic protection.

Books Suggested

1. Symmetry and Spectroscopy Molecules- K.Veera Reddy, New Age Publications , New Delhi.
2. Chemical Applications of Group Theory by Bhattacharya.
3. Group Theory by Habl Bishop.
4. Vogal Text book of Quantitative Chemical Analysis revised by G.H. Jeffrey et al, (5th EDITION ELBS Longman Group, New York).
5. Instrumental Methods of Analysis ,6th EDITION - Willard, Merritt, Dean, Settle, CBS Publications, 1986

	Description of CO	Knowledge
CO1	Apply a vast knowledge in the interpretation of various physical quantities involved in Thermodynamics, enthalpy, work function, entropy and equilibrium constant etc.,	K_3, K_4
CO2	Analyze the theories and applications of quantum mechanical treatment of Schrodinger wave equation to hydrogen atom and perturbation Theory	K_4, K_6
CO3	Identify the concepts and applications of symmetries, group multiplication tables and mulliken character tables	K_1, K_2
CO4	Define the applicative aspects of Debye- Huckel-limiting law and corrosion-factors	K_1, K_4

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	3	1	-	-	1	-	-	-	1	2	-
CO2	2	2	1	-	-	2	-	-	-	-	2	-	1
CO3	2	1	-	2	-	-	-	-	-	-	2	2	-
CO4	3	2	1	1	-	-	-	-	-	-	1	2	1

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC204: GENERAL CHEMISTRY-II

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
II	20RMSCOC204	GENERAL CHEMISTRY-II	4	60	4

UNIT-1: TREATMENT OF ANALYTICAL DATA 15 hrs

Precision and accuracy- Mean and Median values, Standard deviation, Co efficient of variation, Types of errors, determinate and indeterminate errors, confidence limits, significant figures, computations, minimization of errors, statistical evaluation of data – T-test, F- test, χ^2 – test. Correlation co-efficient and coefficient of determination, Limit of detection, Limit of determination, Sensitivity and selectivity of an analytical methods.

UNIT-2: FLAME EMISSION AND ATOMIC ABSORPTION SPECTROSCOPY 15 hrs

Flame Emission Spectroscopy: Principles, Chemical reactions in flame, Interferences, Instrumentation, Types of emission spectra, Applications, Advantages and disadvantages of Emission Spectroscopy.

Atomic Absorption Spectroscopy: Principle, Instrumentation, Sources of radiation (HCL &EDL), Different types of burners, Interferences- Physical, chemical, spectral and back ground correction, Differences and comparison between AAS & FES, Advantages and disadvantages of Atomic Absorption Spectroscopy.

UNIT – III:ELECTRON SPIN RESONANCE SPECTROSCOPY 15 hrs

Principles of ESR spectroscopy, Instrumentation. Presentation of ESR spectrum. Spectroscopic splitting factor (g value) and its significance, factors affecting g value. Hyperfine coupling. ESR spectrum of hydrogen atom, ESR spectra of organic and inorganic radicals: methyl, ethyl, t-butyl, tropylium, benzene, naphthalene, p-benzosemiquinone radicals. Application of ESR spectroscopy to transition metal complexes having one unpaired electron. Zero field splitting and Kramer's degeneracy.

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UNIT – IV: CATALYSIS **15 hrs**

Homogeneous catalysis, Metal ion catalyzed reactions – Redox potentials and processes – Mechanisms of redox processes involving ligands – Factors affecting redox potentials – other types of metal catalyzed reactions – Reactions involving Ag(I), Cu(II) and Os (VIII) – Reactions of oxyanions – Factors affecting rate (General discussion only) – Induced reactions – Free radical reactions – Thermal decomposition of peroxydisulphate – Fe(III) – S_2O_8 reactions – chain reactions – HBr reactions, H_2O_2 – S_2O_2 reactions.

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Books Suggested

1 Vogel Text book of Quantitative Chemical Analysis revised by G.H. Jeffrey et al, (5th EDITION ELBS Longman Group, New York).
2. Instrumental Methods of Analysis ,6th EDITION - Willard, Merritt, Dean, Settle, CBS Publications, 1986.
3. Chemical Structure and Bonding.- R.L.Decock and H.B Gray.
4. Fundamentals of Molecular Russell S Drago –C.N.Banwell& E.A. Mc Cash, 4th Ed.
5. Molecular Structure and Spectroscopy – G. Aruldhas.
6. Co ordination Chemistry ; Experimental Methods –K.Burger, London Butter Worths, 1973.

	Description of CO	Knowledge
CO1	Compare Precision and accuracy, relate the statistical evaluation of Data T-Test and F-Test, Write the importance of Significant figures.	K_6, K_4, K_3
CO2	State the principles of fame emission spectroscopy and atomic absorption spectroscopy, write the difference between AAS and FES, Explain the advantages and disadvantages of AAS and FES.	K_1, K_3, K_6
CO3	Define the principle of ESR spectroscopy, explain ESR spectrum of organic and inorganic radicals, discuss the applications of ESR spectroscopy.	K_1,K_2, K_3
CO4	Outline the Homogeneous catalysis, Analyse the hydrogen bromide(HBr) and Hydrogen peroxide(H_2O_2) reactions, Discuss the factors affecting Redox potentials.	K_1, K_4, K_2.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	-	-	-	-	-	1	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC205: INORGANIC CHEMISTRY LAB –II

Course Outcomes:

On the successful completion of the course, student will be able:
Gain hands on experience in the various ions determination by analysis

1. Analysis of two component mixtures

(i) Determination of Zn (III) and Fe(III)
(ii) Determination of Cu (II) and Zn(II)
(iii) Determination of Ca(II) and Mg(II)
(iv) Determination of Cu (II) and Ni(II)

Books suggested

1. Vogel's Text Book of Qualitative Inorganic analysis.
2. Inorganic semi micro qualitative analysis, V.V. Ramanujam, The National Publishing Company.
3. Practical Inorganic Chemistry, G. Marr and B.W. Rockett, Van Nostrand Reinhold Company.
4. Practical Inorganic Chemistry. G. Pass and H. Sutcliff, 2nd edition, John – Wiley & Sons.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	2	1	2	1	-	-	2	-	1	-	1	2	-

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20RMSCOC206: ORGANIC CHEMISTRY LAB –II

Course Objectives:

The main objective of this course is:

- To understand the basic principles of method of separation of binary mixture of organic compounds

Expected Course Outcomes:

On the successful completion of the course, student will be able:

- Identification of various functional groups in organic compounds and their conformations.

