

DEPARTMENT OF CHEMISTRY
Govt. Degree College (A)(W), SRIKAKULAM
SEMESTER - I

**Course I: Course I: Essentials and applications of Mathematical, Physical and
Chemical sciences (Code: 23BSPM11)**

Credits: 4

Hours: 5hrs/week

Course Content:

Unit-1: ESSENTIALS OF CHEMISTRY

Complex Numbers: Introduction of the new symbol i - General form of a complex number
Modulus-Amplitude form and conversions.

Trigonometric Ratios: Trigonometric Ratios and their relations - Problems on calculation of
Angles.

Vectors: Definition of vector addition - Cartesian form - Scalar and vector product and problems

Statistical Measures: Mean, Median, Mode of a data and problems.

Unit-2: ESSENTIALS OF PHYSICS

Definition and Scope of Physics- Measurements and Units - Motion of objects: Newtonian

Mechanics and relativistic mechanics perspective - Laws of Thermodynamics and Significance-

Acoustic waves and electromagnetic waves- Electric and Magnetic fields and their interactions-

Behaviour of atomic and nuclear particles- Wave-particle duality, the uncertainty principle-

Theories and understanding of universe.

Unit-3: ESSENTIALS OF CHEMISTRY

Definition and Scope of Chemistry- Importance of Chemistry in daily life -Branches of
chemistry and significance- Periodic Table- Electronic Configuration, chemical changes.
classification of matter, Biomolecules- carbohydrates, proteins, fats and vitamins.

Unit-4: APPLICATIONS OF CHEMISTRY, PHYSICS & CHEMISTRY

Applications of CHEMISTRY in Physics & Chemistry: Calculus, Differential Equations &
Complex Analysis

Application of Physics in Industry and Technology: Electronics and Semiconductor Industry,
Robotics and Automation, Automotive and Aerospace Industries, Quality Control and
Instrumentation, Environmental Monitoring and Sustainable Technologies.

Application of Chemistry in Industry and Technology: Chemical Manufacturing, Pharmaceuticals
and Drug Discovery, Materials Science, Food and Beverage Industry.

Unit-5: ESSENTIALS OF COMPUTER SCIENCE

Milestones of computer evolution - Internet, history, Internet Service Providers, Types of
Networks, IP, Domain Name Services, applications.

Ethical and social implications: Network and security concepts- Information Assurance
Fundamentals, Cryptography-Symmetric and Asymmetric, Malware, Firewalls, Fraud
Techniques- Privacy and Data Protection

DEPARTMENT OF CHEMISTRY
Govt. Degree College (A)(W), SRIKAKULAM
SEMESTER – I
Course 2: Advances in Mathematical, Physical and
Chemical sciences
(Code: 23BSPM12)

Hours: 5hrs/week

Credits: 4

Syllabus

Unit-1: ADVANCES IN BASICS CHEMISTRY

Straight Lines: Different forms – Reduction of general equation into various forms – Point of intersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function – Problems on product rule and quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration...

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose of a matrix and determinants

Unit-2: ADVANCES IN PHYSICS

Renewable energy: Generation, energy storage, and energy-efficient materials and devices

Recent advances in the field of nanotechnology: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

Unit-3: ADVANCES IN CHEMISTRY

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method.

HSAB: Person's concept, HSAB Principal & its importance, bonding in Hard-Hard soft combinations.

Unit-4: Advanced applications of CHEMISTRY, physics & chemistry

Mathematical Modelling applications in physics and chemistry Application of Renewable energy: Grid

Integration and Smart Grids, Application of nanotechnology: Nanomedicine

Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics

Application of medical physics: Radiation Therapy, Nuclear medicine

Solid waste management, Environmental remediation- Green Technology, Water treatment.

Unit-5: Advanced Applications of computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec,

Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking

devices- Repeater, hub, bridge, switch, router, gateway.

List of Recommended books

1) Coordinate Geometry by S. L. Lony, Arihant Publications

10.2024-25
2- papers

DEPARTMENT OF CHEMISTRY
GOVT. DEGREE COLLEGE (A)(W), SRIKAKULAM
CBCS/ SEMESTER SYSTEM - II
B.A./B.Sc. HONS. CHEMISTRY - MAJOR
COURSE CODE:3: GENERAL AND INORGANIC CHEMISTRY
(w.e.f 2024-25)

Course Outcomes: At the end of the course the student will be able to-

1. Understand the structure of atom and the arrangement of elements in the periodic table.
- 2 Understand the nature and properties of ionic compounds.
3. Identify the structure of a given inorganic compound.
4. Explain the existence of special types of compounds through weak chemical forces.
5. Define acids and bases and predict the nature of salts.

