ANDHRAKESARI UNIVERSITY:: ONGOLE
(A State University, Recognised by UGC)
M.Sc. ORGANIC CHEMISTRY SYLLABUS
Course Structure as per National Educational Policy-2020 under CBCS
(For the students admitted from the academic year 2023-2024 onwards)
COURSE STRUCTURE & SCHEME OF MARKS

Semester	Components of Study	Course Code	Title of the Course	No. of Credits	Hr/Week	Internal Assessment	Semester End Exams	Total
SEMESTER - I	Mandatory Core	R23CH11	Inorganic Chemistry-I	4	4	30	70	100
		R23CH12	Organic Chemistry-I	4	4	30	70	100
	Compulsory	R23CH13	Foundation for Chemistry	4	4	30	70	100
	Elective Foundation (Opt' 1)	R23CH14A	Physical Chemistry-I	4	4	30	70	100
		R23CH14B	Polymer Science					
		R23CH14C	Nuclear Chemistry and Applications					
	Core Practical-I	R23CH15	Inorganic & Physical Chemistry	4	6	30	70	100
	Core Practical-II	R23CH16	Organic Chemistry	4	6	30	70	100
	Audit course	R23CH17	*Human Values and Professional Ethics*	*2*	*2*	*50*	-	-
	Sub-Total			24				600
SEMESTER - II	Mandatory Core	R23CH21	Physical Chemistry-II	4	4	30	70	100
		R23CH22	Organic Chemistry-II	4	4	30	70	100
	Compulsory	R23CH23	Essential Lab Techniques for Industry	4	4	30	70	100
	Elective Foundation (Opt' 1)	R23CH24A	Inorganic Chemistry-II	4	4	30	70	100
		R23CH24B	Nano Science & Technology					
		R23CH24C	Material Science					
	Core Practical-I	R23CH25	Inorganic &Physical Chemistry	4	6	30	70	100
	Core Practical-II	R23CH26	Organic Chemistry	4	6	30	70	100
	Core Practical-III	R23CH27	Comprehensive Viva-voce (1st & 2nd Semester)	2	--	--	50	50
	Skill Development	R23CH28	*Communicative English/MOOCS Online Course*	*2*	*2*	*50*	--	--
	Sub-Total			26				650
SEMESTER - III	Mandatory Core	R23OC31	Organic Spectroscopy-I	4	4	30	70	100
		R23OC32	Organic Synthesis & Reaction Mechanisms-I	4	4	30	70	100
	Generic Elective-I (Opt' 1)	R23OC33A	Alkaloids, Terpenoids, Quinones &	4	4	30	70	100
		R23OC33B	Chemistry of Aerospace Materials					
		R23OC33C	Drug Discovery, Design and Development					
	Open Elective-II (Opt' 1)	R23OC34A	Chemistry of Natural Products	4	4	30	70	100
		R23OC34B	Chemistry of High Energy Materials					
		R23OC34C	Applications of Synthetic Products					
	Core Practical-I	R23OC35	Multistage Organic Synthesis	4	6	30	70	100
	Core Practical-II	R23OC36	Organic Estimations	4	6	30	70	100
	Skill Enhancement	R23OC37	*MOOC's Online Course*	*2*	--	*50*	--	--
	Sub-Total			24				600
SEMESTER - IV	Mandatory Core	R23OC41	Organic Spectroscopy-II	4	4	30	70	100
		R23OC42	Organic Synthesis & Reaction Mechanisms-II	4	4	30	70	100
	Core Elective-I (Opt' 1)	R23OC43A	Advanced Organic Chemistry	4	4	30	70	100
		R23OC43B	Engineering Chemistry					
		R23OC43C	Quality Control and Quality Assurance in Pharma					
	Open Elective-II (Opt' 1)	R23OC44A	Chemistry of Antibiotics and Drugs	4	4	30	70	100
		R23OC44B	Forensic Science in Solving Crime					
		R23OC44C	Air, Water, Noise & Thermal Pollution					
	Core Practical-I	R23OC45	Analysis of Binary Organic Mixture	4	6	30	70	100
	Core Practical-II (Multi Disciplinary)	R23OC46	Project Work / Spectral Problems	4	6	--	100	100
	Core Practical-III	R23OC47	Comprehensive Viva-voce (3rd& 4th Semester)	2	--	--	50	50
	Sub-Total			26				650
	Grand Total			100				2500

Note: Pass in Audit course, skill development and skill enhancement courses are mandatory

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DEPARTMENT OF CHEMISTRY
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SEMESTER–I

PAPER–I: INORGANIC CHEMISTRY-I (R23CH11)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To know the fundamentals in VSEPR theory.
- ✓ To know the Crystal field theory.
- ✓ To know the Molecular Orbital Theory.
- ✓ To know the Hard and Soft Acids and Bases and Macro Cyclic complexes.
- ✓ To know the higher boranes, Isopoly and heteropoly anions.

UNIT-I **12H**

Structure and Bonding: VSEPR theory and its role in explaining the structures of inorganic molecules. Walsh diagrams for linear molecule (BeH_2) and bent molecule (H_2O). Molecular Orbital theory - Symmetry of Molecular orbitals, Molecular orbitals in triatomic (BeH_2) molecules and ions (NO_2^-) and energy level diagrams.

Participation of p and d orbitals in pπ - dπ bonding- Evidences from both non transition and transition metal compounds.

Non-valence cohesive forces, Hydrogen bonding - Symmetric and unsymmetric hydrogen bonds in inorganic molecules.

UNIT-II **12H**

Metal-Ligand Bonding: Crystal Field Theory of bonding in transition metal complexes Splitting of d-orbitals in octahedral, tetrahedral, trigonal bipyramidal and square pyramidal fields and energy orders of orbitals.

Tetragonal distortions - Jahn Teller effect. Static and dynamic Jahn -Teller effects. Chelates and Jahn - Teller effect

Spectrochemical series. Nephelauxetic effect. Calculation of crystal field stabilization energies. Factors affecting crystal field splitting energies. Applications and limitations of CFT.

UNIT-III **12H**

Molecular Orbital Theory: Evidence for covalence in complexes - Experimental evidences from both σ and π bonded complexes.

Molecular Orbital Theory of bonding for octahedral, tetrahedral and square planar complexes. π- bonding and MOT - Effect of π-donor and π-acceptor ligands on Δ_o. Experimental evidence for π-bonding in complexes .

MOT and Resonance. Resonance in homoatomic molecules (H_2) and hetero atomic ions.
Molecular Orbital Theory and Hybridization. Bents Rule and energetic of Hybridization.

UNIT-IV **12H**

Metal-Ligand Equilibria in Solutions: Step wise and over all formation constants. Trends in stepwise constants, statistical effect and statistical ratio. Determination of formation constants by Spectrophotometric method (Job's method) and Limitations to Jobs method. Determination of formation constants by pH metric method (Bjerrum's method).
Stability correlations and Irwing -William's series for transition metal ions.
Hard and soft acids and bases (HSAB) – Acid-base strength and HSAB , Electro negetivity and HSAB.
Macrocyclic complexes - Crown ethers and Cryptates.

UNIT-V **12H**

Non Metal Cages and Ring Compounds: Preparation and structures of higher boranes, Electron counting rules in boranes-Wades rules and Polyhedral skeletal electron pair theory. Heterocyclic inorganic ring systems Boron-Nitrogen (B-N), Phosphorus–Nitrogen (P-N) and Sulphur-Nitrogen (S-N) cyclic compounds.
Cage compounds of Phosphorous-Oxygen (P-O) and Phosphorous-Sulphur (P-S).
Preparation and structures of Isopoly and heteropoly anions and their sats.

Reference Books:

1) Inorganic Chemistry Huheey, Harper and Row.
2) Physical methods in Inorganic Chemistry, R.S. Drago. Affiliated East-West Pvt. Ltd.
3) Concise Inorganic Chemistry, J. D. Lee, ELBS.
4) Modern Inorganic Chemistry, W. L. Jolly, McGrawHill.
5) Inorganic Chemistry, K. F. Purcell and J. C. Kotz Holt Saunders international.
6) Concepts and methods of inorganic chemistry, B.E. Douglas and D.H.M.C. Daniel.
7) Introductory Quantum mechanics, A. K. Chandra.
8) Quantum Chemistry, R. K. Prasad.
9) Inorganic Chemistry, Atkins, ELBS.
10) Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern.
11) Quantum Chemistry, R. K. Prasad.
12) Concise Coordination Chemistry, R.Gopalan and V.Ramalingam.

Learning Outcomes:

- ✓ The student will understand the VSPER theory, symmetric and unsymmetric Hydrogen bonds in inorganic molecules.
- ✓ Understanding the Crystal field theory and Jahn Teller Effects.
- ✓ The Students are able to understand the basics of molecular orbital theory and energetic of hybridization.
- ✓ The Students are able to understand the Jobs method, hard and soft acids and bases.
- ✓ The Students are able to understand the study of age compounds of oxygen, phosphorous and sulphar compounds and also isopoly and heteropoly anions.

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SEMESTER–I
PAPER-II: ORGANIC CHEMISTRY-I (R23CH12)
Max. Marks: 100 (Internal-30M & External-70M)

Learning Objectives:

- ✓ To Know about Aromaticity in Benenoid compounds and Non-Benzenoid compounds.
- ✓ To know about basics on heterocyclic compounds, their synthesis and to know the importance of natural products, their medicinal use along with synthesis of some terpeoids.
- ✓ To discuss stereochemistry of organic molecules more elaborately.
- ✓ To know about the conformations of acyclic substituted alkenes.
- ✓ To Know the conformations of monocyclic, unsaturated acyclic and fused ring systems.

UNIT-I **12H**

Aromaticity Benzenoid & Non-Benzenoid: Concept of aromaticity, Huckel's rule for aromaticity in benzenoid compounds, Aromaticity of five membered, six membered rings and fused systems.

Non benzonoid aromatic compounds: Cyclopropenyl cation, Cyclobutadienyldication, cyclopentadienyl anion, tropyllium cation and cyclooctatetraenyl dianion. Ferrocene. Azulenes, Fulvenes, Annulenes, Fullerenes. Homo aromaticity, and Anti aromaticity.

UNIT-II **12H**

Heterocyclic Compounds and Natural Products:

a) Synthesis, Properties and Reactions of furan, thiophene, pyrrole, pyridine, quinoline, isoquinoline and indole; Skraup synthesis, Fisher indole synthesis.
b) Heterocyclic compounds more than one hetero atom-: synthesis, properties and reactions of Pyrazole, Imidazole, Oxazole Iso-Oxazole, Thiazole.

Natural Products: Importance of natural products as drugs.

Terpenoids: General methods in the structure determination of terpenes. Isoprene rule. Structure determination and synthesis of α-terpeniol, β-carotene, and camphor.

UNIT-III **12H**

Stereochemistry

a) *Molecular representations of organic molecules* –Wedge, Fischer, Newman and Saw-horse formulae, their description and inter-conservation. Stereoisomerism-Definition, classification.
b) *Concept of Chirality and Molecular Symmetry*: Symmetry operations, Recognition of symmetry elements (Cn, Ci and Sn), Dissymmetric and asymmetric molecules. Chiral structures (one and more than one chiral centres); D-L and R–S nomenciature, diastereoisomerism; Threo and Erythro isomers, racemic mixture, racemization and methods of resolution, stereo specific and stereoselective synthesis. Stereochemistry of compounds containing nitrogen, sulphur and phosphorous.
c) *Geometrical isomerism*–E, Z- nomenclature–Spectral and chemical methods of determining the configuration of geometrical isomers. Determination of configuration in aldoximes and ketoximes.

SEMESTER–I
PAPER-II: ORGANIC CHEMISTRY-I (R23CH12)
Max. Marks: 100 (Internal-30M & External-70M)

UNIT-IV **12H**

Conformational Analysis-I

a) *Conformation of acyclic molecules* –alkanes and substituted alkanes (Ethane and 1,2-disubstituted ethane derivatives like butane, dihalobutane halohydrin, ethylene glycol, butane-2,3-diol, amino alcohols and 1,1,2,2-tetrahalobutanes). Klyne-Prelog terminology for conformers and torsion angles.

b) Factors affecting the conformational stability and conformation equilibrium-Attractive and Repulsive interactrions. Use of Physical and Spectral methods in conformational analysis.

c) Conformational effects on the stability and reactivity of diastereomers in cyclic molecules-steric and stereo electronic factors-examples.

UNIT-V **12H**

Conformational Analysis-II

a) *Conformations of monocyclic compounds*–cyclohexane-chair, boat and twist boat cyclohexanes, energy profile diagram–mono-and di-substituted cyclohexanes–conformations. Effect of conformation on stability and reactivity in mono and disubstituted cyclohexane derivatives.

b) *Conformations of unsaturated acyclic compounds*: Propylene, and 1-Butene

c) *Elementary treatment of fused and bridged ring systems* –Decalines and Bornanes. Conformation of sugars. Steric strain due to unavoidable crowding.

Reference Books:

1) Advanced organic chemistry – reaction, 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) Organic chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5) Organic chemistry, Hendrickson, Cram and Hammond (Mc Graw – Hill).
6) Stereo Chemistry of carbon compounds – E.L. Eliel.
7) Modern organic Reactions, H.O. House, Benjamin.
8) An introduction to chemistry of Heterocyclic compounds, R.M.Acheson.
9) Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
10) Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.
11) Reaction Mechanism in Organic Chemistry, S.M.Mukherji and S.P.Singh, Macmillan.
12) Basic Principles of Organic Chemistry by J. B. Roberts and M. Caserio.
13) Stereo Chemistry of Organic compounds, P. S. Kalsi, New Age International pubs.

Learning Outcomes:

- ✓ Students can able to understand aromaticity in Benenoid compounds and Non-Benzenoid compounds.
- ✓ Students are able to understand formation of various heterocyclic compounds and their synthesis and basics on importance of natural compounds formation of terpeniods in medicinal chemistry
- ✓ Students can able to write the stereo chemical forms for different organic molecules.
- ✓ Understand the conformations of acyclic and substituted alkane.
- ✓ Students can able to understand the conformations of monocyclic, unsaturated acyclic and fused ring systems and applying it to organic molecules.

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SEMESTER–I

PAPER-III: FOUNDATION FOR CHEMISTRY (R23CH13)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To know the fundamentals in analytical & inorganic estimations.
- ✓ To know the possible intermediates formed during course of chemical reactions.
- ✓ To know the type of bonding in organic molecules.
- ✓ To know about molecular symmetry, molecular representations and their application aspects.
- ✓ To know the types & characterisation of environmental segments and also know about biomolecules.

UNIT-I **10H**

Titrimetric analysis: Acid-base titrations, redox titrations, complexometric titrations, precipation titrations-principle, example and corresponding indicators, Pri., Sec.-standards.

UNIT-II **10H**

Treatment of analytical data: Errors, classification, accuracy, precision, SD, MD, Student-T test F-test, Gassiandistributation.

UNIT-III **14H**

Reactive Intermediates: Generation, Structure, Stability and reactivity of Carbocations, Carbanions, free radicals, Carbenes, nitrenes and Benzyne; Electrophiles, Nucleophiles, Catalysts-definition and examples.

Nature of bonding in organic molecules: Localised and Delocalized covalent bonds, Delocalised chemical bonding conjugation, cross conjugation, hyper conjugation, tautomerism.

UNIT-IV **14H**

Symmetry and Group theory in Chemistry - Symmetry elements, symmetry operation, definition of group, suib group, relation between order of a finite group and its sub group. Point symmetry group. Schonfiles symbols, representation of groups by Matrices (representation for the Cn, Cnv, Cnh, Dn etc. groups to be worked out, explicitely). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables and their use. Application of group theory in IR and Raman spectroscopy.

UNIT-V **12H**

Environmental chemistry:

Classification of environmental segments, types of pollutions, acid rains, Global warming.

Chemistry of Biomolecules: Definition, functional uses and examples for Carbohydrates, lipids (fats and oils), enzymes. Chemistry of purines and pyrimidines, Nucleic acids-Structure and functions ofDNA & RNA.

PAPER-III: FOUNDATION FOR CHEMISTRY (R23CH13)

Max. Marks: 100 **(Internal-30M & External-70M)**

Reference Books:

1) Advanced organic chemistry – reaction, 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) Organic Chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5) Organic Chemistry, Hendrickson, Cram and Hammond (Mc Graw – Hill).

Learning Outcomes:

- ✓ The student will understand the required tools in analytical and inorganic estimations.
- ✓ Understanding of various types of reaction intermediates and the bonding present in various organic compounds.
- ✓ Students are able to understand the basics on various environmental concerns.
- ✓ Students know about types of various biomolecules and their functions with reference to structure.
- ✓ Students understand the types of pollutions and understand the chemistry involved in biomolecules.

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SEMESTER–I

PAPER-IV(Elective–A): PHYSICAL CHEMISTRY-I (R23CH14A)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To know the first and second law of thermo dynamics.
- ✓ To know the surface tension, Gibbs-Adsorption, X-ray flouresence and Augar electron spectroscopy.
- ✓ To know the micelles-Hydrophobic interaction.
- ✓ To know the Nernst equation and Debye Huckel-Onsagar equation.
- ✓ To know the complex reactions, Collision theory and chain reactions.