Systematic qualitative analysis of an organic mixture containing two compounds (Identification, 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)

1. Acid + neutral
2. Base + Neutral
3. Phenol + Neutral
4. Neutral + Neutral

Books suggested

1. Practical organic chemistry, Vogel
2. Practical organic chemistry, Mann and Saunders

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	3	1	2	1	-	-	1	-	2	-	2	1	-

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KAKUTUR, NELLORE-524 320 (A.P.)

VIKRAMA SIMHAPURI UNIVERSITY::NELLORE
DEPARTMENT OF CHEMISTRY

Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

20RMSCOC207: PHYSICAL CHEMISTRY LAB - II

Course Outcomes:

On the successful completion of the course, student will be able:

- To conduct the experiments of critical solution temperature of phenol-water system
- To develop knowledge in the determination of rate constant of acid hydrolysis of an ester and investigate the effect of catalyst concentration, reactant concentration and temperature.
- To interpret the experimental results obtained by conductometryand potentiometry.
- Apply concepts of Physical Chemistry and Analytical Chemistry through experimentation.

1. Determination of distribution coefficient of iodine between water and CCl_4.
2. **Conductometry**
   a. Determination of cell constant
   b. Verification of Onsager equation
   c. Determination of dissociation constant of a weak acid
   d. Titration of a strong acid with a strong base
   e. Titration of a weak acid with a strong base
3. **Potentiometry**
   a. Titration of a strong acid with a strong base
   b. Titration of a weak acid with a strong base
   c. Redox titration
4. **Colorimetry:** Verification of Beer's Law, Estimation of Potassium dichromate, Estimation of Potassium permanganate, Estimation of Manganese, Estimation of Iron.
5. **pH metry:** Strong acid, Strong base titrations.
6. Determination of critical solution temperature of phenol-water system and study the effect of electrolyte on CST.

Books Suggested

1. Senior Practical Physical Chemistry – B.D.Khosla, G.C.Garg
2. Vogel's Textbook of Quantitative Chemical Analysis, Revised by G.H.Jeffery,J.Bassett, J.Mendham, R.C.Denney, ELBS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	2	2	1	1	-	-	2	-	1	-	2	2	-

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THIRD SEMESTER

20RMSCOC301 ORGANIC SYNTHESIS –I

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
III	20RMSCOC301	ORGANIC SYNTHESIS – I	4	60	4

UNIT-I: OXIDATIONS

(a) Alcohols to carbonyl compounds – Chromium (iv) oxidants, Dimethyl sulfoxide (DMSO) oxidation, Periodate oxidation, Oppenauer oxidation, MnO_2, Ag_2CO_3 (Fetizons reagent)
(b) Alkenes to epoxides – peroxide induced epoxidation
(c) Alkenes to diols – oxidation with $KMnO_4$, OsO_4, Prevost oxidation.
(d) Oxidative cleavages of carbon-carbon double bonds – cleavage of glycols, lead tetraacetate, periodic acid.
(e) Oxidation of alkyl or alkenyl fragments : Selenium dioxide

UNIT- II: REDUCTIONS

(a) Nucleophilic metal hydrides : Reduction with $LiAlH_4$, $NaBH_4$, Red –Al and alkoxy aluminates.
(b) Electrophilic metal hydrides : Boron aluminium hydride and derivatives
(c) Catalytic hydrogenation
(d) Dissolving metal reductions – Birch reduction and clemmenson reduction
(e) Non metallicreductions :Diimide reduction, Wolf-Kishner reduction.

UNIT- III: REARRANGEMENTS

Rearrangements involving electron deficient Carbon: Pinacol-Pinacolone rearrangement, Wagner-Meerwein rearrangement, Demjanove rearrangement, Dienone-phenol rearrangement, Stevens rearrangement.
Rearrangements involving electron deficient Nitrogen: Beckmann rearrangement, Curtius rearrangement, Schimdt rearrangement.
Rearrangements involving electron deficient Oxygen: Baeyer-Villiger rearrangement, Dakins rearrangement, Benzil-Benzilic acid Rearrangement,
Rearrangements involving electron rich Carbons: Favorskii rearrangement and Neber rearrangement
Aromatic and sigmatropicrearrangements :Fries rearrangement and Claisen rearrangement

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UNIT –IV: MODERN SYNTHETIC REACTIONS

(a) Multicomponent reactions : Ugi reaction, Biginelli and Mannich reactions

(b) C-C formation reactions : McMurry reaction, Julia-Lythgoe olefination, Baylis Hillmann reaction, Mitsunobu reaction, Shapiro reaction, Mukayama aldol reaction