Syllabus:

Unit I: Atomic Structure and Periodic table (9 h)

Electronic configuration: Bohr theory, dual nature of electrons, Heisenberg uncertainty principle, the Schrodinger equation, significance of wave functions, normalization of wave function, radial and angular wave functions, Pauli's exclusion principle, Hund's rule, sequence of energy levels (Aufbau principle).

Periodicity: periodic law and arrangement of elements in the periodic table, IUPAC nomenclature and group number, horizontal, vertical, and diagonal relationships in the periodic table. 1.3 General properties of atoms: size of atoms and ions-atomic radii, ionic radii, covalent radii; trend in ionic radii, ionization potential, electron affinity; electronegativity - Pauling, Mulliken-Jaffe, Allred-Rochow definitions; oxidation states and variable valency; isoelectronic relationship; inert-pair effect;

UNIT 2: Ionic bond (9 h)

Properties of ionic compounds, factors favouring the formation of ionic compounds- ionization potential, electron affinity, and electronegativity. Lattice energy: definition, factors affecting lattice energy, Born-Haber cycle-enthalpy of formation of ionic compound and stability. Stability of ionic compounds in terms of ΔH and U_0 . . Solubility and thermal stability of ionic compounds. Covalent character in ionic compounds-polarization and Fajan's rules; effects of polarization-solubility, melting points, and thermal stability of typical ionic compounds.

UNIT 3: The Covalent Bond (9 h)

Valence Bond theory-arrangement of electrons in molecules, hybridization of atomic orbitals and geometry of molecules- BeCl_2 , BF_3 , CH_4 , PCl_5 , SF_6 - VSEPR model- effect of bonding and nonbonding electrons on the structure of molecules, effect of electronegativity, isoelectronic principle, illustration of structures by VSEPR model- NH_3 , H_2O , SF_4 , ICl_4^- , ICl_2^- , XeF_4 , XeF_6

Molecular orbital theory -LCAO method, construction of M.O. diagrams for homonuclear and hetero-nuclear diatomic molecules (N_2 , O_2 , CO and NO)

UNIT 4: Metallic and Weak Bonds (9 h)

The Metallic bond: metallic properties, free electron theory, Valence Bond Theory, band theory of metals. Explanation of conductors, semiconductors and insulators.

Weak bonds: hydrogen bonding-intra- and intermolecular hydrogen bonding, influence on the physical properties of molecules, comparison of hydrogen bond strength and properties of hydrogen bonded N, O and F compounds; associated molecules-ethanol and acetic acid; Vanderwaals forces, ion dipole-dipole interactions.

UNIT 5: Acids and Bases (9 h)

Theories of acids and bases: Arrhenius theory, Bronsted-Lowry theory, Lewis theory, the solvent system, Nonaqueous solvents: classification-protonic and aprotic solvents, liquid ammonia as solvent-solutions of alkali and alkaline earth metals in ammonia.

Types of chemical reactions: acid-base, oxidation-reduction, calculation of oxidation number. Definition of pH, pKa, pKb. Types of salts, Salt hydrolysis. Pearson's concept, HSAB principle & its importance, bonding in Hard-Hard and Soft-Soft combinations.

List of Reference Books:

1. J. D. Lee, Concise Inorganic Chemistry, 5th ed., Blackwell Science, London, 1996.
2. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., 1996.
3. D. F. Shriver and P. W. Atkins, Inorganic Chemistry, 3rd ed., W. H. Freeman and Co, London,

DEPARTMENT OF CHEMISTRY
GOVT.DEGREE COLLEGE (A)(W),SRIKAKULAM
CBCS/ SEMESTER SYSTEM
B.A./B.Sc. HONS. CHEMISTRY –MAJOR
Course Code 4: INORGANIC CHEMISTRY-I
Credits: 03

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the basic concepts of p-block elements.
2. Explain the concepts of d-block elements
3. Distinguish lanthanides and actinides.
4. Describe the importance of radioactivity.

Syllabus:

UNIT -I Chemistry of p-block elements - 19 h

Group 13: Preparation & structure of Diborane, Borazine and $(\text{BN})_x$ Group14: Preparation, classification and

uses of silicones and Silanes. Group 15: Preparation & structure of Phosphonitrilic Chloride $\text{P}_3\text{N}_3\text{Cl}_6$

Unit II Chemistry of p-block elements - 19 h

Group 16: Classification of Oxides, structures of oxides and Oxoacids of Sulphur

Group 17: Preparation and Structures of Interhalogen compounds.

Pseudohalogens,

UNIT-III Chemistry of d-block elements: 9 h

Characteristics of d-block elements with special reference to electronic configuration, variable valence, colour, magnetic properties, catalytic properties and ability to form complexes. Stability of various oxidation states of 3d series-Latimer diagrams.

UNIT-IV Chemistry of f-block elements: 9 h

Chemistry of lanthanides - electronic configuration, oxidation states, lanthanide contraction, consequences of lanthanide contraction, colour, magnetic properties.