UNIT-I **12H**

Thermodynamics-I: Classical thermodynamics-Brief review of first and second laws of thermodynamics - Entropy change in reversible and irreversible processes-Entropy of mixing of ideal gases-Entropy and disorder-Free energy functions-Gibbs-Helmoboltz equation - Maxwell partial relations-Conditions of equilibrium and spontaneity-Free energy changes in chemical reactions: Van't Hoff reaction isotherm- Van't Hoff equation-Classiuss Clapeyron equation-partial molar quantities-Chemical potential- GibbsDuhem equation-partial molar volume-determination of partial molar quantities – Fugacity- Determination of fugacity-Thermodynamic derivation of Raoult's law.

UNIT-II **12H**

Surface Phenomena and Phase Equilibria: Surface tension-capillary action-pressure difference- across curved surface (young - Laplace equation)-Vapour pressure of small droplets (Kelvin equation)- Gibbs-Adsorption equation - BET equation-Estimation of surface area-catalytic activity of surfaces-ESCA , X- ray flouresence and Augar electron spectroscopy.

UNIT-III **12H**

Surface Active Agents: Classification of surface active agents-Micellisation-critical Micelle concentration (CMC)-factors affecting the CMC of surfactants, microemulsions-reverse micelles- Hydrophobic interaction.

UNIT-IV **12H**

Electrochemistry-I: Electrochemical cells-Measurement of EMF-Nernst equation-Equilibrium constant from EMF Data-pH and EMF data-concentration cells with and without transference-Liquid junction potential and its determination-Activity and activity coefficients-Determination by EMF Method- Determination of solubility product from EMF measurements. Debye Huckel limiting law and its verification. Effect of dilution on equivalent conductance of electrolytes-Anamolousbehaviour of strong electrolytes. Debye Huckel-Onsagar equation-verification and limitations-Bjerrum treatment of electrolytes-conductometric titrations.

PAPER-IV(Elective–A): PHYSICAL CHEMISTRY-I (R23CH14A)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Chemical Kinetics: Methods of deriving rate laws - complex reactions - Rate expressions for opposing, parallel and consecutive reactions involving unimolecular steps. Theories of reaction rates - collision theory - Steric factor - Activated complex theory - Thermodynamic aspects - Unimolecular reactions - Lindemann's theory - Lindemann-Hinshelwood theory. Reactions in solutions - Influence of solvent - Primary and secondary salt effects - Elementary account of linear free energy relationships - Hammet - Taft equation - Chain reactions - Rate laws of H_2-Br_2, photochemical reaction of H2 - Cl2 Decomposition of acetaldehyde and ethane - Rice-Hertzfeld mechanism.

Reference Books:

1) Physical Chemistry P.W. Atkins, ELBS
2) Chemical Kinetics - K.J.Laidler, McGraw Hill Pub.
3) Text Book of Physical Chemistry. Samuel Glasstone, Mcmillan Pub.
4) Physical Chemistry, G.W.Castellan. Narosa Publishing House
5) Thermodynamic for Chemists. Samuel Glasstone
6) Electrochemistry, Samuel Glasstone, Affiliated East West
7) Physical Chemistry, W.J. Moore, Prentice Hall
8) Atomic structure and chemical bond. Manas Chanda. Tata McGraw Hill Company Limited.

Learning Outcomes:

- ✓ Students can able to understand the classical thermo dynamics, fugacity.
- ✓ Students are able to understand Kelvin equation, Gibbs-Adsorption equation - BET equation.
- ✓ Students are able to understand the Classification of surface active agents in detail.
- ✓ Students are able to understand the Electrochemical cells, Liquid junction potential.
- ✓ Understand the kinetics of complex reactions, chain reactions.

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SEMESTER–I

PAPER-IV (Elective–B): POLYMER SCIENCE(R23CH14B)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To learn basic types of polymerization processes and techniques.
- ✓ To learn how to characterize polymers.
- ✓ To learn the rheological characteristics of polymers.
- ✓ To learn how the processing and testing of polymers are done.
- ✓ To learn about high temperature polymers, polymers blends and composites.

UNIT-I **12H**

Introduction to Polymer Science: Monomers, functionality, degree of polymerizations; classification of polymers, polymerization methods: addition and condensation; new techniques of polymerization; copolymerization, monomer reactivity and its significance; azeotropic copolymerization, block and graft copolymers; techniques for copolymerization: bulk, solution, suspension and emulsion.

UNIT-II **12H**

Polymer Synthesis and Characterization: Synthesis of thermoplastics,Fluoropolymers, Thermosetting polymers and Unsaturated polyesters. Polymer Solubility and swelling, concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights. Polymer crystallinity, analysis of polymers using optical and thermal techniques :Infra Red spectroscopy, X-Ray diffraction, DSC, DMTA and TGA.

UNIT-III **12H**

Polymer Rheology: The flow of Newtonian and non-Newtonian fluids and flow equations. Measurements of rheological parameters by capillary rotating, parallel plate and cone-plate rheometer. Mechanical models, control of rheological characteristics through compounding, rubber curing in parallel plate viscometer, Oscillating Disc Rheometer (ODR) and Moving die Rheometer (MDR).

UNIT-IV **12H**

Processing and Testing of Polymers: Types of mouldings: Compression moulding, transfer moulding, injection moulding, blow moulding,reaction injection moulding, extrusion, pultrusion, calendaring, rotational moulding and rubber processing. Testing for Mechanical-static and dynamic tensile, compressive, abrasion, hardness, tear, impact and toughness. Testing for thermal and electrical conductivity, dielectric constant, electric resistance, swelling, ageing and resistance and environmental resistance.

UNIT-V **12H**

Polymer Applications: *High temperature polymers:* synthesis,processing and applicationsof Aromatic liquid crystalline polyesters, Phenolics, polyimide and polyether ketones.

*Polymer blends and Composites:*Difference between blends and composites, their significance, miscible and immiscible blends, polymer alloys, polymer eutectics, plastic-plastic, rubber-plastic and rubber-rubber blends. Fibre Reinforced Polymers (FRP), particulate, long and short fiber-reinforced composites.

PAPER-IV (Elective–B): POLYMER SCIENCE(R23CH14B)

Max. Marks: 100 **(Internal-30M & External-70M)**

Recommended Books:

1) Text Book of Polymer Science, 3rd Ed. (1984), F. W. Billmayer, Jr., Willey-Interscience.
2) Principles of Polymer Chemistry, P. J. Flory, Cornell Press (recent edition).
3) Principles of Polymerization, G. Odian, 3rd Edition (1991), John Wiley, Singapore
4) Principles of Polymer Sciences, P. Bahadur and N.V. Sastry, Narosa Publishing House, NewDelhi (2002)
5) Polymer Sciences, V.R. Gowarikar, N.V. Vishwanathan, J. Shreedhar, Wiley Eastern, NewDelhi (1986)
6) The Elements of Polymer Science and Engineering, Alfred Rudin, 3 rd Ed. Academic Press, New York (2012).
7) Experiments in Polymer Science, E. A. Coolins, J. Bares and E. W. Billmeyer, WileyInterscience, New York (1973).
8) High performance materials in Aerospace, H.M.Flower, Ist ed, Chapman & Hall (1995).
9) Advanced Aerospace materials, B.Horst, B.Ilschner, K.C.Russel, Springer-verlag, Berlin (1992).
10) Applications of high temperature Polymers, R.R.Luise, I ed., CRC Press (1996).

Learning Outcomes:

- ✓ The student is provided with basic theoretical background on polymers.
- ✓ Understands various synthetic techniques used for preparation of polymers.
- ✓ Equipped with necessary knowledge to develop new polymers and new techniques.
- ✓ Familiarized with high temperature polymers uses.
- ✓ Understands various important and diverse applications of polymers in most fields of sciences.

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SEMESTER–I

PAPER-IV(Elective–C): NUCLEAR CHEMISTRY AND APPLICATIONS(R23CH14C)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To learn the principles and importance of Nuclear chemistry.
- ✓ To learn about the detection of radiations from radio active sources.
- ✓ To learn about the radio isotope tracers and their numerous applications.
- ✓ To learn about the nuclear reactors and their working methods.
- ✓ To learn about the handling, safety and protection from radiations.

UNIT-I **12H**

Nuclear Theory and Nuclear Reactions: Radioacive decay processes, Natural radio active series, Determination of half - lives of short and long lived isotopes. α-β-γdecays and K-capture

Nuclear reactions(NR) : NR induced by neutron and charged particles . Nuclear fission and fusion, Interaction of radiation and particles with matter. Determination of energies of α-β-γ particles.

UNIT-II **12H**

Detection of Radiations : Types and principles of measuring instruments, GM tubes and GM counter- their characteristics. Ionization chambers: Scintillation counters and solid state detectors. Neutron detection methods.Energy production in stars, Stellar evolution and Genesis of chemical elements.

UNIT-III **12H**

Radioisotope tracers: Radiometric analysis, various types of dilution techniques. Applications of radio isotopes in the study of isotopic exchange and electron transfer reactions.Applications of radio nuclides in therapeutic and diagnostic purposes. Radio carbon dating and age of earth and minerals by various dating techniques. Radiolysis of water and aqueous solutions. Identification reactions and properties of solvated electrons.

UNIT-IV **12H**

Nuclear reactors: Homogenous and heterogenous reactors: Power reactors, Boiling water reactors, Pressurized water reactors, Fast breeder reactors, Research reactors and Reactors for special purposes. Neutron sources and moderation, Criticality factors, moderators, coolants, Cladding and structural materials.

PAPER-IV(Elective–C):NUCLEAR CHEMISTRY AND APPLICATIONS(R23CH14C)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Radio Activity in the Environment, Safety and Protection: Natural radio active nuclides and their distributon in the environment, nuclear process in the atmosphere, radio activity contributions to the environment from nuclear tests, nuclear reactors, nuclear fuel reprocessing plants and waste management of radioactive isoptopes like Cs-137,I-131,H-3 and Ra-226. Plutonium isotopes in the environment. Hazards associated with radiations, Biological effects of radiations, Radioactive waste handling, disposal and treatment.

Reference Books:

1) Principles of Radiochemistry , H.A.CMcKay, Butterworths, London (1971).
2) Essentials of Nuclear Chemistry, H.J.Arnikar, 4th ed, New age International, New Delhi, (1997).
3) Nuclear Chemistry and its Applications, M.Haissinsky, Wesely publishing comp.Inc, London(1964).
4) Radiochemistry ,An.N.Nesmeyanov, Mir publishers, Moscow (1974).
5) Nuclear and Radiochemistry , G. Friedlander, J.W.Kennedy, Wiley-Inter. NY, (1981).
6) Nuclear Radiation Detection, W.J.Price, 2nd ed, Mc Graw Hill, NY, (1968).

Learning Outcomes:

- ✓ Student understands the basic principles and importance of Nuclear chemistry.
- ✓ Familiarized with the methods of detection of radiations from radio active sources.
- ✓ Essential knowledge is imparted on radio isotope tracers and their numerous applications.
- ✓ Understands the importance of the nuclear reactors and their working modes.
- ✓ Understands how the environment is affected by radioactive sources either natural or waste produced from reactors, knows safety methods to handle radio active. Chemicals to protect from radiations.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–I

PRACTICAL–I: INORGANIC & PHYSICAL CHEMISTRY (R23CH15)

Max. Marks: 100 **(Internal-30M & External-70M)**

A total Six (6)Experiments must be carryout taking minimum of '3' in each section

LIST OF EXPERIMETNS:

SECTION-I: INORGANIC CHEMISTRY

1) Determination of Zn^{2+} with potassium ferrocyanide (Volumetric).
2) Complexomatric titrations: Determination of Mg^{2+}, Ni^{2+} and hardness of water using EDTA.
3) Determination of Fe^{3+} by photochemical reduction.
4) Argentometry: Determination of chloride by argent metric titration using.
   a) K_2CrO_4 (b) Fluorescein as indicators.

SECTION-II: PHYSICAL CHEMISTRY

1) Relative strengths of acids by studying the hydrolysis of ethylacetate / methyl acetate.
2) Determination of equilibrium constant of KI3 ↔ KI + I2 by partition coefficient method and determination of unknown concentration of potassium iodide.
3) Distribution coefficient of Benzoic acid between Benzene and water.
4) Determination of critical solution temperature of phenol-water system Study of the effect of eletrolyteon the miscibility of phenol-water system.

Reference Books:

1) Vogels Text Books of Quantitative Analysis, Revised. J. Asset, R.C. Denny, G.H. Jeffery and J. Mendhan. ELBS.
2) Synthesis and Characterisation of Inorganic Compounds, W.L. Jolly. Prentice Hall.
3) Practical Inorganic Chemistry by G. Pass and H. Sutcliffe Chapman and Hall.
4) Practicle Inorganic Chemistry by. K. Somasekhar Rao and K.N.K. Vani.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–I

PRACTICAL–II: ORGANIC CHEMISTRY (R23CH16)

Max. Marks: 100 **(Internal-30M & External-70M)**

(Minimum Five Experiments must be carryout)

LIST OF EXPERIMENTS:

1) One step & Two step Organic compounds preparation–Yield of crude and crystallized samples and reporting of the melting point/Boiling points.
   Preparations: i) Iodoform ii) n-Dinitroderivative iii) Asprin iv) p-Nitroaniline v) Bezophenone vi) Benzoic acid vii) p-Bromo Acetanilide viii) Acetanilide ix) any other organic compound.
2) Purification of organic compound-The student has to do Recryastallization to final compound(s) (for both steps) and submit the sample.
3) Distillation of Alcohol, Toluene.
4) Chromatography- The student has to submit purity of the final product with TLC
5) Chromatographic separation of impurities by TLC.
6) Student should practice solvent extraction methods.

Note: Apart from (1) & (2) each student must practice S.No. (3) to (6).

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–I

PAPER-VII: HUMAN VALUES AND PROFESSIONAL ETHICS(R23CH17)

Max. Marks: 50(Internal)

Learning Objectives:

- ✓ To know the nature of ethics and goals.
- ✓ To know the basic moral concepts.
- ✓ To know the non-violance of non possession.
- ✓ To know the crime and theories of punishment.
- ✓ To know the Bhagavd Gita, Buddhism, Jainism.

Unit-I: **6H**

Definition and Nature of Ethics – Is relation to Religion, Politics, Business, Law, Medicine and Environment. Need and Importance of Professional Ethics – Goals – Ethical Values in Various Professions.

Unit-II: **6H**

Nature of Values-Good and Bad, Ends and Means, Actual and Potential Values, Objective and Subjective Values, Analysis of Basic Moral Concepts-Right, Ought, Duty, Obligation, Justice, Responsibility and Freedom, Good Behavior and Respect for Elders, Character and Conduct.

Unit-III: **6H**

Individual and Society: Ahimsa (Non-Violence), Satya (Truth), Brahmacharya (Celibacy), Asteya (Non Possession) and Aparigraha (Non-stealing). Purusharthas (Cardinal virtues) - Dharma (Righteousness), Artha (Wealth), Kama (Fulfillment Bodily Desires), Moksha (Liberation).

Unit-IV: **6H**

Crime and Theories of Punishment – (a) Reformative, Retributive and Deterrent, (b) Views on Manu and Yajnavalkya.

Unit-V: **6H**

Bhagavd Gita – (a) Niskama Karma, (b) Buddhism – The Four Nobel Truths – Arya astangamarga, (c) Jainism - Mahavratas and Anuvratas. Values Embedded in Various Religions, Religious Tolerence, Gandhian Ethics.

PAPER-VII: HUMAN VALUES AND PROFESSIONAL ETHICS(R23CH17)

Max. Marks: 50(Internal)

Reference Books:

1) Johns S Mackenjie: A Manual of ethics
2) "The Ethics of Management" by Larue Tone Hosmer, Richard D. Irwin Inc.
3) Management Ethics – Integrity at work by Joseph A. Petrick and John F. Quinn, Response Books, New Delhi.
4) "Ethics in Management" by S.A. Shelekar, Himalaya Publishing House.
5) Harold H. Titus: Ethics for Today
6) Maitra, S.K: Hindu Ethics
7) William Lilly: Introduction to Ethics
8) Sinha: A Manual of Ethics
9) Manu: Manava Dharma Sastra or the Institute of Manu: Comprising the Indian System of Duties: Religious and Civil (ed) G.C. Haughton.
10) Sasruta Samhita: Tr. KavirajKunjanlal, KunjanlalBrishagratha, Chowkamba Sanskrit Series, Vol I,II and III, Varanasi, Vol I PP, 16-20, 21-32 and 74-77 only.
11) Charaka Samhita: Tr. Dr. Ram Karan Sarma and Vaidya Bhagavan Dash, Chowkambha Sanskrit Series Office. Varanasi I, II, III Vol I PP 183-191.
12) Ethics, Theory and Contemporary Issues. Barbara Mackinnon, Wadsworth/Thomson Learning, 2001.
13) Analyzing Moral Issues, Judith A. Boss, Mayfield Publishing Company, 1999.
14) An Introduction to Applied Ethics (Ed.,) John H. Piet and Ayodya Prasad, Cosmo Publications.
15) Text Book for Intermediate First Year Ethics and Human Values, Board of Intermediate Eduction – Telugu Academy, Hyderabad.
16) I.C. Sharma Ethical Philosophy of India. Nagin& Co Julundhar.