(c) Pd catalyzed reactions : Heck reaction, Suzuki coupling, Sonogshira coupling

(d) Metathesis : Grubbs catalyst and their applications

(e) Click chemistry : Click reaction and its applications

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Books Suggested

1. Some modern methods of Organic Synthesis W. Carruthers, Third Edition Cambridge University Press, Cambridge, 1988.
2. Organic Synthesis by Micael B. Smith. McGraw Hill International Editions.
3. Principles of Organic Synthesis by Richard O.C Norman. Raymond Bonnett, James M. Coxon, Edition: 3, illustrated published by CRC Press 1993.
4. Organic Chemistry, by Jonathan Clayden, Nick Greeves, Steurt Warren, Peter Wothers Contributor Jonathan Clayden Edition: reprint illustrated by Oxford University press, 2001.
5. Making Organic Molecules: An Introduction to Organic Synthesis by Jonathan Clayden Published by pearson Education, Limited, 2006
6 .Modern Synthetic Reactions, Herbert O. House, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
8. Advanced Organic Chemistry part A and B – F.A. Carey and R.J. Sundberg, 4th Edition, Plenum Publishers (2000).
9. Organic Synthesis by Robert E Ireland.
10. Organic Synthesis by C Willis and M Willis.
11. Organic Chemistry Claydon and others 2005.
12. Reagents for organic synthesis, by Fieser&Fieser, Vol 1-11 (1984).
13. Handbook of reagents for organic synthesis by Reich and Rigby, Vol. IV.
14. Advanced Organic Chemistry by Jerry March.
15. Organic Synthesis – Ahluwalia, Agarwal.
16. Name reactions: Jie jack lie; Springer publications.
17. Strategic applications of named reactions in organic synthesis: Laszlo Kurti& Barbara Czako; Elsevier Academic Press.
18. Tandem Organic Reactions by Tse-Lok Ho.

	Description of CO	Knowledge
CO1	Explain the applications of variety of oxidants with mechanism and oxidative cleavages of carbon-carbon double bonds.	K1, K5
CO2	Illustrate the applications of different reducing agents in organic synthesis with mechanism.	K1,K3,K5
CO3	Describe the basic concepts in molecular rearrangementand learn the rearrangements involving electron deficient carbon, nitrogen and oxygen.	K1, K2, K5
CO4	Synthesize the multiconponent reactions, palladium catalysed reactions and click chemistry	K1, K5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	-	-	-	-	-	1	2	-
CO2	2	1	2	2	-	-	-	-	-	-	2	-	2
CO3	2	1	1	-	1	-	-	-	-	-	-	2	-
CO4	3	1	2	1	-	-	1	-	-	-	-	2	2

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC302: ORGANIC SYNTHESIS –II

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
III	20RMSCOC302	ORGANIC SYNTHESIS –II	4	60	4

UNIT – I : NONMETALLIC REAGENTS IN ORGANIC SYNTHESIS

Electronic structure and bonding in boron, phosphorus, sulphur and silicon compounds – Their reactivity and applications in organic synthesis.

(a) Boron Reagents :
Hydroboration, Organoboranes in the formation of C-C bonds, alcohols, amines, halogen and carbonyl compounds. Free radical reactions of organo boranes.

(b) Phosphorus reagents:
Formation of C-C double bonds (Wittig reaction, Horner-wordsworth-Emmons reaction), Functional group transformations, Reactivity of nucleophiles and electrophiles. Reactions of quarternary phosphonium compounds.

(c) Sulphur Reagents:
Sulphur Ylides, Stabilized and non-stabilized, preparation and reactivity, Sulphonyl carbanions.

(d) Silicon Reagents:
Petersons Olefination, Influence of trialkyl, silyl reagents in electrophilic reactions, allyl silanes, alkenyl silanes, alkynyl silanes allyl silanes.

UNIT – II : REAGENTS IN ORGANIC SYNTHESIS

Use of the following reagents in organic synthesis

Anhydrous Aluminium chloride, Boron triflouride, DDQ, Dithianes, Diazomethane, N-Bromosuccinimide,Dicyclohexylcarbodiimide, Ziegler-Natta catalysts, Merrifield resin.

UNIT – III : PHOTOCHEMISTRY

Photochemical energy, Frank-Condon principle, Jablonskii diagram, singlet and triplet state.

Photochemistry of carbonyl compounds : Norrish type – I and Norrish type – II reactions, Paternobuchi reaction, Photoreduction, Photochemistry of α, β – unsaturated ketones and *p*- benzoquinones.

Photochemistry of unsaturated systems (olefins): Cis-Trans isomerisation and Dimerization reactions, Photochemistry of 1,3-butadiene, Di-Π methane and Oxa Di -Π methane rearrangements.

Photochemistry of aromatic compounds : Isomerizations, Photo-Fries rearrangement and Barton reaction.

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UNIT – IV : PERICYCLIC REACTIONS

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-Hexatriene and allyl system, Classification of pericyclic reactions.

Electrocyclic reactions : Con rotatory and Dis rotatory mode of electrocyclization in 4n Π and 4n+2 Π electron, allyl systems under thermal and photochemical conditions. FMO and PMO approach, Woodward-Hoffmann Correlation diagrams and Woodward-Hoffmann selection rules of electrocyclic reactions.

Cycloadditions: Antarafacial and suprafacial additions in 4n (2+2 cyclo addition) and 4n+2 (4+2 cyclo addition) systems, FMO and PMO approach, Woodward-Hoffmann Correlation diagrams and Woodward-Hoffmann selection rules of cyclo addition reactions, 2+2 addition of ketene, 1,3-dipolar cycloadditions and cheleotropic reactions.

Sigmatropic rearrangements: 1,3 and 1,5 suprafacial and antarafacial shifts of H and C, FMO and PMO approach and Woodward-Hoffmann selection rules of sigmatropic rearrangements, 3,3 and 5,5-sigmatropic rearrangements - Claisen, Cope and oxy-Cope rearrangements, Ene reaction.

Books Suggested

1. Some modern methods of Organic Synthesis W. Carruthers, Third Edition Cambridge University Press, Cambridge, 1988.
2. Organic Synthesis by Micael B. Smith. McGraw Hill International Editions.
3. Principles of Organic Synthesis by Richard O.C Norman. Raymond Bonnett, James M. Coxon, Edition: 3, illustrated published by CRC Press 1993.
4. Organic Chemistry, by Jonathan Clayden, Nick Greeves, Steurt Warren, Peter Wothers Contributor Jonathan Clayden Edition: reprint illustrated by Oxford University press, 2001.
5. Making Organic Molecules: An Introduction to Organic Synthesis by Jonathan Clayden Published by pearson Education, Limited, 2006
6. Modern Synthetic Reactions, Herbert O. House, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
7. Organic Synthesis viz Boranes, Herbet C. Brown Gray, W. Kratner Alan B. Levy and M. Mark Midland John Wiley & Sons, New York, 1975.
8. Advanced Organic Chemistry part A and B – F.A. Carey and R.J. Sundberg, 4th Edition, Plenum Publishers (2000).
9. Photochemistry and Pericyclic reactions, Jagdambasingh and Jayasingh, Second Edition, NewAge International.