Separation of lanthanides by ion exchange method.

Chemistry of actinides - electronic configuration, oxidation states, actinide contraction, comparison of lanthanides and actinides.

Unit - V Radioactivity 9 h

Definition, Isotopes, n/p ratio, binding energy, types of radioactivity, Soddy-Fajan's displacement law, Law of Radioactivity, Radioactive decay series, Nuclear Reactions- fission and fusion, Applications of radioactivity.

List of Reference books:

1. Basic Inorganic Chemistry by Cotton and Wilkinson
2. Advance Inorganic chemistry vol-I by Satya Prakash
3. Inorganic chemistry by Puri and Sharma
4. Concise Inorganic Chemistry by JD Lee
5. Nuclear Chemistry by Maheshwar Sharon, 2009

DEPARTMENT OF CHEMISTRY
Govt. Degree College (A) (W), SRIKAKULAM

III -SEMESTER

Course Code 5: FUNDAMENTALS IN ORGANIC CHEMISTRY

Credits: 03

I. Course outcomes:

At the end of SEMESTER the student will be able to

1. Understand and explain the differential behaviour of organic compounds based on fundamental concepts learnt.
2. Formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
3. Learn and identify many organic reaction mechanisms .
4. Correlate and describe the stereo-chemical properties of organic compounds and reactions.

Syllabus:

Unit 1. Structural theory in Organic Chemistry (9 h)

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents). Reaction intermediates – Carbocations, carbanions & free radicals. Bond polarization: Factors influencing the polarization of covalent bonds, inductive effect - Application of inductive effect (a) Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyper conjugation and its application to stability of carbonium ions, Free radicals and alkenes.

Unit II Saturated Hydrocarbons (Alkanes and Cycloalkanes) 9 h

General methods of preparation of alkanes- Wurtz and Wurtz Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane and butane). General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram, Conformations of monosubstituted cyclohexane.

UNIT-III Unsaturated Hydrocarbons (Alkenes and Alkynes) 9 h

(General methods of preparation, physical and chemical properties, Saytzeff and Hoffmann eliminations mechanism), Electrophilic Additions, (H₂, HX) mechanism (Markownikoff/ Antimarkownikoff addition) with suitable examples-syn and anti-addition; addition of X₂, HX. Oxymercuration demercuration, ozonolysis, hydroxylation, Diels Alder reaction, 1,2- and 1,4-addition reactions in conjugated dienes. Reactions of alkynes; acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-IV Benzene and its reactivity (9 h)

Structure of Benzene – Preparation - polymerisation of acetylene and decarboxylation- Properties - mechanism of electrophilic aromatic substitution of Friedel- Craft's alkylation and acylation. halogenation and nitration.

UNIT-V Orientation of aromatic substitution (9 h)

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropylium cation) Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO₂ and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens.

II. List of Reference Books

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Guide book to Mechanism in Organic Chemistry by Peter Sykes 6th edition, 1985.

DEPARTMENT OF CHEMISTRY
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III -SEMESTER

Course Code 6: ORGANIC CHEMISTRY (Halogen and Oxygen containing organic compounds)

Credits: 03

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the concept of S_N1 and S_N2 and S_Ni mechanisms.
2. Describe the reactivity of alcohols and phenols.
3. Achieve the skills required to propose various mechanisms.
4. Apply the concepts for synthesising various oxygen containing organic compounds.
5. Interconvert the monosaccharides.

Syllabus:

Unit – I Halogen compounds (9 h)

Alkyl halides: Preparation of alkyl halides from i) alkanes, ii) alkenes and iii) alcohols. Properties - nucleophilic substitution reactions— S_N1 and S_N2 and S_Ni mechanisms with energy profile diagrams, stereo chemical aspects and effect of solvent. Williamson's synthesis.

Aryl halides: Preparation i) from phenols ii) Sandmeyer's reaction, nucleophilic aromatic substitution (Benzyne mechanism); relative reactivity of alkyl, allyl, vinyl and benzyl, aryl halides towards nucleophilic substitution reactions.

Unit II Alcohols and Phenols (9 h)

Alcohols: Preparation of 1°, 2°, 3° alcohols from Grignard's reagent, Bouveault–Blanc Reduction; Chemical properties – substitution of $-OH$ by using PCl_5 , PCl_3 , PBr_3 , $SOCl_2$ and with $HX / ZnCl_2$, Oxidation of alcohols with PCC, PDC; Oxidation of diols by HIO_4 and $Pb(OAc)_4$, Pinacol Pinacolone arrangement with mechanism, relative reactivity of 1°, 2°, 3° alcohols. Phenols :Preparation from diazonium salt and Cumene. Reactions and mechanism—Reimer–Tiemann, Kolbe–Schmitt Reactions, Fries and Claisen rearrangements.