Learning Outcomes:

- ✓ Students are able to understand relation to religion & ethical values.
- ✓ Students are able to understand to character & conduct.
- ✓ Students are able to understand to crime & theories of punishment.
- ✓ Students are able to understand to Gand
- ✓ hian ethics & values embedded in various religions.
- ✓ Studetns are able to understand various individuals of society.

SEMESTER–II
PAPER–I: PHYSICAL CHEMISTRY-II (R23CH21)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To know the Third law and Statistical thermodynamics and Nernst Heat theorem, Entropy and probability.
- ✓ To know the classification of polymers, molecular weights determination.
- ✓ To know the Butler-Volmer equation, polarography and Amperometric titrations.
- ✓ To know the Hydrogen-oxygen reaction, Quantum yield and Stern - Volmer equation.
- ✓ To know the hydrolysis of ATP, thermodynamics of biopolymer solutions.

UNIT-I **12H**

Thermodynamics II: Third law and Statistical thermodynamics-Nernst Heat theorem - Third law of thermodynamics - Its limitations - Determination of absolute entropy - Concept of districution - Thermodynamic probability and most probable distribution - Ensemble-ensemble averaging - Maxwell-Boltzmann distribution law - Partition function - Fermi-Dirac statistics - Bose Einstein statistics - Entropy and probability - Boltzmann-Plank equation - Calculation of thermodynamic properties in terms of partition function - Application of partition function - Chemical equilibrium and partition function - Translational, rotational and electronic partition function - Entropy of Monoatomic gases (Sackur - Tetrode equation).

UNIT-II **12H**

Polymer Chemistry: Classification of polymers - Free radical, ionic and Zeigler -Natta Polymerisation - kinetics of free radical polymerisation - Techniques of polymerisation - Glass transition temperature - Factors influencing the glass transition temperature - Number average and Weight average, Molecular weights - molecular weights determination - End group analysis - Osmometry - Light scattering and ultra centrifugation methods.

UNIT-III **12H**

Electro Chemistry II: Electrode potentials - Double layer at the interface - rate of charge transfer - Decomposition potential - Over potential - Tafel plots - Derivation of Butler - Volmer equation for one electron transfer - electro chemical potential. Electro catalysis - Fuel cells-Theory of polarography - Diffusion current - Ilkovic equation - Equation for half- wave potential – Applications of polarography - Amperometric titrations -Corrosion - Forms of corrosion - prevention methods.

UNIT-IV **12H**

Chemical Kinetics: Branching Chain Reactions - Hydrogen-oxygen reaction - lower and upper explosion limits - Fast reactions - Study of kinetics by flow methods - Relaxation methods - Flash photolysis - Acid base catalysis - protolytic and prototropic mechanism - Enzyme catalysis.

Photo Chemistry: Quantum yield and its determination - Actinometry - Reactions with low and high quantum yields - Photo sensitisation - Exciplexes and Excimers - Photochemical equilibrium – Chemieluminescence - Kinetics of collisional quenching-Stern - Volmer equation - Photo Galvanic cells.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–II
PAPER–I: PHYSICAL CHEMISTRY-II(R23CH21)
Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Biophysical Chemistry: 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 membrance, dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion and dispersion forces.

Reference Books:

1) Physical chemistry, G.K. Vemulapalli (Prentice Hall of India).
2) Physical chemistry, P.W. Atkins. ELBS
3) Chemical kinetics - K.J. Laidler, McGraw Hill Pub.
4) Text book of Physical Chemistry, Samuel Glasstone, Macmillan pub.
5) Statistical Thermodynamics - M.C. Gupta.
6) Polymer Science, Gowriker, Viswanadham, Sreedhar
7) Elements of Nuclear Science, H.J. Arniker, Wiley Eastern Limited.
8) Quantitative Analysis, A.I. Vogel, Addison Wesley Longmann Inc.
9) Physical Chemistry-G.W. Castellan, Narosa Publishing House, Prentice Hall
10) Physical Chemistry, W.J. Moore, Prentice Hall
11) Polymer Chemistry - Billmayer
12) Fundamentals of Physical Chemistry, K K Rohatgi-Mukherjee. Wiley Eastern Limited Publications.
13) Statistical Thermodynamics - M.Dole.
14) M.N. Hughes, The Inorganic chemistry of Biological Processes, John Wiley and Sons, New York 2nd Edition, 1981.
15) A text book of Biochemistry, AV.S.S. Rama Rao.
16) Physical Chemistry by Atkenes.

Learning Outcomes:

- ✓ Students understand the Third law of thermodynamics, Maxwell-Boltzmann distribution law and Sackur - Tetrode equation.
- ✓ Students understand the Free radical, ionic and Zeigler -Natta Polymerisation.
- ✓ Students understand the Butler - Volmer equation and Ilkovic equation.
- ✓ Students understand the Branching Chain Reactions, Enzyme catalysis and Photochemical equilibrium.
- ✓ Students understand the free energy change in biochemical reactions, exergonic and endergonic reactions, DNA and RNA in living systems in biopolymer interactions.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*

SEMESTER–II
PAPER–II: ORGANIC CHEMISTRY-II(R23CH22)
Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To know the general methods of synthesis involving carbon-carbon multiple bonds.
- ✓ To know various mechanisms involved in aliphatic and aromatic Nucleophilic/electrophilic substitution reactions.
- ✓ To know about various elimination mechanisms in different types of substrates.
- ✓ To know the different elimination mechanism and importance of functional group protection in organic synthesis.
- ✓ To know the mechanisms involved in various types of named reactions and their applications in organic synthesis.

UNIT-I **12H**

General Methods for Synthesis: Addition reactions involving electrophiles (Br_2, HBr, HOBr, and H_2O/H_2SO_4); nucleophilic additions (Michael addition, Mannich, and Grignard reactions); Addition to C-C multiple bonds-stereo chemistry of addition, formation and reactions of epoxides, syn and anti hydroxylation; hydrogenation (catalytic and Non catalytic).

UNIT-II **12H**

Aliphatic Nucleophilic Substitutions: The SN_2, and SN_1: Mechanisms, energy profile diagram and stereochemistry; SN_1, mixed SN_1& SN_2, and SET mechanisms; Factors influencing nucleophilic substitution reactions: Effect of structure, nucleophile, solvent, and leaving group.

The neighbouring group mechanism: Neighbouring group participation by O, N, S, halogens, in nucleophilic substitution reactions. Concept of classical and Non-classical carbocations-Participation of Pi and Sigma bonds as neighbouring groups. Anchimeric assistance-steric requirement.

UNIT-III **12H**

Aromatic Nucleophilic Substitutions: The SNAr, SN1 mechanisms and benzyne mechanism. Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The Von-Ritcher, Sommelet-Hauser and Smiles rearrangements.

Aromatic Electrophillic Substitution reactions -Friedel Crafts Alkylation, Acylation, Halogenations.

UNIT-IV **12H**

Elimination and Protecting Groups:

a) Types of elimination (E1, E1CB, E2) reactions, mechanisms, stereochemistry and orientation, Hofmann and Saytzeff's rules, Syn elimination versus anti elimination. Competitions between elimination and substitution.

b)Dehydration, dehydrogenation, decarboxylative elimination, pyrolytic elimination, molecular rearrangement during elimination.

c)*Importance of functional group protection in organic Synthesis:* Protecting agents for the protection of functional groups- Hydroxyl group, Amino group, Carbonyl group and Carboxylic acid group

UNIT-V **12H**

Familiar Named Reactions: Benzoin, Perkin, Cannizaro,Dieckmann and Stobbe condensations; Hofmann, Schmidt, Lossen, Curtius, Clasien, Backmann and Fries rearrangements; Reformatsky, Favoursky, Wittig reaction, Baeyer Villiger reaction and Chichibabin reaction, Oppenaur oxidation, Clemmensen, Wolff-Kishner, Meerwein–Ponndorf–Veriey and Birch reductions..

Reference Books:

1) Advanced organic chemistry – reaction, 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) Organic chemistry, I.L.Finar, Vol. I & II, Fifth ed. ELBS, 1975.
5) Organic chemistry, Hendrickson, Cram and Hammond (Mc Graw – Hill).
6) Stereo Chemistry of carbon compounds – E.L. Eliel.
7) Modern organic Reactions, H.O.House, Benjamin.
8) An introduction to chemistry of Heterocyclic compounds, R.M.Acheson.
9) Structure and mechanism in organic chemistry, C.K.Ingold, Cornell University Press.
10) Principles of organic synthesis, R.O.C.Norman and J.M.Coxon, Blakie Academic & Professional.
11) Reaction Mechanism in organic chemistry, S.M.Mukherji and S.P.Singh, Macmillan.

Learning Outcomes:

- ✓ Students understand the mode of addition reactions involving addition by electrophile and nucleophiles over unsaturated bonds between carbons
- ✓ Students understand and apply the substitution and elimination reaction mechanisms at aliphatic and aromatic substrates for various reactions leading to research
- ✓ Understand how to protect various functional groups in organic synthesis and can apply the same to novel molecules useful for research also.
- ✓ Students understand the mechanisms of studied named reactions and their applications in organic synthesis.
- ✓ To learn the molecular rearrangements.

SEMESTER–II

PAPER–III: ESSENTIAL LAB TECHNIQUES FOR INDUSTRY (R23CH23)
Max. Marks: 100 (Internal-30M & External-70M)

Learning Objectives:

- ✓ To know the fundamentals in separation analysis using various chromatographic techniques.
- ✓ To know the techniques involving reliable separation by HPLC & applications and purification by ion exchange chromatography.
- ✓ To know the instrumentation and applications of AAS &amplications; ICP-OES.
- ✓ To know the basic principles, instrumentation and advantages UV, IR, NMR, ESR, TEM, SEM- techniques in structural analysis.

UNIT-I **14H**

Chromatography–Adsorption and Partition

1) **Introduction to Chromatography:** Different types of Chromatography. Adsorption chromatography- adsorbents, solvents, solutes, apparatus. Column Chromatography- stationary phase, Mobile phase, packing of column, advantages and disadvantages.
2) **Paper Chromatography:** Basic Principles. Ascending and descending types. Selection of mobile phase, Development of chromatograms, Visualization methods. Application of paper chromatography in the identification of sugars and amino acids. One and two dimensional paper paper chromatography.
3) **Thin Layer Chromatography:** Basic Principles. Common stationary phases, Methods of preparing TLC plates, Selection of mobile phase, Development of TLC plates, Visualization methods, R_f value. Application of TLC in monitoring organic reactions.

UNIT-II **14H**

High Performance Liquid Chromatography (HPLC): Basic Principles. Normal and reversed Phases. Selection of column and mobile phase. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative estimation of organic compounds. Concepts on HPLC method development.

UNIT-III **12H**

Gas Chromatography: Basic Principles. Different types of GC techniques. Selection of columns and carrier gases. Instrumentation. detectors; RT values. Applications in the separation, identification and quantitative analysis of organic compounds.

Ion Exchange Chromatography: Basic Principles. Preparation of cross linked polystyrene resins. Different types of cation and anoin exchange resins. Application in the purification of carboxylic acids and amines.

UNIT-IV **10H**

AAS: Principle, instrumentation and applications

ICP-OES: Principle, instrumentation, applications and advantages over AAS

UNIT-V **10H**

UV, IR, NMR, ESR, TEM, SEM-Basic principles, instrumentation and advantages.

Reference Books:

1) Principles of Instrumental Analysis by D. A. Skoog, F. J. Holler and T. A. Nieman, Harcourt College Pub.
2) Separation Techniques by M. N. Sastri, Himalaya Publishing House (HPH), Mumbai.
3) Bio Physical Chemistry by A. Upadhyay, K. Upadhyay and N. Nath, (HPH), Mumbai.
4) A Hand Book of Instrumental Techniques for Analytical Chemistry- Ed-F. A. Settle, PrearsonEdn.,
5) Delhi. Introduction to Organic Laboratory Techniques-D. L. Pavia, G. M. Lampman, G. S. Kriz and R. G. Engel, Saunders College Pub. (NY).
6) Instrumental methods of Chemical Analysis by B. K. Sharma, Goel Publish House, Meerut.
7) Instrumental methods of Chemical Analysis by H. Kaur, Pragati Prakasan, Meerut.

Learning Outcomes:

- ✓ The student will understand advantage of cheromatographic separation and application on various reactions.
- ✓ The studentwill understand the advantage of HPLC & technique over conventional separation techniques.
- ✓ The student will know the GC technique for separation and exchange of ions taking place in ion exchange chromatography.
- ✓ The student will know the procedure of analysing the elements using AAS & ICP-OES.
- ✓ The students understand the working principles and advantages of the UV, IR, NMR, ESR, TEM, SEM- techniques.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*

SEMESTER–II

PAPER-IV (Elective–A): INORGANIC CHEMISTRY-II (R23CH24A)

Max. Marks: 100 **(Internal-30M & External-70M)**

Learning Objectives:

- ✓ To know the Classification and Applications of Metal Clusters.
- ✓ To know the reactions of organo metallic compounds.
- ✓ To know the Anation Reactions and Trans effects.
- ✓ To know the Selection rules, Correlation diagrams and Orgel diagrams.
- ✓ To know the Cotton effect and Faraday effect, structures of Hemoglobin and Myoglobin, Vitamin B_{12}, Photo Chemical Laws.

UNIT-I **12H**

Metal Clusters Classification: LNCs and HNCs**,** Isoelectronic and Iso lobal relationships, electron counting rules: Wade's and Lauher's rules. M-M multiple bonding; Preparation, structure and bonding in di nuclear $[Re_2Cl_8]^{2-}$, tri nuclear $[Re_3Cl_9]$, tetra nuclear $[W_4OR_{16}]$and hexa nuclear $[Mo_6Cl_8]^{4+}$, $[Nb_6Cl_{12}]^{2+}$ cluster molecules and ions.

Poly atomic Zintle ions and Chevrel phases. Applications of clusters

Metal π-Complexes Preparation, structure and bonding in Nitrosyl, Dinitrogen and Dioxygen complexes.

UNIT-II **12H**

Organometallic Complexes of Transition Metals: Classification and electron counting rules. Metallocenes with four, five, six, seven and eight ($\square^4$ - $\square^8$) membered rings. Synthesis, structureand bonding of Ferrocene. Cyclopenta dienyl, Arene, Cyclohepta triene and Tropylium complexes of transition metals.

Reactions of organometallic compounds-oxidative addition, reductive elimination, insertion and elimination.

Applications of organometallic compounds-Catalytic hydrogenation, Hydroformylation and polymerization of olefin using Zeigler- Nutta catalyst.

UNIT-III **12H**

Reaction Mechanism in Transition Metal Complexes: Kinetics of octahedral substitution, acid hydrolysis, base hydrolysis-conjugate base (CB) mechanism. Direct and indirect evidences in favour of CB mechanism.

Anation Reactions: Reactions without metal-ligand bond cleavage. Factors affecting the substitution reactions in octahedral complexes. Trans effect on substitution reactions in square planar complexes.

Mechanism of redox reactions, outer sphere mechanism, cross reactions and Marcus –Hush equation, inner sphere mechanism, complementary and non - complementary reactions.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–II

PAPER-IV (Elective–A): INORGANIC CHEMISTRY-II (R23CH24A)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-IV **12H**

Electronic Spectra of Transition Metal Complexes: Electronic configurations of metal ions and Spectroscopic terms. Selection rules, Breakdown of selection rules, Slator – Condon repulsion parameters, Racah parameters, Term separation energies for d^n electronic configurations.

Correlation diagrams and Orgel diagrams. Tanabe-Sugano diagrams for configurations from d^1 to d^9 octahedral and tetrahedral transition metal complexes of 3d series.

Calculations of Dq, B and β parameters. Charge transfer spectra.

UNIT-V **12H**

Magnetic Properties of Transition Complexes: Types of magnetism, anomalous magnetic moments - Orbital and spin contribution, spin - orbit coupling and magnetic moments. Chiroptical properties, Cotton effect and Faraday effect.

Biochemical Aspects of Iron and Cobalt: Binding, storage and transport of dioxygen by Hemoglobin and Myoglobin, Vitamin B_{12} and its importance.

Photo Inorganic Chemistry: Introduction, Photochemical laws, photo redox reactions and photo anation reactions. Photo chemical decomposition of water.

Reference Books:

1) Inorganic Chemistry, Huheey. Harper and Row.
2) Concise Inorganic Chemistry, J. D. Lee, ELBS.
3) Inorganic chemistry,K.F. Purcell and J.C. Kotz, Holt Saunders international
4) Organometallic chemistry, R.C. Mehrotra and A. Singh. New Age International.
5) Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern
6) Inorganic Reaction Mechanism, Basolo and Pearson, Wiley Eastern
7) Bioinorganic Chemistry, K. Hussan Reddy
8) Biological Aspects of inorganic chemistry, A. W. Addiso, W. R. Cullen, D. Dorphin and G. J. James. WelieyInterscience.
9) Photochemistry of coordination compounds, V.BalzaniandV.Carassiti. Academic Press.