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	Description of CO	Knowledge
CO1	Explain the C-C bond formation, functional group transformations of non metallic reagents in organic synthesis.	K_1, K_2
CO2	Discuss and Design the mechanism and applications of reagents useful in industrial purpose.	K_1, K_3, K_5
CO3	Describe the principles of photochemistry and mechanistic aspects of photochemical reactions through named reactions.	K_1, K_4, K_5
CO4	Outline the frontier molecular orbital symmetry of different systems. Explain the pericylic reactions like electrocyclic, cycloaddition, and sigmatropic rearrangement reactions.	K_1, K_5, K_6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	-	-	2	-	-	-	2	-	1
CO2	2	1	2	-	1	-	1	-	-	-	-	-	2
CO3	1	2	-	1	-	1	1	-	-	-	-	2	1
CO4	3	1	-	1	1	-	1	-	-	-	2	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC303: BIOINORGANIC AND BIOPHYSICAL CHEMISTRY

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
III	20RMSCOC303	BIOINORGANIC AND BIOPHYSICAL CHEMISTRY	4	60	4

UNIT – I: BIOINORGANIC CHEMISTRY **15 hrs**

i) Essential and trace elements in biology : Classification, Concept of essentially, Evaluation of essentially trace elements, Role of bulk (structural) elements and minerals, working of essential trace elements, Deficiency signs and specific function of essentially trace elements (Fe, Cu, Co, Ni, Zn, F, I, Se). ii) Oxygen uptake proteins structural and functional aspects of Haemoglobin(Hb), Myoglobin(Mb), Haemoerithrin(He) and Haemocyanin(Hc).

UNIT – II: ORGANOMETALLIC CHEMISTRY **15 hrs**

Hapticity-based classification and nomenclature of organometallic compounds. Synthesis and properties of Li, Zinc, Copper, Mercury, Cadmium, Palladium, Rhodium, Aluminium and Nickel organometallic compounds. Synthesis of Grignard's reagent and its properties. Alkene hydrogenation, Hydroformylation, Monsanto acetic acid processes and Wacker Process. Biological applications of organometallic compounds in medicine, agriculture and horticulture.

UNIT III – BIOPHYSICAL CHEMISTRY **15 hrs**

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane, dialysis and its function.

UNIT IV – APPLICATIONS OF GROUP THEORY **15 hrs**

Construction of reducible and irreducible representations, Determination of Character Coordinate of C_2V point group based on 3N Co ordinates. Standard reduction formula, Determination of normal modes of vibrations of SO_2, NH_3, $POcl_3$, $PtCl_4^{2-}$ H_2O_2molecules. Mutual exclusion Principle, Direct Product, Accidental Degeneracy and Fermi resonance

Group Theory and Spectroscopy: IR Spectral activity of NH_3 molecule, selection rules, symmetry Criteria for optical activity, symmetry restrictions on dipole moments, symmetry and stereo isomerism. Prediction of IR and Raman Spectral activity of H_2O and CO_2.

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Books suggested

1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg.
2. Bioinorganic chemistry, I. Bertini, H.B. Gray, S.J. Lippard and S.J. Valentine, Viva Low-Priced Student edition.
3. Organometallic Chemistry, R. C. Mehrotra and A. Singh, New Age International Publications.
4. Physical Methods in Chemistry; Russell S Drago, W.B. Saunders, Co 1997.
5. Physical Chemistry by Atkins.

	Description of CO	Knowledge
CO1	Discuss the basic concepts of bioinorganic chemistry like importance of essential and trace elements in biology.	K_1, K_5, K_6
CO2	Outline the role of organometallic reagents in various important reactions like hydroformylation, oxopalladation, Ziegler – Natta polymerization.	K_1, K_4
CO3	Statethe Membrane equilibrium, ion transport through cell membrane, dialysis and its function.	K_1, K_2, K_3
CO4	Determinationof Character Coordinate of C_2V point group and normal modes of vibrations of different molecules . Prediction of spectroscopic properties	K_1, K_5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	-	2	-	1	-	-	1	-	-	1	-	1
CO2	3	1	2	-	1	-	-	1	-	-	-	1	-
CO3	2	2	1	1	-	-	1	-	-	-	1	-	-
CO4	3	2	1	-	1	-	-	1	-	-	1	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC304: ORGANIC SPECTROSCOPY AND ITS APPLICATIONS

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
III	20RMSCOC304	ORGANIC SPECTROSCOPY AND ITS APPLICATIONS	4	60	4

UNIT- I : UV, ORD and CD

UV Spectroscopy: Various electronic transitions, Factors affecting the position of UV band, Woodward –Fieser rules for calculating absorption maximum in conjugated Dienes, α,β – unsaturared carbonyl compounds, Aromatic and Heterocyclic compounds, steric effect in biphenyls

ORD and CD : Optical rotator dispersion and circular dichroism: phenomenon of ORD and CD, Classification of ORD and CD curves, Cotton effect curves and their application to stereochemical problems, α – axial haloketone rule and Octant rule – applications of these rules in the determination of absolute configuration of cyclohexanones, decalones, cholestanones.

UNIT - II: INFRARED SPECTROSCOPY

IR Spectroscopy: Instrumentation, Sample handling, Characteristic Group vibrational frequencies of organic molecules and Interpretation of spectra-alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols, amines, carbonyl compounds, esters, amides, acids, anhydrides, lactones, lactams. Effect of hydrogen bonding and solvent effect on vibrational frequencies. Overtones, Combination bands and Fermi Resonance, FT-IR.