Unit III Carbonyl Compounds (9 h)

Preparation from-Acid chlorides, 1,3-dithiane and nitriles; Structure and reactivity of carbonyl group, Nucleophilic addition reactions with HCN, NaHSO₃ and alcohols. addition- elimination reactions with hydroxylamine, hydrazine, phenyl hydrazine, 2,4DNP, semicarbazide. Oxidations and reductions (Clemmensen's, Wolf-Kishner's, with LiAlH₄ & NaBH₄).

Reaction & Mechanism- Aldol condensation, Cannizzaro reaction, Perkin reaction, Benzoin condensation, Claisen-Schmidt reaction, Haloform reaction.

Unit-IV Carboxylic acid and Active methylene Compounds (9h)

Carboxylic Acids: Preparation from Grignard reagent and hydrolysis of nitriles, Reactions of monocarboxylic acids- Reactions involving -H, -OH and -COOH groups, formation of salts, esters, acid chlorides, amides and anhydrides. Degradation of carboxylic acids by Huns- Diecker's reaction, decarboxylation by Schmidt reaction, Arndt-Eistert synthesis, halogenation by Hell- Volhard- Zelinsky reaction. Mechanisms of acidic and alkaline hydrolysis of esters, Reformatsky reactions, Curtius rearrangement.

Active methylene compounds: Ketoenol tautomerism, preparation of Aceto Acetic Ester(AAE) by Claisen condensation with mechanism, synthetic applications of AAE in the preparation of mono carboxylic acids, di carboxylic acids, α,β -unsaturated acids and heterocyclic compounds.

Unit V : Carbohydrates (9 h)

Classification and their biological importance, Monosaccharides: Structural elucidation of glucose and fructose, epimers and anomers, mutarotation, determination of ring size of glucose and fructose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; Disaccharides- Haworth structure of maltose, lactose and sucrose.

II. List of Reference Books

- 1) 1.Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 2) 2.Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- 3) Guide book to Mechanism in Organic Chemistry by Peter Sykes 6th edition, 1985.

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III -SEMESTER

Course Code 7: PHYSICAL CHEMISTRY - I (Solutions & Electro Chemistry)

Credits: 03

Course outcomes:

At the end of the SEMESTER the student will be able to

1. Understand the ideal and non ideal behaviour of solutions.
2. Determine the molecular mass of non-volatile solutes.
3. Discuss the basic concepts of Photochemistry.
4. Apply the principles of electrical conductivity.
5. Explain the importance of emf and its applications.

Syllabus:

Unit I Solutions (9 h)

Classification - Miscible, Partially miscible and Immiscible - Raoult's Law - Azeotropes- HCl-H₂O system and ethanol-water system. Partially miscible liquids-phenol- water system. Critical solution temperature (CST), Effect of impurity on consolute temperature. Immiscible liquids and steam distillation. Nernst distribution law. Calculation of the partition coefficient. Applications of distribution law.

Unit II Colligative Properties (9 h)

Relative lowering of Vapour Pressure, Elevation in boiling point depression in freezing point and Osmotic pressure. Determination of molecular mass of non-volatile solute by Ostwald- Walker method, Cottrell's method, Rast method and Barkeley-Hartley method. Abnormal colligative properties. Van't Hoff factor.

Unit III – Photochemistry (9h)

Difference between thermal and photochemical processes, Laws of photochemistry- Grothus- Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield- Photochemical reaction mechanism- hydrogen- chlorine and hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram, chemiluminescence - Photosensitized reactions- energy transfer processes (simple example), quenching, Photo stationary state.

Unit IV Electrochemistry-I (9 h)

Conductance, Specific conductance, equivalent conductance and molar conductance - effect of dilution. Cell constant. Strong and weak electrolytes, Kohlrausch's law and its applications, Definition of transport number, determination of transport number by Hittorf's method. Debye-Huckel - Onsager's equation for strong electrolytes (derivation excluded), Application of conductivity measurements- conductometric titrations.

Unit V Electrochemistry-II (9 h)

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal- metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt anion. Determination of EMF of a cell, Nernst equation, Applications of EMF measurements -Potentiometric titrations. Fuelcells – Basic concepts, examples and applications.

List of Reference books:

- 1) Principles of physical chemistry by Prutton and Marron
- 2) Solid State Chemistry and its applications by Anthony R. West
- 3) Text book of physical chemistry by K L Kapoor
- 4) Text book of physical chemistry by S Glasstone
- 5) Advanced physical chemistry by Bahl and Tuli
- 6) Advanced physical chemistry by Gurudeep Raj
- 7) Principles of physical chemistry by Puri, Sharma and Pathania.