Learning Outcomes:

- ✓ The student will understand the various metal clusters and metal ***π*** complexes.
- ✓ Understanding the reactions of organo metallic compounds and its applications.
- ✓ The Students are able to understanding the reaction mechanism in transition metal complexes, anation reactions, and complementary reactions.
- ✓ The Students are able to understand the orgel diagrams and electronic spectra of transition metal complexes.
- ✓ The study of magnetic properties and anamolous magnetic moments of transition complexes.
- ✓ The Students are able to understanding structure and functions of hemoglobin, myoglobin and vitamin B12, photochemical laws.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
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SEMESTER–II
PAPER-IV (Elective–B): NANOSCIENCE AND TECHNOLOGY(R23CH24B)
Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn the types of nano structures and the binding forces.
- ✓ To learn the synthetic and characterization techniques for nanostructures.
- ✓ To learn the chemistry involved in various functional nanostructures.
- ✓ To learn about the role of nanostructures in improving energy efficiency.
- ✓ To learn about the various types of nanosensor devises for biomedical applications.

UNIT -I **12H**

Introduction to Nanoscience: Definition of Nano, emergence and challenges of nanoscience, influence of nano over micro/macro, Types of nanostructures : One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots structures, metal oxides, semiconductors and composites. Nanoscience and Interface: Intermolecular Forces, Van der Waals forces. Kessorn, Debye, and London Interactions. Surface nanoscience and surface active agents.

UNIT-II **12H**

Synthesis and Characterization of Nanostructures: Fabrication techniques: Self assembly, self replication, sol- gels, Langmuir-Blodgett thin films, Nanolithography, Bio inspired synthesis, and chemical vapor deposition. Characterization techniques: Electron microscopy, Scanning probe microscopy, Near field microscopy, Micro- and near field Raman spectroscopy,Surface enhanced Raman spectroscopy and X-Ray photo electron spectroscopy.

UNIT-III **12H**

Chemistry of Nanostructures Carbon nanotubes (CNT): Structure of carbon nanotubes, synthesis and functionalization of Carbon nanotubes, electronic-vibrational- mechanical and optical properties of Carbon nanotubees; Graphene nanostructures. Carbon based nanomaterials in environment and biological systems. Biological aspects of Carbon Nanostructures, Fullerene and its derivatives. Environmental effects of nanostructures.

UNIT-IV **12H**

Applications of Nanostructured Materials: Nanostructures in Ferroelectric materials and coatings, polymer based applications, Hydrophilic - hydrophobic surface-cleaning materials, nanostructures in energy conversion and storage for renewable energy, semiconductor materials, solar cells, fuel cells, Carbon nanotubes for energy storage and hydrogen storage, as nanoscale catalysts to save energy. Nanostructures in waste reduction and improved energy efficiency, in water purification, sensors for bio-medical applications and Carbon nano-adsorbents for environmental purification.

SEMESTER–II

PAPER-IV (Elective–B): NANOSCIENCE AND TECHNOLOGY(R23CH24B)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Nanotechnology in Sensor Devices: Nanosensors: Introduction to sensors, fundamentals and terminology of sensors, static and dynamic characteristics and characterization of sensors. Micro and nano-sensors, biosensors and micro fluids and organic and inorganic nanosensors. Nanotechnology based devices: nanomaterials, nanostructured films, nanoscale electronic and ionic transport devises. Sensor for bio-medical applications. Biosensors: generation of biosensors and nanomaterial based biosensors.

Recommended Books:

1) Nanomaterials: Synthesis, properties and Applications, Edited by A.S.Adelstein.
2) Nanostructured carbon for advanced Applications, Edited by G.Benedek, Kluwer academic publishers, 1996.
3) Chemistry of nanomaterials : Synthesis, properties and applications CNR Rao et.al.
4) Nanoparticles: From theory to applications G. Schmidt, Wiley Weinheim (2004).
5) Processing & properties of structural nanomaterials - Leon L. Shaw
6) Nanochemistry: A Chemical Approach to Nanomaterials, Royal Soc. of Chemistry, Cambridge, UK (2005).
7) Environmental Chemistry for a Sustainable World, Volume -1: Nanotechnology and
8) Health Risk Editors: Lichtfouse, Schwarzbauer, Robert
9) Advances in Nanotechnology and the Environment, Juyoung Kim, CRC Press, Taylor and Francis Group.
10) Nanomaterials for Biosensors, Cs. Kumar, Wiley – VCH (2007).
11) Naostructures and Nanomaterials: Synthesis, properties and applications, G.Cao, ImperialCollege Press (2004).
12) The chemistry of nanomaterials: Synthesis, properties and applications, C.N.R.Rao, A.Muller, A.K.Cheetham (Eds), Wiley VCH Verlag Gmbh&Co, Weinheim, 2004.
13) Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
14) Nanotubes and Nanowires-CNR Rao and A Govindaraj,RCS Publishing.
15) Carbon Nanomaterials for Environmental and Biological Applications, Bergmann andMachado., Springer.

Learning Outcomes:

- ✓ The student is provided with basic theoretical background on nanoscienceand nanostructures.
- ✓ Understands various synthetic and characterization techniques fornanostructures.
- ✓ Equipped with necessary chemistry knowledge involved in variousfunctional nanostructures.
- ✓ Student is encouraged to pursue the development of new Nanostructures for energy efficiency.
- ✓ Understands the challenges of Nanoscience and its potential applications in biomedical and environmental fields.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*

SEMESTER–II
PAPER-IV (Elective-C): MATERIAL SCIENCE (R23CH24C)
Max. Marks: 100 (Internal-30M & External-70M)

Learning Objectives:

- ✓ To learn the basic concepts involved in Material science and material structures.
- ✓ To learn about various types of conducting materials.
- ✓ To learn how testing and characterizations are done for materials.
- ✓ To learn about aerospace materials used in Cryogenic applications.
- ✓ To learn about the materials used in energy production and storage.

UNIT-I **12H**

Material Science: Introduction, Condensed states of matter- crystalline and amorphous states. Ionic, covalent, metallic and molecular bindings- Bond angle, bond length and bond energy. Hybridisation - Delocalised chemical bonding. Basics in crystal morphology, Lattice energy - Madelung constant. Inert gas crystals - van der Waals interaction - Lennard Jones' potential. Simple crystal structures - Sodium Chloride, Cesium Chloride, Diamond and Zinc sulphide structures. Close packed structures - packing efficiency and density of materials.

UNIT-II **12H**

Conducting Materials: Metals, Alloys, Semiconductors-Definition, electrical properties, optical properties, mechanical properties and thermal properties. Specific examples of metals-Copper, Aluminium, Iron, Gold, Silver. Uses of metals. Drawbacks of metals. Alloys-advantages of alloying. Examples-Brass, Bronze, Steel, Stainless steel, Gold alloys, silver alloys and their uses. Semiconductors: Elemental semiconductors- Silicon, Germanium. Doping-n-type and p-type semiconductors, p-n junctions. Qualitative ideas of devices- diodes to Integrated circuits (ICs).

UNIT-III **12H**

Materials Testing and Characterization Vacuum Techniques: Vacuum pumps: Rotary, Vapour diffusion, Turbomolecular and Cryogenic pumps. Vacuum measurement: Thermal conductivity gauges and Pirani and thermocouple gauges. Ionisation gauges: Hot and cold cathode ionisation gauges. Non- Destructive Testing of Materials: X-Ray and Neutron Radiography. Mechanical Testing of Materials: Tensile, Compression and Hardness tests, B-V-R hardness numbers. Impact and Fatigue tests. Materials Characterisation: Electron Microscopy,Transmission Microscopy (TEM)-Scanning Microscopy (SEM) - Atomic Absorption, IR, Raman, Low Energy Electron Diffraction (LEED) and X-ray Photoelectron Spectroscopy (XPS).

UNIT-IV **12H**

Aerospace Materials,Super Alloys and Smart Materials: Aerospace materials-Evaluation of materials for space environment. Materials for Cryogenic applications: Metals for low temperature applications, Austenitic stainless steel, Nitrogen containing steel, Al-Li alloys, Titanium alloys and cryoinsulation materials. Materials for space environment: Radiation shielding materials, Space suit materials and materials for life support system. Metallic materials, super alloys and Smart Materials: Iron based-nickel based–cobalt based super alloys-applications. Smart materials-shape memory effect (SME). Ti-Ni(SM) alloys, Cu based alloys and applications.

UNIT-V **12H**

Materials in Energy Production: Global Energy Scene, Forms of energy, Conservation of energy, Solar Cells, Types of Solar cells. Solar Cell Fabrication Technology. Hydrogen energy-merits as a fuel-Hydrogen storage, sea as source of deuterium. Fuel cells-components, working and performance of fuel cells, Types of fuel cells-Solid oxide fuel cells (SOFC), Molten carbonate fuel cells (MCFC), Phosphoric acid fuel cells (PAFC) Polymer Electrolyte fuel cells and applications. Superconductors: Types - high Tc superconductors - applications of Superconductors.

Recommended Books

1) Elements of Materials Science and Engineering–Lawrence H van Vlack, AddisionWesley(1975).
2) Materials Science and Engineering, V. Raghavan, Prentice Hall India (1993).
3) The Structure and Properties of Materials, Rose, Shepard and Wulff, Vol.I-IV Wiley eastern, (1987).
4) X-Ray Crystallography, M .J Buerger, John Wiley (1942).
5) Introduction to Solids, A J Dekker, McMillan India (1981).
6) Electronic Processes in Materials, L. V Azaroff and J.J. Brophy.McGraw Hill (1963).
7) Materials Science and Technology–A comprehensive treatment, R.W Cahn, P Haasen & E J Kramer.
8) Electronic and Magnetic Properties of Metals and Ceramics: Part I Materials Science andTechnology : A Comprehensive Treatment, **Vol.** 3, R. W. Cahn, P. Haasen, 1991, John Wiley.
9) High performance materials in Aerospace, H.M.Flower, Ist ed, Chapman & Hall (1995).
10) Advanced Aerospace materials, B.Horst, B.Ilschner, K.C.Russel, Springer-verlag,Berlin (1992).

Learning Outcomes:

- ✓ The student is provided with basic theoretical background on Material Science and molecular structures.
- ✓ Understands various types of widely used conducting materials.
- ✓ Gains necessary knowledgeabout material testing and characterization.
- ✓ Understands properties of materials used to protect severe environmentsand extreme stress levels in space crafts.
- ✓ Understands global energy scenario and the role played by materials inenergy storage and conservation.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
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SEMESTER–II

PRACTICAL–I: INORGANIC & PHYSICAL CHEMISTRY(R23CH25)

Max. Marks: 100 **(Internal-30M & External-70M)**

A total Six (6) Experiments must be carryout taking minimum of '3' in each section

LIST OF EXPERIMETNS:

SECTION-I: INORGANIC CHEMISTRY

Semimicro analysis of six radical mixtures containing one interfering radical and one less familiar cation each.

Interfering Anions : Oxalate, tartrate, phosphate, chromate.

Less familiar Cations : Thallium, molybdenum, thorium, zirconium,vanadium, uranium.

(Minimum three Mixtures)

SECTION-II: PHYSICAL CHEMISTRY

1) Potentiometric determination of Fe(II) with Cr(VI)
2) pH-metric determination of strong acid with strong base.
3) Conductometric titration of strong acid with strong base
4) Verification of Beers Law using potassium permanganate.

Reference Books:

1) Vogels Text Books of Qualitative analysis, Revised. J. asset, R.C. Denny, G.H. Jeffery and J. Mendhan. ELBS.
2) Synthesis and Characterisation of Inorganic Compounds, W.L.Jolly. Prentice Hall.
3) Practical Inorganic chemistry by G. Pass and H. Sutcliffe Chapman and Hall.
4) Practical Inorganic Chemistry by. K. Somasekhar Rao and K.N.K. Vani.

SEMESTER–II

PRACTICAL–II: ORGANIC CHEMISTRY(R23CH26)

Max. Marks: 100 **(Internal-30M & External-70M)**

(Minimum Five Experiments must be carryout)

1) **Identification Functional Groups in Organic Compounds:** Phenol, bases, organic acid, ketone, aldehyde, amide and carbohydrate with preparation of two solid derivatives.
   i) Identification of given two compounds with preparation of two solid derivatives and
   ii) Reporting of the melting points for derivatives.

2) **Purification of Derivatives**: The student has to do recryastallization to final derivatives(s) and submit the sample. If the sample is impure liquid must carryout distillation process.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*

SEMESTER–II

PRACTICAL–III: COMPREHENSIVE VIVA-VOCE (R23CH27)

Max. Marks: 50

1) The students will be analyzed with questions covering 1st & 2nd semester topics.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–II
PAPER-VIII: COMMUNICATIVE ENGLISH (R23CH28)
Max. Marks: 50 (Internal)

Learning Objectives:

- ✓ The course helps to improve easy and fluent communication skill among the students.
- ✓ This English Communication Skill based course mainly focuses on to improve the Linguistic Listening, Communicative Competence and Presentation Skills of the students.
- ✓ Activities in the English Communication Skill based course will simulate actual discourses that students will engage in their interaction with their peers, teachers or strangers in their day-to-day situations.
- ✓ To learn the employability skills and descriptions.
- ✓ To learn the extempore and presentaions.

Unit-I: Communication Skills **6H**

a) Verbal: a) Types of Communication; b) Barriers to Communication.
b) Strategies for effective communication.
Nonverbal Skills - a) Body Language-Voluntary and Involuntary;
b) Kinesics Facial Expressions;
c) Proxemics;
d) Oculesics;
e) Haptics and Chronemics.

Unit-II: Advanced Vocabulary **6H**

a) Synonyms & Antonyms; b) Phrasal verbs; c) Idioms; d) One word Substitutes.

Unit-III: Employability Skills & Descriptions **6H**

Employability Skills:

a) Interview Skills; b) Group Discussion c) Resume Writing.

Descriptions:

a) Process Description; b) Picture Description; c) Narration; d) Email etiquette.

Unit-IV: Role Play/Dialogue Writing **6H**

a) Introducing oneself & others;
b) Asking for & giving permissions;
c) Asking for and responding to give directions;
d) Seeking request;
e) Inviting and responding invitations;
f) Apologizing.

Unit-V: Presentation Skills **6H**

Extempore (JAM) Sessions; Paper Presentation.

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DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ANALYTICAL/ORGANIC CHEMISTRY
(*For the students admitted from the academic year 2023-2024 onwards)*
SEMESTER–II
PAPER-VIII: COMMUNICATIVE ENGLISH (R23CH28)

Max. Marks: 50 (Internal)

Learning Outcomes:

- ✓ To realize the importance of communication skills in job arena.
- ✓ To enhance the students ability to communicate.
- ✓ Able to describe procedures and improves analytical thinking.
- ✓ Capable to make the students communicate in Daily life situations.
- ✓ Capable to participate in all recruitment procedures.
- ✓ Able to communicate confidently in oral presentations.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–I: ORGANIC SPECTROSCOPY-I (R23OC31)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about the basics of various spectroscopic techniques.
- ✓ To understand the instrumentation of UV, IR, NMR, ESR spectroscopic techniques.
- ✓ To apply the spectroscopy knowledge for the structural elucidation of organic molecules.
- ✓ To understand the interpretation of NMR Spectroscopy of given compound.
- ✓ To learn and solve the spectral problems of UV-IR & PMR.

UNIT-I

14H

UV-Visible Spectroscopy:

a) **UV Spectroscopy**: Energy transitions – Simple chromophores – UV absorption of Alkenes – polyenes unsaturated cyclic systems – Carbonylcompounds, α,β-unsaturated carbonyl systems - Woodward Fieser rules – aromatic systems – solvent effects – geometrical isomerism – acid and base effects – typical examples – calculation of λ_{max} values using Woodward - Fieser rules.

b) **ORD:** Theory of optical rotatory dispersion, α-Axial haloketone rule and octant rule – Application of these rules in the determination of absolute configuration of cyclohexanones, decalones and cholestanones.

c) **Circular Dichroism:** Principle – positive and negative cotton effects – Absolute configuration.

UNIT-II

12H

Infrared Spectroscopy(FT-IR): Fundamental modes of vibrations – Stretching and bending vibrations – overtones, combination bands and Fermi resonance, factors influencing vibrational frequencies, hydrogen bonding – fingerprint region and its importance – Study of typical group frequencies for – CH, -OH, -NH, -CO-NH_2, -CC, -CHO, -CO and aromatic systems.

Application in structural determination –Simple problems.