UNIT- III :^{1}H NMR SPECTROSCOPY &^{13} C NMR SPECTROSCOPY

Nuclear spin, nuclear resonance, principles of NMR, shielding of magnetic nuclei, deshielding, chemical shifts and its measurements, factors influencing chemical shift, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines and amides), spin-spin interactions, coupling constant (J): Types and classification (ABX, AMX, ABC etc.) of coupling constants, factors influencing coupling constants, Karplus curve variation of coupling constant with dihedral angle, complex spin-spin interaction between two, three, four and five nuclei (First order spectra), virtual coupling, chemical exchange, effect of deuteration, hindered rotation, Simplification of complex spectra: nuclear magnetic double resonance (spin decoupling), contact shift reagents, Nuclear Overhauser effect (NOE).

^{13}CNMR Spectroscopy : General considerations, Chemical shift (aliphatic, olefinic, alkynyl, aromatic, heteroaromatic and carbonyl carbon)coupling constants.

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UNIT – IV: MASS SPECTROMETRY

Introduction, Principle, Instrumentation, Single & Double focusing Mass Spectrometers, Ionization Methods: EI, CI, FDI, PDI, LDI, FAB, TSI and ESI, Mass Analyzers, Molecular-ion peak, Nitrogen rule, Base peak,Metastable ion, isotopic abundance, High resolution mass spectrometry (HRMS), General methods of mass spectral fragmentation, Mc. Lafferty rearrangement, Ortho effect, Factors affecting fragmentation, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books Suggested

1. Organic spectroscopy, W. Kemp, 5th Ed., (ELBS.2)
2. Spectroscopy of organic compounds, R.M. Silverstein and others, 5th Ed., (John Wiley)
3. Spectrometric Identification of organic compounds, R.M. Silverstein, F.X. Webster and D.J Kiemle, 7th Ed., (Wiley)
4. Introduction to Spectroscopy, A guide for students of organic chemistry, Donald L. Pavia, Gary M. Lamp man and George S. Kriz, 3rd Ed., (Thomson).
5. Spectroscopic methods in Organic Chemistry, DH Williams & I Flemming, (TMH)
6. Spectroscopy of organic compounds, P. S. Kalsi, (Wiley)
7. Nuclear Magnetic Resonance Spectroscopy An introduction to Principles, Applications and experimental methods, Joseph B. Lambert and Eugene P. Mazzola, (Pearson Education Inc. Prentice – Hall).
8. A Complete Introduction to Modern NMR Spectroscopy, Roger S. Macomber, (John Wiley & Sons, Inc.).

	Description of CO	Knowledge
CO1	Explain the various aspects involved in the Ultraviolet and Visible Spectroscopy and its applications.	K_2, K_3, K_4, K_6
CO2	Evaluate the principle, instrumentation, aspects of Infrared Spectroscopy and its applications to identify functional groups in organic compounds.	K_2, K_3, K_4, K_6
CO3	Solve the principle, various aspects and applications of ^1H &^{13}C NMRSpectroscopy in structural elucidation of organic compounds.	K_2, K_3, K_4, K_6
CO4	Formulate detailed knowledge about principle; instrumentation, and methods of mass spectrometry and its applications with respect to structure determination of organic compounds.	K_2, K_3, K_4, K_6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	-	3	-	-	-	-	-	-	-	1	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	2
CO3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC305 : PRACTICAL –I (MULTISTEP SYNTHESIS)

Course Objectives:

The main objectives of this course are:

1. understand the basic principles of organic synthesis.
2. Formulate the multi step synthesis, purification and identification of organic compounds.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1. Get skill in the planning, set up, execution, and monitoring of organic synthesis.
2. Attain hands on experience in the work up protocols useful in organic synthesis.
3. Experiment the purification methods and identification techniques of products.

1. Preparation of Benzanilide
2. Preparation of *p*-Nitroaniline
3. Preparation of Symmetric tribromo benzene
4. Preparation of benzopinacol
5. Preparation of *o*-Chlorobenzoic acid
6. Preparation of Chalcone epoxide

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	1	2	1	2	-	-	1	2	1	-	1	2	2

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20RMSCOC306 : PRACTICAL –II (ESTIMATIONS)

Course Objectives:

The main objectives of this course are:

1. Understand the principles involved in the estimation of organic compounds.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1. Gain hands on experience in the various methods of estimation of functional groups in organic compounds.

1. Estimation of Phenol
2. Estimation of Glucose
3. Estimation of Aspirin
4. Estimation of Primary amine

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	2	1	1	2	-	2	-	-	-	-	1	1	-

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FOURTH SEMESTER

20RMSCOC401 : ORGANIC SYNTHESIS –III

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
IV	20RMSCOC401	ORGANIC SYNTHESIS – III	4	60	4

UNIT – I: SYNTHETIC STRATEGIES: I **15 hrs**

(A) Disconnection Approach

Synthetic Strategies; Introduction, Terminology: target, synthon, synthetic equivalent, functional group interconversion (FGI), functional group addition, functional group elimination. Linear and convergent synthesis. Retrosynthetic analysis and synthesis involving chemoselectivity, regioselectivity and stereoselectivity. Reversal of polarity (umpolung) and cyclization reactions.Importance of order of events in organic synthesis- examples. One group C-X disconnections and two group C-X disconnections

(B) Protecting Groups

Principles of protection of alcohol, amine, carbonyl and carboxyl groups

UNIT–II: SYNTHETIC STRATEGIES -II **15 hrs**

(A) One Group C-C Disconnections

Alcohols and carbonyl compounds, Regioselectivity, Alkene synthesis, use of acetylenic compounds in organic synthesis.

(B) Two Group C-C Disconnections

Diels-Alder reaction, 1,3-difunctionalised Compounds, unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annulation.

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UNIT – III :ASYMMETRIC SYNTHESIS 15 hrs

(A) Introduction and terminology

Topicity in molecules : Homotopic, stereoheterotopic (enantiotopic and diastereotopic), **Prochirality nomenclature**: Substitution and addition criteria. Pro-R, Pro-S, Re and Si faces. **Stereoselective reactions:** Enantioselectivity and diastereoselectivity. **Optical purity:** Enantiomeric excess and diastereomeric excess.