DEPARTMENT OF CHEMISTRY
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III -SEMESTER

COURSE CODE 8: INORGANIC AND PHYSICAL CHEMISTRY

Credits: 03

I.Course outcomes:

At the end of the SEMESTER the student will be able to:

- 1) Apply IUPAC nomenclature for Coordination compounds
- 2) Understand the various theories, structure and stereo chemistry of coordination compounds.
- 3) Explain the reaction mechanism in complexes.
- 4) Apply the 18 electron rule.
- 5) Discuss the basic concepts of thermodynamics.

II. Syllabus:

Unit I Coordination Chemistry-I (9 h)

IUPAC nomenclature of Coordination compounds, structural and stereo isomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory(VBT):Postulates- magnetic properties- Inner and outer orbital complexes. Limitations of VBT, CFT- Postulates - Splitting in Octahedral, tetrahedral, tetragonal and square planar fields. Crystal field stabilization energy(CFSE), Crystal field effects for weak and strong fields. Factors affecting the magnitude of crystal field splitting energy, Spectro chemical series, Tetragonal distortion of octahedral geometry, Jahn-Teller distortion.

UNIT-II Coordination Chemistry II (9 h)

1.Inorganic molecular Reaction Mechanism: (6 h)

Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Labile and inert complexes, ligand substitution reactions – SN1 and SN2, Substitution reactions in square planar complexes, Trans-effect, theories of trans effect and its applications

2. Stability of metal complexes: (3 h)

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

Unit III Organo metallic compounds (9 h)

Definition and classification of organo metallic Compounds on the basis of bond type, Metalcarbonyls: 18 electron rule, electron count of mononuclear, poly nuclear and substituted metal carbonyls of 3d series. General methods of preparation of mono and binuclear carbonyls of 3d series. π -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Unit IV Thermodynamics- I (9 h)

Concept of heat(q), work(w), internal energy(U), State function and Path function- statement of first law; enthalpy(H), relation between heat capacities, calculations of q , w , U and H for reversible, irreversible processes, Joule-Thomson effect- coefficient, Calculation of work for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. Temperature dependence of enthalpy of formation- Kirchoff's equation.

Unit V Thermodynamics II (9 h)

Second law of thermodynamics Different Statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes. Third law of thermodynamics, Nernst heat theorem, Spontaneous and non- spontaneous processes, Helmholtz and Gibbs equation - Criteria for spontaneity.

III. List of Reference Books:

- 1) Concise coordination chemistry by Gopalan and Ramalingam
- 2) Coordination Chemistry by Basalo and Johnson
- 3) Text book of physical chemistry by S Glasstone
- 4) Concise Inorganic Chemistry by J.D.Lee
- 5) Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
- 6) A Text Book of Physical Chemistry by K.L.Kapoor Vol 2, 6th edition, 2019.

DEPARTMENT OF CHEMISTRY
Govt. Degree College (A) (W), SRIKAKULAM

IV - SEMESTER

COURSE CODE 9: PHYSICAL CHEMISTRY -II (States of Matter, Phase Rule & Surface Chemistry)

Credits: 03

At the end of the SEMESTER the student will be able to:

I .Course outcomes:

1. Explain the difference between solids liquids and gases in terms of intermolecular interactions.
2. Differentiate ideal and real gases.
3. Discuss the basic concepts of two component systems.
4. Apply the concepts of adsorption.
5. Understand the basic concepts of crystallography.

II . Syllabus:

Unit I - Gaseous state (9 h)

Postulates of Kinetic theory of Gases (exclude derivation) – deduction of gas laws from kinetic gas equation-Vander Waal's equation of state. Andrew's isotherms of carbon dioxide, continuity of state. Critical phenomena. Relationship between critical constants and vander Waal's constants. Law of corresponding states. Joule- Thomson effect. Inversion Temperature.

Unit II – Liquid State (9 h)

Inversion Physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water. Liquid crystals, mesomorphic state. Differences between liquid crystal and solid/liquid. Classification of liquid crystals into Smectic and Nematic. Application of liquid crystals as LCD devices .

UNIT-III - Solid state (9h)

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. Miller indices, Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law and its derivation. Powder method. Defects in crystals. Stoichiometric and non-stoichiometric defects.

Unit IV - Phase Rule (9 h)

The Concept of phase, components, degrees of freedom. Gibbs phase rule. Phase diagram of one component system – water system, Study of Phase diagrams of Simple eutectic systems i) Pb-Ag system, desilverisation of lead ii) NaCl-Water system, Congruent and incongruent melting point- Definition and examples for systems having congruent and incongruent melting point, freezing mixtures .

Unit V Surface Chemistry (9 h)

Definition and classification of Colloids- Coagulation of colloids- Hardy-Schulze rule. Stability of colloids, Protection of Colloids, Gold number. Adsorption - Physical and chemical adsorption, Langmuir adsorption , Freundlich adsorption isotherm, applications of adsorption.

III. List of Reference Books:

- 1) Solid State Chemistry and its applications by Anthony R. West
- 2) Text book of physical chemistry by K L Kapoor Vol.1
- 3) Text book of physical chemistry by S Glasstone
- 4) Advanced physical chemistry by Bahl and Tuli.