UNIT-III

14H

^{1}H NMR Spectroscopy:

a) Magnetic properties of Nuclei, Nuclear resonance, Fourier Transformation and its importance in NMR. Equivalent and non-equivalent protons, The chemical shift and its importance, calculation of chemical shift, factors affecting the chemical shifts such as electronegativity and anisotropy, effect of deuteration, Signal integration, Spin-spin coupling: vicinal (Karplus relationships), germinal and long range. Coupling constants (*J*) and factors affecting coupling constants. Shielding and deshielding mechanisms in acetylene carbonyl and Benzene, anisotropy-Spin-Spin Interactions related to first order and higher order spectra (AB, A_2; AB_2, ABX, ABC, AMX)-temperature dependence spectra, Hydrogen bonding. Nuclear Overhauser effect (NOE).

b) Applications: Interpretation of NMR spectrum of a given compound leading to identification-typical examples of PMR spectroscopy.

PAPER–I:ORGANIC SPECTROSCOPY-I (R23OC31)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-IV **10H**

Electron Spin Resonance Spectroscopy(ESR):

a) Basic Principles, Comparison of NMR & ESR. Determination of 'g' value, Factors affecting the 'g' value. Isotropic and Anisotropic constants. Splitting, hyperfine splitting coupling constants. Line width, Zero field splitting, and Kramer degeneracy. Crystal field splitting, Crystal field effects.

b) **Applications:** Detection of free radicals; ESR spectra of (a) Methyl radical ($CH_3^{\cdot}$), (b) Benzene anion ($C_6H_6^{-}$).

UNIT-V **10H**

Common Problem on UV-Vis, FT-IR, and ^{1}H NMR:

a) Problems involving individual spectral methods-UV, IR, and PMR
b) Problems involving combined any two of UV, IR, andPMR
c) Problems involving all three UV, IR, andPMR spectral data.

Reference Books:

1)Spectrometric identification of organic compounds by R.N. Silverstein & G.C. Bassier (JohnWilley).
2)Spectroscopic methods in Organic Chemistry by Williams and Fleming (McgrawHill).
3)"Organic Photochemistry" by R.O.Kan (Mc GrawHill).
4)"Advanced Organic Chemistry Reaction Mechanisms and Structure" by J March (Mc Graw Hill&Kogshusha).

Learning Outcomes:

- ✓ Students can understand the fundamentals of spectroscopic techniques and apply to investigate the structural information of molecules.
- ✓ It can provide a platform to get the awareness towards UV, FTIR, ^{1}H NMR and ESR Spectrometry which aims to apply this knowledge towards research.
- ✓ Student can understand intrepretaion of NMR and how to structural elucidation.
- ✓ Student can understand the applicatons of ESR spectra.
- ✓ Student can understand to solve the problems of individual spectral methods of UV-IR & PMR.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–II: ORGANIC SYNTHESIS & REACTION MECHANISMS-I (R23OC32)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about the basics of tools required for determining reaction mechanisms.
- ✓ To understand different radical reactions involving additions, substitutions, and decompositions and their mechanisms.
- ✓ To learn different approaches and reagents of various oxidation processes in organic synthesis and also their mechanisms.
- ✓ To learn different approaches and reagents of various same with reduction processes in organic synthesis and also their mechanisms.
- ✓ To learn terminology and selectivity in asymmetric synthesis and also apply the approaches in organic synthetic reactions.

UNIT-I **10H**

Methods for Reaction Mechanism by Kinetic & Non-Kinetic studies

Kinetic studies: Kinetics of reaction, Energy profile diagram, Intermediate versus transition state, Reaction rate and rate limiting step.

Non-Kinetic studies Identification of products, testing possible intermediates, trapping of intermediates, Cross over experiments, Isotopic labeling.

UNIT-II **10H**

Free Radicals

Free radicals and their reactions-Introduction to radical reactions, Addition of halogens, Hydrogen halides. Substitution reactions- Halogenation, Aromatic substitution, Sandmayer reaction, Autooxidation, Decomposition of dialkyl and diacyl peroxides.

UNIT-III **14H**

Oxidations

Introduction: Different Oxidative processes.

Hydrocarbon: Alkenes, aromatic rings saturated C-H groups (activated and unactivated), Alcohols, diols, aldehydes, Ketones, Carboxylic acids, Amines, hydrazines, sulphides. Oxidations with ruthenium tetroxide iodobenzenediaccetate and Tl(III) nitrate, Lead tetra acetate, SeO_2, MnO_2 Ag_2CO_3, peracids.

Oxidation of C=C perhydroxylation using $KMnO_4$, OsO_4, peracids.

UNIT-IV **14H**

Reductions

Introduction: Reductive process Hydrocarbons: Alkanes, alkenes, alkynes, and aromatic rings Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Nitro, nitroso, azo and oxime group Hydrogenolysis. Catalytic hydrogenations, Reduction by dissolving metals, Reduction with metal and acid. Reduction with metal in liquid ammonia (Birch reduction).

Reduction by hydride transfer reagents Aluminium alkoxide, LiAlH4, NaBH4, Diisobutylaluminium hydrides–Sodium cyano borohydride, tryalkylborohydirdes-Reduction with diimide.

PAPER–II:ORGANIC SYNTHESIS & REACTION MECHANISMS-I (R23OC32)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Asymmetric Synthesis-I

Terminology: Topocity in molecules Homotopic, stereo Heterotopic (enantiotopic and diastereotopic) groups and faces- symmetry, substitution and addition criteria. Prochirality nomenclature: Pro-R, Pro-S, Re, and Si.

Selectivity in synthesis: Stereo specific reactions (substrate stereoselectivity). Conditions Stereo selective reactions (product stereoselectivity): Enantio selectivity and diastereoselectivity.:

Analytical Methods:% Enantiomer excess, optical purity, % diastereomeric excess.

Reference Books:

1) Mechanism and structure in Organic Chemistry " E.S.Could Henry – Holt and Co, Newyork.
2) Advances in Organic Reaction mechanism and structure J. March (McGrew Hill).
3) Aguide Book to Mechanism in Organic Chemistry" byP.Sykes.
4) Synthetic approaches in organic chemistry by R.K.Bansal(NarosaPublications).
5) Some modern methods of synthesis by Carruthers (Cambridge).
6) Asymmetric synthesis by Nogradi.
7) Asymmetric organic reactions by it) Morrison and HS Moschcr.
8) Stereo differentiating reactions by Izumi.

Learning Outcomes:

- ✓ Students can understand the fundamental tools required for the determination of reaction mechanisms.
- ✓ Students can able to understand the different types of radical reactions and their mechanisms.
- ✓ Students can able to apply the regents and approaches for various synthetic reactions involving oxidations.
- ✓ Students can able to apply the regents and approaches for various synthetic reactions involving reductions and Students can understand the reduction by dissolving metals, reduction with metal and acid.
- ✓ Students can understand the terminology, selectivity in synthesis and analytical methods the knowledge on asymmetric synthesis provides a platform for carryout various stereochemical reactions wherever necessary to apply towards research.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–III (Elective–A):ALKALOIDS, TERPENOIDS, QUINONES & PHENOTHIAZINES (R23OC33A)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about definition and importance of various alkaloids.
- ✓ To know the structure elucidation and synthetic methods of important alkaloids such as Isoquinoline and stereochemistry.
- ✓ To know the structure elucidation and synthetic methods of Indole alkaloids
- ✓ To know the classification of terpenoids, isoprene rule, structures and their natural sources.
- ✓ To know the structure characterization and synthesis of quinines and phenothiazines.

UNIT-I **14H**

Alkaloids-I: Definition, General methods of identification of alkaloids-nomenclature–occurrence – isolation - chemical tests for identification-general methods of structural elucidation-degradation–classification based on nitrogen heterocyclic ring-role of alkaloids in plants.

a) Structure and synthesis of Atropine, Caffeine.
b) Quinoline alkaloids: Chemistry and synthesis of Quinine, Cinchonine, and their stereochemistry.

UNIT-II **12H**

Alkaloids-II:

a) Isoquinoline-Morphine Group Alkaloids: Papaverine, Hydrastine, narcotine, canadine, Coclawrine, Morphine, Codeine, emetine, Apomorphine, Glaucine.
b) Stereochemistry ofemetine, and morphine alkaloids.
c) Biogenesis of alkaloids.

UNIT-III **10H**

Alkaloids-III:

a) Indole alkaloids: Reserpine, strychnine, brucine, lysergic acid, erogotamine.
b) Structure, stereochemistry, synthesis and biosynthesis of Ephedrine, Conine and nicotine.

UNIT-IV **10H**

Terpenoids: Classificaiton, sources, isolation, synthesis and stereochemistry with special reference to zingiberene, santonin, eudesmol, abietic acid, Biosynthesis of terpenoids.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*
PAPER–III (Elective–A): ALKALOIDS, TERPENOIDS, QUINONES & PHENOTHIAZINES (R23OC33A)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **14H**

Quinones and Phenothiazines:

Quinones: Identification of quinones, Lapachol. Chrysophenol and Physcion-chemistryand synthesis.

Phenothiazines: Classification, pharmacological properties of phenothaizines, general methods of synthesis of phenothiazines with reference to Promazine, Prochlorperazine and Thioriazine.

Reference Books:

1) Alkaloids by K.W.Bentley Vols. I &II.
2) Text Book of Organic Chemistry I.L.Finar Vol.II 3.An introduction of alkaloids by G.A.Swain.
3) Naturally occurring quinines – R. H. Johnson Vol. I & II, Academic Press, London.
4) Chemistry and physiology of alkaloids by Manske Vol. I & II,VII.
5) Medicinal Chemistry by A.Burger.
6) Isoquinoline Alkaloids byM.Shamma.
7) Heterocylclic Chemistry by JA Joule etal., Chapman –Hall.

Learning Outcomes:

- ✓ Students can understand the definitions and importance of various alkaloids.
- ✓ Students can understand the structure elucidation and also know the synthetic processes application and synthetic methods of Isoquinoline alkaloids.
- ✓ Students can understand the structure elucidation and synthetic methods and stereochemistry of Indole alkaloids.
- ✓ Basic ideas of isoprene rule, terpenoids classification, their natural sources, synthesis.
- ✓ Students can understand the structure characterization and synthesis of quinones and Phenothiazines.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–III (Elective–B): CHEMISTRY OF AEROSPACE MATERIALS(R23OC33B)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To introduce the students to various classes of materials used in aerospace.
- ✓ To understand the materials used and their property requirements for different parts of spacecraft.
- ✓ To study composition- structure-processing-property correlation in aerospace materials to enable them to design new materials with improved property.
- ✓ To understand the metallic materials for cryogenic applications.
- ✓ To study the evaluation of materials for space environment and space worthiness.

UNIT-I **14H**

Carbon Based Materials: Carbon fiber, carbon-carbon composites, carbon aerogels and foams, **Ceramic Materials:** Polymer derived ceramics- synthesis, processing of pre-ceramic polymers, ceramic fibers, Ceramic matrix composites, Thermal barrier coatings, Ablative materials, Silica tiles, Ceramic aerogels, Porous ceramics and ceramic foams, Ultrahigh temperature ceramics- TiB_2, ZrB_2, HfB_2 and their composites, Materials with zero thermal expansion-glass ceramics-preparation and application.

UNIT-II **12H**

Metallic Materials: Super alloys, Titanium alloys, Intermetallics and metal matrix composites, Functionally graded materials -production, properties and application.

UNIT-III **10H**

High Temperature Polymers: Aromatic liquid crystalline polyesters, Phenolics, Polyimide, Poly ether ether ketones- synthesis, processing and applications.

UNIT-IV **12H**

Materials for Cryogenic Applications: Metals for low temperature applications, Austenitic stainless steel, Nitrogen containing steel, Aluminium, Aluminium-lithium alloys, Titanium alloys, Cryo insulation materials, Polymers and adhesive for cryo temperature applications.

PAPER–III (Elective–B): CHEMISTRY OF AEROSPACE MATERIALS(R23OC33B)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Materials for Space Environment: Radiation shielding materials, Atomic oxygen resistant materials, Space suit materials and materials for life support systems, Evaluation of materials for space environment and space worthiness.

Reference Books:

1) G. Savage, Carbon-Carbon Composites, 1st ed., Chapman and Hall, 1993.
2) M. Scheffler, P. Colombo, Cellular Ceramics, Structure, Manufacturing, properties and Applications, 1st ed., Wiley-VCH, 2006.
3) W.D. Kingery, H.K. Bowen, D.R. Uhlmann, Introduction to Ceramics, 2nd ed., WileyInterscience, 1976.
4) J.S. Reed, Principles of Ceramic Processing, 2nd ed., Wiley-Interscience, 1995.
5) H.M. Flower, High Performance Materials in Aerospace, 1st ed., Chapman & Hall, 1995.
6) B.Horst, B. Ilschner, K.C. Russel, Advanced Aerospace Materials, Springer-Verlag, Berlin, 1992.
7) F. Mohammad, Speciality Polymers: Materials and Applications, I.K. International publishing House Pvt. Ltd, 2007.
8) W. Krenkel, R. Naslain, H. Schneider, (Eds.) High Temperature Ceramic Matrix composites, 1st ed., Wiley-VCH, 2006.42 13
9) T.W. Clyne, P.J. Withers, E.A. Davis, I.M. Ward, Introduction to Metal Matrix Composites, Cambridge Solid State Science Series, 1st ed., Cambridge University Press, 1993.
10) R.R. Luise, Applications of High Temperature Polymers, CRC press, 1st ed., 1996.

Learning Outcomes:

- ✓ Students will get introduced to different classes of aerospace materials.
- ✓ Students understands property requirements of materials used in different areas of a spacecraft.
- ✓ Students will get an insight into composition-structure-processing-property correlation of aerospace materials to enable them to design new materials with improved properties.
- ✓ Students can understand the metallic materials for cryogenic applications.
- ✓ Students can understand the evaluation of materials for space environment and space worthiness.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–III (Elective–C): DRUG DISCOVERY, DESIGN AND DEVELOPMENT (R23OC33C)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about the definition of basic principles of pharmacology.
- ✓ To know the discovery of optimization of existing drugs as leads.
- ✓ To know the structure activity / relationship in various drugs.
- ✓ To know the introduction orf QSAR & properties.
- ✓ To learn about the structure, uses & mechanisms of action of common drugs.

UNIT-I: Basic Principles of Pharmacology **14 H**

Definitions: Disease, drug, bioassay, pharmacokinetics and pharmacodynamics, stages involved in drug discovery, formulation, drug dosing, routes of drug administration,

Pharmacokinetics: Absorption, distribution, metabolism and excretion of drugs (ADME), drug delivery.

Pharmacodynamics: Nature of drug - receptor interactions, theories of drug action: occupancy theory, rate theory, induced-fit theory, macromolecular perturbation theory.

Drug synergism and antagonism, drug toxicity, clinical trials.

UNIT-II: Lead Discovery and Optimization **14 H**

Lead Discovery: Existing drugs as leads (me too drugs), pharmacophore. Principles of design of agonists e.g.salbutamol, antagonists e.g. cimetidine and enzyme inhibitors e.g. captopril. Drug discovery without lead. Serendipity-penicillin and librium as examples.

Lead Optimization: Bioisosterism, variation of alkyl substituents, chain homologation and branching, variation of aromatic substituents, extension of structure, ring expansion and ring contraction, ring variation, variation and position of hetero atoms, ring fusion, simplification of the lead, rigidification of lead, conformational blockers, discovery of oxamnquine.

UNIT-III: SA **10H**

Structure Activity Relationship (SAR): SAR in sulfa drugs, benzodiazepines, and taxol analogs, principles ofprodrug design.

UNIT-IV: QSAR Studies **10H**

Quantitative Structure Activity relationship (QSAR): Introduction to QSAR, physicochemical properties. lipophilicity: partition coefficient (P) and the lipophilicity substituent constant (π), electronic effects: Hammettconstant (σ), steric effects: Traft's constant (Es), Hanscth analysis, Craig's plot, Topliss scheme, free Wilsonapproach, Lipenski rule of five.

PAPER–III (Elective–C): DRUG DISCOVERY, DESIGN AND DEVELOPMENT (R23OC33C)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V: Common Drugs **12 H**

Structure, uses, mechanism of action of antibacterial agents: sulfamethoxazole, penicillin G, antiviral agents:acyclovir, indinavir, anticancer agents: mechlorethamine, methotrexate, antifungal agents: fluconazole, griseofulvin,gastrointestrinal agents: ranitidine, omeprazole, metoclopramide, cardiovascular agents: amrinone, procainamide,captopril, propranolol, mehyl dopa, anticoagulants: warfarin, central nervous system agents: paracetamol, betamethasone, chlorpromazine, levodopa, diazepam, phenytion, procaine.

Reference Books:

1) Medicinal Chemistry and Pharmaceutical Chemistry, H. Singh and Kaur.
2) An Introduction to Medicinal Chemistry, 4th Ed., G. L. Patrik.
3) Fundamentals of Medicinal Chemistry, Gareth Thomas.
4) Biochemical Approach to Medicinal Chemistry, Thomas Nogrady.
5) Principles of Medicinal Chemistry, William Foye.
6) Medicinal Chemistry, Ashutosh Kar.
7) Medicinal Chemistry, R. R. Nadendla.
8) Berger's Medicinal Chemistry, Vols. 1-5, Manfred E. Wolf.