(B) Strategies in Asymmetric Synthesis

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

ii. Chiral auxiliary controlled asymmetric synthesis: α-Alkylation of chiral enolates, imines. Use of chiral auxiliaries in Diels-Alder reaction.

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

iv. Chiral catalyst controlled asymmetric synthesis: Sharpless and Jacobsen asymmetric epoxidations. Asymmetric hydrogenations using chiral Wilkinson biphosphine and Noyori catalyst. Enzyme mediated enantioselective synthesis.

UNIT – IV : SYNTHETIC POLYMERS

Polymer reactions: Additions and condensation polymerization process – Bulk, Solution, Suspension and Emulsion polymerization.

Stereospecific polymers: Preparation and significance – Classification of polymers based on physical properties –Thermoplastics – Thermosetting plastics – Fibres and Elastomers – General applications.

Preparation of polymers based on different types of monomers. Industrial applications – olefin polymers – Diene polymers – Nylons – Glyptal resins – Urea–formaldehyde, Phenol-formaldehyde and melamine resins, Epoxy resins and Ion exchange resins.

Books suggested

1. Some modern methods of Organic Synthesis W. Carruthers.
2. Guidebook to organic synthesis by R K Meckie, D M Smith & R A Atken.
3. Organic Synthesis by O House
4. Organic Synthesis by Michael B Smith
5. Reagents for organic synthesis, by Fieser&Fieser, Vol 1-11 (1984).
6. Total Synthesis of natural products: the Chiron approach by S.Hanessian
7. Organic Chemistry Claydon and others 2005
8. Name Reactions by Jie Jack Lie
9.Reagents for organic synthesis, by B.P. Mundy and others.
10.Tandem Organic Reactions by Tse-Lok Ho
11.Organic Synthesis by Robert E Ireland
12.Organic Synthesis – The disconnection approach by S Warren
13.Organic Synthesis by C Willis and M Willis
14. Handbook of reagents for organic synthesis by Reich and Rigby, Vol. IV.
15. Problems on organic synthesis by Stuart Warren.

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	Description of CO	Knowledge
CO1	Define the various synthetic strategies and basics of retro-synthetic analysis. Describe protective groups in organic synthesis; special emphasis on protection and deprotection of hydroxyl-, carbonyl-, carboxylic acid and amines.	K_1, K_2, K_5
CO2	Explain the applications of variety of disconnection approaches like one group C-X disconnections, one group C-C disconnections, two group C–C disconnections etc.	K_2,K_5, K_6
CO3	Choose the basic principles as well as modern strategies of asymmetric synthesis and its applications through named reactions.	K_1, K_3, K_4, K_5
CO4	Categorize types of polymerization, mechanism of preparation, properties and utility of synthetic polymers.	K_1, K_4, K_5

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	3	-	1	-	-	-	1	-	2	-	-
CO2	-	1	2	-	2	-	1	-	-	-	1	-	2
CO3	3	1	-	1	1	-	-	-	1	-	-	2	-
CO4	1	2	1	-	1	-	-	-	1	-	-	2	2

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC402: HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
IV	20RMSCOC402	HETEROCYCLIC COMPOUNDS AND NATURAL PRODUCTS	4	60	4

UNIT – I: HETEROCYCLES (Five membered) **15 hrs**

Five membered heterocycles : Synthesis and reactions including applications of Pyrazole, Imidazole, Oxazole, Thiazole, Isoxazole, Isothiazole.

UNIT – II : BENZOFUSED HETEROCYCLES **15 hrs**

Benzofused five membered heterocycles : Synthesis and reactions including applications of Benzimidazole, Benzoxazole and Benzothiazole

Benzofused six membered heterocycles : Synthesis and reactions including applications of Quinoline and Isoquinoline

UNI T – III: STEROIDS AND HORMONES **15 hrs**

Occurance, Nomenclature, Basic Skeleton, Diels Hydrocarbon and Stereochemistry. Isolation, Structure determination of Cholesterol (Total synthesis not expected), Bile acids, Androsterone, Testosterone, Oestrone, Progesterone. Biosynthesis of steroids.

UNIT – IV: FLAVONOIDS AND ISOFLAVONOIDS **15 hrs**

Occurance, Nomenclature and General methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercitin, Butein, Daidzein. Biosynthesis of flavonoids and Isoflavonoids : Acetate pathway and Shikimic acid pathway. Biological importance of flavonoids and isoflavonoids.

Books Suggested

1. Heterocyclic chemistry Vol. 1-3, RR Gupta, M.Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic chemistry, J.A. Joule, K. Mills and G.F.Smith, Chapman and Hall.
4. Heterocyclic chemistry – T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic chemistry, G.R. Newkome and W.W. Paudler, Wiley – Inter Science
6. An introduction to the Heterocyclic Compounds. R.M. Acheson, Jonn Wiley.
7. Comprehensive Heterocyclic chemistry, A.R. Katritzky and C.W. Rees, Eds. Pergamon Press.
8. Principles of Modern Heterocyclic chemistry, L.A. Paquette.

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9. Natural Products: Chemistry and Biological Significance, J. Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J.B. Harborne, Longman, Essex.
10. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
11. Stereoselective Synthesis: A practical approach, M. Nogradi, VCH.
12. Introduction to Flavonoids, T.A. Geissman.
13. New Trends in Natural Products Chemistry, Atta-ur-Rahman and M.I. Choudhary, Harwood Academic Publisher.
14. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, ELBS.
15. Chemistry of Natural Products P.S. Kalsi, Kalyani Publishers.
16. Biosynthesis of steroids, terpenes and acetogenins, J.H. Richards & J.R. Hendrieson.
17. The biosynthesis of secondary metabolites, R.D. Herbert, Chapman & Hall.
18.Chemistry of Organic Natural Products, O.P. Agarwal, Vols, 1&2, Goel Pubs.
19. Natural Products Chemistry K.B.G. Torssell, John Wiley, 1983.
20. The biosynthesis of secondary metabolites, R.D. Herbert, Second Edn. Chapman & Hall.