DEPARTMENT OF CHEMISTRY
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IV - SEMESTER
Course Code 10: GENERAL AND PHYSICAL CHEMISTRY
Credits: 03

Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Correlate and describe the stereochemical properties of organic compounds
2. Explain the biological significance of various elements present in the human body
3. Apply the concepts of ionic equilibrium for the qualitative and quantitative analysis.
4. Determine the order of a chemical reaction.
5. Describe the basic concepts of enzyme catalysis

II. Syllabus:

UNIT-I Stereo chemistry of carbon compounds (9 h)

Molecular representations - Wedge, Fischer, Newman and Saw-Horse formulae. Optical isomerism: Optical activity- wave nature of light, plane polarised light, optical rotation and specific rotation. Chiral molecules- definition and criteria (Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with examples- Glyceraldehyde, Lactic acid, Alanine, Tartaric acid, 2,3-dibromopentane.

Unit II Bioinorganic Chemistry (9 h)

Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals, Na / K- pump, carbonic anhydrase and carboxy peptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Use of chelating agents in medicine, Cisplatin as an anti-cancer drug. Iron and its application in bio-systems, Haemoglobin-transfer of oxygen, Myoglobin-Storage and transfer of iron .

Unit III Ionic equilibrium (9 h)

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, Buffer solutions-Henderson's equation. Indicators-theories of acid - base Indicators, selection of Indicators, Common ion effect Solubility and solubility product of sparingly soluble salts - applications of solubility product principle.

Unit IV Chemical Kinetics-I: (9 h)

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction, Derivation of integrated rate equations for zero, first and second order reactions (similar and different reactants). Half-life of a reaction. General methods for determination of order of a reaction.

Unit V Chemical Kinetics-II: (9 h)

Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only). Enzyme catalysis- Specificity, factors affecting enzyme catalysis, Inhibitors and Lock & key model. Michaels- Menten equation- derivation, significance of Michaelis-Menten constant.

III. Reference books

- 1) Text book of physical chemistry by S Glasstone
- 2) Concise Inorganic Chemistry by J.D.Lee
- 3) Advanced physical chemistry by Gurudeep Raj
- 4) Advanced physical chemistry by Bahl and Tuli
- 5) Inorganic Chemistry by J.E.Huheey
- 6) Basic Inorganic Chemistry by Cotton and Wilkinson.

DEPARTMENT OF CHEMISTRY
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IV - SEMESTER

Course Code 11: Nitrogen containing Organic Compounds & Spectroscopy
Credits: 03

I.Course outcomes:

At the end of the SEMESTER the student will be able to:

1. Distinguish primary secondary and tertiary amines and their properties.
2. Describe the preparation and properties of amino acids.
3. Explain the reactivity of nitro hydrocarbons.
4. Discuss heterocyclic compounds with N, O and S.
5. Apply the concepts of UV and IR to ascertain the functional group in an organic compound.

II. Syllabus:

Unit I Amines: (9 h)

Classification, chirality in amines (pyramidal inversion), preparations – Gabriel synthesis, Hoffmann-Bromamide reaction (with mechanism), reduction of amides and Schmidt reaction. Distinction between Primary, secondary and tertiary amines using Hinsberg's method and nitrous acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Carbylamine reaction, Hoffmann's exhaustive methylation, Hofmann and Cope elimination. Diazonium Salts: Preparation and synthetic applications of diazonium salts including preparation of arenes, haloarenes, phenols, cyano and nitro compounds. Coupling reactions of diazonium salts (preparation of azo dyes).

UNIT- II Amino acids (9 h)

Definition and classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: a) from halogenated carboxylic acid, b) Gabriel Phthalimide synthesis c) Strecker's synthesis. Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point. Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating- peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

UNIT- III Nitro hydrocarbons (9h)

Nomenclature and classification, structure -Tautomerism of nitroalkanes leading to acid and keto form, Preparation of Nitroalkanes, reactivity - halogenation, reaction with HONO (Nitrous acid), Nef reaction and Mannich reaction leading to Micheal addition and reduction.

Unit IV Heterocyclic Compounds (9 h)

Introduction and definition: Simple five membered ring compounds with one hetero atom Ex. Furan, Thiophene and Pyrrole - Aromatic character – Preparation from 1, 4, -dicarbonyl compounds, Paul-Knorr synthesis. Properties: Acidic character of pyrrole - electrophilic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation - Diels Alder reaction in furan. Pyridine – synthesis - Aromaticity -Basicity - Comparison with pyrrole- one method of preparation and properties - Reactivity towards Nucleophilic substitution reaction.