Learning Outcomes:

- ✓ Students can understand the pharmaco kinetics &pharmaco dynamics.
- ✓ Students understand the lead discovery of lead optimization of various existing drugs.
- ✓ Students understand structure activity relationship in sulpha drugs, benzodiazepines of principles of prodrug design.
- ✓ Students understand about the quantitative structure activity relationship of properties.
- ✓ Studetns understand the structure uses, mechanism of action of antibacterial, anti fungal, anti viral, anti cancer agents and also about anti coagulants and central nervous system agents.

PAPER–IV (Elective–A): CHEMISTRY OF NATURAL PRODUCTS (R23OC34A)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To know about classification and general methods of synthesis of various flavonoids.
- ✓ To know the structures and synthesis of Fat and water soluble vitamins.
- ✓ To know the classification of harmones, and synthesis of some steroidal and non-steroidal harmones.
- ✓ To know about aminoacids, proteins, enzymes, cofactors and prostaglandins.
- ✓ To know about the structures and synthesis of insecticides, Rotenoids and Isobutylamines.

UNIT-I **12H**

Flavonoids and Prostagladins

Flavonoids: Classificaiton,sources, isolation, general methods of synthesis of flavones, flavanones, flavonols. Chemistry and synthesis with special reference to quercetin and kampferol.

Prostaglandins: Prostaglandins with special reference to PGE and PGF.

UNIT-II **12H**

Vitamins

Fat Soluble Vitamins: Chemistry,Synthesis & biosynthesis of vitamin A_1,vitamin E(α,β,γ,δ-tocopherols) and vitamin K

Water soluble Vitamins: Chemistry,Synthesis, and biosynthesis of B_1 and C.

UNIT-III **12H**

Steroidal Hormones

Chemistry & synthesis of equilenine, oestrone, progesterone, androsterone, testosterone, cortisone.

Non-Steroid Hormones: Chemistry & synthesis of thyroxin, epinephrine, and oxytocin.

UNIT-IV **12H**

Amino Acids: Classification of amino acids. Specific methods of preparations –Malonic ester synthesis and Erlenmeyer azlactone synthesis. Isoelectric point.

Proteins: General nature of proteins – annealing, Biuret reaction, Ninhydrin test. Classification of proteins. Merrifield solid phase peptide synthesis. Primary, secondary, tertiary, and quaternary structure of proteins.

a) Enzymes: classification, kinetics, and mechanism of enzyme action
b) Coenzymes and cofactors: NAD FAD folic acid citric acid cycle.

PAPER–IV (Elective–A): CHEMISTRY OF NATURAL PRODUCTS (R23OC34A)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Insecticides

Naturally Occurring Insecticides: Introduction, general properties, sources, isolation, synthesis, and stereochemistry of Pyrethrin I and II; Jasmolin I &II; Structure activity relationship (SAR) studies and biosynthesis of pyrethrins.

Rotenoids: Chemistry and synthesis of rotenone.

Isobutylamines: Chemistry and synthesis of anacyclin, and spilanthol.

Minor Insecticides of Plant Origin: Pachyrrhizin and custard-apple.

Reference Books:

1) Steroids by Fieser and Fieser,
2) The Vitamins by S.F.Dykes,
3) The Natural Pigments by K.W. Bentley,
4) Biological Chemistry by Holum,
5) Organic Chemistry Vol.II by I.L.Finar,
6) Naturally occurring insecticides by M.Jacobson and D.G.Crosby, Marcel- Decker Inc, NewYork.
7) General Organic and Biochemistry by F.A. Bettelheim and Jerry March, Saunders College, Publishing.
8) The terpenoids by Simonsen,
9) The steroids by Shoppee,
10) Chemistry of Carbon compounds by Rodd.

Learning Outcomes:

- ✓ Students can understand the classification and general methods of synthesis of various flavonoids.
- ✓ Students can understand the synthesis of fat and water soluble vitamins.
- ✓ To know the classification of harmones, and synthesis of some steroidal and non-steroidal harmones.
- ✓ Students can able to understand functions, structures and synthesis aminoacids, proteins, enzymes, cofactors and prostaglandins.
- ✓ Students able to understand different types of naturally occurring insecticides and their specific and commercial importance.

PAPER–IV (Elective–B): CHEMISTRY OF HIGH ENERGY MATERIALS

(R23OC34B)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about the definitions of high energy materials.
- ✓ To learn about the basis of energetic materials.
- ✓ To know about the theoretical basis of thermodynamics.
- ✓ To know about the importance of various novel energetic materials.
- ✓ To know the handling & synthesis of energetic materials.

Unit -I **10H**

High Energy materials: Introduction, Definitions, Combustion, Deflagration, Detonation, Fire and Combustion, Deflagration and Detonation.

Unit-II **12H**

Classification of Energetic Materials: Primary Explosives, High (Secondary) Explosives, Propellant Charges, Rocket Propellants, Chemical Thermal Propulsion (CTP), Pyrotechnics, Detonators, Initiators, Delay Compositions and Heat-Generating Pyrotechnics, Light-Generating Pyrotechnics, Decoy Flares, Smoke Munitions, Near-Infrared (NIR) Compositions.

Unit-III **14H**

Detonation, Detonation Velocity and Detonation Pressure,

Thermodynamics: Theoretical Basis, Computational Methods, Thermodynamics, Detonation Parameters, Combustion Parameters, Example: Theoretical Evaluation of New Solid Rocket Propellants 101 4.2.5 Example: EXPLO5 Calculation of the Gun Propellant Properties of Single, Double and Triple Base Propellants.

Unit-IV **12H**

Design of Novel Energetic Materials: Classification, Polynitrogen Compounds, High-Nitrogen Compounds, Tetrazole and Dinitramide Chemistry, Tetrazole, Tetrazine and Trinitroethyl Chemistry, Ionic Liquids, Dinitroguanidine Derivatives, Co-Crystallization, Future Energetics.

PAPER–IV (Elective–B): CHEMISTRY OF HIGH ENERGY MATERIALS (R23OC34B)

Max. Marks: 100 **(Internal-30M & External-70M)**

Unit-V **12H**

Synthesis of Energetic Materials: Molecular Building Blocks, Nitration Reactions, Processing, Safe Handling of Energetic Materials in the Laboratory, General, Protective Equipment, Laboratory, Equipment. **Energetic Materials of the Future**.

Reference Books:

1) G.Majano, S.Mintova, T.Bein, T.M.Klapotke, Advanced Materials.
2) R.M.Doherty, Novel Energetic Materials and Applications.
3) H.D.B. Jenkins, Chemical Thermodynamics at a Glance, Black well, Oxford.
4) J.P. Agarwal, R.D. Hodgson Organic Chemistry of Explosives.
5) Prof. Dr. Thomas Kal Potke Energetic Materials-LMU Munich.(https://www.hedm.cup.uni-muenchen.de/personen/professors/klapoetke/index.html)
6) https://www.uidaho.edu/sci/chem/people/faculty/jshreeve

Learning Outcomes:

- ✓ Students can able to understand the definitions of high energy materials.
- ✓ Studetns can understand the categorization of energetic materials.
- ✓ Students able to understand theoretical basis of thermodynamics with examples.
- ✓ Students can understand about the design of various novel energetic materials.
- ✓ Students understand the synthesizing the energetic material of their importance in future.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–IV (Elective–C): APPLICATIONS OF SYNTHETIC PRODUCTS
(R23OC34C)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To know the basics of dyes, drugs and also their importance.
- ✓ To know about the production and working of soaps, detergents and formulations of cosmetics.
- ✓ To know about flavours, sweeteners, insecticides, and their applications.
- ✓ To know about explosions and polymer types.
- ✓ To introduce the students biodegradable and Non-biodegradable polymers and their industrial importance.

UNIT-I **12H**

Dyes: Colour and constitution, classification, dyeing method, and their industrial importance.
Drugs: Basic concepts, classification, sources, the requirement of an ideal drug.

UNIT-II **12H**

Synthetic Drugs: Structure and medicinal properties.
Sulphanilamide: An example of sulpha drug-paracetamol, aspirin, oil of wintergreen; Mephensin.
A muscle relaxant; Ibuprofen-an anti-inflammatory drug; L-dopa-cures Parkinson's disease;

UNIT-III **12H**

Soaps and Detergents: Production and their cleansing action.
Liquid crystals and their applications. Surfactants
Cosmetics: Detailed study of formulations and manufacturing of cream and lotions, lipstick and nail polish, shampoos, hair dyes, and toothpastes.
Flavours: Natural flavouring materials and classification.

UNIT-IV **12H**

Sweeteners: Natural and Synthetic sweeteners.
Pesticides: Introduction, Classification, Applications and their effect on the environment.
Insecticides: Introduction, Classification, Applications and their effect on the environment.
Explosives: Introduction, RDX, Gun Powder.

PAPER–IV (Elective–C): APPLICATIONS OF SYNTHETIC PRODUCTS (R23OC34C)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Polymers: Introduction, biodegradable and non-biodegradable polymers and their industrial importance, plastics (uses and effects on environment), natural and synthetic rubbers, polyamides, and polyesters like nylon, decron, terelyne. Thermoplastics–Poly carbonates, Poly acrylates in lens applications, Polyurethanes, and conducting polymers.

Reference Books:

1) I.L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.742.
2) K. Albert, L Lehninger, D. L. Nelson, M.M. Cox, Principles of Biochemistry, CBZ Publishers, 1st Edition, New Delhi, 1993.
3) Harper's Biochemistry, Ed. R. Harper, 22nd Edition, Prentice Hall Press, New York, 1990.
4) Encyclopedia of Chemical Technology – Kirck – Othmer Series.
5) Harper's Review of Biochemistry – P.W. Martin, P.A. Mayer & V.W. Rodfwell, 15th Edition, Maurzen Asian Edition, California, 1981.
6) Polymer Science, Gowarikar.
7) Industrial Chemistry, B.K. Sharma.

Learning Outcomes:

- ✓ The students able to understand dyes and their industrial importance.
- ✓ The students understand the cleansing action of soaps, manufacture of cosmetics and use of flavours and sweetness.
- ✓ The students able to understand effects of pesticides and insectides to the environment.
- ✓ The students understand about explosive materials and preparation & use of polymers in industries.
- ✓ Students understand the biodegradable and Non-biodegradable polymers and their industrial importance.

PRACTICAL–I: MULTISTAGE ORGANIC SYNTHESIS (R23OC35)

Max. Marks: 100 **(Internal-30M & External-70M)**

(Minimum Five Experiments must be carryout)

Expt-1: Synthesis of paracetomol from benzene

Step 1: Benzene to Nitrobenzene (Nitration)

Step 2: Nitrobenzene to N-phenyl hydroxylamine (reduction)

Step 3: N-phenyl hydroxyl amine to *p*-aminophenol (Rearrangement)

Step 4: *p*-amino phenol to *p*-hydroxy acetanilide/paracetomol(acetylation)

Expt-2: Synthesis of *o*-chlorobenzoic acid from phthalic acid

Step 1: Phthalic acid to phthalic anhydride (Dehydration)

Step 2: Phthalic anhydride –phthalic amide (Amide formation)

Step 3: Phthalmide-Anthranilic acid (Hoffman's Bromamide reaction)

Step 4: Anthranilic acid -*ortho*-chloro benzoic acid

Expt-3: Synthesis of sulpha drug from aniline

Step 1: Aniline to acetanilide

Step 2: Acetanilide to *p*-acetamide benzene sulphonyl chloride (sulphonation)

Step 3: *p*-acetamide benzenesulphonylchloride to *p*-acetamide benzenesulphonamide (s-amination)

Step 4: *p*-acetamide benzene sulphonamide to *p*-amino benzenesulphonamide(hydrolysis)

Expt-4: *m*-Chloro-nitrobenzene from nitrobenzene

Step 1: Nitro benzene to *m*-dinitro benzene (nitration)

Step 2: *m*-dinitrobenzene to *m*-nitro aniline (partial reduction)

Step 3: *m*-nitro aniline to *m*-nitrodiazoniumchloride (diazotization)

Step 4: *m*-nitrodiazoniumchloride to *m*-Chloro-nitrobenzene (sandmayers reaction)

Expt-5: Synthesis of *p*-bromo benzanilide from benzophenone

Step 1: Benzophenone to benzopenone oxime (Addition)

Step 2: Benzophenone oxime to benzanilide (Beckman's rearrangement)

Step 3: Benzanilide to *p*-bromobenzanilide) (bromination)

PRACTICAL–I: MULTISTAGE ORGANIC SYNTHESIS (R23OC35)

Max. Marks: 100 **(Internal-30M & External-70M)**

Expt-6: Synthesis of Methyl orange from aniline

Step 1: Aniline to sulphonic acid (sulphonation)

Step 2: sulphonic acid to Diazonium chloride (diazotization)

Step 3: Diazonium chloride to methyl orange (coupling reaction)

Expt-7: Synthesis of Acridone from Anthranilic acid

Step 1: Anthraninilc acid to o-chlorobenzoic acid (Diazotosation followed by sand mayer's reaction)

Step 2: o-chlorobenzoic acid to N-phenyl anthranilic acid (Substitution)

Step 3: N-phenyl anthranilic acid to acridone (Cyclisation)

Note: All the students must submit the TLC for all the stages of preparation and a photo copy must be pasted in records.

Reference Books:

1) Practical Organic Chemistry A.I.Vogel (Longmans).
2) Text Book of practical organic Chemistry F.G.Mann& B.C. Sanders.
3) A Manual of Practical Organic Chemistry Day Sitaramam&Govindachari.
4) Organic Experiments L.F.Fieser.
5) Practical Organic Chemistry H.T.Openshaw.
6) Systematic Identification of Organic Compounds, P.L.Shriner, R.C.Fuson&D.Y.Curtin.
7) Identification of Organic Compounds N.D.Cheronis&J.B.Entrilkin.
8) Advanced Organic Synthesis by R.S.Monson Academic Press.

Note: For University Practical Examination the Duration is a 9 hours.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–III
(*For the students admitted from the academic year 2023-2024 onwards)*

PRACTICAL–II: ORGANIC ESTIMATIONS (R23OC36)

Max. Marks: 100 **(Internal-30M & External-70M)**

(Minimum Five Experiments must be carryout)

Part I: One theory question either relating to spectral characterization or any practical or as wish by the examiner. **15M**

Part II: The following Estimations/Isolations **45M**

Expt. 1: Estimation of hydroxyl group by acetylation or pthalation method

Expt. 2: Estimation of phenol (Bromination method)

Expt. 3: Estimation of aniline (Bromination method)

Expt. 4: Estimation of carbonyl groups (Hydrazone formation method)

Expt. 5: Estimation of sugars-glucose and sucrose by using Fehlings solution

Expt. 6: Determination of iodine value of oil or fat

Expt. 7: Determination of saponification value of oil or fat

Expt. 8: Estimation of vitamin ‘C’ in lime juice.

Expt. 9: Isolation of caffeine from tea/coffee sample.

Part-III: Record Submission **10M**

Note: For University Practical Examination the Duration is a 6 hours.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–IV
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–I: ORGANIC SPECTROSCOPY-II (R23OC41)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about the basics of ^{13}C NMR, Mass, and 2D NMR spectroscopic techniques.
- ✓ To understand the instrumentation of Mass, types of ionizations, types of analyzers in Mass spectroscopic techniques.
- ✓ To apply the spectroscopy knowledge for the structural elucidation of natural products and stereochemistry of organic compounds.
- ✓ To learn about the structural elucidation of natural products.
- ✓ To know the spectral problems – UV; ^{1}H,^{13}C,Mass spectrometry.

UNIT-I **12H**

^{13}C NMR Spectroscopy:

Types of 13C NMR spectra,Undecoupled, proton- decoupled, single frequency off-resonance decoupled (SFORD) and selectively decoupled spectra. Signal enhancement by Nuclear OVER HAUSER effect. ^{13}C chemical shifts, factors affecting the chemical shifts. Noise decoupled and off-resonance spectra of simple Compounds. Calculation of chemical shifts of alkanes, alkenes, alkynes, and aromatic compounds. Typical examples of CMR spectroscopy –problems.

UNIT-II **12H**

Mass Spectroscopy:

Introduction, Principles of Ionization Methods: EI, CI, FDI, PDI, LDI, FAB, TSI and ESI, Types of mass analyzers; Types of fragments-odd electron and even electron containing neutral and charged species (even electron rule), nitrogen rule, molecular-ion peak, base peak, metastable ion, isotopic abundance. High Resolution-MS (HRMS), index of hydrogen deficiency (IHD). Fragmentation of typical organic compounds-hydrocarbons, aromatics, alcohols, alkyl halides, ethers, Carbonyls, carboxylic acids, esters, amines, amides, nitro compounds. Generalmethods of mass spectral fragmentation-β-cleavage, Mclafferty rearrangement, retro Diels-Alder fragmentation and ortho effect. Factors affecting fragmentation-Mass spectra related problems.

UNIT-III **12H**

2D NMR Techniques:

Principles of 2D NMR, classification of 2D-experiments, 2D-J-resolved spectroscopy. Correlation spectroscopy (COSY), HOMO COSY (^{1}H-^{1}H COSY), COSY of *m*-dinitrobenzene, isopentyl acetate, Hetero COSY (1H, ^{13}C COSY) Hetero COSY of isopentyl acetate and 4-methyl-2-pentanol, HMQC, HMQC of codeine, long range ^{1}H, ^{13}C COSY (HMBC), HMBC of codeine and NOESY, NOESY of 9-benzylanthracene, 2-D INADEQUATE experiments.