	Description of CO	Knowledge
CO1	Explain the synthesis and applications of five membered heterocycles	K_2, K_3, K_4 K_5
CO2	Discuss the synthesis and applications of Benzofused heterocyclic compounds	K_3, K_4, K_5
CO3	Discover the biosynthesis of various steroids. Describe structures, synthesis and uses of various male and female sex hormones	K_2, K_3, K_4, K_5, K_6
CO4	Outline familiarity on nomenclature, occurance and biological pathways of flavonoids and isoflavonoids.	K_2, K_3, K_4, K_5, K_6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	-	2	1	-	-	1	-	1	-	2
CO2	2	1	-	1	-	1	-	-	1	-	2	-	2
CO3	-	2	1	1	-	-	-	-	1	-	1	2	1
CO4	2	3	1	-	1	-	-	1	-	-	-	2	2

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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VIKRAMA SIMHAPURI UNIVERSITY::NELLORE
DEPARTMENT OF CHEMISTRY

Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

20RMSCOC403: BIOMEDICINAL CHEMISTRY

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
IV	20RMSCOC403	BIOMEDICINAL CHEMISTRY	4	60	4

UNIT – I: CARBOHYDRATES

Carbohydrates and lipids: Structure and biological functions, Mucopolysaccharides, Glycoproteins and Glycolipids, Role of sugar in biological recognition, blood group substances.

Fatty acids: Essential fatty acids- structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids, prostaglandins – composition and functioning of lipo proteins – properties of lipids aggregates – liposomes and their biological functions.

UNIT – II: BIOMOLECULES

Proteins : Acid and enzymatic hydrolysis of proteins. Determination of aminoacids, Sequence in poly peptides by end group analysis. Chemical synthesis of di and tri peptides.

Enzymes: Definition, Classification based on mode of action. Mechanism of enzyme catalysis. Lock and key model and Induced fit model. Factors affecting enzyme catalysis. Enzyme inhibition- Reversible and Ireversible Inhibition. Enzymes in organic synthesis. Immobilized enzymes.

Nucleic acids: Primary, Secondary and Teritiary structure of DNA, Types of RNA, mRNA, tRNA and rRNA. Replication, Transcription,Translation and Genetic code.

UNIT – III: VITAMINS AND PROSTAGLANDINS

Vitamins : Definition, Occurance, Structural formulae, Physiological functions and synthesis of vitamins. Structure determination and synthesis of Retinol(A), Thiamine (B_1), Riboflavin (B_2), Pyridoxine (B_6), Biotins (H) and Nicotinic acid.

Prostaglandins: Occurance, Nomenclature, Classification, Physiological effects of prostaglandins, Structure and synthesis of PG E_1, PG E_2.

UNIT – IV: ANTIMALARIALS AND ANTIBIOTICS

Antimalarials : Chemotherapy, Synthesis and activity of Quinoline group – Quinine, Acridine group – Quinacrine and Guanidine group – Paludrine.

Antibiotics : General characterization – structure –activity relationships, Synthesis and activity of Penicillin G, Cephalosphorin C and Streptomycin.

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Books Suggested

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, McMillan, 1992. (For Merrifield synthesis of peptides and also for other aspects of Unit IV)
4. Bio-organic Chemistry, H. Dugas and C. Penney, springer, New York. 1981.
5. Details of Primary literature: Nomenclature: Structure: Dolastatin – 10: JACS, 1987, 109, 6883 (structure), ibdi, 1989, 111, 5463, JCS, Parkin I. 1996, 859 (synthesis).
6. Textbook of organic chemistry, Vol II by I. L. Finar
7. Chemistry of Natural Products, Vol 12, by Atta-Ur-Rahman
8. An introduction to the chemistry of terpenoids and steroids, by William Templeton
9. Systematic identification of flavonoid compounds by Mabry & Markham
10. Steroids by Fieser arid Fieser
11. Alkaloids by Manske
12.The Terpenes by Simenson
13. Alkaloids by Pelletier
14. Total Synthesis of Natural Products by Apsimon Vol 1-5
15. Biosynthesis by Geismann
16. Principles of organic synthesis 3rd Ed. ROC Norman and JM Coxen
17. One and two dimensional NMR Spectroscopy by Atta Ur-Rahman.
18. Classics in total synthesis K C Nicolaou and E J Sorenson.
19. Chemistry of Natural Products, N. R. Krishnaswamy.
20. Chemistry of Natural Products, S.V. Bhat, B.A. Nagasampagi and M. Siva kumar.

	Description of CO	Knowledge
CO1	Describe about carbohydrates, lipids and fattyacids and their biological functions	K_1, K_5, K_6
CO2	Discuss the synthesis and properties of amino acids; classification and nomenclature of peptides and peptide synthesis. Explainthe structure and biological importance of nucleic acids.	K_2, K_3, K_5
CO3	Illustrate the structure and synthesis of different vitamins and prostagladins	K_1,K_3, K_5
CO4	Explain the structure, synthesis and activity of different antimalarials and antibiotics	K_2, K_3, K_4, K_5, K_6

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	-	2	3	1	-	-	2	-	1	-	2	1	-
CO2	2	-	1	-	1	-	1	-	-	-	2	-	1
CO3	3	1	2	1	-	-	1	-	-	-	1	2	-
CO4	3	1	1	1	-	-	1	-	1	-	-	2	-

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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20RMSCOC404 : GENERAL ORGANIC CHEMISTRY

Semester	Course Code	Course Title	Hours/Week	Hours	Credits
IV	20RMSCOC404	GENERAL ORGANIC CHEMISTRY	4	60	4

UNIT–I: GREEN CHEMISTRY 15 hrs

Concept of green chemistry, principles of green chemistry and green synthetic methods –
Use of green reagents in green synthesis: Dimethyl carbonate, Polymer supported reagents – peracids, chromic acid, PNBS, Polymer supported peptide coupling reagents.
Use of green catalysts in green synthesis: Acid catalysts, oxidation catalysts, Basic catalysts, polymer supported catalysts.
Organic reactions in aqueous media: Advantages and applications in Pinacol coupling, Mukaiyama aldol reaction.
Ionic liquids in organic synthesis: Introduction, composition, and application of ionic liquids – acid catalyzed reactions, catalysis, hydrogenation and oxidations.