Unit V UV-Visible & IR Spectroscopy (9 h)

Selection rules for electronic spectra, types of electronic transitions in molecules, concept of chromophore and auxochrome, effect of conjugation- Woodward Fischer rules for calculating unsaturated compounds. Infrared spectroscopy and types β, α max of conjugated dienes and λ of molecular vibrations and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intra molecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on $>C=O$ stretching absorptions).

III. List of Reference Books

- 1) A Text Book of Organic Chemistry by Bahl and Arunbahl
- 2) A Text Book of Organic chemistry by I L Finar Vol I
- 3) Organic chemistry by Bruice
- 4) Organic chemistry by Clayden
- 5) Spectroscopy by William Kemp
- 6) Spectroscopy by Pavia
- 7) Organic Spectroscopy by J. R. Dyer
- 8) Elementary organic spectroscopy by Y.R. Sharma
- 9) Spectroscopy by P.S.Kalsi
- 10) Spectrometric Identification of Organic Compounds by Robert M Silverstein, Francis X Webster

DEPARTMENT OF CHEMISTRY
GOVT. COLLEGE FOR WOMEN(A), SRIKAKULAM
SEMESTER V (2023-24 Academic Year, 2023-24)
PROGRAMME THREE YEAR B.Sc. Domain Subject: CHEMISTRY

Course: D: Environmental Chemistry
(Skill Enhancement Course (Elective), Credits -05) Max Marks: 100+50

Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the environment functions and how it is affected by human activities.
2. Acquire chemical knowledge to ensure sustainable use of the world's resources and ecosystems services.
3. Engage in simple and advanced analytical tools used to measure the different types of pollution.
4. Explain the energy crisis and different aspects of sustainability.
5. Analyze key ethical challenges concerning biodiversity and understand the moral principles, goals and virtues important for guiding decisions that affect Earth's plant and animal life.

Syllabus : (Total Hours: 90, including Teaching, Lab, Field Skills Training, Unit tests etc.)

Unit-I Introduction 10h

Environment Definition – Concept of Environmental chemistry- Scope and importance of Environment in nowadays – Nomenclature of environmental chemistry – Segments of Environment– Effects of human activities on environment – Natural resources–Renewable resources–Solar and biomass energy and Nonrenewable resources – Thermal power and Atomic energy – Reactions of atmospheric oxygen and Hydro logical cycle.

Unit-II Air Pollution 10h

Definition - Sources of air pollution - Classification of air pollution - Ambient air quality standards- Climate change - Global warming - Pollution from combustion systems- Acid rain - Photochemical smog - Greenhouse effect - Formation and depletion of ozone - Bhopal gas disaster-Instrumental techniques to monitor pollution - Controlling methods of air pollution.

UNIT-III Water pollution 10h

Unique physical and chemical properties of water - Water quality standards and parameters - Turbidity- pH Dissolved oxygen - BOD, COD, Suspended solids, total dissolved solids, alkalinity- Hardness of water-Methods to convert temporary hard water into soft water - Methods to convert permanent hard water into soft water - eutrophication and its effects -Industrial waste water treatment.

UNIT-IV Chemical Toxicology 10h

Toxic chemicals in the environment - effects of toxic chemicals - cyanide and its toxic effects - pesticides and its biochemical effects - toxicity of lead, mercury, arsenic and cadmium- Solid waste management.

UNIT-V Ecosystem and biodiversity 10h

Ecosystem

Concepts-structure-Functions and types of ecosystem-Abiotic and biotic components - Energy flow and Energy dynamics of ecosystem- Food chains - Food web- Tropic levels- Biogeochemical cycles (carbon, nitrogen and phosphorus)

Biodiversity

Definition - level and types of biodiversity - concept- significance - magnitude and distribution of biodiversity-trends-bio geographical classification of India-biodiversity at national, global and regional level.

III. List of Reference books:

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry by W. Moore and F.A. Moore
3. Environmental Chemistry by Samir k.Banerji
4. Water pollution, Lalude, MC Graw Hill
5. Environmental Chemistry, Anil Kumar De, Wiley Eastern Ltd.
6. Environmental analysis, SMKhopkar (IIT Bombay)

Course 6-D: Environmental Chemistry – Practical syllabus IV. Lab work-Skills Outcomes:

1. successful completion of this practical course, student shall be able to:

List out, identify and handle various equipment in Chemistry lab.

Learn the procedures of preparation of standard solutions.

Demonstrate skills in operating instruments.

Acquire skills in handling spectrophotometer.

Analyse water and soil samples.