PAPER–I: ORGANIC SPECTROSCOPY-II (R23OC41)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-IV **12H**

Spectral Characteristics of Natural Products involving all Spectral Data: Use of spectroscopic methods UV, IR, ^{1}H and ^{13}CNMR and Mass spectra in the structure elucidation of natural products. Illustration with suitable compounds like Apigenin(Flavone), Kaempferol (flavonol), Umbelliferone (coumarin), Camphor (Terpenoid), Lawsone (Naphthoquinone), Papaverine (Alkaloid), and Equilenine (steroid).

UNIT-V **12H**

Spectral Problems:

Applications of ^{13}C NMR spectroscopy: Stereochemistry, and reaction mechanisms.

Applications of ^{1}H NMR spectroscopy: Stereochemistry-Geometrical and optical isomerism.

Spectral Problems involving all spectral data UV-Vis. ^{1}H NMR, ^{13}C NMR, Mass spectrometry & 2D NMR techniques.

Reference Books:

1) Spectrometric identification of organic compounds by R.N.Silverstein&G.C.Bassier (John Willey)
2) Spectroscopic methods in Organic Chemistry by Williams and Fleming (McGraw Hill).
3) Organic photochemistry by R.O.Kan (Mc GrawHill)
4) Advanced organic Chemistry Reaction Mechanisms and Structure by J March (Mc Graw Hill &Kogshusha).
5) Carbon-13 NMR Spectroscopy by J.B.Stothers.

Learning Outcomes:

- ✓ Students can understand the fundamentals of ^{13}C NMR and Mass spectroscopic techniques and apply to investigate the structural information of molecules.
- ✓ It can provide ability to apply the spectroscopy knowledge for the structural elucidation of natural products and stereochemistry of organic compounds.
- ✓ It also provides platform for awareness towards ^{13}C NMR and Mass Spectrometry which aims to apply these knowledge towards research.
- ✓ Students can understand the spectral characterstics of natural products involving all spectral data.
- ✓ Students can understand the spectral problems involving all spectral dataUV-Vis. ^{1}H NMR, ^{13}C NMR, Mass spectrometry & 2D NMR techniques.

PAPER–II: ORGANIC SYNTHESIS & REACTION MECHANISMS-II (R23OC42)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To learn about the basics of C-C single and double bond formations and Diels-Aider reactions.
- ✓ To learn terminology and develop skills in writing retro-synthetic routes for target molecules with one and two functional groups.
- ✓ To learn different approaches in photochemical and pericyclic reactions.
- ✓ To learn terminology and selectivity in asymmetric synthesis and also apply the approaches in organic synthetic reactions.
- ✓ To learn the Nucleophilic additions to chiral carbonyl compoundsand Felkin-Anhmodel.

UNIT-I **12H**

Formation of C-C Single &Double Bonds and Diels–Aider &Related Reactions:

Formation of C-C single bonds–enamines and related reactions.

Formation of C-C double bonds–Corey-winter olefination, Peterson olefination, Julia olefination, McMurry coupling, witting reaction of Phosphorus ylides–stereoselective synthesis of tri and tetra- substituted alkenes.

Diels–Aider and related reactions –diene-dienophile, intramolecular Diels –Alder reactions, Stereochemistry and mechanism Retro Diels – Alder reaction –1,3-dipolar reactions.

UNIT-II **12H**

Synthetic Strategies or Retro Synthetic Analysis: Terminology- Target Molecule(TM), synthon, synthetic equivalent, functional group interconversion (FGI), and representation of disconnection of bonds. Linear and convergent synthesis. One group and two group disconnections in simple molecules- Alcohols, Olefins, aryl ketones, α,β-Unsaturated compounds – 1,3 dicarbonyl compounds. synthesis involving chemoselectivity, regioselectivity, reversal of polarity and cyclizations.

UNIT-III **12H**

Photochemistry: Photochemistry of olefins–conjugated olefins–Aromatic compounds–isomerisation–additions. Photochemistry of carbonyl compounds–Norrish type I and II reactions–Paterno–Buchi Reaction. Photo reduction, Photochemical rearrangements–Photo Fries rearrangement, Di-π-methane rearrangement.

UNIT-IV **12H**

Pericyclic Reactions: Definition, classification, MO theory, Electronic configuration in ground and first excited states of aliphatic conjugated polyene system (upto 4 double bonds).

Electrocyclic Reactions: Mechanism, stereochemistry, PMO, FMO, correlation diagram, Woodward Hoffman rules. **Cycloaddition Reactions**: FMO and correlation diagram methods-(2+2) and (4+2) cycloaddition reactions, stereochemistry. Woodward Hoffman rules.

Sigmatropic Rearrangement: classification, Mechanism by FMO method, Woodward Hoffman rules. Cope, claisen and Aza-cope rearrangements.

PAPER–II: ORGANIC SYNTHESIS & REACTION MECHANISMS-II (R23OC42)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Asymmetric Synthesis-II: Substrate Controlled Asymmetric Synthesis: Nucleophilic additions to chiral carbonyl compounds. 1,2- asymmetric induction, Cram's rule, and Felkin-Anhmodel. i) Chiral auxiliary controlled asymmetric synthesis: Į-Alkylation of chiral Enolates, azaenolates, 1,4-Asymmetric induction and Prelog's rule. Use of chiral auxiliaries in DielsAlder and Aldol reactions. ii) Chiral reagent controlled asymmetric synthesis: Asymmetric reductions using BINAL-H.; Asymmetric Hydroboration using $(IPC)_2BH$ and $IPCBH_2$.

Reference Books:

1) Some Modern methods of synthesis By Caruthers (Cambridge)
2) Organic synthesis by Robert & Ireland (Printce Hall ofIndia)
3) Designing Organic Synthesis B staurt Warron, John Wiley &Sons
4) "Pericyclic reactions a mechanistic study"S.M.Mukheji
5) Synthetic approaches in Organic Chemistry " R.K.Bansal NarosaPublications
6) Advances in Organic Chemistry – Reaction mechanism and structure" by J. March (Mc GrawHill).
7) 'Organic Photo chemistry and Pericyclic reactions' M.G.Arora Anmol Publications Pvt.Ltd.
8) Fundamentals of photochemistry by K.K.Rohatgi–Mukharjee Now Age internationalpublishers.
9) Photochemistry by C W S Wells.
10) Organic Photochemistry by Turro.
11) Molecular Photochemistry by Gilbert &Baggo.
12) Organic Photochemistry by D Coyle.
13) Asymmetric synthesis by Nogradi.
14) Asymmetric organic reactions, J. D. Morrison and H. S. Moschcr.
15) Principles of Asymmetric synthesis, R. E. Gawley and J. Aube, 2nd Ed., Elsevier, 2012.

Learning Outcomes:

- ✓ Students understand the basics of C-C single and double bond formations and Diels–Aider reactions.
- ✓ Students learnt the terminology and develop skills in writing retro-synthetic routes for target molecules with one and two functional groups.
- ✓ Students learnt different approaches in photochemical and pericyclic reactions
- ✓ Students are able to understand the terminology and able to know selectivity in asymmetric synthesis and also able to apply the approaches in organic synthetic reactions.
- ✓ Students understand the Nucleophilic additions to chiral carbonyl compounds and Felkin-Anhmodel.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–IV
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–III (Elective–A): ADVANCED ORGANIC CHEMISTRY (R23OC43A)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To introduce novel named reactions in modern organic synthesis.
- ✓ To know importance and principles of green chemistry, and microwave assisted reactions.
- ✓ To know the role of Nanochemistry in various fields and synthesis methods (Solid and Gase phase).
- ✓ To introduce green chemistry and microwave assisted reactions.
- ✓ To know use of organoboranes and organosilanes in synthesis.
- ✓ To introduce supramolecular chemistry and to know the mechanism of building blocks.

UNIT-I: **12H**

Advanced named Reactions in Organic Synthesis:

Baylis-Hillmon reaction, RCM Olefin metathesis, Grubb's catalyst, Mitsunobu reaction, Suzuki Coupling, Heck Coupling, Stille Coupling, Sonagashia, Coupling, Negishi Coupling, Hiyama Coupling, Buchwold – Hartwig Reaction, Click Reaction.

UNIT-II: **10H**

Nano Chemistry

Introduction, Carbon Nanotubes:Structure of single and multi wall carbon nanotubes, synthesis-solid and gaseous carbon source-based production techniques, synthesis with controlled orientation. Growth mechanism of carbon nanotubes-catalyst free growth, catalyst activated growth, nano buds, nanotorusproperties-general, adsorption, electronic & optical, Mechanical and reactivity. Defects, Toxicity Applications.

UNIT-III **12H**

Green Synthesis:

Introduction, Principles, Green solvents- supercritical fluids, water, ionic liquids and PEGs as green solvents for organic reactions. Examples of green reactions-synthesis of Ibuprofen, Clean Fischer-Indole synthesis comparison of the above with conventional methods.

Microwave Organic Synthesis: Introduction, Applications: Microwave-assisted reactions in water (oxidation of toluene to benzoic acid, oxidation of alcohols); organic solvents (Diels-Alder reaction and Decarboxylation); solvent-free reactions (solid state reaction)-Michael addition and Knoevenagel reaction), multistep V/s single pot synthesis.

UNIT-IV: **12H**

Organoboranes and Silanes:

Organoboranes: Synthetic applications of organoboranes–protonolysis, oxidation, carbonylation Reaction of alkenyl borane–enantioselective synthesis of secondary alcohols from alkenes.

Organosilanes: Synthesis of organosilanes, general features of carbon-carbon bond forming reactions of organosilicon compounds, addition reactions with aldehydes and ketones, acylation reactions, conjugate addition reactions.

PAPER–III (Elective–A): ADVANCED ORGANIC CHEMISTRY (R23OC43A)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V: **12H**

Supramolecular Chemistry: Introduction-the meaning of supramolecular chemistry, phenomenon of molecular recognition and their quantification Building blocks of supramolecular chemistry-acyclic receptors for neutral and charged guests, macrocycles and crown ethers, macrobicycles and cryptands, macropolycycles, cucurbituril and cyclodextrins.

Reference Books:

1) New trends in green Chemistry by V.K.Ahluwalia
2) Organic synthesis by Robert & Ireland (Printce Hall ofIndia)
3) Designing Organic Synthesis B staurt Warron, John Wiley &Sons
4) Green chemistry, ***V.K.Ahluwalia***, Anebooks.
5) P.T. Anastas and J.C.Warner***Green chemistry***,Oxford.
6) G.A.Ozin, A.C. Arsenault ***Nano chemistry***,RSC.
7) Diwan, Bharadwaj, ***Nanocomposites***,Pentagon.
8) V.S.MuralidharanA.Subramania, ***Nanoscience and Technology,*** AneBooks.
9) J.W Steed and J.L Atwood, Supramolecular chemistry, John Wiley & Sons, Ltd. New York.
10) Piet W.N.M.van Leeuwen, Supramolecular Catalysis, Wiley-VCH Verlag GmbH &Co.
11) Principles and methods in supramolecular chemistry, Hans-Jorg Schneider and A.Yatsimirsky, John Wiley and Sons.
12) Analytical Chemistry of Macrocyclic and Supramolecular Compounds, S.M.Khopkar, Narosa Publishing House.

Learning Outcomes:

- ✓ Students able to understand novel named reactions and applications in modern organic synthesis.
- ✓ Students understand the importance and principles of green chemistry, microwave assisted reactions and know applying the green synthesis to organic reactions.
- ✓ Students know current importance of Nanochemistry in various fields and their synthetic methods(Solid and Gase phase).
- ✓ It provides the knowledge of using organoboranes and organosilanes in synthesis.
- ✓ Students understand requirements of guest and host and formation of building blocks of supramolecular chemistry.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–IV
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–III (Elective–B): ENGINEERING CHEMISTRY (R23OC43B)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives: The student should be conversant with the:

- ✓ Chemistry of engineering materials and their applications.
- ✓ Principles of polymer chemistry and engineering applications of polymers.
- ✓ Principles of electro chemistry, electrochemical cells, Reference electrodes, Solar and fuel cells, Energy Storage Devices.
- ✓ Mechanism of corrosion and Principles of corrosion control.
- ✓ Analytical techniques and their importance.

UNIT-I: Engineering Materials 12H

Refractories: Classification – Acidic, Basic and Neutral refractories; Properties: refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling; Preparation, Properties and applications of alumina, magnesite and zirconia bricks,

Composites: Introduction Constituents of Composites, types-Fibre reinforced Particulate and Layered composites and their applications.

Lubricants: Mechanism of lubrication, Liquid lubricants - properties: viscosity index, flash and fire points, cloud and pour points, oiliness; Solid lubricants - graphite and molybdenum sulphide.

UNIT-II: Polymer Chemistry 12H

Introduction, polymerization: types – addition and condensation polymerization; Mechanism of free radical addition polymerization with suitable example; Polymer Tacticity and Ziegler Natta polymerization (mechanism).

Plastics: Classification (Thermoplastic and thermosetting); Preparation, properties and uses of PVC, Teflon, Bakelite, Nylon-6,6.

Rubbers: Natural rubber**,** drawbacks of raw rubber**,** Vulcanization of rubber; Synthetic rubbers: Buna-S, Buna-N and Poly urethane.

UNIT-III: Electro Chemistry 12H

Electrode potential, Determination of single electrode potential; Nernst equation (problems); Electrochemical series – significance; Electro chemical cells, Reversible and irreversible cells, Reference electrodes – Standard Hydrogen electrode, Calomel electrode, Ion selective electrode (glass electrode) – measurement of pH;

Solar cells: Introduction, Solar Panels, Applications;

Fuel Cells: Hydrogen – Oxygen Fuel Cell;

Batteries: Lead – acid, NiCad and Lithium Batteries.

PAPER–III (Elective–B): ENGINEERING CHEMISTRY (R23OC43B)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-IV: Corrosion and Corrosion Control **12H**

Corrosion: Types of corrosion-Chemical or dry corrosion, Pilling–Bedworth rule; Electrochemical or wet corrosion; Galvanic corrosion, pitting, stress and differential aeration corrosion; factors influencing corrosion;

Corrosion Control–sacrificial anodic method and impressed current cathodic methods, corrosion inhibitors; Protective coatings: Metallic coatings–electro plating (Au) and electroless plating (Ni). Paints–constituents and functions,

UNIT-V: Analytical Techniques **12H**

Beer-Lambert's law; Colorimetry:principle, instrumentation (with block diagram) and Estimation of iron, Flame photometry: principle, instrumentation (with block diagram) and estimation of sodium; **A**tomic **A**bsorption Spectroscopy: principle, instrumentation (with block diagram) and estimation of nickel.

Conductometric titrations (Acid-Base) and Potentiometric titrations (Redoxtitrations–Fe^{2+}*vs* dichromate).

Reference Books:

1) P.C. Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi 15th edition (2010).
2) S.S. Dara &Mukkanti K. "A text book of engineering chemistry" S. Chand & Co. Ltd., New Delhi (2006).
3) B. Sivasankar "Engineering Chemistry" Tata McGraw Hills co., New Delhi (2008).
4) Dr. B. K. Sharma, Instrumental methods of analysis, Krishna Prakashan Media, 2000.
5) Text Book of Engineering Chemistry by C.P. Murthy, C.V. Agarwal, A. Naidu B.S. Publications, Hyderabad (2006).
6) Engineering Chemistry by K. Maheswaramma, Pearson publishers 2015.

Learning Outcomes: To impart a sound knowledge on the principles of Engineering Chemistry involving the different application oriented topics required for all chemistry courses. After studying this course, students will be able to:

- ✓ Apply their knowledge in designing and preparing different materials and their utility at various needs to overcome all the problems that commonly arise in construction, automobile, metallurgical industries etc.
- ✓ Design economically new synthetic methods of polymers, their usages, and substitute metals with Cheaper, durable & light weight polymer materials.
- ✓ Have the capacity of applying energy sources efficiently and economically for various needs with knowledge of construction of energy devices.
- ✓ Understand corrosion methods and able to develop methods to prevent corrosion of metals and also to protect the environment by designing safer chemical techniques.
- ✓ Apply their knowledge in analyzing the structure of organic compounds and estimations of elements in various samples by using different instrumental techniques.

PAPER–III (Elective–C): QUALITY CONTROL AND QUALITY ASSURANCE IN PHARMA INDUSTRY (R23OC43C)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To know about the basics of quality audit like SOP, ICH, ISO etc.
- ✓ To understand the various documentation processes and handling of materials.
- ✓ To understand the organizational responsibilities and personal responsibilities in the pharma sector.
- ✓ To acquire basic knowledge about the regulatory aspects and quality control.
- ✓ To know about the Basic concepts of Quality Assurance

UNIT-I: **12H**

Pharmaceuticals Concept of drug, lead compound and lead modification, prodrugs and soft drugs.Importance of quality control, drugs and pharmaceuticals, sources of impurities in pharmaceutical chemicals, analytical quality control in finished/final products, common methods of assay.