UNIT – II: NEWER METHODS IN ORGANIC SYNTHESIS

Solid-solid, Solid-liquid systems – Mechanism of catalytic action, Types of catalysts, Application in few important reactions :
Enamine mediated reactions: Formation, role of enamines as synthons for the synthesis of organic molecules.
Microwave reduced reactions: Principle, conditions, advantages over conventional heating methods – applications.

UNIT –III: DRUGDISCOVERY AND PRINCIPLES OF DRUG DESIGN

(A) Basic principles of Pharmacology
Definitions: Disease, drug, bioassay, pharmacokinetics and pharmacodynamics. Stages involved in drug discovery. **Pharmacokinetics (ADME):** Routes of drug administration, Absorption, Distribution, Metabolism and Excretion of drugs. **Pharmacodynamics:** Nature of drug – receptor interactions, Theories of drug action: Occupancy theory, Rate theory, Induced-fit theory. Drug toxicity, clinical trials.
(B) Drug design
Lead discovery, Existing drugs as leads, Pharmacophore, Principles of design of agonists (e.g.Salbutamol), antagonists (e.g. cimitidine) and enzyme inhibitors (e.g. captopril). Drug discovery without lead – serendipity-Penicillin and Librium as examples.

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UNIT – IV: NANOMATERIALS

Definition, Introduction, classification and properties of nano particles, Preparation of nano particles (a) Physical / Aerosol methods – Vapour condensation method, Spray pyrolysis (b) Chemical methods – Sol-gel Micelles/reverse microemulsion method. Characterization of nano particles using X-Ray diffraction (XRD), Scanning Electron Microscopy (SEM) and Transmission electron microscopy (TEM). Applications of carbon nano particles.

Books Suggested

1. Organic Synthesis in water by Paul A. Grieco Blackie.
2. Green Chemistry, Theory and Practical, Paul T. Anastas and John C. Warner.
3. New trends in Green Chemistry by V.K. Ahulwalia and M.Kidwai.
4. Organic Synthesis: Special techniques, by V.K. Ahulwalia and Renu Aggarwal.
5. Burger's medicinal chemistry and drug discovery by Manfred E. Wolf
6. Introduction to Medicinal Chemistry by Patrick.
7. Introduction to drug design by R Silverman.
8. Comprehensive Medicinal Chemistry, Vol1-5 by Hanzsch.
9. Principles of Medicinal Chemistry by William Foye
10. Biochemical approach to medicinal chemistry, YhomasNogrady.
11. Organic drug synthesis, Daniel Ledneicer.
12. Introduction to nanotechnology, Charles P. Poole Jr, Frank J. Owens, Wiley India Pvt. Ltd.
13. Solid State Chemistry and its applications, A.R. West, Plenum
14. Nanoscale materials in chemistry, Kenneth J. Klabunde, Wiley Interscience.
15. Self-Assembled Nanostructures, Jin Z. Zhang, Zhang-lin Wang, Jun Liu, Shaowei Chen, Gang-Yu Liu, Kluwer Academic Plenum publishers.

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	Description of CO	Knowledge
CO1	Categorize the concept and principles of green chemistry followed by variety of green synthetic methods. Gain detailed knowledge about concept and principles of green chemistry and advantages and applications of green synthetic methods	K_3, K_4, K_6
CO2	Design new technology developed in the organic synthesis like ptc, microwave reactions	K_1, K_4
CO3	Illustrate the basic principles of pharmacokinetics and pharmacodynamics and concepts of drug delivery systems Design the concept of drug design, lead modification strategies of drugs	K_3, K_6
CO4	Develop fundamental knowledge regarding the synthesis, classification and properties of nano particles and also characterization of nanomaterials by using XRD, SEM and TEM	K_1, K_2

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	1	2	-	-	-	2	-	2	1	-
CO2	1	1	2	-	1	-	-	-	1	-	2	-	2
CO3	-	2	2	1	-	-	1	-	-	-	-	2	2
CO4	3	2	1	-	1	-	-	-	1	-	-	2	2

NOTE: 1-LOW, 2-MEDIUM, 3-HIGH

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DEPARTMENT OF CHEMISTRY

Syllabus for M.Sc. Organic Chemistry (2 Year Course) for V.S. University College, Nellore with effect from the Academic Year 2020-2021

20RMSCOC405 : PRACTICAL –I (SPECTRAL PROBLEMS)

Course Objectives:

The main objectives of this course are:

- To understand the basic applications of UV, IR, ^{1}H &^{13}C NMR and Mass spectra.
- To understand the structural elucidation of organic compounds using combination of UV, IR, ^{1}H &^{13}C NMR and Mass spectral data.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

- Justify the assignment of different spectral values to the relevant groups in organic molecules.
- Evaluate the structural elucidation of organic molecules with the aid of combination of UV, IR, ^{1}H &^{13}C NMR and Mass spectral data analysis.
- Iidentification of products in a sequence of reactions using spectral data.

Spectral Identification of Organic Compounds (UV, IR, ^{1}H and ^{13}C NMR, MASS).
A minimum of 15 representative examples should be studied.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	1	1	2	1	-	-	-	1	2	-	1	2	1

20RMSCOC406 : PRACTICAL –II DISSERTATION

Course Objectives:

The main objectives of this course are:

- To perform research based laboratory work in the topic of interest.
- To compile the outcome of work done, in the form of dissertation for submission for valuation.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

- To get skill in the literature survey, designing of research work and its execution in the laboratory.
- Summarize the data analysis and compilation of data in the form of dissertation.

To attain presentation skills on the field of research work done.

(Inorganic / Organic /Physical)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	2	2	1	2	-	-	2	2	1	-	2	2	-

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