7. Practical (Laboratory) Syllabus: (30hrs) (Max.50Marks).

1. Identification of various equipment in the laboratory.

2. Determination of carbonate and bicarbonate in water samples by double titration method.

3. Determination of hardness of water using EDTA

a) Permanent hardness b) Temporary hardness

4. Determination of Chlorides in water samples by Mohr's method.

5. Determination of pH, turbidity and total solids in water sample.

6. Determination of Ca^{+2} and Mg^{+2} in soil sample by flame photometry.

7. Determination of PH in soil samples using pH metry.

VI. List of Reference books:

1. A Text Book of Quantitative Inorganic Analysis (3rd Edition)-A.I.Vogel

2. Water pollution, Lalude, MC Graw Hill

3. Environmental analysis, SMKhopkar (IIT Bombay)

4. Web related references suggested by teacher.

VII. Co-Curricular Activities:

a)Mandatory: (Training of students by teacher on field related skills: 15hrs)

1. **For Teacher:** Skills training of students by the teacher in classroom, lab and field for not less than 15 hours on field related quantitative techniques for the water quality parameters, soil pollution and air pollution.

2. **For Student:** Individual visit to any one of the local field agencies/research laboratories in universities/research organizations/private sector culminating writing and submission of a handwritten fieldwork/project work Report not exceeding 10 pages in the given format.

3. Max marks for Fieldwork/project work Report: 05.

4. Suggested Format for Fieldwork/project work: Title page, student details, index page, details of places visited, observations, findings and acknowledgements.

5. Unit tests (IE)

1. Learning Outcomes:

Students after successful completion of the course will be able to:

1. Understand the importance of Green chemistry and Green synthesis.
2. Engage in Microwave assisted organic synthesis.
3. Demonstrate skills using the alternative green solvents in synthesis.
4. Demonstrate and explain enzymatic catalysis.
5. Analyse alternative sources of energy and carry out green synthesis.
6. Carry out the chemical method of nanomaterial synthesis.

II. Syllabus: Total Hours: 90, including Teaching, Lab, Field Training, Unit tests etc.)

UNIT-I Green Chemistry: Part-I (10 hrs)

Introduction-Definition of green Chemistry, Need for green chemistry, Goals of Green chemistry Basic principles of green chemistry. Green synthesis- Evaluation of the type of the reaction

- i) Rearrangements (100% atom economic), ii) Addition reaction (100% atom economic).
- Organic reactions by Sonication method: apparatus required and examples of organochemical reactions (Heck, Hunsdiecker and Wittig reactions).

UNIT- II Green Chemistry: Part- II (10 hrs)

A) Selection of solvent:

i) Aqueous phase reactions

ii) Reactions in ionic liquids, Heck reaction, Suzuki reactions,

epoxidation.iii) Solid supported synthesis

B) Supercritical CO₂: Preparation, properties and applications, (decaffeination, drycleaning)

C) Green energy and sustainability.

UNIT-III Microwave and Ultrasound assisted green synthesis: (10 hrs)

Apparatus required, examples of MAOS (synthesis of fused anthraquinones, Leukart reductive amination of ketones) - Advantages and disadvantages of MAOS. Aldolcondensation -Cannizzaro reaction- Diels-Alder reactions-Strecker's synthesis

UNIT-IV Green catalysis and Green synthesis 10 hrs.

Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis - biocatalysis:Enzymes, microbes Phase transfer catalysis (micellar /surfactant)

1. Green synthesis of the following compounds: adipic acid, catechol, disodium menudo acetate(alternative Strecker's synthesis)

2. Microwave assisted reaction in water - Hoffmann elimination - methyl benzoate to benzoic acid - oxidation of toluene and alcohols - microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction.
3. Ultrasound assisted reactions - sonochemical Simmons-Smith reaction (ultrasonic alternative to iodine)

10 hrs

UNIT - V Nanotechnology in Green chemistry

Basic concepts of Nano science and Nanotechnology - Bottom-up approach and Top down approaches with examples - Synthesis of Nano materials - Classification of Nanomaterial - Properties and Application of Nanomaterial. Chemical and Physical properties of Nanoparticles - Physical synthesis of nanoparticles - Inert gas condensation - aerosol method - Chemical Synthesis of nanoparticles - precipitation and co-precipitation method, sol-gel method.

III. Lab work - Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in the laboratory.
2. Learn the procedures of green synthesis.
3. Demonstrate skills in the preparation of Nanomaterials.
4. Acquire skills in Microwave assisted organic synthesis.
5. Perform some applications of Nanomaterials.

IV. Practical (Laboratory) Syllabus: (30 hrs.) (Max.50 Marks).

1. Identification of various equipment in the laboratory.
2. Acetylation of 1° amine by green method: Preparation of acetanilide
3. Rearrangement reaction in green conditions: Benzil - Benzilic acid rearrangement
4. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
5. Green oxidation reaction: Synthesis of adipic acid
6. Preparation and characterization of biodiesel from vegetable oil/ waste cooking oil
7. Preparation and characterization of Nanoparticles of gold using tea leaves.
8. Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide.
9. Photo reduction of Benzophenone to Benzopinacol in the presence of sunlight.

V. Reference books:

1. Green Chemistry Theory and Practical. P.T. Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)