UNIT-II: **12H**

Quality Audit, Documentation Quality audit. Standard operating procedure (SOP); international conference harmonization (ICH); ISO-9000; ISO-14000, WHO specifications, USFDA guidelines and ICMR. Documentation and Handling : Manufacturing documents, Master Formula, batch formula, Record, Distribution of records, Handling of returned goods, Recovered materials and Reprocessing.

UNIT-III: **12H**

Organization and Personnel Responsibilities Training, Hygiene, Premises: Location, Design, Plant layout, Construction, Maintenance and Sanitations. Environmental control, sterile areas, control of contamination.

UNIT-IV: **12H**

Regulatory Aspects and Quality Control Regulatory aspects. Validation f Personnel, Equipment and cleaning methods, regulatory aspects of pharmaceutics. Quality Control. In-process quality Control on various dosage forms, Sterile and non-sterile operations.

UNIT-V: **12H**

Basic concepts of Quality Assurance Basic concepts, principles or prescription, Needs, requirements and expectations, characteristics of quality, Achieving, sustaining and improving quality, Quality dimensions and costs of quality. Elements of quality Assurance, Quality Management System, Quality management concepts and principles: ISO 9001:2000, QMS Case studies on ISO 9001: 2000 in chemical industries.

PAPER–III (Elective–C): QUALITY CONTROL AND QUALITY ASSURANCE IN PHARMA INDUSTRY (R23OC43C)

Max. Marks: 100 **(Internal-30M & External-70M)**

Reference Books:

1) R. Pannerselvam, Production and Operations Management, Prentice Hall India Learning Pvt. Ltd 3rd Ed., 2012.
2) M. Savsar, Quality Assurance and Management, InTech-Croatia, 2012, ISBN 978-953-51-0378-3.
3) D.C. Montgomery, Statistical Quality Control, John Wiley & Sons, 5th Ed., 2005.
4) M. K. Starr, Production and Operations Management, Biztantra, Delhi, 2004.
5) D.H. Shah, QA Manual, Business Horizons, 2000.
6) D.H. Besterfield, C. Besterfield-Michna, G.H. Besterfield, M. BesterfieldSacre, TotalQuality Management, Pearson Education, Inc., 3rd Ed., 2003.
7) P. Konieczka, J. Namiesnik, Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, 1st Ed., CRC press 2009.
8) D. Hoyle, ISO 9000 Quality Systems Handbook, 5th Ed., Butterworth Heinemann-Elsevier, New York, 2006.
9) E. Prichard, V. Barwick, Quality Assurance in Analytical Chemistry, John Wiley & Sons, 2007.

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

- ✓ To learn the preliminary issues of standard operating procedure, international conference harmonization, ISO-9000, ISO-14000 etc.
- ✓ To get awareness about the methods of documentation and handling of materials.
- ✓ To gain detailed knowledge on organizational responsibilities and personal responsibilities in the maintenance of Pharma industry.
- ✓ To develop knowledge validation procedures and regulatory aspects of and quality control aspects
- ✓ To understand the basics of Quality Assurance.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–IV
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–IV (Elective–A):CHEMISTRY OF ANTIBIOTICSANDDRUGS (R23OC44A)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To know the basics on antibiotics, their importance and various drugs in medicinal chemistry.
- ✓ To know the chemistry of structures and synthesis of some antimalarials, sulpha drugs, antiseptic and antifungals.
- ✓ To know the classification of herbal drugs and their therapeutic efficacy and isolation.
- ✓ To know the types & classification of Antiseptics.
- ✓ To know the CNS stimulants.

UNIT-I **12H**

Antibiotics:

Synthesis of penicillin-G, ampicillin, amoxicillin, chloramphenicol, cephalosporin.

Streptomycin, tetracyclines, Terramycin, aureomycin,gramicidin.

UNIT-II **12H**

Drugs and Medicinal chemistry:

Anticancer Agents: Synthesis & Activity relationship of Taxol, Vinblastine, Vincristine,Camptothecin.

CNS Stimulants: Strychnine (CNS activity only), caffeine, Nicotine; CNS depressants, General anesthetics, mode of action of Sedatives & Hypnotics.

UNIT-III **12H**

Antimalarials: Paludrin – quinacrin – chloroquin – camoquin – pamaquin –sontoquine.

SulphaDrugs: Sulphanilamide – Dihydrocurprine – Prontosil

UNIT-IV **12H**

Antiseptics and Antifungal agents

Antiseptics: Common types, triclosan, aminacrine hydrochloride. Antiseptics *Vs* Disinfactants-Properties, Mechanism of action, classification

Antifungal Agents: 1,8-dihydroxyanthranol –griseofulvin.

PAPER–IV (Elective–A):CHEMISTRY OF ANTIBIOTICSANDDRUGS (R23OC44A)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Herbal Drugs: i) Classification of herbal drugs- Pharmacological and Chemical classification. ii) Adulteration and evaluation of drugs. iii) Different chemical groups of Herbal drugs- Alkaloids, Terpenoids, Glycosides, Volatile oils, Isolation of volatile oils, Tannins, and carbohydrates. iv) Herbal drugs and their therapeutic efficacy. Isolation of- Laxative-Aloe- emodin from Aloes. Anti-diabetics- Neem oil (Neem); Anti-malarial- Quinine (cinchona); Anti-hypertensive- Reserpine (rauwolfia).

Reference Books:

1) Introduction to Medicinal Chemistry – WileyVCH.
2) Text Book of Organic Medicinal and Pharmaceutical Chemistry, Wilson and Gisvild, (ed Robert F.Dorge)
3) An introduction to drug design by SSPandeya
4) Buger's Medicinal Chemistry and drug discovery Vol.I by (Ed) ME Wolff – John – Wileyby A.Burger
5) The Organic Chemistry of drug design and drug action by RB Silverman, Academicpress
6) Principles of Medicinal Chemistry by William O. Foye, Lea &Febiger, Philadelphia/London,1989.
7) Natural products. By P.S.Kalsi
8) Medicinal chemistry. By Chatwal.- And By Ashtoshkar.
9) Chemistry of Drugs. By V.N.Ivers.
10) May's chemistry of synthetic drugs. Hand Book of Reagents for organic synthesis. By Reich,Rigby
11) Top Drugs: The synthetic routes. J.Saunders
12) Organic natural products By Barton and Ollis
13) Organic natural products by OP Agarwal
14) Organic natural products By Barton and Ollis.

Learning Outcomes:

- ✓ Students under the basics on antibiotics, their importance and various drugs used in medicinal chemistry.
- ✓ Students are able to understand chemistry and synthesis of antimalarials, sulpha drugs, antiseptic and antifungals used in medicine.
- ✓ Students can identify the classification of herbal drugs in various types and understand their therapeutic afficacy and isolation methods.
- ✓ Students understand the types of Antifungal agents.
- ✓ To understand the mode of action of sediatives.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–IV
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–IV (Elective–B):FORENSIC SCIENCE IN SOLVING CRIME (R23OC44B)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ The significance of Forensic science to human society.
- ✓ The fundamental principles and functions of Forensic science.
- ✓ The divisions in a Forensic science laboratory.
- ✓ The various steps to be taken to thoroughly record the crime scene.
- ✓ The legal importance of chain of custody.

UNIT-I **12H**

Introduction to Forensic Science: Need and functions of Forensic science. Historical aspects of Forensic science. Development of Forensic Science Laboratories. Definitions and concepts in Forensic science. Basic principles of Forensic science. Scope of Forensic science. Governing principals of Forensic Science. Forensic Science in Indian scenario. Admissibility in Indian Courts. Frye standard and Daubert standard.

Unit-II **12H**

Divisions of Forensic Science

Branches of Forensic science and their importance. Hierarchical set up of various Government Forensic Science Laboratories.

Forensic Evidences: Concise of Forensic Physical, Biological, Chemical and Psychological evidences, Medico-Legal Cases. Legal and Scientific problems. Forensic intelligence and Interviews.

UNIT-III **12H**

Crime Scene

Types of crime scenes. Safety measures at crime scenes. Role of First Responding Officer. Coordination between police personnel and Forensic scientists at crime scenes. The evaluation of 5Ws (who? what? when? where? why?) and 1H (how?)

UNIT-IV **12H**

Police and Forensic Science

Relationship between police and forensic expert, Role of Police at the Crime scene, scientific help at crime scene,Importance of Chain of custody, handling of various types of crime scenes by police, forensic teaching of police personals, forensic case documentation by Police, Technological Advance and Police, Mobile device forensics, Role of Media, Human Rights Commission & Criminal Justice System.

PAPER–IV (Elective–B): FORENSIC SCIENCE IN SOLVING CRIME (R23OC44B)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V **12H**

Administration and Organizational Setup:

DFSS, CFSL, GEQD, SFSL, RFSL, MFSL, FPB, NICFS, CDTS, NCRB, BPR&D, Qualifications and duties of Forensic Scientists Academic centres of education and research: Indian and Academy of Forensic Science, American Board of Forensic Science, American Board of Forensic Odontology, Bureau of Alcohol Tobacco and Firearms, Interpol and FBI, Australian Academy of Forensic Sciences. Forensic Science in India: Teaching Courses and Research fields in Forensic Science, Scope and jobs in Forensic Science.

Reference Books:

1) Max. M. Houck, Forensic Science: Modern Methods of Solving Crime.
2) U.S. Attroney'sBulletion: Forensic Science & Forensic Evidence.
3) Ross M. Gardeneer and Tom Bevel: Practical Crime scene analysis and reconstruction.
4) Dr. Karanam Satyanarayana: Step by step in police investigation and ground realities, Ist edition.

Learning Outcomes:

- ✓ The definition and difference between Forensic Science and Criminalists.
- ✓ The major contributors to the development of Forensic Science.
- ✓ Importance of physical evidence.
- ✓ To Learn Forensic Technology solving crimes with advanced technology
- ✓ Explain the steps typically required to maintain appropriate health and safety standards at the crime scene.

ANDHRA KESARI UNIVERSITY::ONGOLE
DEPARTMENT OF CHEMISTRY
SYLLABUS FOR M.Sc. ORGANIC CHEMISTRY :: SEMESTER–IV
(*For the students admitted from the academic year 2023-2024 onwards)*

PAPER–IV (Elective–C): AIR, WATER, NOISE & THERMAL POLLUTION (R23OC44C)

Max. Marks: 100 **(Internal-30M & External-70M)**

SYLLABUS

Learning Objectives:

- ✓ To understand the properties and measurement of air pollution.
- ✓ To understand the control methods of SO2, NOX & CO.
- ✓ To understand the various types of water pollution & water quality methods.
- ✓ To understand the study of noice pollution & its parameters.
- ✓ To understand the thermal pollution.

UNIT-I: Air Pollution **12H**

Classification and properties of air pollutants-emission sources-major emissions from global sources-importance of anthropogenic sources-behavior and fate of air pollutants photochemical smog and its effects on health-vegetation-material damage in India.

Air pollution sampling and measurement-ambient air sampling-collection of gaseous air pollutants-collection of particulate pollutants-stack sampling-analysis of air pollutants-sulphur dioxide-carbon monoxide-nitrogen dioxide-oxidants-ozone-hydro carbons and particulate matter

UNIT- II: Control Methods **12H**

Sources-correction methods-particulate emission control-gravitational settling chambers-cyclone separators-fabric filters-electrostatic precipitator-wet scrubbers-control of gaseous emissions by adsorption of solids and liquids-control methods of sulphur dioxide emission, flue gasesanalysis-control method, nitrogen oxides, carbon monoxide and hydrocarbon-mobile sources.

UNIT-III: Water Pollution and Quality Assessment: **12H**

Domestic, industrial, agricultural, soil and radioactive wastes as sources of pollution; assessment of toxic metal ions in water; impact of organic pollutants. DO, BOD, COD, TOC.

UNIT-IV: Noise Pollution **12H**

Noise pollution: sources-measurement of noise and indices-effect of meteorological parameters on noise propagation-noise exposure levels and standards–measurement of noise-impact of noise on human health

PAPER–IV (Elective–C): AIR, WATER, NOISE & THERMAL POLLUTION
(R23OC44C)

Max. Marks: 100 **(Internal-30M & External-70M)**

UNIT-V: Thermal Pollution **12H**

Thermal Pollution: Introduction-definition-sources-harmful effects-toxic compounds in traces-prevention and control of thermal pollution –thermal power projects in India.

Reference Books:

1) Environmental Chemistry by AK.DE.
2) Environmental Chemistry by Tyagi & Mehra.
3) Engineering Environmental Chemistry P. Anandan.

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

- ✓ Student understand the sampling collection of gases air.
- ✓ Student understand Source & Control methods of pollutants.
- ✓ Student understand the DO, BOD, COD determination.
- ✓ Student understand noise propagation & noise exposure.
- ✓ Studetns understand prevention & control methods of thermal pollution.

PRACTICAL–I: ANALYSIS OF BINARY ORGANIC MIXTURE (R23OC45)

Max. Marks: 100 **(Internal-30M & External-70M)**

(Minimum Five Experiments must be carryout)

Part-I: One Theory question relating to any topic out of four semesters or any practical or as wish by the examiner. **15M**

Part-II:Two Component Organic Mixture Analysis **45M**

The Mixture Separation should be done by chemical methods and their identification by chemical reactions. Separation is based on solvent selection like ether, dil HCl, 5 % aqueous $NaHCO_3$, and Na_2CO_3 solutions, checking the purity of two components by TLC, identification of the compounds by a systematic study of the physical characteristics (mp/bp), extra elements (nitrogen, halogens and sulfur), functional groups, preparation of crystalline derivatives and identification by referring literature data.

(The student must be given trained in at least eight mixtures with different functional groups)

Note: 1. *For University examinations the student has to submit at least one derivative for each individual component*. *Examination- Duration: 9 hours.*

Part-III: Record submission **10M**

Note: For University Practical Examination the Duration is a 9 hours.

PRACTICAL-II: PROJECT WORK / SPECTRAL PROBLEMS(R23OC46)

Max. Marks: 100 **(Internal-30M & External-70M)**

(Minimum Five Experiments must be carryout)

Title Selection: 1) Project Work / 2) Spectral Problems

1) **Project Work:** For University students- Project Work / Internship is compulsory and have to submit a dissertation containing Background of the work, Experimental, Results and Discussion and Summary.
   In respect of Affiliated Colleges-Project work is optional for only colleges having doctorate degree faculty and students may opt for project work and others have to select *Spectral Problems paper*.
2) **Spectral Problems:** For students who selected spectral problems will be given spectra of two different compounds for structural elucidation along with Viva-voce. (A minimum of 10 representative examples should be studied in regular practical hours).

Note: For University Practical Examination the Duration is a 6 hours.

PRACTICAL–III: COMPREHENSIVE VIVA-VOCE (R23OC47)

Max. Marks: 50M

1) The students will be analyzed with questions covering 3rd& 4thsemester topics.

MODELPAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Chemistry Examination

Semester-I: Paper-I. Inorganic Chemistry (R23CH11)

Time:3 Hours **MaximumMarks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
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9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODELPAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Chemistry Examination

Semester-I: Paper-II. Organic Chemistry (R23CH12)

Time:3 Hours **MaximumMarks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODELPAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Chemistry Examination

Semester-I: Paper-III. Foundation for Chemistry (R23CH13)

Time:3 Hours **MaximumMarks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
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9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODELPAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Chemistry Examination

Semester-I: Paper-IV. Physical Chemistry (R23CH14A)

Time:3 Hours **MaximumMarks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
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10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-II: Paper-I Physical Chemistry-II (R23CH21)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
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7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-II: Paper-II Organic Chemistry-II (R23CH22)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-II: Paper-III Essential Lab Techniques for Industry (R23CH23)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
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10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-II: Paper-IV Inorganic Chemistry-II (R23CH24A)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
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6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-III: Paper-I - Organic Spectroscopy-I (R23CH31)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
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7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-III: Paper-II - Organic Synthesis & Reaction Mechanisms-I (R23CH22)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-III: Paper-III- Alkaloids, Terpenoids, Quinones & Phenothiazines (R23CH33A)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-III: Paper-IV Chemistry of Natural Products (R23CH34A)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-IV: Paper-I - Organic Spectroscopy-II (R23OC41)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-IV: Paper-II - Organic Synthesis & Reaction Mechanisms-II (R23OC42)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-IV: Paper-III- Advanced Organic Chemistry (R23OC43A)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)

MODEL PAPER

ANDHRA KESARI UNIVERSITY

M.Sc. Organic Chemistry Examination

Semester-IV: Paper-IV Chemistry of Antibiotics and Drugs (R23OC44A)

Time:3 Hours **Maximum Marks: 70**

SECTION-A

(Answer any five questions, each question carries 4 marks) (5X4=20 Marks)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

SECTION-B

(Answer all questions each question carries 10 marks) (5X10= 50 Marks)

11. (a.) (10M)

(or)

(b)

12. (a) (10M)

(or)

(b)

13. (a) (10M)

(or)

(b)

14. (a) (10M)

(or)

(b)

15. (a) (10M)

(or)

(b)